

# Chapter 1

## Explaining Deforestation: The Role of Local Institutions

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### Introduction

governments, citizens, and scientists are increasingly concerned about the role of forests in global environmental change. Evidence is mounting from multiple studies that humans at an aggregate level are exploiting forests at unsustainable rates in tropical regions.<sup>1</sup> While some deforestation can be attributed to rational and sustainable transfers of land to agricultural and other valuable uses, unplanned deforestation can generate significant negative externalities: loss of biodiversity, elevated risk of erosion, floods and lowered water tables, and increased release of carbon into the atmosphere associated with global climate change. More importantly, deforestation can decrease the welfare of forest users by eliminating habitat for game species, altering local climates and watersheds, and destroying critical stocks of fuel, fodder, food, and building materials.

While aggregate levels of deforestation are relatively well-known, less agreement exists among forest managers, policymakers, and scholars about the underlying and proximate causes of these increases.<sup>2</sup> The most frequently mentioned causes of deforestation include:

- population growth (Rudel, 1994);
- population density (Burgess, 1992);
- affluence (Ehrlich and Ehrlich, 1991; Rudel, 1994);
- technology (Ehrlich and Ehrlich, 1991);
- national debt (Kahn and McDonald, 1994);
- commercial logging (Capistrano, 1994);
- government policy (Repetto and Gillis, 1988; World Bank, 1992);

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<sup>1</sup> In contrast, the area and volume of forest resources are growing in most temperate regions.

<sup>2</sup> For a brief overview of the competing explanations given for deforestation see Turner (1995).

- forest accessibility (Kumrner, 1992); and
- political stability (Shafik, 1994).

Such disagreement about the most important factors means either that there are multiple processes at work and/or that significant knowledge gaps exist about these processes. Even when agreement has been reached on the importance of a certain factor, researchers have disagreed about its effect. For example, while some researchers argue that population growth is a major cause of deforestation, Caldwell (1984) suggests there is no linear relationship between population pressures and land degradation. Bilsborrow and DeLargy (1991), as well as Wolman (1993), assert that solid empirical evidence about the impact of population pressure is almost nonexistent. In fact, Blaikie and Brookfield (1987) report that land degradation occurs in areas with both increasing and decreasing population pressure, and Allen and Barnes (1985) find no relationship between the population and deforestation. An important study by Tiffen, Mortimore, and Gichuki (1994) demonstrates the impact of a five-fold increase in population in the Machakos District of Kenya between 1930 and 1990. They provide substantial evidence that increased labor availability in the locality—when combined with market opportunities, technological knowledge, and appropriate institutions—has led to sustainable resource practices, including the planting and husbandry of more, rather than fewer, trees.<sup>3</sup> And Varughese (this volume) finds no direct link between population and deforestation in a comparison of 18 communities in the Middle Hills of Nepal.

Similarly complex and multidirectional results are reported for other variables asserted to be causes of deforestation, including:

- individual wealth (Shafik, 1994);
- national debt (Capistrano, 1994);
- forest accessibility (Agrawal, 1995; Schweik, this volume); and
- commercial logging (Burgess, 1992; Capistrano, 1994).

Contributing to such contradictory findings is the dearth of forestry data at the national, regional, and local levels; the lack of time-series data; and the disparate definitions and measurements employed in studies of deforestation.

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<sup>3</sup> *What is important about the Tiffen, Mortimore, and Gichuki study is that it demonstrates the variability of responses to population changes in different localities. It challenges the presumption that a population increase at a local level will harm the ecological system at the local level. It does not address the question of population increases at a global scale (see Hotting, 1994, for an overview of ecological research showing diverse responses at multiple scales to population increases), nor does it address the issues regarding secondary forests that may result from human efforts to restore areas where primary forests previously stood.*

Additionally, most analyses of forest exploitation lack linkages to the local level, despite a growing awareness among scholars and practitioners that the actions of local people greatly determine the success or failure of natural resource management schemes.<sup>4</sup> Because the debate about the causes of deforestation and other environmental harms has been largely confined to macroanalyses, it has failed "to benefit from the wealth of data generated at the micro level—data which provide rich information on the social and economic factors that mediate the relation between population and the environment" (Arizpe, Stone, and Major, 1994: 3).

And yet the role of people at the local level is crucial. National governments rarely possess enough personnel or money to enforce their laws adequately, prompting many officials to consider decentralizing authority over forest resources. It is becoming increasingly clear that local communities both filter and ignore the central government's rules. Importantly, they also add their own rules, generating local institutions—rules in use—and patterns of activity that can diverge widely from legislators' and bureaucrats' expectations. Because local communities live with forests, are primary users of forest products, and create rules that significantly affect forest condition, their inclusion in forestry management schemes is now considered essential by many researchers and policymakers (Arnold, 1992).

The authors in this volume seek to understand the complex interactions between local communities and their forests. To do so, they depart significantly from conventional national-level analyses and offer groundbreaking efforts to identify the relationship between forest conditions, individuals, and institutions at a local level. The presumption that guides the authors is that institutions at the local level—together with the incentives and behaviors they generate—lay at the heart of explanations of forest use and condition.

Local institutions can modify the effect of factors thought to be the driving forces of deforestation. Rare is the market, technological, demographic, or political factor that affects individuals without first being filtered by local institutions. Given certain institutional arrangements, individuals may forgo the use of a resource if it is not culturally acceptable (see Schweik). Individuals may ignore central government rules that contradict their daily patterns of resource use (see Banana and Gombya-Ssembajjwe) or ask the central government for help in protecting their resources (see Agrawal and Varaghese). Individuals may construct rules to prevent the immediate commodification of their forest resource (see Agrawal, Becker and Leon,

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<sup>4</sup> *FAO, 1990; Ostrom, 1990; Hecht and Cockburn, 1990; Marks, 1984; Blockhus et al, 1992; Poffenberger, 1990; Bromley et al, 1992; McCay and Acheson, 1987; Ascher, 1995; Gibson and Marks, 1995. Studies of local communities and forest use do exist (for example, see Atran, 1995), but these are generally single-case studies.*

and Varughese) or they may allow the resource to be put on the market quickly (see Becker and Gibson). Since local institutions guide the daily consumption of natural resources, it is appropriate to keep them at the center of analyses concerning forest use.

Any analysis of how local institutions affect forest conditions necessarily crosses the neat boundaries of academic disciplines. Evaluating the condition of a forest requires employing the concepts and measurement techniques of biologists and ecologists. Understanding local behavior needs insights from anthropology and sociology. Examining the creation and enforcement of rules needs the input of political scientists and estimating the impact of a forest on household budgets must borrow from the economists' toolbox. The authors of the empirical studies found in this volume invest substantial effort to weave together the natural and social sciences to create more comprehensive explanations of the people-forest nexus. Further, all of the cases explicitly use the methods of the International Forestry Resources and Institutions (IFRI) research program, which not only employs a multidisciplinary approach but allows for comparison across time and space as well (see Appendix I to this volume).

Because the authors in this volume move away from simple, national-level studies of forests and towards more comprehensive accounts of forests and communities at the local level, their studies offer policymakers a more sophisticated view of forest management from which to derive policy options. The cases in this volume demonstrate that forests should not be considered as the source of only one commodity, wood; nor should users of the forest be clumped together as one group. Rather, these studies underscore how forests are associated with *multiple products* (e.g., wood for construction and/or fuel, wildlife, water, leaves, fruits, fodder, seeds, straw, shade, fertile soil, stones, etc.) and *multiple user groups* (defined by property rights, product, location, citizenship, religion, caste, ethnicity, technology, income, access). The variation of local institutions discovered by the authors also discourages the view that template forest policies are likely to work when imposed on a country as a whole. The diversity of conditions, rules, and outcomes presented in this volume's chapters, therefore, equips policymakers with an appreciation for the complexity of forestry resources as well as examples of management successes and failures that should assist in the construction of the most appropriate roles to be played by local, regional, and national authorities.

### **Forests, goods, rights, and owners**

Clarifying the differences and similarities between types of goods, property rights, and owners is an essential first step toward an understanding of the interaction between people and forests. McKean explores these concepts in Chapter 2, noting that the differences between public and private types of goods, rights, and owners are more than semantic. The differences can have critical effects on the distri-

bution of a forest's benefits and, ultimately, on the overall condition of the forests. To misjudge the types of goods involved with a resource system can lead to the design of inappropriate property-rights arrangements, and these can in turn create the incentive for grievous depletion rather than sustainable use.

As economists have long defined these things, property rights to resources are not the resources themselves but are human institutions, sets of mutually recognized claims and decision-making powers over those resources. Private property rights are those that are clearly specified (not vague), secure (not subject to whimsical confiscation), and exclusive to the owner of the rights. Rights that are vague, tenuous, or nonexclusive are not fully private. Private property arrangements win praise and admiration, appropriately, because they can encourage protection and investment in the goods to which they attach. Of course, they cannot do this—perhaps nothing can—in an atmosphere of chaos, insecurity, and short time horizons, and we would be wrong to blame the property-rights institutions when the real problem is overwhelming uncertainty.

McKean argues that much of the theoretical foundation underpinning the debates over property rights assumes that there are only two kinds of goods: public goods and private goods. For several decades now, political-economists have agreed that the two crucial dimensions we should use to classify goods are (1) the ease with which potential users can be excluded from access to the good (the "excludability" of the good) and (2) whether using a portion of the good shrinks the supply that remains (the "subtractability" or "rivalness" of a good). Pure public goods are nonexcludable and nonsubtractable, and private goods are both excludable and subtractable. The dichotomy of pure public goods and private goods has become the focus of discussion about types of goods ever since, and consequently many have overlooked the other two types of goods that are created by this two-by-two typology: Club goods are excludable but nonsubtractable, and common-pool goods are difficult to exclude but subtractable. Little harm has been done by ignoring club goods, because they are easy to produce (because they are excludable) and undepletable (because they are nonsubtractable). However, ignoring common-pool goods, which are difficult to produce and easy to deplete, is tragic indeed. It turns out that most environmental and natural resources that we care about are common-pool goods. They are as subtractable as private goods, but because it is difficult to control or restrict access to them (the excludability dimension), it is very difficult to restrict the rate at which they are consumed. Thus, we arrive at a recognition of environmental crisis rather underequipped and ill-accustomed to thinking about the crucial features of environmental resources. Because we have become accustomed to thinking in terms of only public goods and private goods, when we recognize that environmental resources are subtractable we begin to think of them as private goods.

If forests were like farms, producing wood as farms grow tomatoes or flax, then viewing them as private goods and creating individual private property rights in forests might be sensible. But even monoculture tree farms are frequently complex ecosystems of varied and interdependent species producing multiple products. And nonmonoculture forests are even more complex, generating goods that range from fallen leaves to berries to kindling to timber, and their resilience as productive systems requires that complexity. They also provide environmental services beyond the forest, in terms of erosion control, flood control, conservation of water, cleaning of air and water, and stabilization of local climate. The size of many forests, and the inevitable complications involved in monitoring the use of the forest and balancing one use against another, make exclusion or restrictions on access intrinsically problematic. Thus, McKean asserts that it is appropriate to think of forests as a complex of many commodities with attributes of both common-pool and public goods.

The definition of private property rights has to do with the clarity, security, and exclusivity of the right, and does not actually include any stipulation that they be vested only in single individuals. Although larger entities and groups of individuals may theoretically hold private property rights—and do in actual fact as well (e.g., business partnerships and joint-stock corporations)—much discussion forgets this. As a result, campaigns to create private property rights tend to consist of transferring ownership from larger entities and groups to individuals. In some instances, these interventions may destroy the property-rights arrangements that they should want most to create. Most privatization campaigns would ignore or even oppose the assertion that there might be conditions when it is more desirable for clear, specific, secure, and exclusive rights to be vested in a group rather than in single individuals, but McKean outlines conditions in which group rights may make more sense.

It is widely agreed that private property rights are the appropriate institution to create for commodities that are subtractable and from which it is easy to exclude others from benefits. Thus, if one thinks of natural resource systems as potentially private goods, one will advocate creating private property rights for those resources. And if one's notion of private property rights requires vesting all such rights in individuals, then one will fail to consider the possibility of vesting rights in groups or communities when that might be appropriate. McKean argues that natural resource systems that are really combinations of public and common-pool goods can have as many as four attributes that make vesting property rights in groups more efficient than vesting those rights either in a single individual or trying to parcel the resource into individually titled patches.

First, some resources are simply indivisible, and some resource systems like forests contain or produce useful items that are themselves fugitive or

mobile resources. Second, on some large resource systems, particularly in arid regions, there is great uncertainty in the location from year to year of the most productive zones. Third, on resource systems with congested and competing uses and high population pressure, coordination among users is essential to cope with externalities. Fourth, group ownership and thus group enforcement of rules can be an efficient way to cope with the costs of monitoring otherwise porous boundaries and enforcing restraints on use within those boundaries. In many resource systems including forests, more than one condition, or even all four conditions, may pertain. Thus, forests make good candidates for common-property regimes: or vesting clear, specific, secure, exclusive rights to managing a resource in nearby communities.

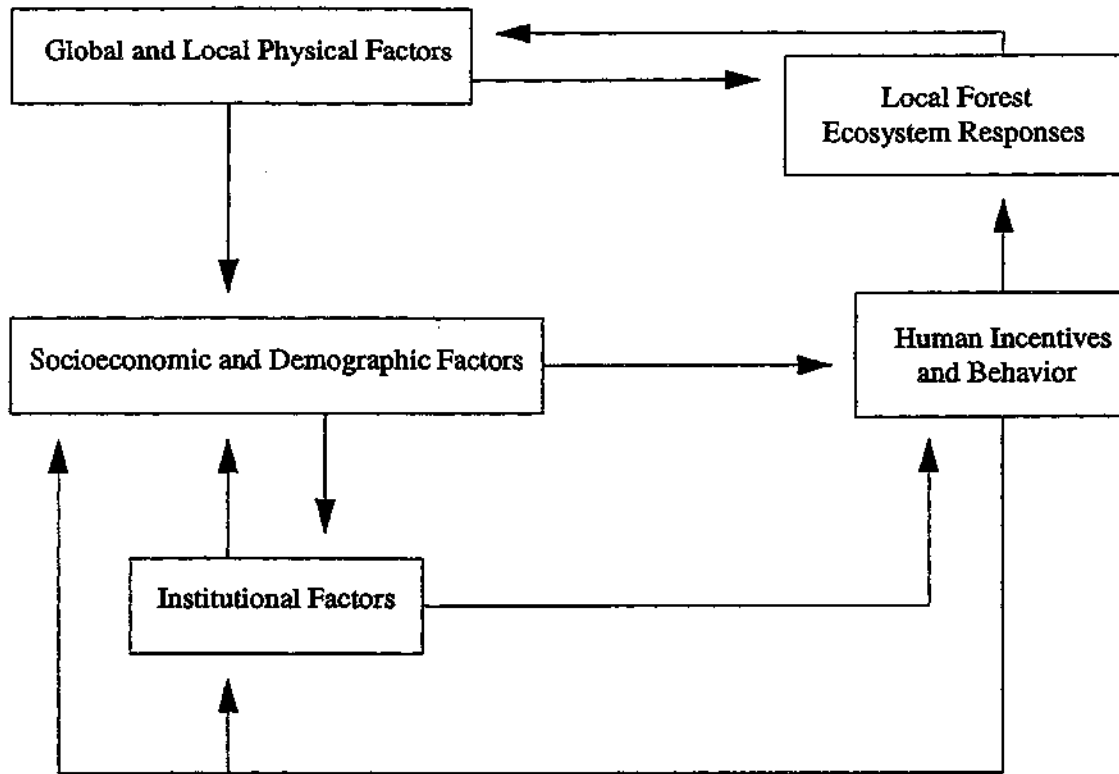
The contributions in this volume address a variety of property-rights arrangements, and take into consideration how the institutions that surround these arrangements provide incentives for local residents to use their forests. These property-rights arrangements often have critical influences over the condition of forests.

### **IFRI research program**

The empirical chapters following McKean's theoretical exploration accept the challenge that our understanding of forests relies on our understanding of how people at the local level interact with forest resources. In their quest for untangling these complex relationships, they draw upon the design, principles, and hypotheses of the International Forestry Resources and Institutions (IFRI) research program. The IFRI research program is a multilevel, multicountry, over-time study of forests and the institutions that govern, manage, and use them.

To help explain deforestation and loss of biodiversity, the IFRI research program draws on the Institutional Analysis and Development (IAD) framework developed and used by colleagues associated with the Workshop in Political Theory and Policy Analysis at Indiana University over several decades (Kiser and Ostrom, 1982; Ostrom, 1986; Oakerson, 1992; Ostrom, Gardner, and Walker, 1994). The IAD framework has been used to study how institutions affect human incentives and behavior as these impact on urban services in metropolitan areas, the provision and production of infrastructure (such as roads and irrigation systems), and the governance and management of natural resource systems. At the core of the IAD framework are individuals who hold different positions (e.g., members of a local forest user group; forest officials; landowners; elected local, regional, and/or national officials) who must decide upon actions (e.g., what to plant, protect, harvest, monitor, or sanction) that cumulatively affect outcomes in the world (e.g., forest conditions, the distribution of a forest's benefits and costs). To simplify representation, the complex set of incentives and resulting behavior is initially represented in Figure 1.1 as a single box.

This “box,” like all of the other boxes in Figure 1.1, can be opened and contains a nested set of other conceptual boxes within it.



**Figure 1.1: The IAD framework relating multiple factors affecting local ecosystems**

In a dynamic setting, human behavior impacts on local ecologies that are also affected by (and affect) global and local physical factors. Human incentives and behavior are affected by socioeconomic and demographic factors as well as institutional factors. Each of the factors on the left-hand side of Figure 1.1 unpacks into a large set of variables. For example, unpacking the institutional factors that may affect human incentives and behavior across a large number of diverse settings includes variables at multiple levels. At a micro level, these would include, but not be limited to, such variables as:

- Specific rules-in-use for each parcel of land (or forest product) in a local ecology that differs in regard to who can harvest, when and how, and how much harvesting of different products is authorized or forbidden.
- What types of afforestation or other enhancement or protection activities are encouraged and by what means.



- What types of subsidies are provided related to the inputs or outputs of a local economy.
- How forest use and investment practices are monitored and sanctioned.
- The level of common understanding of what rules are used, monitored, and enforced.
- Whether forest users are organized and what such organization means in terms of individual incentives.
- What representatives of local, regional, or national government are involved in local activities.

At a macrolevel, these would include, but not be limited to, such variables as:

- National legislation authorizing diverse types of forests and parks in a country and the restrictions or subsidies involved in the use and administration of each type of forest.
- Types of private and/or communal land and tree tenure authorized.
- The personnel rules of national, regional, and local agencies affecting recruitment, retention, promotion, and discipline of public officials.
- Taxation laws on land, extraction rates, and corporate profits.
- The availability of courts to resolve disputes over land and/or tree tenure, contracts related to concessions, and disciplinary actions within public agencies.

Systematic information about institutional variables at a micro level are not available in any existing data set, nor are most relevant macroinstitutional variables.

One advantage of a simple framework is that a large number of nested variables can be included. And, given the complexity of the forest-local community nexus, such complexity was a given. Workshop colleagues sought input from a wide range of international scholars, including biologists, ecologists, resource economists, foresters, anthropologists, sociologists, demographers, lawyers, geographers, and political scientists. Their input was even more deeply embedded after early field testing occurred in Bolivia, Nepal, and Uganda. Thus, researchers from a variety of disciplines contributed invaluable advice about the factors that may help explain how humans impact forest condition and biodiversity. Given these many and interrelated factors, Workshop colleagues also employed a relational database to record the information gleaned by the IFRI protocols and to allow the testing of a nearly unlimited number of specific hypotheses.

IFRI researchers have concentrated first on the design of ten research protocols and careful field methods for collecting valid and reliable information about micro-level institutional, socioeconomic and demographic, and local physical factors that affect human incentives and behavior, and the impact of this behavior on local forest ecologies.<sup>5</sup> It is the first research program to our knowledge that combines systematic forest mensuration techniques for a sample of 1,3, and 10-meter radius forest plots for each forest in sites where data is also systematically collected about local institutions and socioeconomic and demographic variables.

In the early stages of this research program, IFRI colleagues are analyzing a small number of cases from the initial countries where research has been conducted—Bolivia, Ecuador, India, Nepal, Uganda, and the United States. The analyses contained in this volume, for example, range from a focus on a single case study to as many as 18 cases. All of the individual studies, however, have utilized the same research protocols. Thus, as the number of studies within each country grows, it will be possible to analyze results from an ever larger number of sites. Further, IFRI researchers intend to revisit sites on a regular basis to investigate more precisely the dynamics of how local institutional changes impact on the actions of forest users and officials as well as the results of these actions on forests. Thus, the IFRI research program provides a unique opportunity to undertake systematic, micro-level, comparative studies of institutions and their impact on rates of deforestation over time.

This volume represents our initial effort to report on studies conducted in Bolivia, Ecuador, India, Nepal, and Uganda based on a common framework and using the same research protocols. Since the IFRI research program has just entered its operational phase, we hope this is the first of a growing series of publications helping policymakers, forest users, and scholars understand the microprocesses at work under the macrovariables that have been the focus of recent attention.

### **Empirical chapters**

The empirical studies in this volume seek to fill at least two critical gaps in current forestry research. The first is the lack of comparable micro-level studies. The second is the shortage of studies that address the pivotal influence of local-level institutions on forest use and condition.

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<sup>5</sup> Now that the design of the micro-level studies has been completed, we are starting to design a macrolevel study using the same framework but including variables characterizing national-level entities.

### ***Why micro and comparative analyses are important:***

**Variation at local levels.** Country-level data on rates of deforestation do little to help policymakers and scholars unravel the web of the causes of forest use. For example, while Uganda and Nepal have the same rate of deforestation at the national level, around 1 percent, these deforestation rates vary significantly within each country over space and time (FAO, 1993). And yet for forestry policy to be effective, an understanding of the causes of such dynamic and spatial variation within a country is critical. The empirical studies in this volume clearly demonstrate the need for scholars and policymakers to appreciate such local-level variation.

In Chapter 3, Agrawal investigates how local-level variation within the Indian *van panchayat* (forest council) system of community forestry leads to substantially different outcomes for the management of forest resources. Agrawal begins his analysis by reviewing the legislation that undergirds the van panchayat system. In response to widespread protest to the confiscation of lands by the colonial government, the British passed the 1931 Van Panchayat Act, which allowed village communities to create van panchayats to control forested areas previously administered by state revenue officials. While the Act includes the broad outlines of the panchayats' powers, local factors still generate the pattern of a panchayat's day-to-day operations.

Agrawal demonstrates that these local factors help to explain why not all of the van panchayats have managed their forest resources successfully. Comparing five van panchayats from the same region (Almora District), operating within the same ecological and administrative areas, Agrawal finds that the councils range widely in terms of their size, organization, age, and resource endowments. Evaluating how these characteristics affect forest condition, Agrawal argues against those who would assert that either per capita income or the age of van panchayats are the major factors that account for the success of local councils in managing their forest resources. Rather, Agrawal indicates that the size of the van panchayat is an ignored but important factor that affects its performance. Very small van panchayats are disadvantaged, Agrawal argues, in their efforts to generate sufficient human and other resources to monitor and enforce local rules. Moderate-sized van panchayats are able to generate greater amounts of monetary and voluntary contributions in their efforts to monitor the use of their forest, which are under constant threat of exploitation by locals and outsiders. These findings challenge those scholars and practitioners captured by an invariant "smaller is better" view. Rather, Agrawal indicates that somewhat larger organizations can have great advantages in managing forest resources at the local level. Additional studies of van panchayats are planned that will enable

Agrawal to examine a broader array of these local institutions so that the possibility of a curvilinear relationship between size of forest organization and capabilities to monitor and enforce local rules can be explored.

Banana and Gombya-Ssembajjwe's analysis of forests in Uganda (Chapter 4) further underscores the diversity of outcomes at the local level. In their examination of five forests located in four different ecological zones, Banana and Gombya-Ssembajjwe discover that the level of human consumptive activity differs widely, and has a dramatic impact on the physical condition of the forests. Three forests (Mbale, Lwamunda, and Bukaleba) show signs of heavy use in the forms of illegal commercial logging activities and livestock grazing; over 70 percent of the 90 sample plots had evidence of illegal utilization. Two other forests (Namungo and Echuya), however, showed significantly less disturbance, despite the fact that they, too, contain valuable commodities such as commercial tree species and grazing areas.

Discounting environmental and biological factors as explanations for this variation, Banana and Gombya-Ssembajjwe then consider social explanations. They indicate that most forested lands in Uganda are state property, thus offering little incentive for locals to constrain their consumption of forest products. Colonial and post-colonial regimes vested forested lands within the central government, disregarding indigenous property rights or management schemes. Without a stake in the tenure of the resource, the authors argue, local villagers have the incentive to consume forest commodities opportunistically. Thus, the degradation of Uganda's forested lands should be expected.

But Banana and Gombya-Ssembajjwe assert that this general lack of tenure at the local level does not explain the variation of forest condition found in their five cases. The authors turn to the level of enforcement for each forest to account for these differences. Mbale, Lwamunda, and Bukaleba Forests are all state-owned forest reserves. Each forest is monitored only by Uganda's Forest Department, which possesses relatively few staff to fulfill their protective function. Further, Department staff have few incentives to patrol frequently, since the benefits resulting from their employment are not closely tied to their enforcement of the law. During the past several decades, the Forest Department has not been able to enforce its rules in a uniform manner. Thus, little common understanding exists of what rules might actually be in practice. The Echuya and Namungo Forests, on the other hand, both have had a much greater stability in the rules that are enforced and a much greater level of monitoring and enforcement. While Echuya is a government reserve, the Forest Department has augmented its monitoring capabilities by using the help of an Abayanda (pygmy) community that resides in the forest. The Abayanda benefit from access to forest products in return for their monitoring duties. Namungo's Forest is a

privately-owned woodland for which a family hires its own guards. Those villagers who live near to Namungo's Forest also help monitor its use since the family allows villagers their traditional rights to extract certain levels of firewood, poles, medicines, fruit, fodder, and other forest products. Thus, Banana and Gombya-Ssembajjwe demonstrate that property rights and their enforcement help to explain the variation of forest conditions found in their site.

Schweik's analysis in Chapter 5 delves even more deeply into issues regarding the spatial variation of forest condition. Schweik seeks to account for the spatial variation of the Sal tree, *Shorea robusta*, that villagers living in the Chitwan District of southern Nepal find particularly valuable for fuelwood, tool-making, and construction. Using a sophisticated combination of tools including Global Positioning Satellite (GPS) equipment, Geographic Information System (GIS) software, the BFRI research protocols, and a maximum likelihood regression model, Schweik attempts to capture the influence of the most important factors that affect the growth pattern of *Shorea robusta*.

To establish the human and nonhuman impedances to the growth of *Shorea robusta*, Schweik first gathers data from a relatively undisturbed forest to establish the unimpeded or "natural" distribution of *Shorea robusta*. In such a setting, the tree lives in clusters, generating a negative binomial distribution (as opposed to a random or uniform distribution of trees), a finding critical to the appropriate specification of his statistical model. Schweik then discusses and measures the nonhuman factors that could influence *Shorea robusta's* distribution, including slope steepness, slope aspect, elevation, competing species growth, soil characteristics, proximity of other seed trees, animal grazing, and meteorological factors. Finally, the author attempts to capture the influence of humans on the tree's distribution by pinpointing the position of villages in relation to more than 90 sampled forest plots by using GPS and GIS technologies.

Schweik's results reveal that the distribution of *Shorea robusta* trees in the sample forest plots differs significantly from the distribution found in an undisturbed setting, i.e., it does not follow a clumped pattern. Certain nonhuman factors account for some of this pattern: steepness of slope, slope aspect, competing trees, number of extant *Shorea robusta* trees, and depth of humus layer.

Schweik also finds two location variables—the elevation and the east-west location of plots—to be significant, and he links them with human behavior at the local level. Given that *Shorea robusta* grows at elevations up to 1,200 meters, its distribution should not be affected in the area under study (extant hills do not exceed 800 meters). Schweik's results, however, show that in the study site, the number of

trees increases at higher elevations. Such an outcome resonates with optimal foraging theory, which argues that individuals seek the easiest source for their resources: climbing hills to gather trees makes them more difficult to acquire, and thus fewer would be taken at higher elevations. The decrease in trees from west to east, however, is not captured by either the nonhuman factors or simple optimal foraging theory, since the pattern of exploitation should result only in a ringed pattern surrounding villages, not in a systematic decrease in trees from west to east. Schweik finds the operation of Nepal's caste system to be the most convincing explanation for the west to east decrease of *Shorea robusta*: villages in the west tend to be composed of higher caste Nepalis, who are allowed to gather wood in both their forests and neighboring forests used by lower castes. Members of eastern villages can only use their own forests, being disallowed from using the forests of the higher castes in the west. Thus, the forests of the east are used at a greater rate than those in the west. Schweik's path-breaking analysis demonstrates how human use patterns vary significantly at the micro level, leading to differences in forest condition within forested areas as small as 10 square kilometers.

Becker and Gibson's examination of the relationship between the members of the Loma Alta commune and their fog forest in Ecuador highlights how the nexus of users, property rights, and forest products may account for the variation found in a forest's condition (see Chapter 6). Their study of the *comuna* is timely: Loma Alta is one of many comunas located along the watersheds of the Chongon Colonche mountain range of western Ecuador, whose last stands of tropical forest are home to numerous endemic species—so many, in fact, that some conservationists consider the area's protection a global priority.

Unlike other national governments—and central to this study—is the fact that Ecuador recognizes the rights of some local communities to govern their local affairs. In 1936, the central government passed the Law of the Comunas, empowering 32 communities living in the coastal areas to hold land jointly and act as their own local governments. Although the land is held in common, the comuna still allocates its members distinct plots to use as they see fit. The members' rights to the land are only constrained by two rules: they must use the land, and they may not sell it. Otherwise, the plots are treated as private property, with members making capital improvements to the land, passing it on to their offspring, and renting it to other comuna members.

Becker and Gibson argue that this system of property rights directly affects the condition of the comuna's upland fog forest. In the part of the forest that has not been allocated to individuals, members and outsiders have seriously degraded the forest. Approximately 70 percent of the forest cover has been removed, and large

cleared areas exist—testimony to the commercial selling of timber and the conversion of forest into pastureland. Where individuals have been allocated plots in the forest, however, it has endured far less exploitation.

Variation also exists within those plots that have been allocated to individuals. At elevations above 300 meters, some land within the forest has been cleared to establish plantations of the cash crop paja toquilla (*Carludovica palmate*). Farmers plant paja at this elevation since the tree needs the moisture that the forest at higher elevations provides.

Becker and Gibson find that the particular system of property rights within the Loma Alta comuna, the value of the forest as land for paja toquilla, and timber sales has led to a specific pattern of deforestation in the communal forest. Although many parts of the forest still display the characteristics of a relatively healthy secondary forest (having been commercially logged over the last century), the authors argue that the forest remains threatened by the possible expansion of farming activities and the lack of comuna rules regarding land use.

Becker and Leon (Chapter 7) investigate the variation that occurs in forest conditions even where used by the same ethnic group along the same river. The authors focus on the relationship between three Yuracare settlements and their adjacent riparian forest along the Rio Chapare in Bolivia. In their attempt to explore if and how these Yuracare communities might manage their forest, Becker and Leon draw on biological measures of the forests and compare them with a reference forest of the same type that has known to be relatively unused. In addition, the authors selected the three sites because they vary in their distance from the closest market and in their population.

Becker and Leon find a complex pattern of behavior and outcomes in their study. The forests do, in fact, display predictable variations along the dimensions of moisture gradient, distance to markets, and population pressure. But the authors find results that go beyond these simple causes, the most important of which is that the Yuracare are clearly managing their forested areas to increase the populations of game animals. By planting and tending to fruit trees, the Yuracare intentionally alter the forest to suit their preferences for certain food types. Becker and Leon argue that these local institutions are under threat, however, as markets increasingly penetrate the area, causing changes in Yuracare preferences in food and labor.

In Chapter 8, Varughese encounters substantial variation in both the condition of the forest and community forest management in his study of 18 cases in the Middle Hills of Nepal. Although all the communities he studied depended on

forest products to substantial degrees, Varughese found that forests ranged from being in good condition (as evaluated by a professional forester along both subsistence and commercial scales) to poor condition. In some sites, this condition was improving; in others, it was growing worse.

Varughese, interested in explaining this variation, first tests the simple hypothesis that population (measured in different ways) drives forest condition. This view was widely held in the 1970s and 1980s when studies began to show alarming patterns of deforestation in Nepal. This simple neo-Malthusian approach would argue that in those locations where population is large and/or growing, the forest would be put under additional pressure, leading to its worsening condition. In those sites where population is low and/or steady, on the other hand, forest condition should be good or stable. Varughese, however, finds no support for this argument. In his sample, areas of high population have forests of both good and poor condition, as do areas of low population.

Since population does not appear as a major driver of forest depletion (and variation) in his sample, Varughese investigates the role of local institutions. He finds that those communities that have a higher level of organization vis-a-vis the forest—as measured by the presence of institutions such as monitoring arrangements and entry and harvesting restrictions—tend to have forests in better condition.

### ***Why micro and comparative analyses are important:***

**Variation in self-governance.** The micro and comparative studies of deforestation found in this volume do more than merely offer data regarding local-level variation, they offer much-needed analyses of the workings of local institutions as well. For most of the authors, institutional environments emerge as a critical factor in accounting for a forest's condition. The authors show how local forest users are able in some cases to devise rules regulating access and use that reduce the pressure to overharvest. Thus, there is substantial innovation and creativity exhibited in many settings. On the other hand, the task of devising adequate rules to govern and manage forest resources is particularly challenging and one that is not always achieved by local forest users nor by central government officials. Degraded forest landscapes have resulted in spite of pronouncements made by officials and the best intentions of local forest users. It is, thus, particularly important to learn from both successful and unsuccessful local cases what factors tend to account for successful development of local institutions that enhance forest conditions.



Using data from the forest panchayat system of India, Agrawal challenges the current conventional idea that smaller groups manage their resources better than larger groups. The lesson one learns from his chapter is that forest users who develop successful local institutions must contribute time and effort to monitor and enforce the rules they have crafted for their own setting. Self-governing institutions are costly, especially when they regulate a territory that is relatively large and not immediately visible to local villagers as they go about their daily tasks. A moderately-sized village appears able to generate the time and resources needed to control access to a forest that a very small village cannot, while avoiding the costs of organization that may plague larger villages.

Schweik demonstrates that physical variables alone do not account for differences in the availability of a valuable tree species. There is, however, a subtle institutional factor that does help to account for the availability of these trees. The differential access of high-caste forest users, as contrasted to low-caste forest users, provides a coherent explanation for the variation of these trees across forest space. Without the statistical analyses conducted by Schweik, and data regarding institutional variables, it would be impossible to sort out the relative importance of different physical and cultural factors.

Banana and Gombya-Ssembajjwe also demonstrate the subtle differences among institutions at the local level of forest use. In their study of one private forest and four government forests, they identify two forests where rule conformance is generally much higher. Even though these two forests have quite different formal structures, the time horizons and immediate incentives of participants are such that monitoring rule conformance occurs at a higher rate. The physical structure of both forests reduces the time and effort needed to achieve higher levels of rule conformance. The lessons we learn from this chapter reinforce Agrawal's analysis and the importance of understanding how physical variables and locally understood and enforced rules and norms jointly affect incentives and behavior.

Even with appropriate-sized groups and security of tenure, however, successful resource management may not occur. A great deal of development scholars and practitioners aver that microinstitutional arrangements are likely to be created in an environment where local autonomy is tolerated, where a history of institutional creation has occurred, and where local communities have secure property rights. In their study of a rural community in western Ecuador, Becker and Gibson find most of these institutional prerequisites for successful natural resources management exist, and yet the authors discover parts of the community's tropical forest characterized by open access. The authors argue that even within a local community, differences

between user groups and the variation over their preferred forest product critically affect how and if rules are created to manage forest resources.

Becker and Leon's study of the Yuracare challenges those in the central government of Bolivia who had thought forested areas of the Amazon were unmanaged. The Yuracare have a long history of managing their forests for particular ends. The authors find evidence of such forest institutions in the language of the Yuracare as well as in the biological condition of the forest where indigenous timber species are more conserved than commercial timber species, and fruit trees preferred by the game the Yuracare hunt are planted and nurtured.

Locally-constructed institutions are at the center of Varughese's explanation of forest condition in 18 sites in Nepal as well. In those sites where communities have crafted institutions to deal with the management of forest resources, the forest tends to be in better condition than in those sites where communities have not made, or confronted obstacles to, efforts at organizing themselves. Varughese finds that such obstacles can result from both internal or external sources. This study offers powerful evidence that research that focuses solely on population as a driver of deforestation may be far off the mark, especially if the attempt is to explain the variations that may be found at the local level.

## Conclusion

By featuring variation at the local level, this volume's contributions offer two general lessons to policymakers interested in forest management. First, national- or even regional-level policy may not fit local circumstances. The studies show that within even relatively small, ecologically similar areas under the same set of national laws, numerous nonbiological factors help to explain variation in forest condition. Different user groups, systems of property rights, types of commodities taken from a forest, and extant levels of rule enforcement interact with national legislation in different ways to produce particular patterns of forest use and conditions. Thus, while each local community operates under the same national legislation, their behavior and impact on forests differs substantially. For example, Agrawal and Varughese both report that some local communities respond by hiring guards to protect their forests while others do not. Banana and Gombya-Ssembajjwe demonstrate that locals enforce national forestry legislation in some areas of Uganda while in other areas it is ignored by community members. Schweik claims that most individuals in his study area routinely flout the national law proscribing wood harvesting. Such cases reveal that forest management is intensely local, and that national legislation can be modified, ignored, or enforced by local communities to fit their circumstances.

In addition to the lessons generated by the cases' variance, they also offer common insights regarding how management schemes may be successful. One crucial factor that emerges is the importance of commonly understood rules and their enforcement. Successful enforcement at the local level is partially dependent upon individuals generally agreeing upon what rules they should follow (and, hopefully, why they have been adopted). Without this agreement, there is less incentive to comply with rules: if either local forest users or government guards monitor forest use, a lack of agreement about rules would achieve a lower level of rule compliance. Efforts to guard effectively in this case result either in the type of corruption that often occurs between government guards and local forest users (especially bribery) or very high levels of conflict. Once some common agreement is achieved, then investment in monitoring has a high return by ensuring that the temptations that face all users do not grow into consistent rule-breaking behavior. In the case from Uganda, for example, the well-understood and long-standing extension of traditional rights by a private owner to nearby residents combined with active monitoring has generated a forest in relatively good condition, especially as compared to a neighboring government forest that does not enjoy much protection from its government guards. One of the central points of Agrawal's investigation is that moderately-sized communities who agree on a general set of rules regarding forest use can better afford to share monitoring duties and thus enjoy better forest resources. Becker and Gibson find that lands that lack an agreed-upon set of rules for their use are overexploited by both locals and outsiders. These studies concur with the growing theoretical consensus that argues that without common understanding and resources sufficient to monitor and sanction rule breakers, rules restricting activities that generate high private benefits are moot, whether made and enforced by the national government or the local community.

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