Rural residents depend on forests and woodlands for fuelwood and other resources. Here, women carry firewood in the spiny forest region of Madagascar.

CHAPTER 3

Poverty in Forests Stems from Remoteness and Lack of Rights

Poverty is pervasive in the tropical world—especially in rural areas. What is special about forest poverty? Why does it deserve policy attention? Do forest dwellers constitute a substantial proportion of all poor people? Are poor people the majority among forest dwellers? What poverty reduction policies might be tailored to forest dwellers?

This chapter argues that it is fruitless to seek simplistic connections between forests and poverty. Empirically, the links are weak. Some people derive wealth from forests, others from converting forests to agriculture. Many poor people live in marginal lands without trees.

There are three distinctive forest poverty syndromes, with different causes, locales, and possible remedies. First, remote areas tend to have high forest cover, high poverty rates, and low population densities. This remote forest and poverty syndrome poses a challenge for development because most standard approaches are inapplicable or extremely costly. A corollary is that forest-poverty relationships are quite different in remote and nonremote areas. Second, forest dwellers depend on forest resources for food, fuel, medicine, and income. But many interests compete to control or exploit forest resources. So changes in rights or access to forest resources can profoundly affect the livelihoods of people who live in and near forests. Third, there can be impediments—in policy, technology, or marketing—to commercializing forest products.

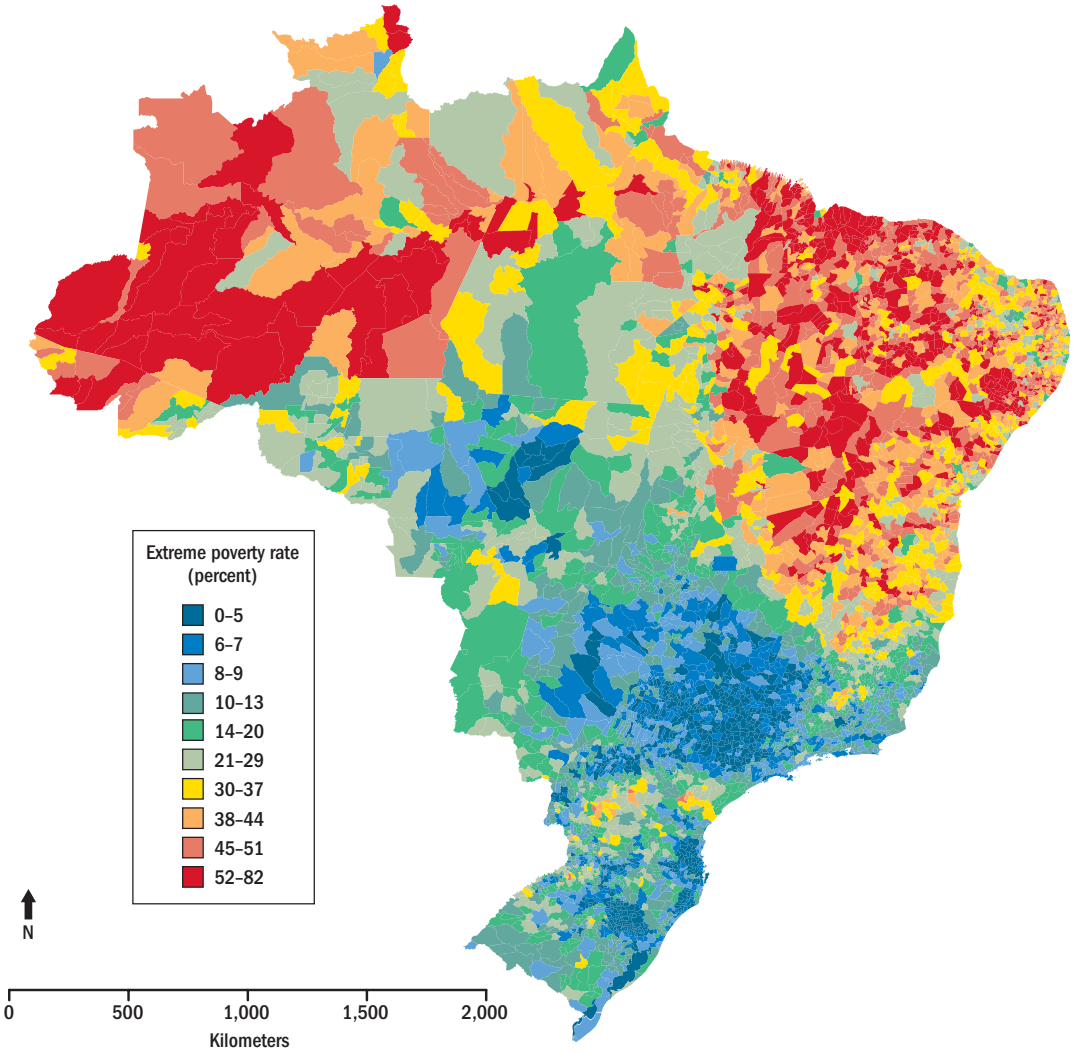
Building on chapter 2 and Sunderlin, Dewi, and Puntodewo (2006), the discussion here uses a geographic lens to examine spa-

tial overlaps between forests and poverty. This raises another question that may seem simple but is not: what do we mean when we say that an area is poor?

Poverty Rates and Poverty Density: Two Ways of Viewing Poor Areas

Let's set aside, for the moment, the question of how poverty should be measured at the level of individuals and households. Whatever the measure, a common approach to identifying high-poverty areas is to map, by province or district, the poverty *rate*: that is, the pro-

Map 3.1a Poverty Rates for Brazil, 2000



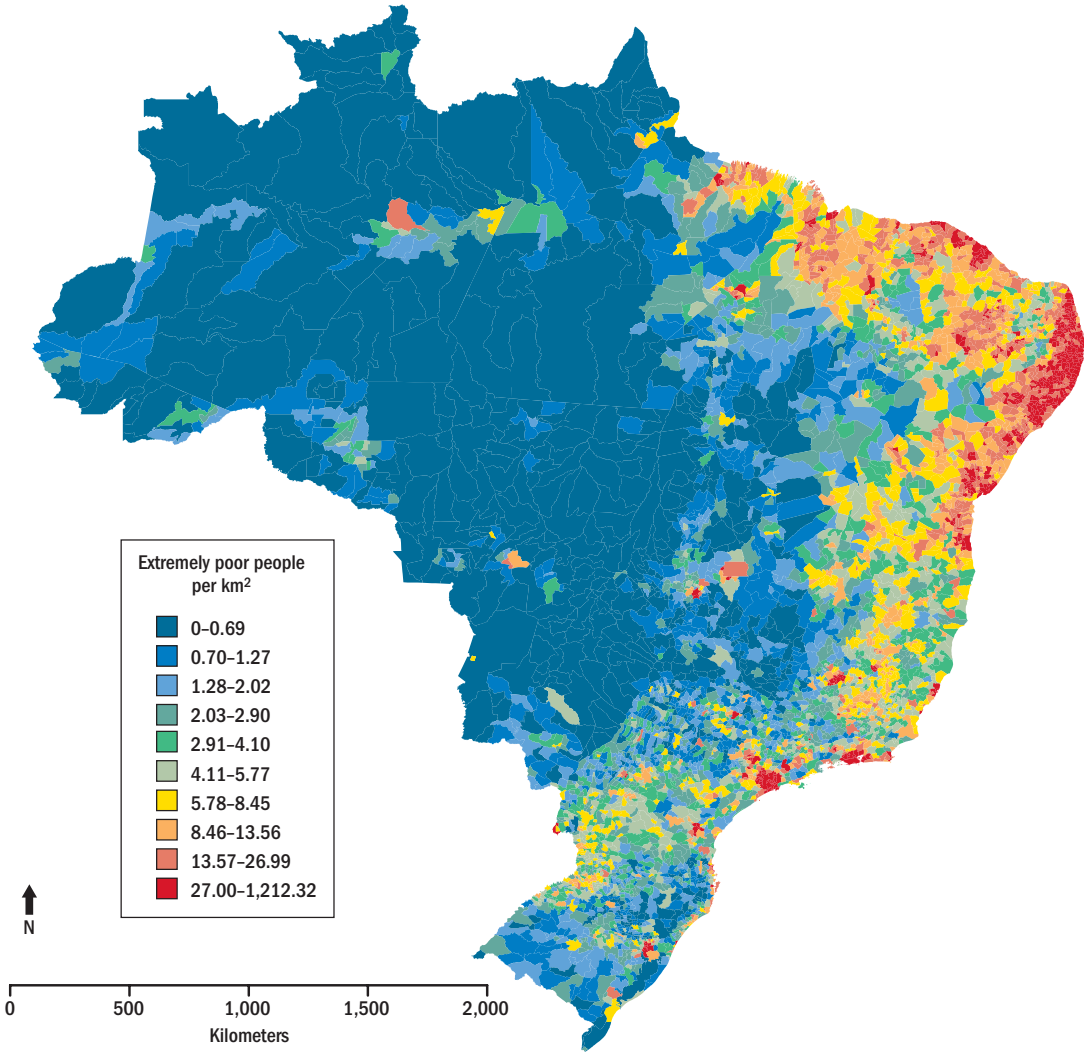
Source: Authors' mapping based on UNDP.

portion of inhabitants who are poor. Map 3.1a shows this strikingly for Brazil: poverty rates are very high in Amazônia.

But high-poverty areas can also be defined as places where the poverty *density* is high. Places with high poverty densities have a lot of poor people per square kilometer. Map 3.1b presents this measure for Brazil—where, as in many places, the two maps are like photographic negatives of one another. Areas with high poverty rates tend to have low poverty densities, and vice versa.

Which is the better definition of high-poverty areas? Later this chapter argues that each type of high-poverty area has distinct needs and policy implications. But first it examines the forces that shape

Map 3.1b Poverty Densities for Brazil, 2000



Source: Authors' mapping based on UNDP.

the geographic distribution of forest cover, deforestation, and poor people.

Remote Forests—High Poverty Rates, Low Poverty Densities

Remoteness mediates strong connections between forests, poverty, and population (see chapter 2). Because it is expensive to send produce to markets from remote areas, it is rarely worth growing crops or harvesting timber for commercial use—meaning that deforestation is low and forest cover high. The situation is even worse if areas have remained remote because they offer poor prospects for agriculture. In remote areas low land rents lead to low incomes because farm profits are negligible and off-farm employment opportunities missing. Hence poverty rates are high.

Because farmgate prices are low, it is not worth applying much labor to a plot of land. Only extensive land uses such as pasture, shifting cultivation, and forest extraction are feasible. This means that population density is low—probably so low that poverty density is also low. Low population densities, together with distance from administrative centers and poor communications, mean that forest dwellers have little voice in regional and national affairs. The problem is compounded if, as is likely, they are indigenous people not yet displaced by farmers or ranchers. Disempowered, they are subject to neglect or exploitation by elites seeking timber or mineral wealth. Finally, remoteness from law and communications and low population density mean that land and forest tenure are likely to be insecure. Table 3.1 summarizes predictions about remoteness and its effects on poverty and the environment.

Evidence

These relationships are evident in Nicaragua, a small country with a dominant city (Managua) and a forest frontier (Chomitz 2004). Extreme rural poverty rises sharply and smoothly with increasing travel time to Managua (figure 3.1). Population density falls just as smoothly and even more sharply, causing poverty density to decrease with increasing distance (figure 3.2). In addition, the ratio of rural workers to farmed land falls with remoteness, as expected. Forest cover rises with remoteness—though not as smoothly, partly because some nonremote areas are on slopes (figure 3.3). Tenure is less secure in frontier areas on the Atlantic side of the country:

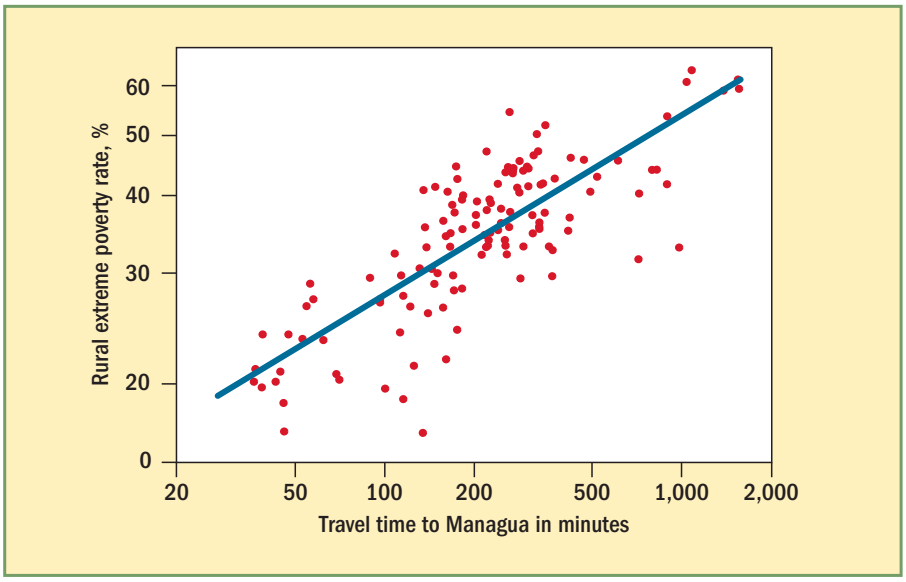
Table 3.1 How Does Increasing Remoteness from Markets Affect Poverty and the Environment?

Indicator	Effect
Population density	Decreases with remoteness
Poverty rate	Increases with remoteness
Poverty density	Decreases with remoteness
Land productivity	Decreases with remoteness
Labor intensity	Decreases with remoteness
Tenure security	Decreases with remoteness
Forest cover	Increases with remoteness

a substantially lower proportion of farms have titles. This part of the country also has a prominent indigenous population. And unlike western Nicaragua, the Atlantic side has uniformly poor soil quality, as measured at the *municipio* level.

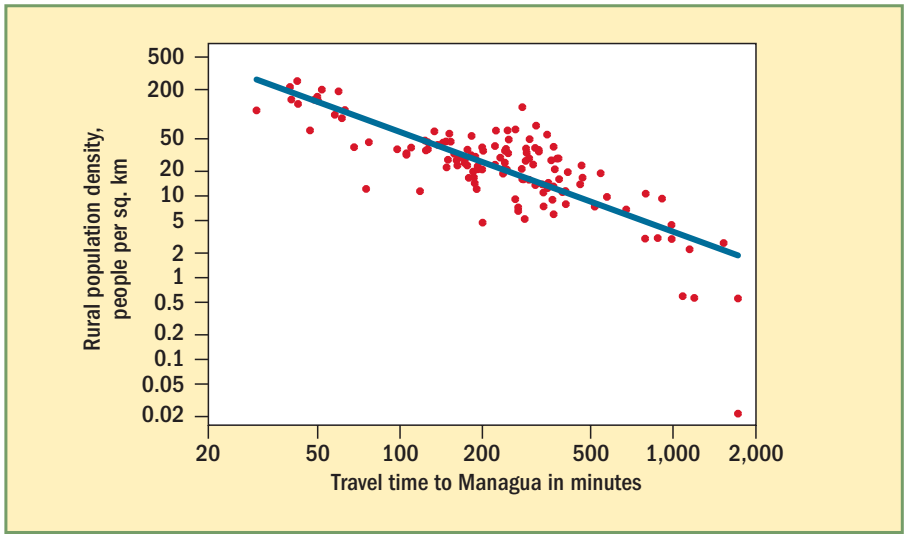
Areas near Managua (within about four hours' imputed travel time) make up only a quarter of the nation's area but contain half of its extremely poor rural population. The most remote areas (those

Figure 3.1 Extreme Rural Poverty Increases with Travel Time to Managua



Source: Chomitz 2004.
Note: Excludes Managua department.

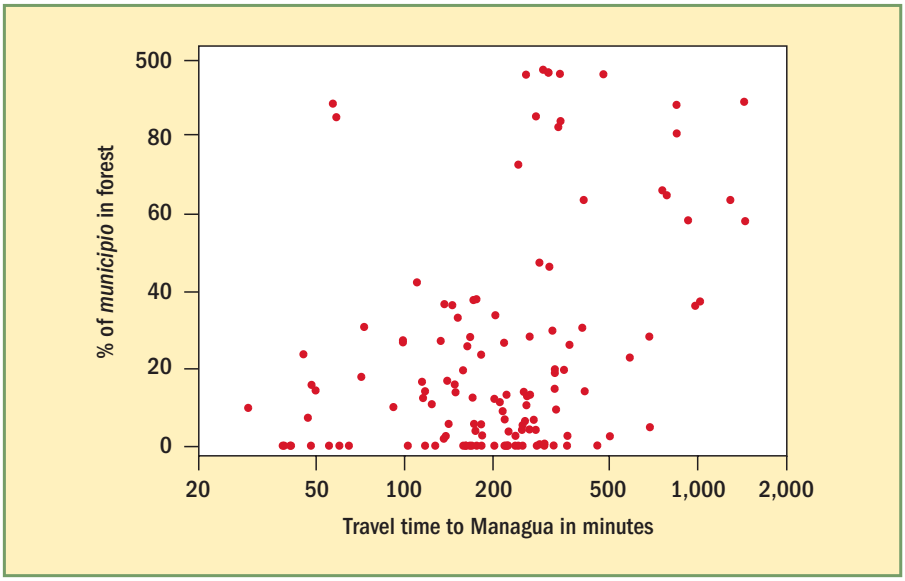
Figure 3.2 Rural Population Density Decreases with Travel Time to Managua



Source: Chomitz 2004.
Note: Excludes Managua department.

more than 16 hours' journey) occupy about a third of the nation's area but contain only about 10 percent of its extremely poor rural population. The most remote areas have abundant forests; areas near Managua, sparser forests except on mountainsides.

Figure 3.3 Forest Cover Increases with Travel Time to Managua



Source: Chomitz 2004.

Implications

The remoteness connection points to a distinct poverty-forest syndrome. At the extreme end are places with relatively undisturbed forest cover and low population densities—perhaps 1 or 2 people per square kilometer, or less. Limited empirical and anecdotal evidence suggests that these people are extremely poor in terms of consumption, assets, and health indicators (such as child mortality). For instance, detailed measures of poverty for Vietnam in 1998 found that 73 percent of northern upland minority groups and 91 percent of central highlands minority groups lived below the poverty line, compared with 30 percent of the majority population (Baulch and others 2004, p. 278).

Although data are lacking, indigenous people account for a large share of remote forest dwellers, and a disproportionate number of indigenous people live in remote forest areas. For instance, Baulch and others (2004, p. 291) found that Vietnamese upland and highland minority members were four times farther from a market and six times farther from a telephone than were majority group members. Being indigenous compounds the difficulties associated with remoteness. Indigenous people have historically been subject to severe discrimination and exploitation. Despite legal and social progress in some countries, indigenous people remain disadvantaged. A recent study of indigenous people in Latin America found that:

- Indigenous children in Ecuador, Guatemala, and Mexico are twice as likely to be stunted (an indicator of severe malnutrition) as nonindigenous children. About half of indigenous children are stunted.
- Indigenous adults have 2.3–3.7 fewer years of schooling than do nonindigenous.
- Indigenous people earn significantly less than do nonindigenous, and about half the gap cannot be explained by differences in education or other personal characteristics (Hall and Patrinos 2005).

These differences would presumably be even larger if attention were limited to remote forest dwellers.

Remote communities, indigenous or not, face enormous challenges. For example, providing education and health care is difficult and expensive in remote areas (Chomitz and others 1998). Infra-

structure is also difficult to provide in remote communities. Water and electricity systems cannot exploit economies of scale or density. Building and maintaining feeder roads is expensive in rainy, swampy, or mountainous environments, and their unit costs skyrocket if they serve few people and little traffic.

Lack of roads is also an obstacle to realizing the potential of forestry. Community forestry is often considered a development option that combines environmental and livelihood benefits for remote forest communities. Timber is, apparently, the main commercial resource that these communities have in abundance. But to benefit communities, that timber has to get to market. Poor roads mean high transport costs, and high transport costs reduce the stumpage value of timber—the value received by communities. Roper (2003) identifies poor roads as one of the main barriers for commercializing the forests owned by indigenous people of Nicaragua's Atlantic region. Transport costs of $0.34 a cubic meter per kilometer eat into wood values, for these communities, of about $20 a cubic meter.

In sum, there is not necessarily a strong relationship between forest cover and poverty rates, though poverty densities tend to be lower in forested areas. But some forest areas suffer from poverty because of their remoteness from agricultural markets and because low population densities make it difficult to deliver services and infrastructure.

Incomes of Forest Dwellers Depend on Rights and Access to Forestlands

Forests provide food, fuel, fodder, wood, and medicine to their inhabitants and neighbors, for personal consumption and for sale. Though these resources represent a substantial portion of forest dwellers' income, it is difficult to measure forest income and dependence. It seems reasonable to suppose that households' degree of reliance is inversely related to population density. People living at extremely low densities—say, fewer than five per square kilometer—probably rely heavily on the forest for their livelihoods. These people are numerous in aggregate, but spread thinly across the world. For logistical and cultural reasons, they are hard to survey.

Because Living Standards Measurement Surveys (LSMS) usually omit remote, low-density districts and provinces, there is little quantitative information about this most forest-dependent population. On the other hand, there are hundreds of millions of people in

high-population-density forests and forest-agriculture mosaics. Here the problem is accurately enumerating, measuring, and attributing cash values to the extraction of dozens of forest products. Standard survey instruments probably underestimate this income stream. A further issue is that forest products serve as a safety net, relied on more heavily in times of crop failure and other hardship. One-time surveys could easily miss this feature.

With these concerns in mind, Vedeld and others (2004) conducted a metareview of 54 case studies that measured income from forest products. The studies are not a representative sample, so their data are merely indicative. Forest income (averaging $678 a year, adjusted for purchasing power parity) accounted for about a fifth of household income in the sample—a significant contribution, particularly for families near the survival line. Wild food and fuelwood were the most important products, accounting for 70 percent of forest income (although some products, such as fodder, are probably underreported in the sample).

Forest income was higher the farther that households were from markets—suggesting that for remote communities, a lack of alternative income opportunities and an abundance of forests lead to greater dependence on such resources. Reinforcing this, the most forest-dependent half of the sample cases (earning an average of 42 percent of their income from forest products) lived in more remote areas, had less education and livestock, and averaged only about half as much income per household. The few studies that examined the distribution of income within communities found that because poor people depended more on forest products, forest income reduced inequality. The average Gini coefficient (a common measure of inequality) was 0.51 when forest income was excluded but fell to 0.41 when it was included.

Forest Control and Tenure Can Affect Income

Because rural poor people are dependent on forest resources, anything that affects their rights or access to those resources merits attention. Three policy concerns arise here. The first is a potential tragedy of the commons. Although some forests are effectively managed by communities as common property resources, others are open access—managed by no one, exploited by all. If these forests are degraded, local income streams are destroyed.

Second, forest regulations from colonial times, or recently imposed on environmental grounds, may restrict forest dwellers'

ability to gather fuelwood, food, and other forest products. Forest officials can also use these regulations as a source of rents, extracting bribes from poor forest dwellers.

Third, changes in legal or de facto ownership of forests affect local dwellers' ability to undertake commercial forestry and agriculture, both of which can provide a route out of poverty.

Open Access Forests Suffer Degradation

There is a long history of concern that rural households, dependent on woodlands for fuel, suffer when those woodlands are depleted. A thorough recent literature review by Arnold, Kohlin, and Persson (2006, p. 604) concludes that "the body of information now available suggests that the greater part of rural populations in both Africa and South Asia do not face serious welfare implications due to decreasing access to biomass, but resource poor areas and households can face a problem, in particular landless people without access to common pool biomass stocks."

It is difficult to measure the extent and depth of deprivation due to degradation of open access forests. Given the substantial proportion of income derived from forests, forest degradation may translate into lower consumption or increased workloads as it becomes harder to glean resources from thinned-out woodlands. But it is hard to measure consumption of forest resources and local access to them, and to control for other correlates of resource availability.

This point is illustrated by Bandyopadhyay, Shyamsundar, and Baccini (2006), who marshal unusually detailed and comprehensive data to assess the impacts of biomass scarcity in Malawi. They report that deforestation and forest degradation reduced biomass, nationwide, by 16 percent over 1990–2004, and that fuelwood accounts for about 12 percent of the value of household consumption. Gathering fuelwood takes an average of 1.5 hours a day—and 84 percent of this burden falls to women.

In this setting one might hypothesize a vicious circle of poverty and degradation. As forests thinned, people would be expected to reduce their consumption of fuelwood or to devote more time to gathering it. But Bandyopadhyay, Shyamsundar, and Baccini (2006) find that, other things being equal, households in lower-density forests did not spend more time gathering fuelwood, and that fuelwood gathering did not come at the expense of agriculture. In the rural south of Malawi, where forests are more degraded, the authors found that a 10 percent lower biomass density was associated with

0.2 percent lower consumption. This modest association suggests that households adapt their fuel sources or strategies as forest resources dwindle. But because this effect applies to every household in a neighborhood, forest degradation might be significant in areas with higher population densities.

On the other hand, the study found that consumption actually fell with higher levels of biomass in less degraded areas. This may be a spurious association: high-biomass areas are likely more remote and less suitable for agriculture. But the study's bottom line is that low biomass densities are not associated with drastic poverty burdens—meaning that people are resourceful in adapting to exhausted biomass or that proper measurement is extremely difficult. More studies like this are needed in a wide variety of settings before general conclusions can be drawn.

Another potential tragedy of the commons could result from overexploitation of bushmeat. Some 2.2 million tons of wild mammals and other animals are exploited for food each year in the Congo Basin, representing a major source of animal protein for the region (Fa, Currie, and Meeuwig 2003). Bushmeat accounted for about 10 percent of household production in a very poor village surveyed by de Merode, Homewood, and Cowlishaw (2004), and was especially important in the lean agricultural season. But bushmeat extraction already exceeds the sustainable supply by more than 25 percent in Cameroon and the Democratic Republic of Congo (Fa Currie and Meeuwig 2003). Population and income growth, increased road access, and shrinking animal populations threaten to make exploitation increasingly unsustainable.

Regulations Can Limit Forest Use

Forest regulations may restrict forest dwellers' ability to gather firewood or other forest products, to market timber, or to convert forests to agriculture. For instance, Cameroonians cannot legally sell trees they grow as part of a cocoa agroforest (Gockowski and others 2006). Facing depressed prices, their timber stock is undervalued by $1,460 a hectare. In Indonesia regulations discourage farmers from selling rubber trees they cultivate in an agroforestry system. The potentially valuable wood is burnt instead (Joshi and others 2002).

Dwellers Are Often Dispossessed of Land and Forests

When wealthy interests seize or degrade forests, poor local populations can suffer. These situations do not lend themselves to con-

trolled study, so evidence is anecdotal. For instance, Davis (2005) estimates that 100,000 Cambodians depend for their livelihoods on tapping forest dipterocarp trees for oleoresin, a commercially valuable product. Davis, McKenney, and others (2004) and McAndrew and others (2004) report that illegal logging and conversion of forests to acacia plantations have deprived resin tappers of access to trees.

Establishment of protected areas has sometimes involved displacement of and loss of assets by local populations (Ghimire and Pimbert 1997; Geisler and De Sousa 2001). (See chapter 6 for a discussion of efforts to emphasize comanagement of parks as an alternative to displacement.) Cernea and Schmidt-Soltau (2003) and Schmidt-Soltau (2003) review the establishment of nine national parks in central Africa and conclude that about 51,000 people were displaced. In only two of the nine cases were there formal resettlement policies. In two cases no compensation was made to the displaced populations, and in most of the other cases compensation was inadequate. The loss of assets could be thousands of dollars per capita depending on the potential surrendered stumpage value of timber, but this valuation is complicated by the need to estimate transport costs from these remote areas.

Ferraro (2002) analyzes how the establishment of Ranomafana Park in Madagascar affected its inhabitants, who were subsequently denied park access and forced to rely on buffer zones for agriculture and forest extraction. The analysis accounts for different time paths of resource degradation under the unsustainable agricultural technologies used by the residents. Access to the park allows them to defer the long-term effects of soil fertility decline and timber exhaustion. Ferraro finds that park exclusion imposed a mean annual cost of $39 a household—equivalent to 14 percent of household income. This is consistent with a survey by Shyamsundar and Kramer (1996) that asked households how much they would require in compensation for resettlement.

Forests without Trees Are a Widespread Dilemma

Large swathes of tropical Asia are legally forestland but devoid of trees:

- In Indonesia between 333,000 square kilometers (Contreras-Hermosilla and Fay 2005) and 370,000 square kilometers (Boccucci, Muliastra, and Dore 2005)

of land are under Forest Department control but devoid of forests. Of this, about 100,000 square kilometers was designated for conversion to oil palm, timber, or pulp plantations that never materialized. The rest represents deforestation of forests gazetted for conservation, watershed protection, or sustainable timber production.

- In India 20 percent of reserved forest—at least 100,000 square kilometers—is without trees (Ministry of Environment and Forests 2005).
- In the Philippines a 1981 presidential decree declared all land with a slope greater than 17 percent to be within the public domain. Today only a small fraction of these 150,000 square kilometers retains any forest (Fay and Michon 2005).
- In Thailand 70,000 square kilometers of state forestland was treeless when a 1992 reform sought to rezone the forest domain (Fay and Michon 2005).

Treeless forests are problematic because they are inhabited by people without secure land rights. The populations are large—at least 40 million in Indonesia alone (Boccucci, Muliastra, and Dore 2005). But lack of security makes it hard for them to invest in land improvements, such as reclaiming degraded grasslands or planting trees. Weak tenure depresses land values and reduces access to credit (Deininger 2003).

Forests, Poverty, and Deforestation: Ambiguous Relationships

The search for win-win solutions to poverty and environment dilemmas motivates the hypothesis that there is substantial spatial overlap between areas with high poverty rates and areas with high forest cover, high deforestation, or both. This chapter and the previous one offer several reasons to expect those relationships to be muddled:

- Remoteness is associated with high poverty rates and forest cover, but low deforestation.
- Insecure tenure may be associated with high deforestation and either low or high poverty rates, depending on the deforestation process.

- Deforestation is sometimes undertaken by wealthy commercial interests.
- Deforestation can create valuable agricultural assets for smallholders.
- On the other hand, deforestation may reflect the expansion of subsistence-oriented populations onto increasingly unsuitable lands.

Empirical studies reflect this ambiguity. Sunderlin, Dewi, and Puntodewo (2006) analyze associations between poverty rates, poverty densities, and forest cover in seven countries. In three of the seven they find a significant positive correlation, at the district level, between poverty rates and forest cover. Vietnam is a clear example, with high poverty rates, low population densities, and high forest cover in the remote mountain regions of the north and central parts of the country. In three countries there is no significant relationship.

Only one country has a significant negative relationship: Brazil. At the national level, across all forest types, the relationship is negative because the semiarid region of northeast Brazil has high poverty rates and low forest cover—while the wealthy southernmost part of the country, well into the forest transition, has low poverty rates and high forest cover. This national-level correlation result obscures the relationship evident in map 3.1: remote western Amazônian forests have high poverty rates and high forest cover.

Deininger and Minten's (1999) study of Mexico related municipal poverty to deforestation, controlling for a host of biophysical and socioeconomic factors including slope, elevation, rainfall, indigenous proportion of population, and land tenure. They found a strong partial relationship, statistically and quantitatively, between deforestation over 1980–90 and poverty rates in 1990. Other things constant, a one standard deviation increase in poverty was associated with an increase of almost 3 percentage points in the annual deforestation rate. But rainfall and hilliness were strongly negatively associated with deforestation and positively associated with poverty. So it is likely that the simple correlation between poverty and deforestation is negative.

The rest of this section uses newly available, fine-scale data to examine spatial relationships between poverty rates, population densities, forest cover, and deforestation in four important forested countries: Brazil, India, Indonesia, and Madagascar. Keep in mind

that measures of poverty, forest cover, and deforestation are not comparable between countries.

Deforestation and Poverty in Brazilian Amazônia Are Largely Unrelated

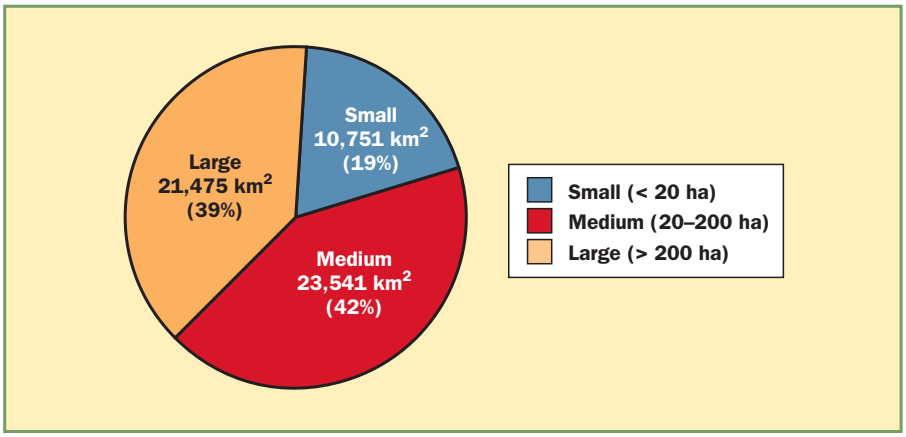
Deforestation of Brazilian Amazônia is sometimes blamed on poor people. But evidence suggests that poverty and deforestation problems in Amazônia are largely separate problems requiring separate approaches:

- Poverty and deforestation are spatially localized, with limited overlap.
- Most deforestation is undertaken by large-scale, well-capitalized actors.
- Much of this large-scale deforestation occurs on public land and so represents a regressive transfer of public resources.
- Deforestation is profit-driven, but typically yields modest profits per hectare.

Scale of Deforestation

Remote sensing data suggest that poor people are responsible for less than a fifth of deforestation in Brazilian Amazônia (figure 3.4).[1] Because clearing is expensive and large clearings require mechanical

Figure 3.4 Most Deforestation in Brazilian Amazônia Reflects Large- and Medium-scale Clearing, August 2000 to July 2003

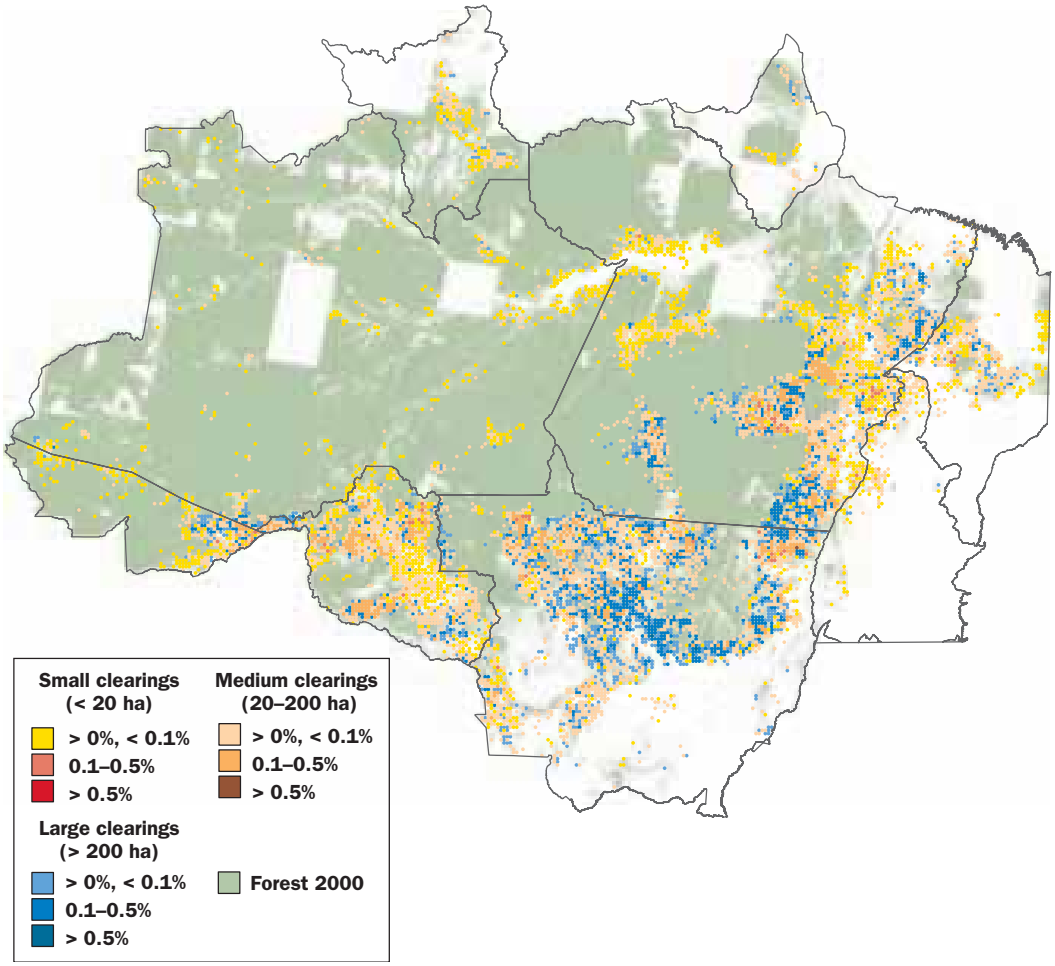


Source: Wertz-Kanounnikoff 2005.
Note: Categories reflect size of clearings, not properties.

equipment, there is a strong correlation between clearing size and the deforester's wealth or access to capital. Subsistence farmers are unlikely to be able to afford to clear more than 20 hectares a year, and most probably clear far less.

About 39 percent of deforestation occurs in incremental clearings larger than 200 hectares, which likely represent wealthy interests. This finding is consistent with Chomitz and Thomas (2003), who find that agricultural establishments of 2,000 hectares or more contain 53 percent of privately owned, cleared land in Amazônia. It is also consistent with the description by Margulis (2004) of large-scale ranching activities in the Amazon.

Map 3.2 Amazônian Deforestation 2000–03 Showing Rates and Predominant Clearing Size

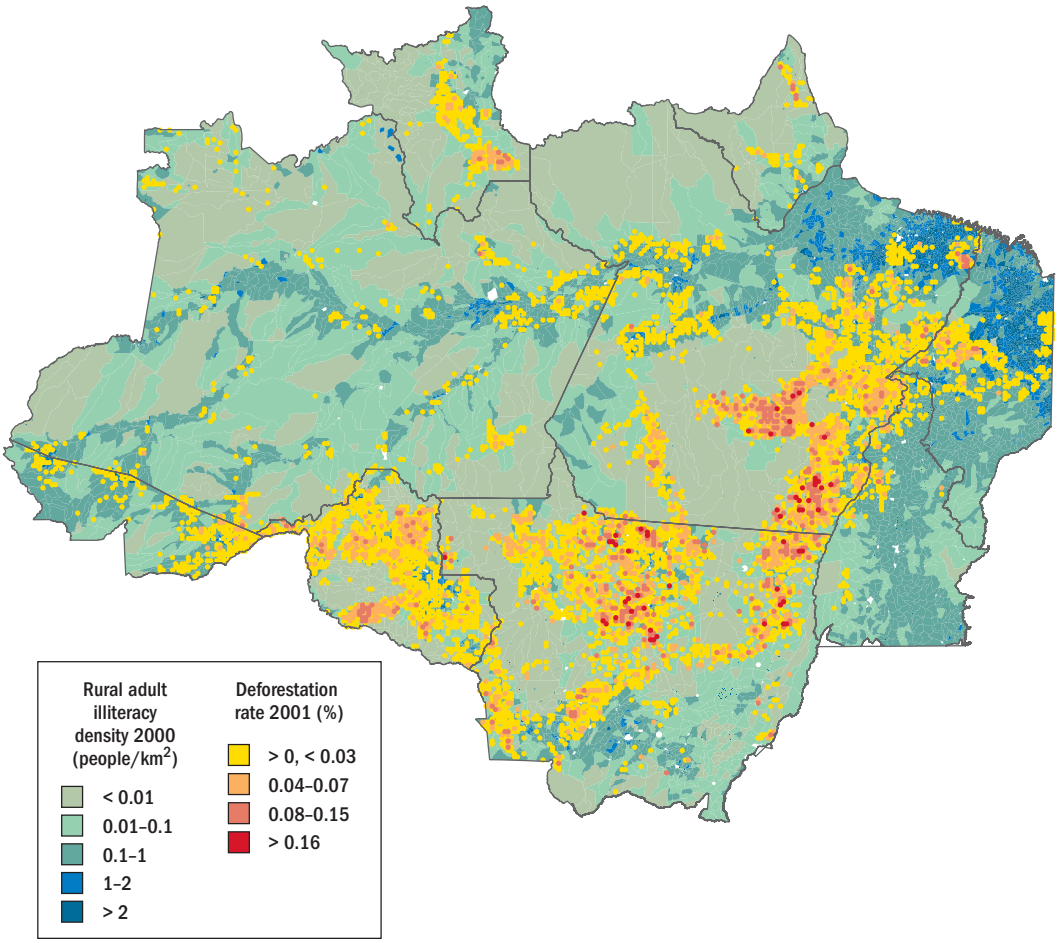


Source: Authors' calculations, see Appendix B.
Note: Rate = deforested area/total area.

Location of Poverty and Deforestation

Map 3.2 shows the concentration of deforestation in Brazil between 2000 and 2003, following a broad arc extending from Maranhão to Rondônia. The map, based on data from the Brazilian National Institute for Space Research (INPE), includes only deforestation of mature Amazônian forest, excluding deforestation of *cerrado* (savanna) woodland and secondary regrowth. Darker colors correspond to more rapid deforestation. The colors represent predominant shares of deforestation by size of incremental clearing, a proxy for the scale of the actors involved. The map shows that large-scale clearings predominate in Mato Grosso and southern Pará along the

Map 3.3 Amazônian Deforestation Rates and Rural Illiteracy Densities



Source: Authors' calculations, see Appendix B.
Note: Rate = deforested area/total area.

forest-cerrado boundary. Small-scale clearings—and thus, presumably, small-scale landholders—are scattered throughout but are most prominent in Rondônia and parts of Pará.

Map 3.3 shows the density of rural adult illiteracy in Brazil in 2000, overlaid by deforestation rates in 2001. Most of the deforestation hotspots of Mato Grosso and Pará are in areas where rural adult illiteracy density (a proxy for poverty density) is extremely low—from 0.01–0.1 per square kilometer. These densities are too low for poverty to be a plausible cause of deforestation, reinforcing the conclusions drawn from the predominance of large-scale clearings in these spots. But there are places where deforestation hotspots and higher illiteracy densities coincide, as in central Rondônia.

About 12 percent of deforestation in Brazil between 2000 and 2003 occurred on lands known as *terras arrecadadas*—unambiguously public lands. This represents private appropriation of public lands. It is not known how much of this transfer was legal. Some, perhaps most, took place through an opaque process called *grilagem*,[2] which results in an award of title to land of uncertain status (Margulis 2004). What is clear is that about half of this deforestation occurred on incremental clearings of 20–200 hectares, and another quarter on clearings more than 200 hectares. (The properties themselves are presumably much larger than the clearings.) The breakdown of deforestation by size is similar in the regions for which tenure status is unknown. These regions contain *terras devolutas*—unallocated and undemarcated public lands. So it is plausible that much deforestation in Brazilian Amazônia constitutes the appropriation of public lands by large private actors, in nontransparent and possibly illegal ways.

India Contains Net Reforestation with Patches of Deforestation

Despite its huge poor rural population and limited arable land, India has experienced a forest transition (see box 2.1). Between 1971 and 2003 forests grew from 10 to 24 percent of national area (Foster and Rosenzweig 2003).

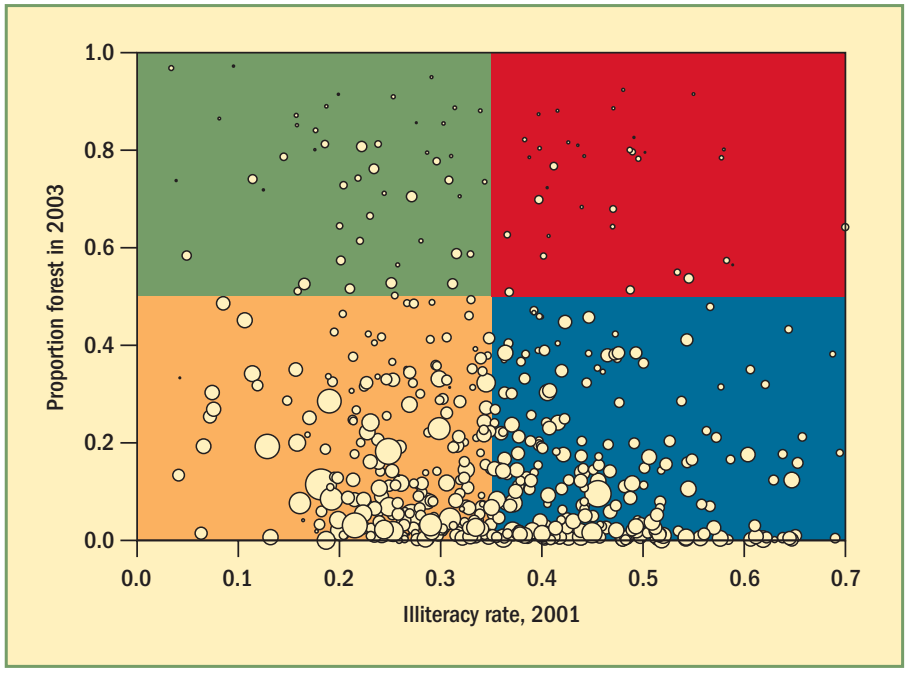
This expansion conceals a welter of local processes. One explanation may be a supply response to a long-term increase in the price of fuelwood. While some of this response may have occurred on private lands or in regenerating forests under joint forest management, it is also due to the Indian government's massive investments in tree plantations—on a nominal scale of about 1 million hectares a year

since 1980. At the same time, forests dwindled in villages where the green revolution increased the value of putting land into agriculture (Foster and Rosenzweig 2003). A 1980 decree forbade deforestation for agriculture and probably restrained large government-sponsored projects (Rudel 2005).

Still, deforestation continues in places. Many forests are thinning under human pressure, so the proportion of very dense forest is only 7.5 percent, or 1.5 percent of the national area (Ministry of Environment and Forests 2005). In sum, there is continuing conversion and degradation pressure on India's remaining native forests, while planted forests—already about half of the forest estate—expand.

Figure 3.5 shows the relationship in India, at the district level, between forest cover and illiteracy—a rough indicator for poverty.[3] There is no clear relationship. Districts with more than 50 percent forest cover contain just 3.6 percent of the country's illiterates. Additional analysis finds examples of both coincidence and divergence of forest cover, illiteracy, and tribal populations. The role of joint forest management in stimulating reforestation and reducing poverty remains to be comprehensively investigated.

Figure 3.5 Illiteracy and Forest Cover Have No Clear Link in India



Source: Authors' calculations based on Ministry of Environment and Forests 2005 and Census India 2001.
Note: Bubble sizes are proportional to population.

Indonesia Is a Complex Pastiche of Deforestation Processes

In Indonesia the relationship between corporate interests and smallholders, poverty, and deforestation is complex and varies across the archipelago. FWI and GFW (2002), like other sources, surmise that most deforestation is due to clearance by timber, pulp, and oil plantation interests. In some, perhaps most, cases these parties used conversion permits to obtain timber or pulp, but failed to install promised plantations.

There are no nationwide, reliable, quantitative estimates of the importance of corporate relative to smallholder deforestation. In a detailed study combining ethnography and remote sensing data, Dennis and others (2005) examine nine disparate sites in Sumatra and Kalimantan, sometimes finding multiple agents of deforestation at a single site. They find smallholders converting forest to commercially oriented permanent agriculture in two sites, smallholders engaged in short-rotation shifting agriculture in six sites, and land clearance by large plantation companies in six sites. Deforestation was also caused by arson connected with land tenure disputes between communities and companies, and by escaped fires lit by hunters in search of easier paths to deer, fish, and turtles. This kaleidoscope of actions by rich and poor actors illustrates the futility of seeking easy generalizations about the relationship between poverty and deforestation.

Here is a tale of two islands: one where poverty and forests coincide, another where deforestation appears to accompany relative prosperity (see maps 3.4 and 3.5). The tale uses new subdistrict data on poverty, forest cover, and deforestation over 1990–2000. (The deforestation data, although the best available, were assembled from disparate and possibly inconsistent sources and must be interpreted with caution.)

Consider first the island of Sulawesi. Panel A of map 3.5 shows the relationship between its forest cover and poverty rate in 2000, with the bubble sizes indicating the population of each subdistrict (*kecamatan*). In many subdistricts that are mostly (more than 50 percent) forested, the poverty rate exceeds the national average of 17 percent. These subdistricts contain 95 percent of the poor people in Sulawesi's mostly forested subdistricts, and about a third of its poor people.

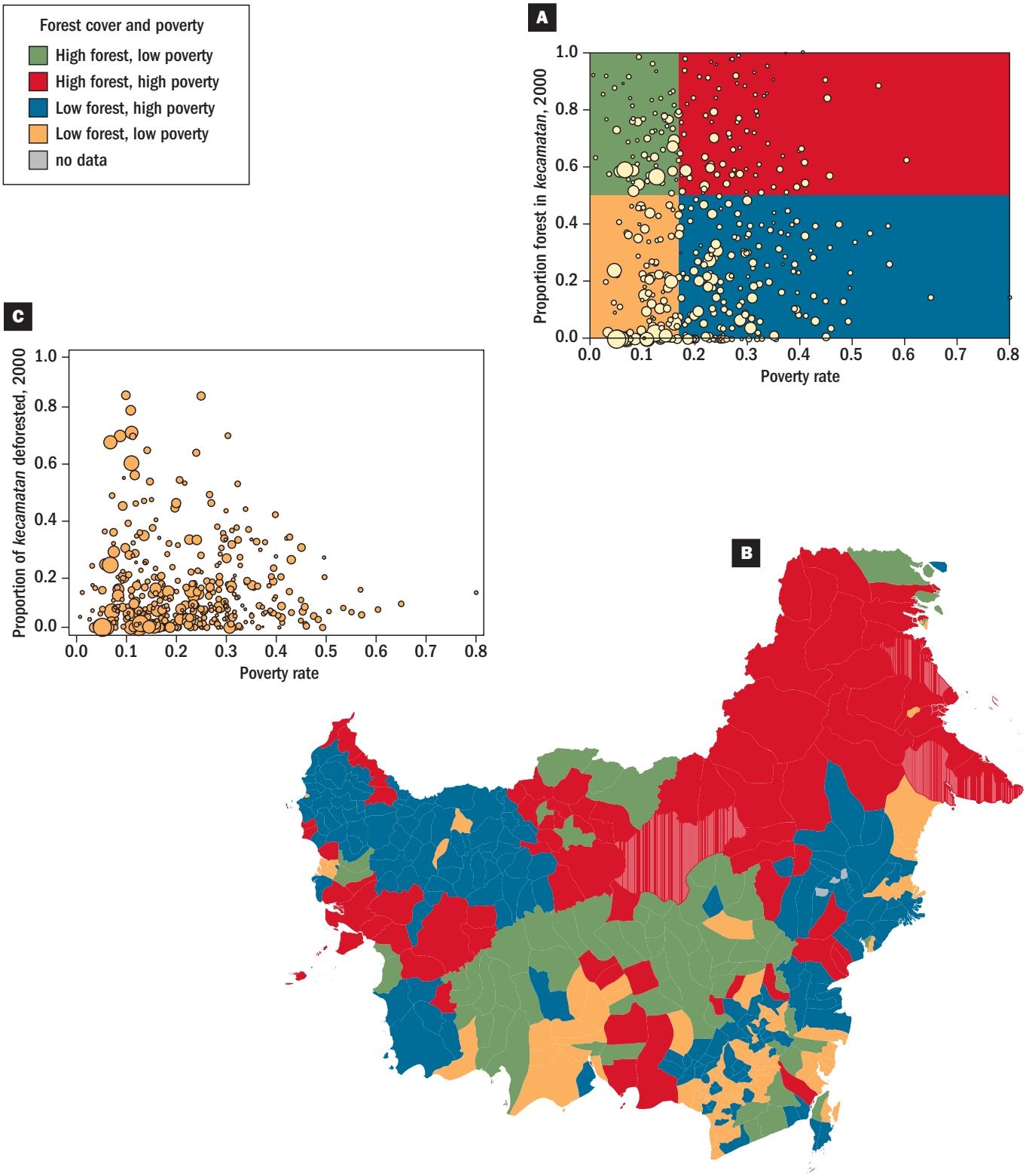
Panel B of map 3.5 shows that most of these high-forest, high-poverty districts are in the remote central portion of the island, far from the urban centers at the tips of its "arms." Panel C shows the slightly negative relationship between the deforestation rate and poverty rate, with the bubble sizes showing initial forest cover. In sum, Sulawesi conforms with the remoteness–high poverty rate–high forest cover syndrome and does not show a strong positive association between poverty rates and deforestation.

Kalimantan, to the west, presents a different picture (map 3.4). Some areas have high forest cover and high poverty rates (panel A). Again, these are mostly in the remote center of the island (panel B) and are large in area but have few people. A much larger population lives in subdistricts that are mostly forested and have lower than national average poverty rates (green areas of panels A and B). Overall, the poverty rate in the high-forest areas is 19 percent—scarcely more than the national average. Panel C of map 3.4 shows that the subdistricts undergoing the most rapid deforestation tend to have much lower poverty rates than more stable subdistricts.

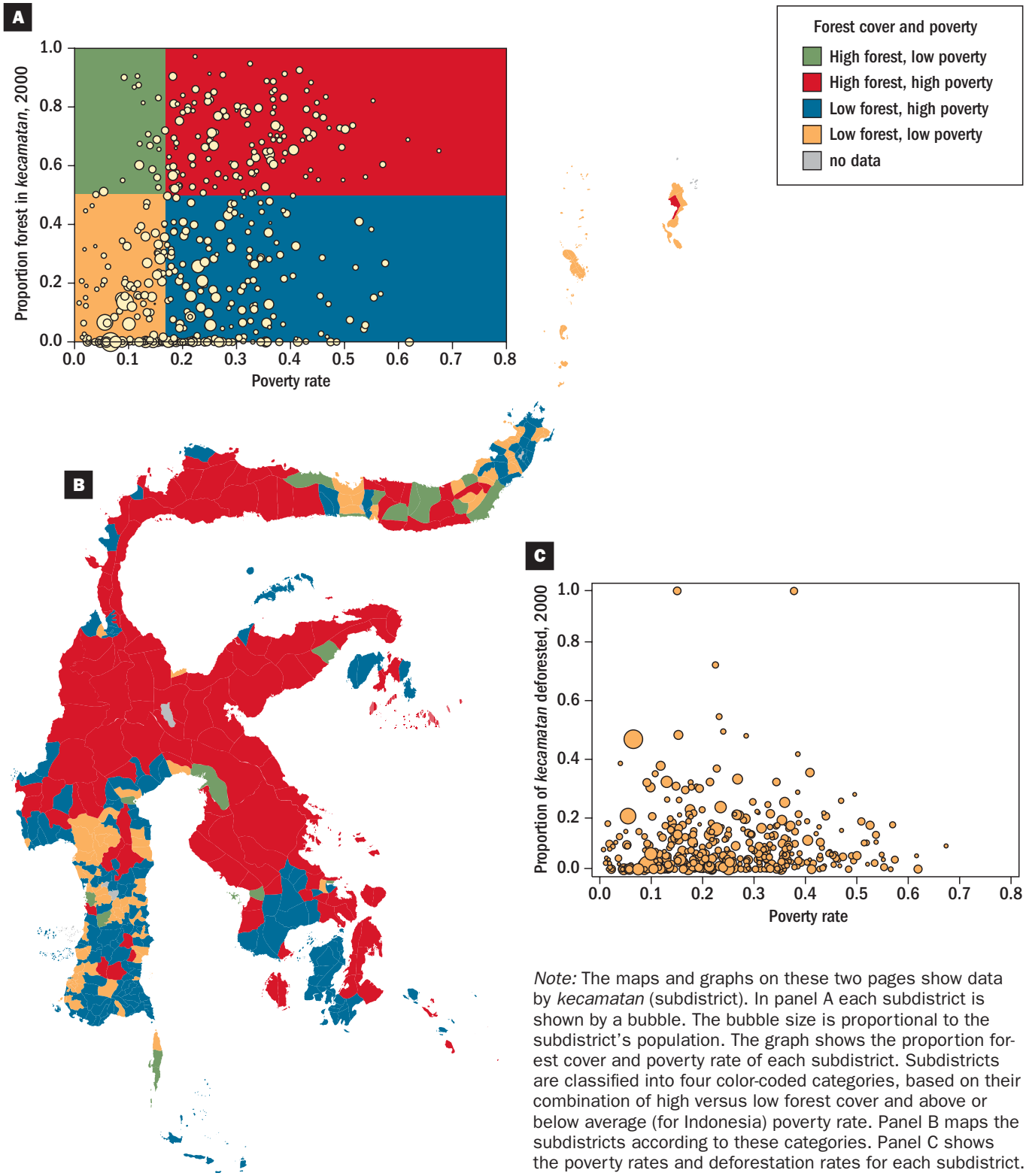
Why the difference between the two islands? Kalimantan has a much more active logging industry than Sulawesi. An hypothesis, to be confirmed, is that there is a pulse of income and deforestation at the logging frontier. This would be consistent with case studies of two forest communities, one on each island, by Deschamps and Hartman (2005). The remote Kalimantan site is inhabited by forest- and agriculture-dependent groups; the forest is threatened mostly by logging. The Sulawesi site abuts a national park, and here the threat is conversion to rice, cocoa, cloves, and other cash crops.

The authors find that all three groups (the two in Kalimantan and the one in Sulawesi) receive similar agricultural incomes per household. The agriculturally oriented groups earn about as much again from forest extraction. The forest-oriented Kalimantan group, however, earns three times as much from forest extraction than from agriculture. It can draw on commercially valuable wood and gaharu (a prized nontimber forest product)—neither of which is plentiful at the Sulawesi site. Further investigation is needed to determine whether these income gains are sustainable. High poverty rates in low-forest areas hint at unsustainability and may reflect populations living in degraded forests without trees, with insecure land rights.

Map 3.4 Poverty, Forests, and Deforestation in Kalimantan



Map 3.5 Poverty, Forests, and Deforestation in Sulawesi



Note: The maps and graphs on these two pages show data by *kecamatan* (subdistrict). In panel A each subdistrict is shown by a bubble. The bubble size is proportional to the subdistrict's population. The graph shows the proportion forest cover and poverty rate of each subdistrict. Subdistricts are classified into four color-coded categories, based on their combination of high versus low forest cover and above or below average (for Indonesia) poverty rate. Panel B maps the subdistricts according to these categories. Panel C shows the poverty rates and deforestation rates for each subdistrict. The rate is defined as forest loss/total subdistrict area.

Madagascar Shows a Spatial Association between Forests and Poverty, with Other Factors at Work

In Madagascar much deforestation is undertaken by people who are extremely poor by absolute standards. About three-quarters of the population lives below the national poverty line. How, then, are we to understand the relationship between poverty and forests within the country? Map 3.6 presents some perspectives, using district data on poverty in 1993 and deforestation over 1990–2000.

About 10 percent of the country's poor people lived in districts with high forest cover (more than 50 percent forested). Almost all lived in districts that were mostly forested and had higher than average poverty rates (red areas in map 3.6). Areas with the highest poverty rates also tended to have higher deforestation rates. But the overwhelming majority of Madagascar's poor people live in areas with low forest cover—including formerly forested areas that have become degraded.

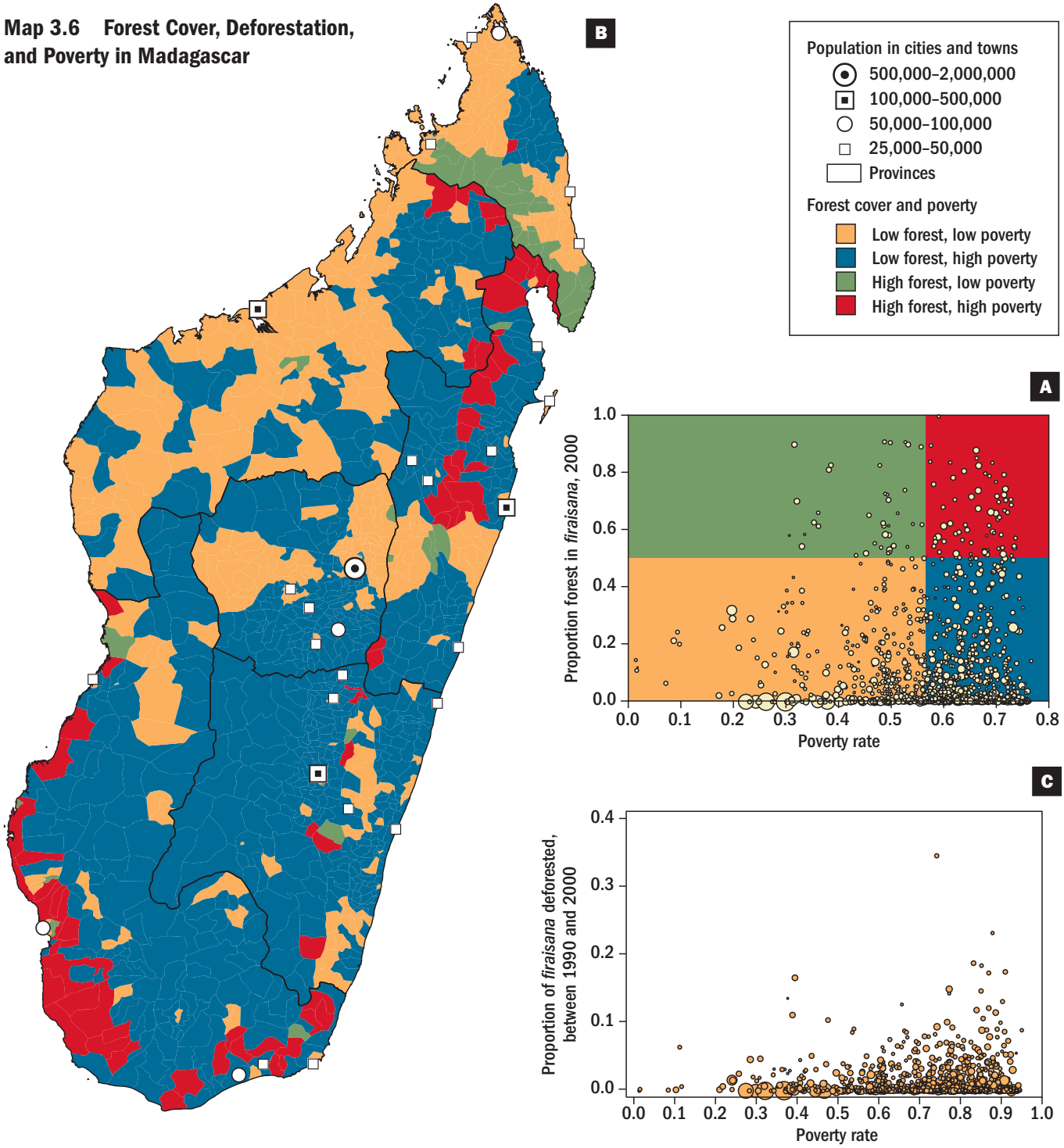
The link between poverty and deforestation in Madagascar unravels, however, when other factors that might affect forest clearance are taken into account. Gorenflo and others (2006) assessed the impact of poverty on deforestation, controlling for road access, topography, and the presence of protected areas. These factors were powerful correlates of deforestation. Holding them constant, there was a mild partial correlation between poverty and deforestation in most of the country's subregions. But in the southwest, where commercially oriented maize cultivation prevails, poverty was negatively associated with deforestation—suggesting that deforestation is at least temporarily associated with higher incomes.

Summary

Beware of facile generalizations about poverty, forests, and deforestation. In general, forest cover is an unreliable indicator of poverty rates, and poverty is a poor proxy for deforestation. In Brazil, India, Indonesia, and Madagascar only a small proportion of poor people live in mostly forested districts. In India and Indonesia there are forested places with low poverty rates (by national standards) as well as high. A more reliable generalization is that highly forested areas tend to have low densities of poor people.

But there are several important forest-poverty linkages that can guide policy. First, remote, forested areas in transfrontier zones often

Map 3.6 Forest Cover, Deforestation, and Poverty in Madagascar



Note: The maps and graphs on this page show data by *firaisana* (subdistrict). In panel A each subdistrict is shown by a bubble. The bubble size is proportional to the subdistrict's population. The graph shows the proportion forest cover and poverty rate of each subdistrict. Subdistricts are classified into four color-coded categories, based on their combination of high versus low forest cover and above or below average (for Madagascar) poverty rate. Panel B maps the subdistricts according to these categories. Panel C shows the poverty rates and deforestation rates for each subdistrict. The rate is defined as forest loss/total subdistrict area.

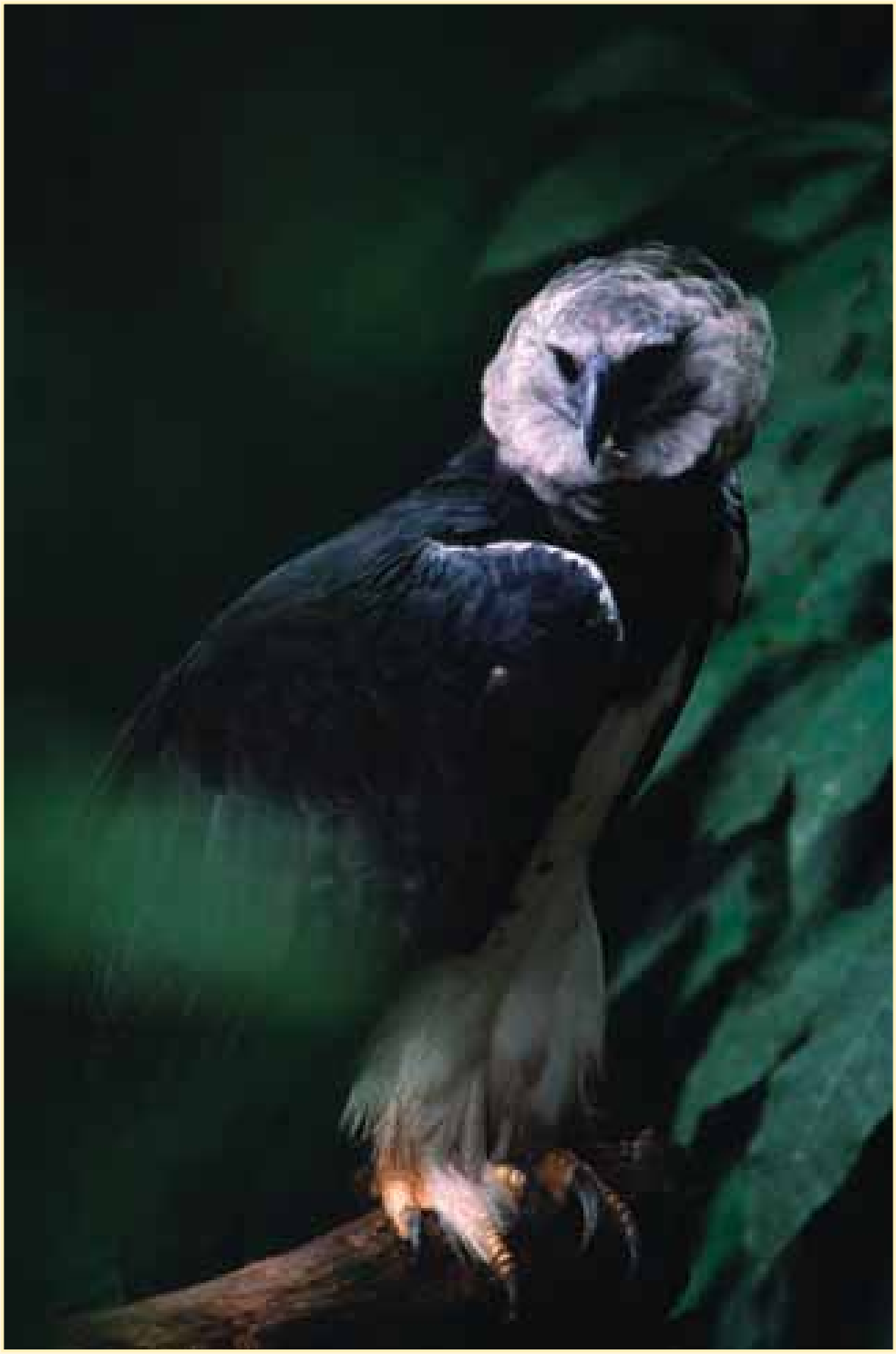
have high poverty rates, especially when timber markets are distant. Providing services and development options in these areas is a great challenge, but they may benefit some of the world's poorest people. Second, forest-dwelling populations may face legal or bureaucratic obstacles to using forest assets. The scope of this problem is not well quantified, but it could be quite large. Third, tens of millions of people occupy hundreds of thousands of square kilometers of forests without trees. More secure tenure in these areas could improve both livelihoods and the environment.

Endnotes

1. The satellite sensor used by the Brazilian National Institute for Space Research (INPE) may be unable to detect extremely small clearings (on the order of a hectare), leading to an underestimate of smallholder clearings. But the incremental expansion of such small clearings might be detected over two or three years. Thus on a statistical basis the area of small clearings might be approximately correct. It is also possible that some large clearings represent neighboring small clearings.

2. The word is said to derive from the practice of using crickets to soil forged documents to make them look antique.

3. Population data are from Census of India (2001). Forest cover data are from Ministry of Environment and Forests (2005) and include forests outside the tropical forest biome and both native and planted forests. Data are missing for some states and districts.



Harpy eagles, found in Latin America, exemplify the need to manage landscapes to ensure biodiversity survival. A nesting pair of harpy eagles requires 100 km^2 of forest to provide enough prey for sustenance. A viable population of harpy eagles requires dozens of times as much.

Juan Pablo Moreiras / Fauna & Flora International / Comisión Centroamericana de Ambiente y Desarrollo photo archive.