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People and Trees: An Institutional Analysis

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The Global Forest Resources Assessment 2000 reports that the estimated net annual loss of forest area worldwide during the 1990s was 9.4 million hectares (FAO 2001: 1). While forested areas in developed countries appear to be recovering and even gaining extent, forested areas in developing countries are continuing to lose forested areas, adversely affecting global climate processes, biodiversity, soil conditions, water percolation, and many other ecosystem services. Further, many of the poorest people living in the world are highly dependant on forests and adversely affected by deforestation.

Many causes are blamed for environmental change in general and deforestation in particular. Unfortunately, substantial differences exist in the way biophysical and social scientists view global change processes. As shown in **Figure 1**, physical scientists have viewed the role of humans as one of polluters only and ignored many of the active and positive strategies that humans may undertake. In an otherwise excellent study of the human factors affecting deforestation, Kaimowitz and Angelsen (1998) examined a variety of human factors without including any reference to biophysical variables (**Figure 2**). The presumed causes of deforestation are also quite diverse. Commercial logging is viewed by some authors as the major cause of deforestation.[1] Shifting or new cultivation is viewed as the primary cause by scholars in other narratives.[2] Population increase is considered by many to be the most important underlying cause of deforestation and other environmental harms.[3] Poverty is also considered by many to affect the level and types of demands placed on forest resources.[4] Recent work on this question assumes that there are many intertwined causes of deforestation (Contreras-Hermosilla 2000).

In this talk I will summarize some of the recent work on the human causes of deforestation. Then I will describe the International Forestry Resources and Institutions (IFRI) research program and summarize some of the initial findings from studies in Nepal and Ecuador. The IFRI research program is a micro-level, multi-year, multi-country study that combines careful measures derived from a random sample of plots from forests about which a substantial, systematic social science data set is also collected. In addition to forest mensuration conducted in a sample of plots, data are obtained about the population making use of a forest, its socioeconomic and political organization, the market forces affecting local

use patterns, and the rules-in-use related to investment in and harvesting of timber and nontimber forest products. The IFRI research methodology is designed to fill the substantial knowledge gaps about the impact of human choice on forest conditions, while also integrating biophysical measures of forest conditions (extent, fragmentation, biomass, etc).

What Do We Know about Human Driving Forces on Deforestation? 5

Macrolevel Statistical Models

All efforts to study rates of deforestation and subsequent loss of biodiversity suffer from vast uncertainty concerning the rate of deforestation itself (FAO 1993, FAO 2001). Consistently measured assessments are available for only a few countries over time. Estimates of loss rely on different definitions of deforestation, ranging from total clearance to degradation in forest cover. Methods of conducting inventories, surveys, and even remote-sensing analysis vary from one study to the next (Pearce and Brown 1994).

So far, most quantitative studies are not time-series or longitudinal studies, but cross-sectional analyses conducted at one time period rather. Many of these studies use the percentage of a country under forest cover as the dependent variable and conduct cross-sectional analyses at a national level (for citations to these studies and a discussion of their findings, see Kummer and Sham 1994 and Pearce and Brown 1994). Using forest cover as a dependent variable is questionable, because the amount of forest cover that exists at any particular time in a country is the result of the quantity of forest cover in the area prior to deforestation and a history of deforestation that could extend backward a few decades or several millennia. The percentage of forested land in a country is the result of a cumulative process over time and is not an appropriate dependent variable for studies of the causes of recent deforestation. Further, forest cover is not an entirely satisfactory proxy measure for forest biodiversity, given that monoculture forest plantations are included within the measurement of forest cover.

Kummer and Sham (1994) compared three cross-sectional analyses of the amount of forest cover per province in the Philippines (in 1957, 1970, and 1980) with a panel study of the loss of forest cover between 1970 and 1980. In the three cross-sectional studies, the statistical results appear to be strong and unambiguous: "absolute provincial forest cover in 1957, 1970, and 1980 is negatively related to the presence of human settlements (roads and people)" (Kummer and Sham 1994). In the panel study, the authors originally included change in population from 1970 to 1980 and change in the length of roads from 1970 to 1980, but neither of these variables was significant. The final equation contained two variables: changes in agricultural area from 1970 to 1980, and the provincial annual allowable cut (used as a proxy for commercial logging). What is startling is that "none of the independent variables in the cross-sectional equations are found in the panel analysis and vice versa" Kummer and Sham 1994). Policy recommendations based on the cross-sectional studies showing population density to be a causal factor would not be supported by the panel study.

Deacon (1994) used recent FAO estimates of forest cover in 1980 and 1985 to measure the proportionate rate of deforestation between 1980 and 1985. Deacon was interested in the P and A variables posited by the Commoner-Ehrlich model and in the relative importance of institutional variables (Commoner 1972, Ehrlich and Ehrlich 1991). He argued that investments in conserving forest resources will be made only when those who choose to defer harvesting today are assured that their "sacrifice" will be protected for the future. When Deacon included variables concerning political instability and the presence of centralized national governments, he found that political institutions account for about as much variance in

rates of deforestation as population density or income. However, using data from 120 countries in a cross-sectional analysis that included variables reflecting change over time as dependent and demographic variables as independent, Deacon was able to explain only about 20% of the variance. In other words, 80% of the variance in deforestation at a national level was not accounted for.[6]

In a perceptive effort to summarize the extensive literature on the human factors affecting land use and environment in developing countries, Bilsborrow and Geores (1994) developed a framework and tested many of the linkages in this model. What is particularly important about the Bilsborrow and Geores framework is that they posited diverse ways that people may adapt to increasing population density in a country, including out-migration, land extensification (e.g., opening new land), and land intensification (e.g., use of commercial fertilizer or irrigation). The Bilsborrow and Geores framework is not intended to represent a series of driving forces, but rather to represent the variety of choices that rural residents make when a resource base is challenged by increases in population. Which types of human adaptive strategies are selected depends to a large extent on various government policies that affect the expected costs and benefits of diverse types of adaptations. This framework focuses primarily on the land-use decisions of the rural population rather than on the decisions of political elites who may attempt to gain and keep power by manipulating the incentives of a rural population.

Bilsborrow and Geores examined the sequential links posited in this framework, keeping in mind the problems of data reliability throughout their analysis. They examined the links between demographic factors, intensive versus extensive adaptations, and impacts on levels of deforestation. They generally find weak positive relationships between population growth and increases in both land extensification (in the form of increases in the amount of agricultural land) and land intensification (in the form of increases in use of chemical fertilizers), and deforestation. Most of the relationships, however, depend on the inclusion or exclusion of particular "outlier" countries (Bilsborrow and Geores 1994: 131). The researchers concluded that extensive effort needs to be devoted to developing more accurate over-time data sets at a national level before this type of analysis can be used as the foundation for rigorous policy recommendations. Cross-sectional analysis is fruitful; however, they argue, efforts must be made to communicate to data-producing agencies the importance of certain kinds of data and the need to examine whether outliers in this type of analysis are real numbers or artifacts.

Further, Bilsborrow and Geores recommended that macrolevel analysis can also help identify and investigate relationships in units smaller in scale than an entire country. Given the importance of the choices made by individuals to adapt according to their own conceptual framework, data aggregated at a national level are too coarse for careful analysis of these kinds of relationships. What is important, for example, is not overall population density, or even density relative to arable land, but rather where the population is concentrated, and whether thresholds of density (plots too small to be economically viable or human habitation too large for the sustainability of the ecosystem) are being surpassed in certain areas as populations continue to grow. Sub-national data for provinces or even districts are better suited for this. Such data would also greatly facilitate cross-area analyses that would permit controlling for a number of additional economic, institutional, and contextual factors (Bilsborrow and Geores 1994)

Bilsborrow and Geores (1994) recommend even more disaggregated studies that get down to a household or farm level. Careful theories about the variables that affect the incentives of actors can be formulated and tested at these levels. "And it is at this level that fully multidisciplinary collaboration in *both* the data collection in the field and the analysis−involving ecologists and social scientists working together−can be most

useful, and is most needed" (Bilsborrow and Geores 1994). When forest conditions are measured at a local level, the relationship between human and biological conditions can be more closely and accurately observed.

As more and better estimates of rates of deforestation are developed at a national level, relying both on satellite images interpreted by means of spectral signatures validated by extensive field studies, and on better inventory and survey methods, macro-level modeling efforts will become a more valid source of understanding of the causes of deforestation than they have been in the past.[7] Macro-level studies, however, can never be the primary means of testing how various combinations of factors affect deforestation within particular regions, countries, and local ecological systems. They are particularly inappropriate in efforts to understand how human uses affect forest biodiversity. Only micro-level data can provide essential information about human impacts on forest biodiversity, because they permit the linking of human incentives and behavior to specific forests.

Existing analyses of demographic, socioeconomic, and institutional factors on deforestation are not supportive of a conception of human driving forces, mechanisms that operate everywhere in the same way, similar to gravity or other physical forces. Cumulative human actions affect national and global rates of deforestation and biodiversity loss. They result from individual actions taken in a wide diversity of local, regional, and national settings. Moreover, decisions made at national and regional levels frequently affect those made at a local level. The complex feedback loops between upward and downward causal chains are extremely difficult to sort out. Human actions are the result of people's perceptions of the choices available to them and the expected benefits and costs of different strategies, given the configuration of ecological and human structures involved.

Microlevel Field Studies

During the past decade, extensive studies have been undertaken of the formation and performance of local common-property regimes related to communal forests and other local common-pool resources (see, for example, Brown 2002). What is now well established is that it is feasible for local users to organize, establish their own rules, monitor and sanction for rule infraction, and manage ecological systems for long periods of time when (1) they value the flow of benefits more than the flow of costs and (2) they are located in remote settings or have substantial legal authority to govern and manage a resource system over which they hold ownership rights.[8] Local forest users know local names and uses for a wide diversity of local plants, and they frequently enhance the setting and manage valuable plants so that they can be harvested in a sustainable manner (Alcorn 1990; Atran 1993; Gadgil, Berkes, and Folke 1993). In some countries, such as Mexico, a large proportion of forested land is communally owned (Bray 1991). Recent research by the Center for International Forestry Research has found that 25% of the worlds forests are locally governed (CIFOR 2001).

Governance systems organized by local users, however, are fragile when challenged by (1) national authorities who assert claims to ownership of communal lands, (2) rapid commercialization of forest products, and (3) settlers encouraged to migrate to a region by external economic or political incentives (Guha 1983; Arnold and Campbell 1986; Blaikie et al. 1992, Shah 2002). National governments frequently deny local forest users any rights once these governments claim ownership to forested land formerly owned by local communities. Further, individual title to land has usually been based on evidence that the land has been "put to beneficial use," which usually has meant converting land from forests to agriculture. This has legitimized deforestation in most of the developing world. In many cases, forests are allocated for use by "government-sanctioned concessionaires, ranchers, or plantation companies; and communities

immediately lose rights to their forest and become labeled 'squatters' instead of being recognized as holders of any property rights at all" (Alcorn 1995).

When Do Users Create New Rules?

Evidence from field research challenges the generalizability of the earlier presumption that users cannot self-organize to protect local forests. This is a good presumption in settings in which users are alienated from one another or cannot communicate effectively. It does not, however, provide an explanation for settings in which appropriators are able to create and sustain agreements to avoid serious problems of overappropriation. Nor does it predict well when government ownership will perform appropriately, or how privatization will improve outcomes. A fully articulated, reformulated theory encompassing the conventional theory as a special case does not yet exist. On the other hand, scholars familiar with the results of field research substantially agree on a set of variables that enhances the likelihood of appropriators' organizing themselves to avoid the social losses associated with open-access, common-pool resources (McKean 1992, Wade 1994, Schlager 1990, Tang 1992, Ostrom 1990, Ostrom 1992a, Ostrom 1992b, Baland and Platteau 1996, Ostrom et al. 1994). As summarized in Ostrom (2001), considerable consensus exists that the following attributes of resources and of appropriators indicate an increased likelihood that self-governing associations will form:

Attributes of the Resource:

R1. Feasible improvement. Resource conditions are not at a point of deterioration such that it is useless to organize, or so underutilized that little advantage results from organizing.

R2. Indicators. Reliable and valid indicators of the condition of the resource system are frequently available at a relatively low cost.

R3. Predictability. The flow of resource units is relatively predictable.

R4. Spatial extent. The resource system is sufficiently small, given the transportation and communication technology in use, that appropriators can develop accurate knowledge of external boundaries and internal microenvironments.

Attributes of the Appropriators:

A1. Salience. Appropriators are dependent on the resource system for a major portion of their livelihood.

A2. Common understanding. Appropriators have a shared image of how the resource system operates and how their actions affect one another and the resource system.

A3. Low discount rate: Appropriators use a sufficiently low discount rate in relation to future benefits to be achieved from the resource.

A4. Trust and reciprocity: Appropriators trust one another to keep promises and relate to one another with reciprocity.

A5. Autonomy. Appropriators are able to determine access

and harvesting rules without external authorities countermanding them.

A6. Prior organizational experience and local leadership. Appropriators have learned at least minimal skills of organization and leadership through participation in other local associations or learning about ways that neighboring groups have organized.

It is important to stress that many of these variables are affected by the type of larger regime in which users are embedded. Larger regimes can facilitate local self-organization by providing accurate information about natural resource systems, arenas in which participants can engage in discovery and conflict-resolution processes, and mechanisms to back up local monitoring and sanctioning efforts. Participants are more likely to adopt effective rules in regimes that facilitate their efforts over time than they are in regimes that ignore resource problems entirely or, at the other extreme, presume that all decisions about governance and management need to be made by central authorities. The key to further theoretical integration is to understand how these attributes interact in complex ways to affect the basic benefit-cost calculations of a set of users and their officials.

Beyond the consensus concerning the variables most likely to enhance the probability that users will devise their own rule to govern and manage forests, several unresolved theoretical issues still exist. Two key questions relate to the effect of the size of a group and the heterogeneity within a group of users. The impact of size and heterogeneity on the capacity of individuals to self-organize and sustain a common-property regime is highly contested. Scholars have found that the size of group using a forest is negatively, positively, or not at all related to successful organization for collective action (see Agrawal 2002). Of course, there are many other factors besides the size of the group that may be more important in affecting outcomes. The findings regarding heterogeneity are similarly varied. One reason is that groups can differ along a diversity of dimensions, including their sociocultural backgrounds, interests, and endowments (see Baland and Platteau 1996, 1998; Keohane and Ostrom 1995). Each dimension may operate differently under a variety of circumstances.

While a great deal has been learned from field studies conducted at a micro level, it is difficult to assign confidence levels to the knowledge so acquired. Few studies have collected the same set of variables systematically across a large number of forests within one country or several countries. Many studies that focus on human use and organization do not include systematic measures of forest conditions. Similarly, rigorous studies of forest conditions frequently provide little or no information about human uses and organization. There are excellent examples of over-time studies of human uses and forest conditions in single sites (Fox 1993, Tiffen et al.1994). Over-time studies in the same sites that combine systematic measures of both human and ecological variables in multiple, micro-level field settings are rare enough that they have evaded systematic literature searches.

The International Forestry Resources and Institutions Research Program

One effort to address the knowledge gaps described above has been initiated recently in the design of a micro-level, multi-country, over-time study of forests and the related institutions involved in governing, managing, and using these forests. The International Forestry Resources and Institutions (IFRI) research program has its home base at Indiana University. Collaborating Research Centers (CRCs) have been established in Africa, Asia, Latin America, and the United States. The IFRI program draws from an examination of diverse policy processes rather than from a

model of a specific problem such as deforestation. Thus its approach is broader and can be used to incorporate and test among the specific models outlined above.

The Institutional Analysis and Development (IAD) framework, developed and used by colleagues associated with the Workshop in Political Theory and Policy Analysis (Kiser and Ostrom 1982, Ostrom 1986, Oakerson 1992), has been used to develop grounded theory concerning how institutions affect human incentives and behavior as these bear 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 approach are individuals who hold different positions (e.g., member of a forest user group, forest official, local forest user group official, landowner, elected local, regional and/or national official) who must decide upon actions (e.g., what to plant, protect, harvest, monitor, or sanction) that cumulatively affect outcomes in the world (e.g., a forest ecosystem and the distribution of forest benefits and costs). To simplify representation, the complex set of incentives and resulting behavior is initially represented in **Figure 3** as a single box. This "box," like all the boxes in Figure 3, can be opened and contains a nested set of other conceptual boxes within it. Thus, all the complexity of the above discussion can eventually be contained within this one overarching framework. Theories relating human incentives to human use to forest ecosystem responses can then be tested using a consistent set of data collected systematically in multiple countries at multiple points in time.

In a dynamic setting, human behavior affects local forest ecosystem responses that also affect and are affected by global and local physical factors. Human incentives and behavior are also affected by socioeconomic and demographic factors as well as institutional factors. Each of the factors on the left-hand side of Figure 3 can be unpacked into a very large set of variables. For example, unpacking the institutional factors that may affect human incentives and behavior across a large number of diverse settings produces 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 ecological system that differ in regard to who can harvest, when and how harvest may be conducted, 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.
- Which representatives of local, regional, or national governments are involved in local activities.

At a macro level, these variables would include, but not be limited to:

- National legislation authorizing diverse types of forests and parks 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.
- Constitutional rules that limit the extent of arbitrary decision-making powers of nationally elected 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 is not available in any existing data set, nor are most relevant macro-institutional variables.

The advantage of a simple framework to organize large numbers of nested variables is that researchers are not limited to an initial set of variables derived from a single disciplinary literature. As we have designed the IFRI research protocols, we have reviewed a rich multidisciplinary literature and have included many variables posited in one or more traditions as important in understanding human impacts on forest conditions and forest biodiversity. In a pretest and review of the research protocols, suggestions were made by more than 50 researchers located in 10 countries. Most of the variables discussed above that are measurable at a micro level are included in the IFRI research protocols. By using a relational database, variables about multiple entities that are richly interconnected can be linked in multiple ways depending on the specific hypotheses of interest to a particular researcher (Jerrells and Ostrom 1995).

We have concentrated on the design of 10 research protocols and careful field methods to collect microlevel institutional, socioeconomic and demographic, and local physical factors that affect human incentives and behavior and the impact of this behavior on local forest ecological systems.[9] We combine reliable forest mensuration techniques for a sample of forest plots of 1, 3, and 10 meter radii, in sites where systematic data are also collected about local institutions and socioeconomic and demographic variables. A 2-month training program is now offered every fall at Indiana University during which a local study is also conducted. During the training program, the basic institutional theory underlying the design of the database and the field methods for conducting each of the 10 research protocols (described in **Table 1** and **Table 2**) is covered. The course is open to graduate students in social science, biology, and environmental science, as well as to researchers from other institutions interested in conducting collaborative research.[10]

Efforts are underway by each IFRI CRC to obtain data for a large sample of sites in each country and then to return to each of these sites regularly as long as funding is made available.

As of November 2002, 150 sites have been visited, and data have been entered in the IFRI database. More than 20 of these sites have been visited a second time. More than 6,000 forest plots and 97,500 trees have been coded within these forest plots. In addition to measures of extent, composition, and species diversity, we also obtain information about how forest products are valued and used in a local community. Findings from micro-level, cross-sectional studies within countries will provide enhanced understanding of how micro-level institutional factors affect current forest ecological systems.

Initial Findings from Nepal

A study of the relations of human organization of forest conditions has now been completed in the Middle Hills of Nepal (Varughese 1999; Varughese and Ostrom 2001). **Figure 4** shows the location of sites in Nepal. In this region, subsistence agriculture is the main occupation, although villagers supplement their livelihoods by entering the market economy whenever opportunities arise. The rural population in the Middle Hills is mostly distributed in small villages or hamlets that are sometimes parts of larger, dispersed settlements. Forests are rarely immediately

adjacent to any one house. These forests are vital sources of fuelwood, fodder, and leaf litter for animal bedding and composting, especially in the winter months when agricultural residues are exhausted.

The 18 cases included in this study are listed in **Table 3**. The data for these particular cases were obtained over a period of 3 years. Each case was studied by a five-member team composed of natural science and social science researchers over a period of 4 weeks using research methods described above. For the purposes of this study, the names of settlements are omitted and, instead, locations are identified using the names of the VDC within which the settlements and forests were studied.

Forest use and management in Nepal occur in settings characterized by a variety of physical and community attributes that can potentially affect the organization of collective action. Some of the physical attributes are the nature of the forest resource; its size, its proximity to roads and markets; and the topography of the location. Some of the community attributes that affect their incentives to cooperate with one another are the size of the community of resource users; differences in users′ proximity to forested areas; differences in forest users′ incomes; presence or absence of economic, social, religious, and ethnic disparities; and the availability of alternate forest resources.

The Effect of Collective Action on Forest Conditions

One of the major questions addressed in our work is whether the level of collective action undertaken by a community is associated with forest conditions. To examine this question, Varughese (1999) developed a measure of collective activity derived from a set of questions about rules (formal and informal) related to entry into a forest, harvesting in a forest, and monitoring of a forest; and about how the group organizes its forest-related activities. A low degree of collective activity is recorded for cases in which individuals are aware of forest degradation and resource scarcity and observe harvesting constraints on their own, without any group-level activities or rules of harvest. For this study, low collective activity is classified along with no collective activity. A moderate level of collective activity is recorded when a group of individuals has harvesting and entry rules and planned minimal forest-related group activities, but there is little or no monitoring of rule breakers. A high level of collective activity is recorded when a group of users has harvesting and entry rules, monitoring by members, and organized forest-related group activities.

Given the diversity of ecological zones of the 18 sites, one could not use biological measures (species diversity and biomass, for example) to compare forest conditions. The indicators of forest conditions used for comparison across the 18 cases are of two kinds: "forest stock" and "trend in forest condition." The indicator "forest stock" provides a subjective assessment of forest condition with respect to abundance and species composition of vegetation. In most of the 18 cases, the professional assessments of district forest officials were also obtained to validate the research team′s subjective assessment. The "trend in forest condition" indicator is a subjective assessment of forest condition derived from the historical perceptions of diverse local forest users, and, in many instances, of local government forest officials, about the relative abundance of products, disappearance of valuable species, and change in forest area. "Worsening" indicates their assessment of a depletion of species and reduction in forest area, and "improving" indicates their perception of an increase in abundance of tree species and shrubs. By itself, this assessment is not a good longitudinal indicator of forest condition, but when combined with a measure of change in forest condition, a general picture of resource use and management patterns emerges. A validation exercise is performed to establish the relative accuracy of these subjective assessments (see Varughese 1999).

The level of collective activity is strongly associated with forest condition,

as shown in **Table 4** (tau=0.80). A high level of collective activity related to forest management is seen in five out of six sites (83 percent) in forests that are improving in condition. In six out of seven sites (86 percent) in forests that were found to be deteriorating, the local community was undertaking little or no collective activity. In the majority of locations where the forest resource was seen to be stable (neither deteriorating nor improving), the users were engaged in at least moderate collective action.[11]

Heterogeneity and Collective Action

An important question examined in this study is whether diverse forms of heterogeneity affect the level of collective action related to forest conditions. Multiple forms of heterogeneity are potentially important.

Distance

The distance some users have to travel, or their relative proximity to forested areas they use in relation to distance traveled by other users, affects the symmetry of relationships among forest users and their relationship with the resource. In many forest resource systems, users who live closer to the forest have a more secure and accessible supply of products regardless of whether or not allocation rules are in place. The more proximate users may not be as motivated as more distant users to provide institutional arrangements to allocate duties and benefits. Users who live farther away from a forest may raise questions about the allocation of duties and benefits. When some users have to walk much longer than others to participate in maintenance and protection activities, it is more difficult to allocate duties and benefits in a way that is perceived to be fair.

For some distant users, participation might be worthwhile if there were some assurance that closer users will not take more products, or that benefits will be allocated in a manner that takes account of additional costs to those who live farther away. Or, since it is easier for those who live closer, perhaps they should shoulder more provision responsibility and, no doubt, get more benefits? This issue becomes more complicated when users come from a settlement other than where the forest is legally located. It is even more complex when the forested area lies in more than one jurisdiction. Significant variation in distance of user households from the forest resource can also give rise to opportunistic behavior. Those who live closer may be tempted to sneak into the forest at unauthorized times or harvest unauthorized amounts which can be easily concealed in nearby houses. For a resource that has subtractable benefits, too many incursions can have deleterious effects, especially if a forest is on the verge of regeneration. Effective monitoring of forest use may be costly and complicated when some users live much closer to the forest than others.

To ascertain whether locational heterogeneity is associated with the level of collective activity in a site, information was obtained regarding the size of each settlement and distribution patterns of all houses within the user group; number and distribution pattern of forested areas used; and the distance from each settlement in the user group to the forested areas used. This information was utilized to create an index of locational differences from low to high for each of the 18 groups. Groups with fragmented (noncontiguous) forest patches at a distance from settlement were considered high on the index of locational differences. Groups with one contiguous area of forest in close proximity to settlement were considered low on the index of locational differences.

Of the 18 locations studied, 11 had less difficulty with regard to the location of settlements and forest distribution than did the other seven (**Table 5**). Among these 11, five groups manifested higher levels of

collective activity, and six groups manifested lower levels of collective activity. While areas farther away from settlements were expected to have lower levels of collective action, the finding was contrary to expectations. Five of the seven cases with greater locational differences had higher collective activity. A negligible positive association exists between locational differences and the organization of collective action for this group of 18 sites (tau=0.25).

Wealth

In the rural areas of the Middle Hills of Nepal, differences in wealth (or economic endowments) relate directly to the extent of economic stratification within the group (or relative economic well-being) which, in turn, partially depends upon the occupation or livelihood strategy of each household. People's interest in forest resources differs based on whether or not they raise cattle for milk or goats for meat, run a teashop or restaurant, weave baskets and mats, make charcoal or furniture, prepare medicine from forest products, use oxen for hauling, or just cook food for the family. Most households need the forest for almost all of these reasons, but they use it only for subsistence. In other words, in the general poverty of the Middle Hills, most user groups depend upon forests as an integral part of their daily subsistence, and few within any group have commercial interests in communal forests. The village blacksmith and the local teashop owner are two important exceptions.

So, while most residents are subsistence farmers, differences in their wealth are evidenced more by the extent of land and livestock holdings. Wealthier households have greater need for animal fodder and agricultural compost. Wealthier farmers are frequently able, however, to construct alternative fuel sources such as methane-producing compost pits, which supply them with cooking and lighting gas. They tend to have some surplus food and cash for modern medicine as well, and depend less than do the poor upon forests for fuel, food, and herbal cures. These differences, even among subsistence farmers, can generate different incentives for forest use and for devising cooperative arrangements for forest governance and management.

In some cases, those with greater assets may bear the higher initial costs of organizing collective action, even though the benefits from such organization may accrue to a larger, less wealthy community. Individuals with more livestock have an interest in assuring a secure and adequate supply of fodder. If these individuals also have large landholdings, they may have substantial interest in the compost benefits of forest byproducts. In this case, while assets may be distributed unevenly within a group, the interests of both rich and poor are similar with regard to the need for forest resources. On the other hand, the wealthy of a community may have many more alternatives to using a particular forest for their livelihood than the less endowed members of that community, making for an imbalance of interest in organizing the forest's governance and management.

Wealth disparity in a group was determined by obtaining information on the local definition of wealth; the number of households that were wealthy and poor by that definition; and any obvious wealth disparities in a group. Wealth was usually viewed by users as being in possession of land, livestock, food surplus, and remittances from family members working elsewhere, in order of relevance for that community. This information was then used to create an index of wealth disparity in a group. This index was utilized to separate the 18 groups into high and low categories of wealth disparity. Of the 18 locations studied, six were viewed by users to have higher levels of wealth disparity among forest users, while twelve had little or no disparity of wealth among users (**Table 6**). Eight of the twelve cases in which there was a low disparity of wealth had collective activity ranging from moderate to high. However, where the disparity of wealth was greater, four of six cases had not organized for collective

action. The measure of association indicates a modest negative relationship between level of wealth disparity and collective action (tau=-0.32).

Sociocultural Differences

In Nepal, villagers of different ethnicity or caste frequently reside in physically separate clusters (hamlets or toles) in a given settlement. How this affects their ability to cooperate is not well understood, nor has it been studied in depth. It is not uncommon to find that user groups have one or two castes whose members outnumber those of the others. This may not translate directly into dominance, however, because there are frequently more members of lower castes than of higher castes. This complicated dynamic of caste, number, and dominance may be the reason some researchers, citing examples of difficulties in organizing and sustaining cooperation within ethnically heterogeneous user groups (e.g., Chhetri and Pandey 1992), did not observe such difficulties systematically across multiple cases.

Sociocultural composition has been observed to influence educational, economic, and political opportunities in Nepal. The skills that one group brings may complement those of other groups and, in some cases, be indispensable. In forest user groups, the more educated people are sometimes from the higher castes. These individuals bring writing and bookkeeping skills that are essential to organization. Members of lower castes who use forests for more specialized products than others--such as the artisans who work with iron and leather--bring their knowledge of flora and fauna to the group. For marking boundaries or trees, a tradeoff may be applied whereby some members of the lower castes do most of that work.

Sociocultural differences in a group were determined by information obtained on a minimum of three (if present, with no maximum) caste and ethnic types for each of the 18 groups. An index of fractionalization was used to measure sociocultural heterogeneity (caste/ethnic), computed by:

n

A=1- ? (Pi)2

i=1

where

Pi is the proportion of total population in the ith ethnic/caste type, and

A varies from 0 to 1 and measures the probability that two randomly selected persons from one user group will not be of the same sociocultural type.

This index was then used to separate the 18 groups into low, moderate, and high categories of sociocultural heterogeneity.

Thirteen of the locations studied (>60%) were observed to be more heterogeneous in sociocultural composition, varying from moderate to high levels of heterogeneity (**Table 7**). The cases in which sociocultural heterogeneity was greater were also those in which collective action was seen to be high (eight of thirteen cases). In the cases in which heterogeneity was lower (five of the eighteen, or about 28 percent), there is almost no difference in the level of collective activity. The measure of association indicates a negligible positive relationship between sociocultural heterogeneity and the organization of collective activity for the eighteen cases studied (tau=0.20).

Table 8 arrays the level of collective action and the measures of heterogeneity for all eighteen cases. Heterogeneity is certainly not a strong predictor of successful collective action. Only one of the five most successful user groups (Doramba) is relatively homogeneous across all of the attributes we have examined in this paper. What is apparent in examining Table 8 is that groups with similar patterns of attributes with regard to location, wealth, and sociocultural composition do not have similar levels of collective action. Doramba, Riyale, and Chhoprak (Sites 3, 7, and 17), for example, all have low levels of differences in regard to location, wealth, and sociocultural attributes (while two of these have alternative usage), but Doramba has a high level of collective action, Riyale has a moderate level of collective action, and Chhoprak has a low level of collective action. Alternatively, Bandipur, Barbote, and Chunmang (Sites 5, 9, and 14) are all coded as having high differences in all three attributes, but vary from high to low levels in terms of collective action.

In some of the cases with high levels of collective action and also substantial heterogeneity, forest users have designed a set of rules that specifically takes into account the heterogeneity they face. This trend was particularly evident in areas that evidenced high locational differences. Sites 4 and 5, Raniswara and Bandipur, present particularly interesting cases for further analysis. Both sites have highly organized user associations with written rules and regulations governing user behavior. In fact, both associations have explicitly recognized that their membership is scattered and that the access to forested areas varies by settlement. In both cases, the inclusion of settlements that are farther away generates substantial advantages to the group, and the rules of the group have been crafted accordingly. Both groups have a two-tier system of user membership. Those who live farther away can pay an extra fee in exchange for reduced monitoring duties. In addition, those who cannot participate in joint maintenance, harvesting, or monitoring activities can pay special membership fees to avail themselves of forest products at special, below-market rates. In Raniswara, special membership is noted after payment of a fee; written requests for forest products have to be processed by the Harvest Subcommittee; and the committee provides products to the member at a special rate.

Initial Findings from Ecuador

It is important to recognize that there is a variety of reasons communities fail to organize themselves for collective action. As we have shown from our studies in Nepal, heterogeneity is not the determining cause of failure, as many have presumed. Lack of knowledge can be a major cause of inactivity even in settings where forest users already have considerable authority over forest resources. An IFRI study conducted in Ecuador and the follow-up activities by an IFRI researcher illustrate this point very well.

In western Ecuador, a series of local institutions referred to as comunashave extensive authority to manage the land within their boundaries. In 1997, an IFRI study was conducted led by Clark C. Gibson and C. Dustin Becker of a local comuna called Loma Alta (Gibson and Becker 2000). The Loma Alta community is composed of approximately 2,000 people who share property rights to 6,842 hectares of land. About 1,700 hectares is forested land that has not been allocated for traditional agricultural crops. Some of it, however, has been allocated to individuals who have planted paja toquilla (Carludovica palmate). The leaves of paja toquilla are sold to the makers of a wide diversity of handy crafts including Panama hats.

The forested area of the comuna is located far from the settlement. Substantial degradation had occurred in the forest at the time of our first IFRI study. In addition to the degradation and the replacement of indigenous species with paja toquilla, the IFRI team found two disturbing

findings. One was a substantial incursion by a neighboring rancher in the farthest northern reaches of the forest. Comuna members were vaguely aware of this problem, but because of the distance, they had not been able to effectively cope with it. Furthermore, given the wealth of their neighboring rancher, seeking formal restraint by the legal system on the encroachment was beyond the resources of the community. Secondly, comuna members were unaware that conversion of much indigenous forest in the higher reaches to paja toquilla had an adverse effect on their local water supply.

Loma Alta has many characteristics that would seem to support local self-organization. The community is well organized for the provision of many local public goods. It has full local autonomy and extensive prior organizational experience. Moreover, residents tend to have a low discount rate related to the forest, in that many intend to live their full lives in Loma Alta, obtaining some of their livelihood from the forest. Thus, the comuna had many of the attributes that are conducive to successful collective action found in other sites, such as those examined in Nepal.

The distance of the forest from its users, however, has contributed to both the trespassing and the forest conversion problems. Because the forest is located far away, and because the distance from one end of it to the other is substantial, many Loma Alta residents had a false image of the extent of the forest. Many Loma Alta residents did not regularly make the long trip to harvest from the forest, and they perceived that the forest extended much farther than the portion of it they actually owned. Thus, members of the community did not share a common understanding of the problems they faced both from the incursion of neighboring users and from their own overharvesting, and they did not perceive the link between the conversion of forestland to cropland and the degradation of their water supply. The substantial distance between the community and the forest made any effort to monitor the use of the forest difficult and expensive.

After our initial research visit, Becker returned to Loma Alta as part of an effort organized by a local NGO to help the local community establish a reserve in their valuable forest (Becker 1999, Becker 2003). Residents of the community participated in a scientific effort to measure the amount of water captured by the forest that subsequently percolated into their own underground water supplies. The community and the local NGO also prepared a video about their local forest that enabled most members of the community to come to a different understanding of the value of the forest, the danger of overharvesting, and the benefits community members would achieve by finding an effective way to preserve part of their forest for the future. With this kind of facilitative external assistance, the common understanding of benefits and costs changed in the community, and members are now regulating the use of their forests to achieve a more sustainable pattern.

No fixed relationship exists between the size, location, and shape of a forest and the perceptions that individuals hold about these variables. The relationship between perceptions and reality is itself potentially alterable through collective action. However, when a forest is located at a substantial distance, it increases the difficulty of achieving a common understanding of likely benefits, and increases the cost of achieving successful local, collective action. Further, relying only on community ownership of forests, or only on external agents of change, represents too simple an approach to increasing the sustainability of forest resources. As Becker (2003) demonstrates, when local groups with strong autonomy and organization work together with external groups providing scientific knowledge and modest external resources, effective long-term solutions to the challenging problem of sustainable forestry are more likely to emerge.

Conclusion

In an era of massive deforestation and biodiversity loss, most observers agree that action must be taken to halt these alarming trends. Many of the actions taken within the last several decades to reverse them, however, do not appear to have succeeded. Findings from macro-level analyses of human factors thought to affect deforestation have not provided a consistent picture of the human variables that affect these rates. Many different models and frameworks exist, but they do not offer much hope of sorting among competing hypotheses as long as analysis continues to rely solely on cross-sectional, macro-level data. Moreover, interventions are not likely to succeed when policies are made with little understanding of the underlying processes at work.

One way to begin to close the extensive gaps in our knowledge of human factors associated with deforestation and forest biodiversity is to undertake systematic studies of both ecological and human variables in a large number of micro-level settings over time. Scholars already involved in collecting data from forest plots can learn extensively from each others' methods and modes of analysis. What is needed is substantial cooperation among scientists already working in diverse sites. By adding better social science indicators to studies based entirely on biotic and abiotic variables, and by adding better biotic and abiotic indicators to strictly social science studies, progress can be made. The readers of this symposium volume confront an opportunity to increase useful information about humanly crafted, micro-level processes that influence forests in similar ecological zones. Over time, the findings from studies combining good forest mensuration with sensitive social science indicators will address the many knowledge gaps identified above.

References

Abernathy, V. 1993. Population Politics: The Choices that Shape our Future. New York: Plenum Press.

Agrawal, A. 1995. Population pressure = forest degradation: An oversimplistic equation? Unasylva 181(46):50-58.

Agrawal, A. 2002. Common resources and institutional stability. Pp. 41-85 in The Drama of the Commons (E. Ostrom, T. Dietz, N. Dolsak, P. C. Stern, S. Stonich, and E. Weber, eds.) (Committee on the Human Dimensions of Global Change). Washington, D.C.: National Research Council, National Academy Press.

Alcorn, J. 1990. Indigenous agroforestry systems in the Latin American tropics. Pp. 203-229 in Agroecology and Small Farm Development (M. A. Altieri and S. B. Hecht, eds.). Boca Raton, FL: CRC Press.

Alcorn, J. 1995. Economic botany, conservation, and development: What's the connection? Annals of the Missouri Botanical Garden 82(1):34-46.

Arnold, J.E.M., and J. G. Campbell. 1986. Collective management of hill forests in Nepal: The community forestry development project. Pp. 425-454 in Proceedings of the Conference on Common Property Resource Management. Washington, D.C.: National Academy Press.

Ascher, W. 1993. Political Economy and Problematic Forestry Policies in Indonesia: Obstacles for Incorporating Sound Economics and Science. Durham, NC: Center for Tropical Conservation Report.

Atran, S. 1993. Itza Maya tropical agro-forestry. Current Anthropology 34 (5):633-700.

Baland, J.-M., and J.-P. Platteau. 1996. Halting Degradation of Natural Resources: Is There a Role for Rural Communities? Oxford: Clarendon Press.

Becker, C. D. 1999. Protecting a Garúa forest in Ecuador: The role of institutions and ecosystem valuation. Ambio 28(2) (March): 156-61.

Becker, C. D. 2003. Grassroots to grassroots: Why forest preservation was rapid at Loma Alta, Ecuador. World Development 31(1):163-176.

Berkes, F., ed. 1989. Common Property Resources: Ecology and Community-Based Sustainable Development. London: Belhaven Press.

Bilsborrow, R., and M. Geores. 1994. Population, land-use and the environment in developing countries: What can we learn from cross-national data? Pp. 106-133 in The Causes of Tropical Deforestation: The Economic and Statistical Analysis of Factors Giving Rise to the Loss of the Tropical Forests (K. Brown and D. W. Pearce, eds.). Vancouver, BC: UBC Press.

Blaikie, P. M., J. C. Harriss, and A. N. Pain. 1992. The management and use of common-property resources in Tamil Nadu, India. Pp. 247-264 in Making the Commons Work: Theory, Practice, and Policy (D. W. Bromley et al., eds.). San Francisco, CA: ICS Press.

Blomquist, W. 1992. Dividing the Waters: Governing Groundwater in Southern California. San Francisco, CA: ICS Press.

Bray, D. 1991. The forests of Mexico: Moving from concessions to communities. Grassroots Development 15(3):16-17.

Bromley, D. W. 1991. Environment and Economy: Property Rights and Public Policy. Oxford: Basil Blackwell.

Bromley, D. W., D. Feeny, M. McKean, P. Peters, J. Gilles, R. Oakerson, C. F. Runge, and J. Thomson, eds. 1992. Making the Commons Work: Theory, Practice, and Policy. San Francisco, CA: ICS Press.

Brown, D. 2002. From Supervising 'Subjects' to Supporting 'Citizens': Recent Developments in Community Forestry in Asia and Africa. ODI Natural Resources Perspectives, no. 75.

Burger, J., E. Ostrom, R. B. Norgaard, D. Policansky, and B. D. Goldstein, eds. 2001. Protecting the Commons: A Framework for Resource Management in the Americas. Washington, D.C.: Island Press.

Chhetri, R. B., and T. R. Pandey. 1992. User Group Forestry in the Far-Western Region of Nepal. Kathmandu, Nepal: International Centre for Integrated Mountain Development.

CIFOR 2001—need to find

Clay, D. C., M. Guizlo, and S. Wallace. 1994. Population and land degradation. Working paper, Michigan State University, Departments of Agricultural Economics and Sociology, Geography, and Resource Development, East Lansing.

Commoner, B. 1972. The Closing Circle. New York: Knopf.

Contreras-Hermosilla, A. 2000. The Underlying Causes of Forest Decline. CIFOR Occasional Paper No. 30. Bogor, Indonesia: CIFOR. Available at: <www.cifor.cgiar.org/publications>.

Dasgupta, P., and K.-G. Mäler. 1992. The Economics of Transnational Commons. Oxford: Clarendon Press.

Deacon, R. T. 1994. Deforestation and the rule of law in a cross-section of countries. Discussion Paper no. 94-23, Resources for the Future, Washington, D.C.

Eggertsson, T. 1990. Economic Behavior and Institutions. New York: Cambridge University Press.

Ehrlich, P. R., and A. H. Ehrlich. 1991. Healing the Planet: Strategies for Resolving the Environmental Crisis. Reading, MA: Addison Wesley.

Feeny, D., F. Berkes, B. J. McCay, and J. M. Acheson. 1990. The tragedy of the commons: Twenty-two years later. Human Ecology 18(1):1-19.

Fischer, G. 1993. The population explosion: Where is it leading? Population and Environment 15(2):139-153.

Food and Agriculture Organization of the United Nations (FAO). 1993. Forest Resources Assessment 1990. Rome: FAO.

Food and Agriculture Organization of the United Nations (FAO). 2001. State of the World's Forests 2001. Rome: FAO.

Fortmann, L., and J. W. Bruce. 1988. Whose Trees? Proprietary Dimensions of Forestry. Boulder, CO: Westview Press.

Fox, J. 1993. Forest resources in a Nepali village in 1980 and 1990: The positive influence of population growth. Mountain Research and Development 13(1):89-98.

Gadgil, M., F. Berkes, and C. Folke. 1993. Indigenous knowledge for biodiversity conservation. Ambio 22(2-3):151-156.

Gibson, C., and C. D. Becker. 2000. A lack of institutional demand: Why a strong local community in Western Ecuador fails to protect its forest. Pp. 135-161 in People and Forests: Communities, Institutions, and Governance (C. Gibson, M. McKean, and E. Ostrom, eds.). Cambridge, MA: MIT Press.

Grant, J. P. 1994. The State of the World's Children 1994. Oxford, NY: Oxford University Press for UNICEF.

Guha, R. 1983. Forestry in Britain and post-British India. Economic and Political Weekly (India) 18(43 and 44): 1,882-1,196; 1,940-1,946.

Herring, R. J. 1990. Rethinking the commons. Agriculture and Human Values 7(2):88-104.

Hess, C. 1999. A Comprehensive Bibliography of Common Pool Resources. (CD-ROM) Bloomington: Indiana University, Workshop in Political Theory and Policy Analysis.

Holdren, C. 1992. Population alarm. Science 255:1,358.

Holloway, M. 1992. Population pressure: The road from Rio is paved with factions. Scientific American (Sept.).

Jerrells, J., and E. Ostrom. 1995. Current developments in a relational

database for biological and social science research. Paper presented at the IUFRO World Congress conference, Tampere, Finland, August 8-11, 1995.

Kaimowitz, D., and A. Angelsen. 1998. Economic Models of Tropical Deforestation: A Review. Bogor, Indonesia: CIFOR.

Keohane, R. O., and E. Ostrom, eds. 1995. Local Commons and Global Interdependence: Heterogeneity and Cooperation in Two Domains. London: Sage.

Kiser, L. L., and E. Ostrom. 1982. The three worlds of action: A metatheoretical synthesis of institutional approaches. Pp. 179-222 in Strategies of Political Inquiry (E. Ostrom, ed.). Beverly Hills, CA: Sage.

Kummer, D., and C. H. Sham. 1994. The causes of tropical deforestation: A quantitative analysis and case study from the Philippines. Pp. 146-158 in The Causes of Tropical Deforestation: The Economic and Statistical Analysis of Factors Giving Rise to the Loss of the Tropical Forests (K. Brown and D. W. Pearce, eds.). Vancouver, BC: UBC Press.

Li, Y., P. Mausel, Y. Wu, E. Moran, and E. Brondizio. 1994. Discrimination between advanced secondary succession and mature moist forest near Altamira, Brazil, using Landsat TM data. Pp. 350-364 in Proceedings of the 1994 American Society for Photogrammetry and Remote Sensing.

Libecap, G. D. 1989. Contracting for Property Rights. New York: Cambridge University Press.

Mausel, P., Y. Wu, Y. Li, E. Moran, and E. Brondizio. 1993. Spectral identification of successional stages following deforestation in the Amazon. Geocarto International 8(4):61-71.

McCay, B. J., and J. M. Acheson. 1987. The Question of the Commons: The Culture and Ecology of Communal Resources. Tucson: University of Arizona Press.

McKean, M. A. 1992. Success on the commons: A comparative examination of institutions for common property resource management. Journal of Theoretical Politics 4(3):247-282.

Moran, E., E. Brondizio, P. Mausel, and Y. Wu. 1994. Integrating Amazonian vegetation, land-use, and satellite data. BioScience 44(5):329-338.

Myers, N. 1988. Tropical forests and their species: Going, going . . . Pp. 28-35 in Biodiversity (E. O. Wilson and F. M. Peter, eds.).Washington, D. C.: National Academy Press.

National Research Council. 1986. Proceedings of the Conference on Common Property Resource Management. Washington, D.C.: National Academy Press.

Ness, G., W. Drake, and S. Brechin. 1993. Population-Environment Dynamics: Ideas and Observations. Ann Arbor: University of Michigan Press.

Netting, R. McC. 1993. Smallholders, Householders: Farm Families and the Ecology of Intensive, Sustainable Agriculture. Stanford, CA: Stanford University Press.

Oakerson, R. J. 1992. Analyzing the commons: A framework. Pp. 41-59 in Making the Commons Work: Theory, Practice, and Policy (D. W. Bromley

et al., eds.). San Francisco, CA: ICS Press.

Ostrom, E. 1986. An agenda for the study of institutions. Public Choice 48:3-25.

Ostrom, E. 1990. Governing the Commons: The Evolution of Institutions for Collective Action. New York: Cambridge University Press.

Ostrom, E. 1992a. Crafting Institutions for Self-Governing Irrigation Systems. San Francisco, CA: ICS Press.

Ostrom, E. 1992b. The rudiments of a theory of the origins, survival, and performance of common-property institutions. Pp. 293-318 in Making the Commons Work: Theory, Practice, and Policy (D. W. Bromley et al., eds.). San Francisco, CA: ICS Press..

Ostrom, E. 1998. "The International Forestry Resources and Institutions Research Program: A Methodology for Relating Human Incentives and Actions on Forest Cover and Biodiversity." Pp. 1-28 in Forest Biodiversity in North, Central and South America, and the Caribbean: Research and Monitoring, Man and the Biosphere Series, vol. 21 (F. Dallmeier and J. A. Comiskey, eds.). Paris: UNESCO; New York: Parthenon.

Ostrom, E. 2001. Reformulating the commons. Pp. 17-41 in Protecting the Commons: A Framework for Resource Management in the Americas (J. Burger, E. Ostrom, R. B. Norgaard, D. Policansky, and B. D. Goldstein, eds.). Washington, D.C.: Island Press.

Ostrom, E., R. Gardner, and J. Walker. 1994. Rules, Games, and Common-Pool Resources. Ann Arbor: University of Michigan Press.

Ostrom, V., D. Feeny, and H. Picht, eds. 1993. Rethinking Institutional Analysis and Development: Issues, Alternatives, and Choices. 2d ed. San Francisco, CA: ICS Press.

Pearce, D., and K. Brown. 1994. Saving the world's tropical forests. Pp. 2-26 in The Causes of Tropical Deforestation: The Economic and Statistical Analysis of Factors Giving Rise to the Loss of the Tropical Forests (K. Brown and D. W. Pearce, eds.). Vancouver, BC: UBC Press.

Pearce, D., and D. Moran. 1994. The Economic Value of Biodiversity. London: Earthscan Publications.

Pimental, D., R. Harman, M. Pacenza, J. Pecarsky, and M. Pimental. 1994. Natural resources and an optimal human population. Population and Environment 15(5):347-369.

Pinkerton, E., ed. 1989. Co-operative Management of Local Fisheries: New Directions for Improved Management and Community Development. Vancouver: UBC Press.

Rowe, R., N. Sharma, and J. Browder. 1992. Deforestation: Problems, causes, and concerns. Pp. 33-46 in Managing the World's Forests (N. Sharma, ed.). Dubuque, Iowa: Kendall/Hunt.

Schlager, E. 1990. Model specification and policy analysis: The governance of coastal fisheries. Ph.D. diss., Indiana University, Bloomington.

Sengupta, N. 1991. Managing Common Property: Irrigation in India and the Philippines. London and New Delhi: Sage.

Shah, S. G. 2002. Conservation and development in buffer zones of protected areas in Terai-Sewaliks, Nepal: Equity and resources management. Kathmandu, Nepal: Winrock International.

Shivakoti, G. P., and E. Ostrom, eds. 2002. Improving Irrigation Governance and Management in Nepal. Oakland, CA: ICS Press.

Simmons, O. G. 1988. Perspectives on Development and Population Growth in the Third World. New York: Plenum Press.

Tang, S. Y. 1992. Institutions and Collective Action: Self-Governance in Irrigation. San Francisco, CA: ICS Press.

Task Force on Global Biodiversity, Committee on International Science. 1989. Loss of Biological Diversity: A Global Crisis Requiring International Solutions. Washington, D.C.: National Science Board.

Thomson, J. T. 1992. A Framework for Analyzing Institutional Incentives in Community Forestry. Rome: Food and Agriculture Organization of the United Nations, Forestry Department, Via delle Terme di Caracalla.

Tiffen, M., M. Mortimore, and F. N. Gichuki. 1994. More People, Less Erosion: Environmental Recovery in Kenya. New York: Wiley.

Turner, P. 1995. Explaining deforestation: A preliminary review of the literature. Working paper, Indiana University, Workshop in Political Theory and Policy Analysis, Bloomington.

Varughese, G. 1999. Villagers, bureaucrats, and forests in Nepal: Designing governance for a complex resource. Ph.D. diss., Indiana University, Bloomington.

Varughese, G., and E. Ostrom. 2001. The contested role of heterogeneity in collective action: Some evidence from community forestry in Nepal. World Development 29(5) (May): 747-765.

Wade, R. 1994. Village Republics: Economic Conditions for Collective Action in South India. San Francisco, CA: ICS Press.

Notes

[1]Task Force on Global Biodiversity (1989: 3); see also discussion in Ascher (1993).
[2]"It is this broad-scale clearing and degradation of forest habitats [by communities of small-scale cultivators] that is far and away the main cause of species extinctions" (Myers 1988: 29).
[3]For views stressing the primary role of population increases see Holdren 1992; Rowe, Sharma, and Browder 1992: 39-40; Abernathy 1993; Fischer 1993; Ness, Drake, and Brechin 1993; and Pimental et al. 1994. On the other hand, other scholars argue that "we do not yet understand even the basics of population and degradation dynamics" (Clay, Guizlo, and Wallace 1994; see also Simmons 1988; Holloway 1992; Agrawal 1995; Turner 1995).
[4]See, in particular, Grant (1994).
[5]This section draws on Ostrom (1998).
[6]Many of the cross-sectional studies summarized in Pearce and Brown (1994) and Kummer and Sham (1994) achieve R2 values far in excess of Deacon's estimates. The R2 values that Kummer and Sham themselves achieved range from .41 to .76 in the cross-sectional studies (with significant F tests) and was .50 (and significant) in the panel study within a single country.
[7]This improved accuracy results from extensive microlevel studies. Emilio Moran and colleagues have conducted, for example, extensive studies of

different types of land use on the rates of secondary succession following deforestation in Brazil (see Mausel et al. 1993; Moran et al. 1994). Findings by Moran and colleagues are based on field studies of forest, cropped areas, and regrowth sites for a sample of plots linked to Landsat Thematic Mapper satellite data. The methods developed to recognize spectral signatures for age classes of secondary growth (at 5-year intervals) is now able to achieve a land cover classification with an accuracy of over 95% (Li et al. 1994).

[8]National Research Council 1986; McCay and Acheson 1987; Fortmann and Bruce 1988; Wade 1994; Berkes 1989; Libecap 1989; Hess 1999; Pinkerton 1989; Eggertsson 1990; Feeny et al. 1990; Herring 1990; Ostrom 1990, 1992a and b; Bromley 1991; Sengupta 1991; Blomquist 1992; Bromley et al. 1992; Dasgupta and Mäler 1992; McKean 1992; Tang 1992; Thomson 1992; Ostrom, Feeny, and Picht 1993; Netting 1993; Ostrom, Gardner, and Walker 1994; Burger et al. 2001; Shivakoti and Ostrom 2002. It is important to point out that communal ownership of resources does not guarantee sustainable management.

[9]Once the design of the micro-level instruments was completed, Turner (1995) designed a macro-level study using the same framework but including variables characterizing national-level entities.

[10]Visiting scholars from Bolivia, Colombia, Ecuador, Guatemala, Kenya, India, Mexico, Nepal, Sweden, Tanzania, and Uganda have already participated in this program. Inquiries about the content of the training program, admission criteria, training fees, and housing arrangements in Bloomington can be directed to the author.

[11]See Varughese (1999) for an examination of the mechanisms that lie behind these positive associations.

[12]Locational differences may operate quite independently of sociocultural differences, although these may be correlated in the Middle Hills, because different ethnic/caste groups tend to live in their own hamlets, which may be at different distances from forested areas.

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