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Conditions for Successful Local Collective Action in Forestry: Some Evidence From the Hills of Nepal

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In the context of an ongoing debate on the type of institutions or tenurial arrangements that are appropriate for the sustainable management of common pool resources (CPRs), this article examines the role played by local institutions in determining the conditions of two forests located in the Middle Hills of Nepal. The institutional robustness of the forests' governance systems is evaluated using Ostrom's (1990) design principles that characterize the configuration of rules devised and used by long-enduring CPR institutions. The findings show that the two forests are different in level of historical degradation as well as present condition, and these differences are generally explained by the structural characteristics of the local institutions governing the forests. The analysis indicates that Ostrom's design principles are useful for analyzing institutional robustness of local forest governance systems. However, some of the principles need modification or expansion if they are to be prescribed for forestry situations.

Keywords common pool resources, design principles, forestry, local institutions, sustainability, Nepal

Scholars working on common pool resources (CPRs), including forests, have highlighted roles played by local institutions. There is, however, considerable disagreement about the types of local institutions or tenurial arrangements that are appropriate for organizing sustainable management of these resources (see Hardin 1968; 1998; Larson and Bromley 1990; Ostrom 1990; Arnold 1998).

Traditionally, privatization and government control have been regarded as the appropriate solutions to control the overexploitation of common property resources. The arguments supporting privatization or nationalization are based on the prediction that common pool resources will be overexploited and eventually ruined due

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to individual users' rational incentive to maximize utility (Hardin 1968). This argument has been challenged extensively in academic literature for its inability to recognize the capacity of individuals involved in the situations just described to devise their own rules based on their knowledge of the problems and changes, and to alter the incentives they face. There is growing empirical evidence that CPR users often create institutional arrangements that shape interactions among community members and the resource, which helps them to protect their resources and allocate benefits among themselves equitably with a reasonable degree of efficiency over a long period of time (Ostrom 1990; Thompson 1992; McGinnis and Ostrom 1996; Gibson and Koontz 1998; Agrawal and Gibson 1999; Gibson et al. 2000).

Not all users of CPRs, however, are equally successful in protecting and managing their resources in a sustainable manner. What determines the ability of CPR users to be engaged in meaningful forms of collective action? Researchers have come up with several explanations for this question. Gibson (1999, 2–3), based on the findings from two case studies in Guatemala, argues that salience and scarcity, as perceived by the user groups, are two necessary conditions for the creation of successful institutions for managing local forests. Agrawal (2001) found state policies, demographic shifts, technology, and market as important factors related to outcomes from local level collective action, along with characteristics of local communities, institutions, and resources. In a watershed-level study in northern Thailand, Wittayapak and Dearden (1999) found that collective action is likely to be more successful in smaller watersheds close to the communities with clearly demarcated boundaries and fewer users with high individual involvement in decision making.

After extensive studies of CPR management cases with various levels of success, some authors have come up with a list of factors they think help to predict the likelihood of a CPR regime being successful (e.g., Baland and Platteau 1996, 343–345). Based on lessons learned from a sample of 14 cases of community based governance of CPRs in different parts of the world, Ostrom (1990) suggested eight design principles that characterize the configuration of rules devised and used by long-enduring CPR institutions (Table 1). She defines "design principle" as "an essential element or condition that helps to account for the success of these institutions in sustaining the [common-pool resource] and gaining the compliance of generation after generation of appropriators to the rules in use" (Ostrom 1990, 90). Ostrom emphasized that her design principles do not provide a blueprint for analyzing resource management regimes, but they have been found consistently in long-enduring CPR situations.

Some institutional analysts have questioned the applicability of existing design principles in more complicated natural resource systems such as forestry. Morrow and Hull (1996), for example, tested the relevance of Ostrom's CPR design principles for indigenous forest management regimes involving donor assistance and other external influences in Peru and suggest the expansion of several of the principles for durable CPR institutions. Steins and Edwards (1999) point to three major shortcomings in the formulation of existing CPR design principles: (1) They are based on studies of resources that are subject to one single extractive use; (2) they focus on the internal dynamics of resource management, ignoring the ecological context and the wider political economy in which they are embedded; and (3) they involve the study of organizations in terms of "successes" and "failures," which is problematic because the definition of "success" differs among stakeholders. Steins and Edwards are of the opinion that the formulation of a priori design principles for successful collective action hinders rather than facilitates CPR research and policies. They propose instead a social constructivist perspective for the study of CPRs. Agrawal

TABLE 1 Design Principles Illustrated by Long-Enduring Common Pool Resource Institutions

Principle	Explanation
1. Clearly defined boundaries	The resource and users are clearly defined.
2. Congruence	(a) The distribution of benefits from appropriation rules is roughly proportionate to the costs imposed by provision rules. (b) Appropriation rules restricting time, place, technology, and/or quantity of resource units are related to local conditions.
3. Collective-choice arrangements	Most individuals affected by operational rules can participate in modifying these rules.
4. Monitoring	Monitors, who actively audit CPR conditions and appropriator behavior, are accountable to the appropriators and/or are the appropriators themselves.
5. Graduated sanctions	Appropriators who violate operational rules are likely to receive graduated sanctions from other appropriators, from officials accountable to these appropriators, or from both.
6. Conflict-resolution mechanisms	Appropriators and their officials have rapid access to low-cost, local arenas to resolve conflict among appropriators or between appropriators and officials.
7. Minimal recognition of rights to organize	The rights of appropriators to devise their own institutions are not challenged by external government authorities.
8. Nested enterprises (for CPRs that are part of larger systems)	Appropriation, provision, monitoring, enforcement, conflict resolution, and governance activities are organized in multiple layers of nested enterprises.

Note. Adapted from Ostrom (1990).

(2002, 54–63) highlights the effects of external factors (markets, technology, states, and population pressures) on CPRs and complains that the existing design principles have given little consideration to them. These and other concerns expressed by various researchers show that it is not yet clear whether Ostrom's design principles are sufficiently developed to be applicable in forestry. This indicates the necessity for more research to adapt these concepts to the complexity of forest management.

Building on the theoretical background presented above, this article first examines and compares the conditions and governance systems of two forests located in similar socioeconomic and ecological settings in the Middle Hills of Nepal. It then evaluates the institutional robustness of the forests governance systems using Ostrom's (1990) design principles as a theoretical and evaluative framework. The objective is to determine whether Ostrom's design principles are relevant for forestry, and if indeed relevant, to know whether the principles are met in the study sites.

The study attempts to address some critical questions related to community based forest management, such as what roles the local institutions play in determining condition of a forest, and how to evaluate the institutional robustness of a local forest governance system. Despite substantial research on community-based forest management during the last two decades, such basic yet critical research questions remain largely unanswered for Nepal. This gap in scientific research could be related to the present conflict between civil society, particularly the Federation of Community Forestry Users, Nepal, and government policymakers regarding the role of government agencies and local communities in the implementation of the community forestry program (see Gautam et al., 2004). The findings of this research are expected to contribute towards resolving the conflict and help design or improve future forest governance in Nepal and other developing countries. Moreover, the study is expected to be a substantial contribution to existing CPR theory.

Study Sites

The study was carried out in two forest systems (the forest, its users, and forest governance system combined), *Dhulikhelko Thulo Ban* (hereafter, Dhulikhel) and Jyalachitti, both located within the Kabhrepalanchok district, in the Middle Hills of Nepal (Figure 1). The two sites are located in similar ecological and socioeconomic settings but differ in terms of the size and nature of forest user groups, forest size, forest governance arrangement, level and history of past forest degradation, and external supports (Table 2).

In Dhulikhel, the forest users are not organized and there is a conflict of interest between the town residents and villagers accessing the Dhulikhel forest in terms of forest management objectives. The residents of the town of Dhulikhel want to keep the forest under strict protection for water conservation and nonconsumptive uses such as scenic beauty, while the villagers want to keep the forest under active management for a sustained supply of products for household uses. The forest is legally a national government forest under the authority of the local district forest office (DFO) but is under de facto control and claim ownership by the Dhulikhel municipality. The DFO has informally recognized this local claim and has not tried to implement any forest management activities there for the past several years. The forest has thus been under a semigovernment type of jurisdiction.

In Jyalachitti, the users are formally organized into a forest user group (FUG). Unlike Dhulikhel, most of the users of the Jyalachitti forest are subsistence agriculturists and thus have similar forestry requirements. Consequently, there is a general consensus among the users in terms of forest management objectives.

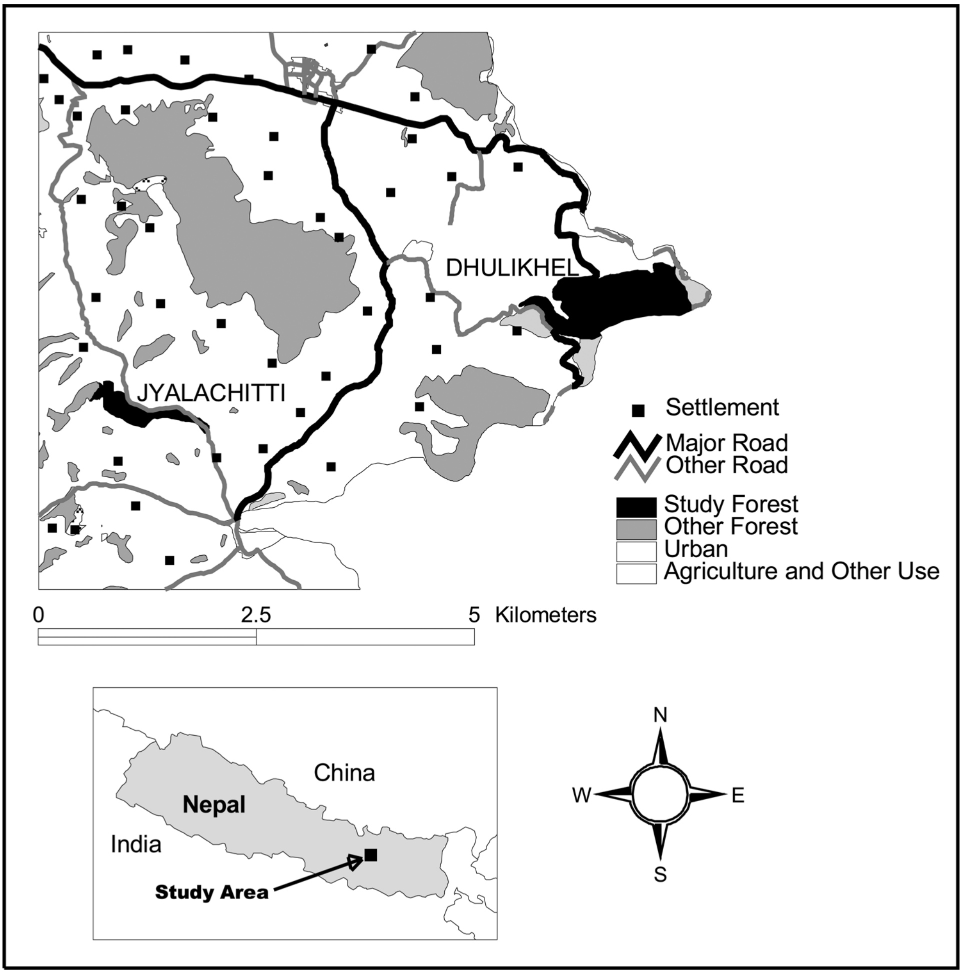

FIGURE 1 A section of Kabhrepalanchok district in the Middle Hills of Nepal showing the location of the study sites (Dhulikhel and Jyalachitti).

The forest was formally handed over to the local community in 1992 by the DFO under the state-sponsored program of community forestry. Since then, the forest has been managed by the FUG according to a forest management plan prepared by the FUG itself with technical support from the DFO.

The two sites have been selected for this study for two main reasons. First, the sites represent the two most common types of local forest governance systems in Nepal. Second, despite being located in similar ecological and socioeconomic settings, the two forests had distinctly different trends of forest cover changes during 1976–2000 (Gautam 2002).

Methodology

Data Collection

Data were collected between January and April 2001 by a team comprised of a forester, a botanist, and a social scientist. Data on attributes of the user groups,

TABLE 2 Comparison of Dhulikhel and Jyalachitti Forest Systems

Attribute	Dhulikhel	Jyalachitti
Forest size (ha)	98.0	25.9
Elevation range (m, above means sea level)	1475–1700	1460–1600
Average slope steepness (degrees)	26.1	26.4
Slope orientation	Northwest	North (most part)
Dominant soil	Sandy Loam	Clay Loam
Average depth of humus layer (cm)	1.4	1.1
Forest type	Lower-temperate mixed broadleaf	Lower-temperate mixed broadleaf
Changes in forest condition during the last 5 years, as perceived by local users	Worsening	Improving
Level of historical degradation	Never heavily degraded	Severely degraded around 1960
Size of forest user group (households)	1288	264
Distance from motorable road	<1 km	<1 km
Distance from nearest market	<2 km	<2 km
Forest governance type	Semigovernment	Community
Nature of forest user group	Not organized	Formally organized
Mutually agreed forest governance rules	Do not exist	Exist
External support for forest management	No	Yes (technical and some financial)

historical use and trends of changes in forest condition, the perceptions of local forest users of changes in forest conditions during the last 5 years, forester's appraisal of forest conditions in terms of vegetation density, species diversity, commercial value, and subsistence value, and characteristics of institutional arrangements were collected through Rapid Rural Appraisals, interviews, group discussions, and field observations.

Botanical data were collected through forest inventories from randomly selected forest plots composed of three concentric circles that were 1 m, 3 m, and 10 m, in radius. In the innermost circle (1 m radius), woody seedlings and herbaceous groundcover were sampled. In the next circle (3 m radius), shrubs, saplings, and climbers were identified and counted, and also the diameter at breast height (DBH; 1.37 m above ground) and heights of woody stems between 2.5 and 10 cm in diameter were recorded. In the largest circle (10 m radius), stems of 10 cm or greater in DBH were identified, counted, and DBH and height were measured. In total, 40 forest plots were sampled in Dhulikhel and 30 were sampled in Jyalachitti. Each forest plot was also described in terms of its topography (elevation, slope, aspect) and soil condition (depth of humus layer, soil depth, color, texture, drainage). The geographic location and elevation of each forest plot were recorded by using a global positioning system (GPS) and an altimeter. Soil texture was determined by the feel method, following the instructions given in the IFRI Field Manual (IFRI 2001), and soil color was determined with the help of the Munsell color chart. Secondary data/information available from the forest management plan of the Jyalachitti forest, the constitution of its FUG, office records, reports, research papers, and other published sources were used to supplement the primary data.

Data Analysis

We used both qualitative as well as quantitative techniques to analyze forest conditions. Historical use and level of past forest degradation, the perceptions of the users in terms of changes in the forest conditions during the last 5 years, and the forester's appraisal of forest conditions were analyzed qualitatively. Biological conditions of the two forests were analyzed and compared quantitatively using measured values of selected dependent variables, including the basal area of trees ($\geq$10 cm DBH), density of trees, density of saplings (tree species with 2.5 to $<$10 cm DBH), and species richness.

Local institutions governing the forests, particularly those relating to the maintenance, monitoring, and harvest of products were evaluated qualitatively on the basis of the existence of rules, effectiveness of enforcement, and level of their compliance. An evaluation and comparison of overall institutional robustness of the two forest governance systems was then made using Ostrom's design principles as a theoretical and evaluative framework.

Study Findings

Condition of the Forests

The two forests were distinctly different in terms of historical use and level of past degradation. The Dhulikhel forest was never heavily degraded in the past, due mainly to its protection by the residents of Dhulikhel town. However, the users perceived that there has been a decline in tree density and area of this forest during

TABLE 3 Users' and Forester's Evaluation of Dhulikhel and Jyalachitti Forest Conditions

	Dhulikhel forest	Jyalachitti forest
Users' evaluation of changes in forest during the last 5 years		
Density of trees	Decreased	Increased
Density of shrubs	Increased	Decreased
Density of ground cover	Remained the same	Decreased
Forest area	Decreased	Remained the same
Forester's appraisal of present forest condition		
Vegetation density	About normal for this ecological zone	Somewhat abundant (i.e., above normal)
Species diversity	About normal for this ecological zone	Somewhat abundant
Commercial value	Below normal	Above normal
Subsistence value	Normal	Normal

the last 5 years due to increased "illegal" extraction of forest products (firewood, fodder, and small timbers) by the villagers, and due to road and other constructions inside the forestland. The Jyalachitti forest experienced a severe degradation around the middle of the last century, and by 1960 it was converted into an open grazing land with only scattered bushes and a few *Schima wallichii* trees remaining. However, the users perceived that the density of the forest trees increased during the last 5 years as a result of protection of the forest by the FUG. The forester's appraisals of the forest's condition indirectly supported the users' perceptions (Table 3).

The two forests also differed in present biological condition. The Jylachitti forest had substantially higher per unit basal area as well as density of trees compared to the Dhulikhel forest, while sapling density was much higher in the Dhulikhel forest than in the Jyalachitti forest. Total species richness (without taking account for the difference in forest size) was also slightly higher in the Dhulikhel forest compared to Jyalachitti (Table 4). Although the inconsistent patterns in the values of the dependent variables did not allow us to draw a firm conclusion, the findings suggested a relatively better condition in the Jyalachitti forest than in the Dhulikhel forest. This inference becomes more evident when the

TABLE 4 Selected Dependent Variables Representing Present Biological Condition of Dhulikhel and Jyalachitti Forests

Variable	Dhulikhel forest	Jyalachitti forest
Average basal area of trees (m^2/ha)	7.5	11.6
Average density of trees (stems/ha)	403	491
Average density of saplings (stems/ha)	3140	1321
Species richness (total number of plant species recorded in the forest)	74	68

findings are interpreted in the context of the distinctly different degradation history of the two forests.

Forest Governance Arrangements

The two sites differed widely in terms of forest governance arrangements and their effectiveness. In Dhulikhel, there are no mutually agreed forest use, monitoring, maintenance, or development rules. The local municipality has imposed a total ban on the harvest of forest products. These rules do not match with the customary rules of the local villagers or the formal rules defined by the 1993 National Forest Act. Two local guards hired by the Dhulikhel municipality regularly monitor the forest. However, the effectiveness of monitoring and compliance with the rules is very low. As a result, the "illegal" harvest of products by local people is common in this forest.

In Jyalachitti, the FUG has crafted and implemented rules restricting the quantity of forest products that can be harvested and the frequency of those harvests. Harvesting is done on a rotational basis among the six forest units according to the technical specifications outlined in the forest management plan. Two forest guards hired by the FUG and one or more FUG leaders supervise the harvesting activities. The de facto and de jure rules generally match, and the effectiveness of rules enforcement as well as rules compliance is higher in this site compared to the Dhulikhel site. The institutional settings in the two sites have been more extensively and more explicitly considered in the following section.

Application of Ostrom's (1990) Design Principles

Given these background observations, this section analyzes the study sites' institutional settings using Ostrom's design principles as a theoretical and evaluative framework, determines the relevance of each of the seven design principles for these forestry situations, and examines whether the two forest systems under study meet these principles. The eighth design principle was not relevant for this study because neither of the two forests was part of a larger system.

Design Principle 1: Clearly Defined Boundaries

Both the Dhulikhel and Jyalachitti forest systems have clear boundaries. The Dhulikhel forest borders a community forest to the east, a private forest to the west, and agricultural lands on the other two sides. Jyalachitti borders a private forest to the west and is surrounded by agricultural land on the other three sides (see Figure 1). The boundaries of both forests are clear and most of the forest users are aware of these boundaries.

Another aspect of the principle, one that concerns a clear definition of users with a legal right to the resource, was met in Jyalachitti but not in Dhulikhel. The Jyalachitti FUG has a clear listing of user households as its members. In the Dhulikhel case, forest users had not been identified clearly; nor were they organized into a user group. Most of the Dhulikhel town residents did not consider the villagers from the other five settlements as legal users of the forest. The villagers claimed to have used this forest for generations, but there was no consensus among them as to how many or from which settlements the traditional users derive. We identified 1269 households as users of the Dhulikhel forest that were residing in the Dhulikhel town (nearly 80%) and the five nearby settlements. However, this identification, which was based on the criterion of substantial use of the forest as perceived by the local people, provides only a rough estimate. This was because the perception of "substantial use" varied widely among the users. Due to a lack of a clear distinction between the actual users and "outsiders," most of the "identified" users were not interested in investing in the protection and maintenance of the forest. Based on our analysis, we concluded that this design principle was important, although it was only partially met at the study sites.

Design Principle 2: Congruence

The first part of this design principle, congruence between the appropriation rules and provision rules, suggests that users who contribute more to the development and maintenance of the resource system should receive more benefits from the system. The crucial point here is that these rules should be considered fair and legitimate by the participants themselves (McGinnis and Ostrom 1996).

This condition of design principle 2 was partially met in Dhulikhel. The town residents bore the cost of forest protection indirectly through the regular taxes paid to the municipality (part of which is used in hiring the local forest guards). In addition, the municipality leaders have spent a substantial amount of time in monitoring the forest by themselves and supervising the activities of the guards. In return, they enjoy many benefits from the forest, such as a relatively intact watershed and its scenic beauty. In addition, the leaders of the forest protection campaign have likely gained indirect social and/or political benefits. The village users, particularly those from outside the municipal areas, have not incurred any direct cost for the protection of the forest; nor have they received benefits from the forest on the level that the town users have received over the years. The village users generally acknowledge the efforts of the municipality to protect the forest, but they do not think that the provision rules imposed by the municipality, rules that ban forest products harvesting, are fair or legitimate. Similarly, the town users feel that the villagers illegally receive consumptive benefits from the forest without bearing any direct cost for its protection.

In the case of the Jyalachitti forest, congruence between appropriation rules and provision rules generally exists. All users contribute to forest protection and maintenance by paying a fixed and equal membership fee, which is used for hiring forest guards. There is a clear system for harvest and distribution of forest products, which is considered fair and legitimate by most of the users. Some leaders in the FUG spend more time in the system than other users, but their additional contributions seem to be compensated for by extra financial benefits and the knowledge they gain by participating in occasional training sessions and study tours organized by the DFO. Recognition of their leadership by the general members, as well as by concerned agencies, might have also provided them with some indirect social benefits. The fact that the FUG chairman and the general secretary also hold elected positions in the local municipality and a local cooperative bank, respectively, can be taken as evidence of such social benefits.

The second part of design principle 2 concerns matching appropriation rules to local conditions. By "local condition," Ostrom (1990) implies the ecological condition and the other attributes of the resource. For Dhulikhel, the answer is no. The forest structure, species composition, topography, soil, and other ecological conditions in most of the Dhulikhel forest are suitable for active forest management that can meet the diverse needs of both the village and town communities. An extension of the Dhulikhel forest on the eastern side, which has species composition, topography, soil, and other ecological conditions very similar to those of the Dhulikhel forest, is being successfully and actively managed by a local FUG for multipurpose use (Webb and Gautam 2001). This evidence suggests that the Dhulikhel forest can also be managed in a similar way for meeting subsistence requirements of the rural communities, while at the same time preserving the integrity of forest and watershed resources as is desired by the town people. Thus, the existing informal rules imposed by the Dhulikhel municipality that favor passive management (i.e., a fully protected forest) do not meet the condition of this design principle in the Dhulikhel forest.

In Jyalachitti, the appropriation rules were partially matched to local conditions. Forest tending and other silvicultural rules of the FUG have given some consideration to local microecological conditions and are generally in tune with the concept of sustainable forest management and soil conservation. However, the rule restricting timber harvest, when the forest had a relatively good stock of timber-size trees, does not match the forest condition, even accounting for more rigid rules where the forest is a very scarce resource. This design principle can thus be considered as relevant and it was partially met at the study sites.

The definition of "local condition" provided by Ostrom seems to be insufficient to explain the congruence level in Dhulikhel. An important aspect of the non-congruence of the appropriation rules with local conditions in this forest system was the lack of consideration of local customs, the sociocultural context, and the livelihood strategies of the villagers by these rules. For example, collection of leaf litter for animals' bedding, fallen tree branches and twigs for firewood, and fodder from communal and public forests is considered villagers' customary rights throughout the Middle Hills, but these rights are not recognized by the appropriation rules in the Dhulikhel forest. It must be realized that these forest products are essential and integral components of this agrarian living system. As a consequence, this design principle needs to be expanded to accommodate these local factors.

Design Principle 3: Collective-Choice Arrangements

In Dhulikhel, the structure of the operational rules is complex. There are three sets of such rules applicable to this forest system: (1) the formal rules stated in national forestry legislation, which requires a permit from the local district forest officer before harvesting forest products (2) the informal rules of Dhulikhel municipality imposing a total ban on the harvest of any product from the forest; and (3) the local customs or social norms, which allow the harvest of fallen tree branches and twigs for firewood, leaf litter, and other minor forest products from nearby government or communal forests for subsistence use. There are no clear methods for community members to be involved in the formation or change of any of these rules, even if they feel that they are not appropriate and conducive to sustainable forest management. As there is a conflict between the informal rules imposed by the local municipality and the subsistence needs of the villagers, and as there is no mechanism to resolve this conflict, the villagers simply ignore the rules imposed by the municipality and extract forest products whenever they can. The lack of ownership and responsibility over the resource is another important factor contributing to the behavior of the villagers, which likely arose as a consequence of a nonparticipatory decision-making process.

In Jyalachitti, the operational rules devised by the FUG, conceptualized with assistance from local forestry staff and decided through consensus among the FUG members, largely conform to local customs and social norms. These rules can be changed by consensus among FUG members during the regularly held (usually once a year) FUG assembly meeting. There were some external influences during the formation and modification of operational rules in the sense that some forestry officials were involved indirectly in the process and the rules devised or revised by the FUG required approval by the district forest officer before they became operative. These external influences, however, were not so significant that they could materially affect the self-governing status of the FUG. This design principle can thus be considered as relevant, although it is only met in Jyalachitti but not at the Dhulikhel site.

Design Principle 4: Monitoring

The importance of monitoring in self-governed CPR regimes is clear because there are always conditions that tempt some individuals to cheat and gain substantially, to the disadvantage of others (Ostrom 2000). In case of Dhulikhel, the two guards, who regularly monitor the forest, come from among the appropriators, but they are not accountable to the majority of forest users. Instead, the guards are accountable to the municipality leaders who hired them for this job. Even the municipality leaders, who occasionally monitor forest conditions, are not accountable to a substantial proportion of the users who come from outside the municipal area. The villagers do not bear the responsibility of bringing others' violations to the attention of the municipality for three reasons: (1) They do not recognize the authority of the municipality, (2) they think that most of the violations do not merit intervention, and (3) their common subsistence needs and social obligations outweigh the utility of the rules.

Monitoring effectiveness in Dhulikhel was diminished in the last few years also due to external stresses. A substantial proportion of the forest land was lost to the newly constructed Banepa-Bardibas road, which passes through this forest. A number of laborers working on the road construction project are believed to have collected firewood for subsistence while camping near the forest. The two local forest guards were not able to control this loss.

In Jyalachitti, the FUG hired two people from its membership for regular monitoring of the forest. Their salaries are supplied by a small annual fee paid to the FUG by each member household. The forest guards are thus accountable to the users. In addition, members of the Forest Users' Committee (the executive council of the FUG) occasionally monitor forest conditions, especially during harvesting and forest maintenance activities. The committee is also responsible for auditing and reporting the annual income and expenditures of the FUG to the general members once a year during its FUG assembly meeting. Most of the users and local forestry staff thought that these monitoring arrangements have been effective and play an important role in the smooth functioning of the governance system. The findings show that this design principle is highly relevant for managing institutions in a community forest setting. It can be considered to be fully met in Jyalachitti and partially met at the Dhulikhel site.

Design Principle 5: Graduated Sanctions

According to Ostrom (1990; 2000), the necessity to have graduated sanctions arises for two reasons: first, to give appropriators a message that any cheating will be noticed and punished, and second, to show that those who break the rules repeatedly will face a heavy penalty, making the cost of breaking rules higher than the benefits to be received so that eventually rule breaking becomes an unattractive option for the appropriators. This is important for CPR institutions because it allows flexibility in the system and helps them to adapt to changing circumstances (Morrow and Hull 1996).

In Dhulikhel, the punishment for breaking rules is limited to a verbal warning by the forest guards or in some cases seizure of the product harvested and equipment used. As there is no system of recording punishments and there is no legal authority with the guards or the municipality to impose a penalty for breaking rules, any punishments are unsystematic (not graduated). They largely rely on the discretion of the forest guard on duty or the municipality leader who receives the report. Provisions for graduated sanctions exist in the National Forest Act (HMGN 1993), but there is no single case in the last 10 years when anybody was punished by the district forest officer for breaking government rules in this forest.

The Jyalachitti FUG has a clear provision for graduated sanctions in its constitution. Though it received a consensus agreement from users, its implementation status is not very clear. According to the FUG leaders, a first-time violator of the rules faces verbal warning and seizure of product and equipment used in illegal harvesting, but if the same person is caught breaking the rules a second time, the users' committee leaders impose a cash penalty. The FUG leaders also claim that the system has been effective in controlling illegal harvest and compliance of users is very high. There was, however, no documented record with the FUG about who received such graduated sanctions, or when and for what offense. The available information is thus insufficient to determine the relevance of this design principle in community based forest management. If considered relevant, this principle is partially met in Jyalachitti but not met in Dhulikhel.

Design Principle 6: Conflict Resolution Mechanisms

This design principle assumes that some type of conflict is bound to occur in field settings, even when the rules are clear and unambiguous, because there may be differences in the interpretation of appropriation rules among users. If these conflicts are not resolved at a low cost and in an orderly manner, then the users may be increasingly unwilling to conform to the rules (Ostrom 2000).

Several factors have made conflict resolution complicated in Dhulikhel. First, the difference in economic status and livelihood systems between the town and the village users has led to a difference in understanding about each other's forestry related problems and priorities. Second, the political ecology of resource use among various actors (the villagers, town residents, municipality, DFO, local political leaders) has made any initiative intended to resolve conflicts very costly. Third, traditional mechanisms for dealing with internal conflicts that worked for centuries have eroded in recent years due to strong political divisions among the users. The institutions governing the Dhulikhel forest system have also failed to provide low-cost, local arenas to resolve conflict.

Jyalachitti has three types of provisions for conflict resolution. The forest users' committee usually resolves smaller internal conflicts, particularly related to the harvest and distribution of forest products. More complicated conflicts internal to the FUG are resolved in FUG assemblies, sometimes with facilitation by local forestry staff. The FUG seeks support from the DFO for resolving conflicts arising from external factors. Being a semiautonomous entity, the FUG has the right to go to court for more serious conflicts, but that has not yet happened.

The findings suggest that this design principle has particular relevance for community-based forest management. Contrary to many other CPRs (e.g., irrigation systems, fisheries), forests can be expected, almost by definition, to accommodate multiple and often conflicting interests. Efficiently dealing with those conflicts seems especially crucial in forest management. Of the two study sites, the condition of this design principle is largely met in Jyalachitti but not in Dhulikhel.

Design Principle 7: Minimal Recognition of Rights to Organize

The concept behind this design principle is that when the rights of user groups to devise their own rules are recognized by relevant laws, then the local rules will be less frequently challenged (Ostrom 1990). The national forestry legislation of Nepal strongly supports the rights of user groups to devise their own rules (HMGN 1993). Because of this, forestry officials have remained positive toward these rights at both sites.

In Dhulikhel, the rights of users to devise their own institutions are obstructed, if not directly challenged, by other local organizations, particularly the local municipality. This relationship (i.e., the future FUG vs. municipality) has tremendous influence in the design and functioning of the CPR institutions at this site. In Jyalachitti, although the rights of appropriators to devise their own institutions are not challenged by external authorities, there was some influence of district forest office staff during the process of devising those rules. The Jyalachitti FUG thus can be considered to have partial autonomy in devising its own institutions.

This design principle is relevant in forestry and largely met in Jyalachitti. It can also be considered as partially met in Dhulikhel on the basis that the users' rights to organize into a FUG have been recognized by the national forestry legislation. The village users, however, are de facto denied the right to manage the forest by municipal authorities due to differences in the management objectives of the town residents and the villagers. How these two forest systems conform to the conditions of Ostrom's design principles is summarized in Table 5.

TABLE 5 Do the Dhulikhel and Jyalachitti Forest Systems Meet the Conditions of Ostrom's Design Principles?

Design principle	Dhulikhel	Jyalachitti
1. Clearly defined boundaries		
(a) Of resource	Yes	Yes
(b) Of users	No	Yes
2. Congruence		
(a) Between appropriation rules and provision rules	Partially yes	Yes
(b) Between appropriation rules and local conditions	No	Partially yes
3. Collective choice arrangements	No	Yes
4. Monitoring	Partially yes	Yes
5. Graduated sanctions	No	Partially yes
6. Conflict-resolution mechanisms	No	Yes
7. Minimal recognition of rights to organize	Partially yes	Yes

Discussion and Conclusions

Given that the local ecological conditions (elevation, topography, climate), forest origin, and forest types are similar in the two sites, the substantially higher per unit basal area, as well density of trees, in the Jyalachtti forest may be the result of regulated forest use and regular maintenance of resources, contrary to what happened in Dhulikhel. Regular extension services provided by the district forestry staff also contributed to the successful implementation of these activities in Jyalachitti. The Dhulikhel users did not receive similar external supports because such supports are available only to those users who are formally organized into a FUG and registered in the DFO. Effective protection and regular silvicultural activities (thinning, pruning, bush clearing) of the FUG created favorable conditions for the growth of trees in the Jyalachitti forest, resulting in substantially higher DBH and density, which in turn led to higher per unit basal area compared to the Dhulikhel forest.

The Dhulikhel forest, which historically enjoyed a much higher level of protection compared to Jyalachitti and many other forests in the region, has come under high extraction pressure more recently due to the absence of a forest use, monitoring, and maintenance plan that has been mutually agreed on by town and village users. In addition, there has been poor enforcement of national forestry rules at the local level. As a result, some sections, particularly in the western corner of the forest, have already lost tree cover, and degradation is expanding toward the rest of the forest area. There was a complete absence of trees in 12.5% of the sample plots in this forest, and tree density across the plots varied widely. Moreover, construction and development of infrastructural facilities, particularly the recent construction of a main road through the forest, also contributed to the degradation of the Dhulikhel forest (Gautam 2002).

The finding indicated that the two forests had similar plant diversity. The small difference in the values of the species richness could be because of the difference in size of the two forests (98 ha vs. 25.9 ha). Species richness does not change proportionately with changes in area, but, other factors remaining the same, larger forests are generally expected to have higher number of species compared to smaller ones. The finding suggests that the historical degradation of the Jyalachitti forest and the recent degradation in the Dhulikhel forest were not at a level sufficient to cause the extinction of any plant species from these forests. This conclusion is supported by the forester's appraisals as well as the perceptions of elderly local people and FUG leaders interviewed, who indicated that the forestlands at both sites were never completely laid bare. Although the Jyalachitti forest was heavily degraded around 1960, forest regeneration following protection by local communities led to a marginally higher level of species richness in this forest. The evidence also suggests that the silvicultural activities of the FUG in the Jyalachitti forest have not negatively affected species richness.

The substantially higher number of saplings in the Dhulikhel forest compared to Jyalachitti could be related to the difference of historical use and degradation in the two forests. As discussed, the Dhulikhel forest was never heavily degraded until recently, which helped to keep its microecological condition substantially intact. This made the forest land more amenable to forest regeneration through coppicing and root stock regeneration. The relatively high stocking of saplings in this forest, however, could also be a result of increased opening of the forest canopy, thereby making conditions more favorable for the regeneration of undergrowth. Selective removal of smaller individuals of less preferred species by the Jyalachitti forest FUG during forest maintenance could be another factor contributing to these results.

The preceding evaluation of forest governing institutions at the two sites using Ostrom's design principles as a theoretical and evaluative framework indicated a relative superiority of institutions in Jyalachitti. The findings from the two analyses included in this study (forest condition and institutions) are thus in conformity with each other. Most of the factors predicted to positively affect institutional sustainability are met in Jyalachitti, where the present forest condition is relatively better and, according to the users, the forest has been improving over the last 5 years. In Dhulikhel, where the forest condition is generally poorer than in Jyalachitti and is deteriorating, most of the conditions required for the effectiveness and sustainability of CPR institutions have not been met.

Since the institutional characteristics of the two forest systems, as evaluated using Ostrom's (1990) design principles, largely explain the changes and present conditions of the forests, this study's findings also generally confirm the relevance of these design principles in forestry. The findings, however, point toward the following limitations and, we believe, necessitate expansion of some of the design principles to meet location-specific requirements.

1. The definition of "local condition" (principle 2) given by Ostrom does not fully explain the problem of congruence in Dhulikhel. Ignorance of local customs, sociocultural context, and livelihood strategies of the villagers by the appropriation rules is an important aspect of noncongruence of these rules with local condition in this forest system, which the principle does not cover. The definition of "local conditions" in this design principle should thus be extended to include these attributes of the community, along with the ecological condition and the other attributes of the resource.
2. The effect of external factors in making monitoring ineffective (principle 4) is another issue not dealt with by Ostrom's principles. In Dhulikhel, for example, controlling the loss of forest due to the construction of a main road through the forest and other factors associated with it was beyond the scope of monitoring arranged by the local municipality. No local community can be expected to control the loss of resources associated with large-scale government projects. Even if the condition of design principle 4 were fully met, the loss of the Dhulikhel forest associated with the road project was impossible to control with only the efforts of local communities or the municipality. This principle should therefore be expanded to include other pressures, such as planned interventions from government agencies, sudden demographic events (e.g., invasion of the area by refugees), and so on, which can effectively undermine local monitoring efforts.
3. The condition set out by design principle 7 seems to be important but not always sufficient for users to devise their own forest governing institutions. For example, the users of the Dhulikhel forest have not been able to devise their own institutions even though they want to and their rights to do so have been strongly supported by national forest policy and legislation. This is because the local municipality, representing the interest of the town residents, has obstructed the organization and participation of the villagers in the devise of institutions. Moreover, the municipality itself is reluctant to let the whole forest go under the communities' management and lose its control over the

forest. The differences of the interests of town users (more powerful) and village users (less powerful), as well as the lack of provision in the national policy to accommodate the interest of the local municipality along with that of the communities, have tremendous influence in the design and function of the CPR institutions at this site. Design principle 7 should thus be modified and expanded to accommodate these concerns.

The analysis indicates that Ostrom's design principles are useful for analyzing the institutional robustness of local forest governance systems and generally relevant for forestry. However, it points toward the necessity of expanding three of the principles (principles 2, 4, and 7) if they are to be useful prescriptions for forestry management situations (Table 6). Further studies under different ecological and socioeconomic contexts are needed to test the principles expanded by this study in order to learn whether other modifications or expansion are necessary.

TABLE 6 Revised set of design principles for local common pool forestry

Ostrom's design principle[a]	Need revision?	Revised design principle
1	No	—
2	Yes	(1) The distribution of benefits from appropriation rules is roughly proportionate to the costs imposed by provision rules. (2) Appropriation rules restricting time, place, technology, and/or quantity of resource units are related to local ecological, socio cultural, and economic conditions.
3	No	—
4	Yes	(1) Monitors, who actively audit CPR conditions and appropriator behavior, are accountable to the appropriators and/or are the appropriators themselves, and (2) there is no external pressure, which can effectively undermine local monitoring efforts.
5	No	—
6	No	—
7	Yes	(1) The rights of appropriators to devise their own institutions are not challenged or obstructed by any external or local authorities that have the ability to undermine the users' institutions, and (2) there is no single powerful user group that prevents other user groups from organizing and participating in the devise of institutions.

[a]Refer to Table 1 for explanation.

In general, the findings of this study suggest that the biological sustainability of heavily used local forests is mainly dependent on the robustness of the local institutions that regulate forest use, monitoring, and maintenance. This implies that recognition and incorporation of local institutions in the formulation of forest policies are of crucial importance for improving governance and management of the remaining forest resources.

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