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Policy Options

Determinants and impact of local institutions for common resource management

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ABSTRACT. In this article, local institutions for forest conservation and management are analysed. The discussion is based on data from 37 villages and 180 households randomly sampled from a protected area in Rajasthan, India. Local management institutions are described, factors affecting inter-village differences in management institutions and collective action are analysed in a logit model, and the impact of institutions and other variables on common resource dependency and forest outcomes is tested using instrumental variable regression. Village population size has a positive effect and prior institutional experience a negative effect on the probability of collective action. It is concluded that efforts at improving forest management should not be confined to the poorest farmers. Large landowners are heavily involved in degrading use practises, especially when resources have good market potential. Local management institutions play a positive role in the area, but their impact appears insufficient to safeguard forests and commons from continued degradation. Conservation policies should target win–win options through interventions aimed at improving technologies for private and common lands as well as institutional changes.

1. Introduction

In developing countries, forest and conservation policies have traditionally been characterized by general distrust of local people's ability to manage the natural resources on which they depend. Governments have nationalized forests and other natural resources and established protected areas in order to protect wildlife habitats from human utilization. However, for a number of reasons, state ownership and management have failed to prevent the conversion and degradation of many forests.

Realizing the shortcomings of traditional top–down state forest and bio-

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diversity management, developing countries are increasingly embracing participatory approaches to natural resource management (NRM). The goal is to promote local people's active involvement in management of protected areas and other natural resources (Kiss, 1990). The same trend has manifested in India with the adoption of Joint Forest Management, which aims to involve user groups on a large scale, marking an important shift in official forest policies. In parallel, the recent literature on CPR management emphasizes the ability of user communities to effectively manage collectively owned natural resources through informal institutional arrangements (e.g. Wade, 1988; Ostrom, 1990).

Yet, design of policies for natural resource and protected area management is complex. There is still insufficient solid empirical knowledge about the evolution and functioning of local NRM institutions and how government and donor interventions can shape that process. A single idea, resource, property regime or policy option is sometimes highlighted as the main key to improved natural resource management, underestimating the inherent complexities. Also, the important theoretical discussion regarding the interplay between population growth, poverty, institutional change, and environmental degradation remains empirically unsettled (Dasgupta, 1995; Dasgupta and Mäler, 1995). In the enthusiasm for participatory NRM, it should not be overlooked that local resource users occasionally lack incentives and ability to organize collective action. One should not be naïve about the ability of specific groups and organizations to sustainably manage resources. The incentives and constraints for effective management faced by different user groups and forest departments have to be taken into account (Bromley and Cernea, 1989; Ostrom, 1996). Improved understanding of the shadow costs, market opportunities, management institutions, and other factors shaping environmental outcomes is desirable to better guide NRM policies.

In this article, the challenges for improved management of protected areas are explored. The aim is to encompass the entire range of resources, users and property rights involved in the study area. The article is based on case study of Sariska Tiger Reserve in eastern Rajasthan, India, where forests are degrading at an alarming rate. Major causes of forest degradation are legal and illegal land-use changes; use pressure from villages inside and outside the Reserve in the form of fuelwood collection and grazing of livestock; and institutions that fail to manage the forests. Dependency of villagers on the Reserve is compounded by declining and mismanaged village commons and low and variable yields on private farm land. Policymakers are faced with a difficult trade-off between local livelihoods and biodiversity conservation.

The focus of this paper is on local management institutions, their determinants and their impact on use pressure and forest outcomes. Key institutional concepts are outlined in section 2, and the framework of analysis is presented in section 3. Study area, sampling, and data are described in section 4. In section 5, the determinants of village collective action are analysed. Patterns of resource use and dependency are the subject of section 6, with forest outcomes assessed in section 7. Conclusions and policy implications appear in section 8.

2. Key concepts

It is important to distinguish between deforestation, meaning permanent clearing of tree cover from an area, and forest degradation, which is the loss of forest quality and diversity. The extent of forest degradation is determined by (1) legal and illegal forest clearing (and replanting); (2) the amount of biomass extracted; and (3) the technology, location, and seasonality of extraction. Institutions affect degradation in a number of ways by regulating and shaping land use, land conversion, amount extracted and extraction technology.

Institutions are defined as rules, norms, formal hierarchies, monitoring, and sanctioning which shape individuals' actions and expectations (North, 1991). Operational rules for NRM consist of access and conservation rules, charged with the following tasks:

A. Access Rules (flow management)
1. Defining and enforcing rules of resource access—to delineate who is entitled to appropriate resource flows and to exclude outsiders.
2. Regulating the sharing of output from the resource among users.

B. Conservation Rules (stock management)
3. Limiting aggregate output from the resource to ensure continued future flows of benefits, often through restrictions on users' effort, season or technology.
4. Organising investment in resource maintenance and improvement, including cost sharing.

Access rules are concerned with the *flow* of output from the resource, while the purpose of conservation rules is to manage the resource *stock* by solving the assurance problem—convincing individual users that self-restraint is worthwhile, and that other users also exhibit restraint (Runge, 1981). Applied to forest management, task 1 above is to delineate which village or individual has the right to appropriate forest produce in given areas, task 2 relates to the sharing of output flows among individuals, task 3 could be restrictions on land use, and on the amount, season and technology of biomass collection and grazing, while task 4 includes investment in fencing and tree planting.

Resource regimes are often defined on the basis of property rights held over resources, distinguishing between open access, common property, private property, and state ownership. *Open access* is the lack of ownership and control, and is characterized by the absence of access and conservation rules. Resources under open access are highly exposed to overuse and degradation (Ciriacy-Wantrup and Bishop, 1975).

Common property resources belong to the community, and access rules are defined with respect to community membership. Common ownership has distinct advantages, including equity and insurance (Platteau, 1991), yet potential free-rider problems have to be surmounted for communities to organize collective action, especially related to tasks 2–4. Hence, conservation rules may or may not be established in common property regimes. *Unregulated common property* is where access is limited by com-

munity membership, but conservation rules are not enforced. Unregulated common property is prone to cause resource degradation if (1) the user population is large relative to the resource, and (2) the income from exploiting the resource is high relative to the opportunity cost of time, for example because of easy access, good extraction technology, high value of the resource, or if users lack outside employment options. *Regulated common property* is when both access and conservation rules are in place (Baland and Platteau, 1996).

Open access and common property resources jointly constitute *the commons*. Important characteristics of the commons are that (1) there is an exclusion problem related to defining and enforcing access rules, and (2) use is subtractable statically and dynamically. That is, resources appropriated by any one user cannot be appropriated by other users within the same period, and resource overuse subtracts from future benefit flows (Oakerson, 1992).

Private and state property are the alternatives to the commons. *Private property*, though no guarantee for sustainable use, is often characterized by the presence of both access and conservation rules. *State-owned* resources comprise resources formally under state ownership such as protected areas. Ideally, state ownership is associated with both access and conservation rules. However, in many instances states fail to effectively enforce rules, and state-owned resources become *de facto* open access or private property.

3. Framework of analysis

When analysing the impact and determinants of NRM institutions, it is important to conduct the analysis within a framework that explicitly details how different groups of variables are related. The analytical framework used in this paper distinguishes four groups of variables: Physical and technological characteristics of resources and users (T); resource regimes and institutions (I); human behaviour and interaction (B); and forest outcomes (Y). The postulated relationship between this set of variables is shown in figure 1 (inspired by Oakerson, 1992). Physical and technological characteristics, such as population size, rate of population growth, and resource scarcity, are the exogenous variables of the system and influence (in a non-deterministic manner) the formation and functioning of local NRM institutions, especially access and conservation rules. Physical and technological characteristics together with institutions and resource regimes shape the opportunity costs and constraints that resource users face and determine their use patterns, e.g. the degree to which biomass needs are met by exploiting the commons. Human behaviour—use pressure and land conversion—together with physical characteristics and technologies determine forest outcomes.[1]

In order to serve as a guide for econometric estimation it has to be clarified which variables are endogenous and which are exogenous in each of

[1] The framework can be elaborated by adding feedback effects. This would be important in long-term studies, whereas the static formulation of figure 1 is defensible in the present context of a short-term cross-sectional study.

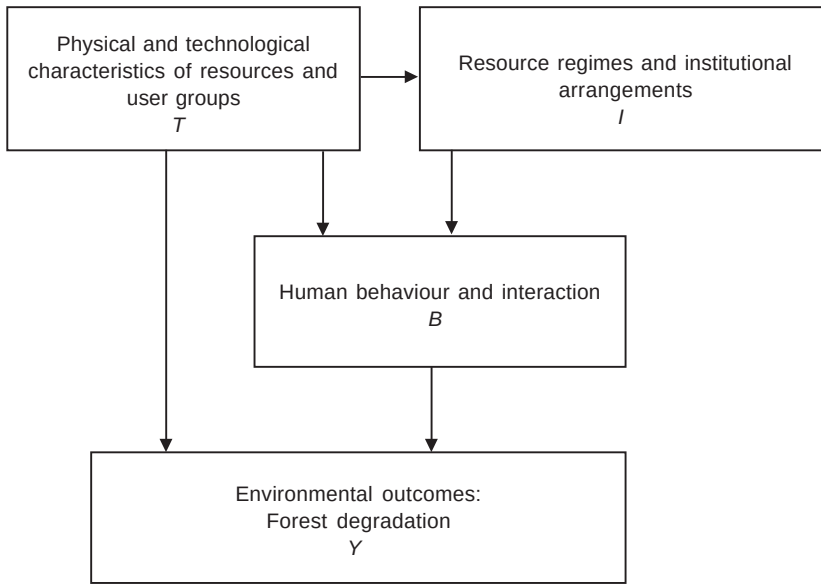

Figure 1. *Conceptual framework*

the relationships of interest. This can be seen by writing the basic static framework in semi-reduced form

$$I = I(T) \tag{1}$$

$$B = B(T, I) \tag{2}$$

$$Y = Y(T, B(T, I)) = Y(T, I). \tag{3}$$

The endogeneity of I has to be taken into account in estimations. Therefore, instrumental variable techniques are applied when estimating (2) and (3). This approach will produce unbiased estimates of the impact of I provided the instruments are correlated with I but do not belong in the second-stage regression. Instruments are a predetermined subset of the I and T variables which are theoretically expected to influence I but not B and Y. Two instruments are used: Presence of a *Temple Land* (an I variable), a generation-old management institution independent of short-term variation in use pressure and outcomes, and *Development Index* (a T variable), an indicator of the amount of physical infrastructure placed in the village. These two variables are used as instruments because they belong in (1) (good predictors of management institutions), they are exogenous from the point of view of villagers, and they should not be among the determinants of B and Y (as also confirmed in tests). Relationship (1) is estimated in section 5.4 using logit, and relationships (2) and (3) are estimated in sections 6.2 and 7, respectively, using instrumental variables.

One specific application of the basic framework is the theoretical discussion of the relationship between population growth, poverty, institutions, and the environment. Boserup (1965) contended that

population pressure relative to available land resources (a *T* variable) would lead to agricultural intensification and better resource management. The mechanism for this to work was through institutional change, especially more secure property rights. This process seems to have been at work in Machakos, Kenya, where a six-fold increase in population over the 1930–90 period has been associated with rising agricultural productivity, more tree cover, and less soil erosion (Tiffen and Mortimore, 1994). Dasgupta (1995), among many others, has a more pessimistic view on population growth and the flexibility of local management institutions, postulating a negative spiral (or vicious circle) between population growth, poverty, and CPR management. Population growth is hypothesized to cause degradation of CPRs, both directly as more users exploit limited and imperfectly managed commons, and indirectly through worsening poverty and breakdown of management institutions. Poverty is thought to pose a threat to the viability of management institutions in particular and to environmental sustainability in general, as the poor presumably have higher discount rates, are more dependent on the commons, and lack alternative income sources when the commons degrade. In conclusion, the key *T* variables identified by leading theories are population growth, population pressure/resource scarcity, and poverty. In the remaining part of this article, the influence of these variables on management institutions, use pressure, and forest outcomes are tested.

4. Study area and data

4.1 Study area and survey design

The data employed for this study were obtained through a random sample of 37 villages and 180 households bordering Sariska Tiger Reserve, Rajasthan in the semi-arid northwest of India.[2] The Reserve consists of approximately 800 km^2 of open tropical dry forests and shrubs. The reserve supports over 100 species of avifauna, a large population of peafowl, and leopard, caracal, sambar, nilgai, chital, wild boar and the endangered Bengal Tiger of which there is a population of around 25. Sariska is one of 23 protected areas included in Project Tiger, the Indian government's scheme for tiger conservation. Human utilization of the forest conflicts with biodiversity conservation. Fuelwood and fodder collection, grazing, clearing of land for farming, mining, and small timber collection degrade Reserve and village commons.

Random sampling of a substantial number of villages and households is not yet common in the (mostly socio-anthropological) literature on CPR management, which frequently relies on small and non-randomly selected samples, with the ensuing risk of biased conclusions (Baland and Platteau, 1996). The Reserve was chosen as the study site because it was thought to be representative of protected areas in northwest India, and because per-

[2] Nagothu Udaya Sekhar carried out field surveys and supervised local assistants, with the author present part of the time. Data were collected from October 1996 to March 1997.

sonal connections would facilitate field work here. There was no intention to select neither a successful case of forest management, nor an unsuccessful case. Judged from a review of Project Tiger carried out in 1993, the biotic pressure (especially grazing and fuelwood collection) and management problems in Sariska appear broadly similar to those in other Project Tiger sites (Project Tiger, 1993).

The sample frame consists of 117 villages surrounding Sariska Tiger Reserve. Survey villages and households were selected through a multistaged sampling procedure. First, 37 villages were selected from the sample frame through stratified random sampling. A stratification technique known as Gaussian Quadrature (Arndt and Preckel, 1996) was employed, using population, number of households, distance to the Reserve, and village area as stratification parameters. This method ensures sufficient variation across those four parameters in the selected sample. In order to make results representative at the level of the sample frame all village-level analysis in this paper is conducted using weights which are inversely related to the likelihood of each village being sampled. The village survey was carried out by conducting interviews with groups of key informants in the 37 selected villages, gathering information on natural resource use, management institutions, and other village-level variables. Additional data on population, land use, and forest offences were collected from administrative records for the same 37 villages. Second, household surveys were carried out in a subset of four of the sample villages, which were selected to represent different conditions of access to the Reserve. From each of those four villages households were randomly selected, and data on their farm production and natural resource use was collected. Hence, data refer to either the village level or the household level.

A number of resource regimes are found within the study area, including Tiger Reserve (state-owned protected area), other state-owned forests, private farm land, and village commons. Village commons are comprised of (1) cultivable wastelands (*gochar*), common property lands belonging to the village *Panchayat* (local council); (2) uncultivable wastelands (*padath*), formally owned by the state revenue department, but *de facto* used by villagers as part of the commons; and (3) Temple Lands (*oran*), small forest patches preserved by religious taboos. Cultivable wastelands were allocated in the 1950s to villages in proportion to their livestock population at that time. Since then, livestock populations have substantially outgrown the capacity of commons for meeting grazing requirements. Interestingly, even in the complete absence of *de jure* rights in the Reserve, villagers operate un-demarcated 'domains of influence' within the Reserve from where they extract forest produce and seek to exclude people from other villages.

4.2 Forest degradation

The consequences of forest degradation are reductions in wildlife numbers supported, land degradation and soil erosion, reduced water availability, less wildlife tourists, more travel time to collect firewood and minor forest products, and reduced ability to support grazing livestock. Data on forest degradation were obtained in the village survey from three different vari-

ables: through visual inspection of the extent of forest degradation by the interviewer (taking remaining root stock into account); by asking villagers to compare the condition of the forest today with earlier times (25 years back); and by visual determination of forest use penetration, that is, the depth into the forest from the village boundary where use pressure was evident. Forest degradation is severe in 14 villages (31 per cent of villages when using sampling weights), and medium in 48 per cent, implying a considerable extent of deforestation. Only in six cases was damage less severe. Forests had declined compared to earlier in 63 per cent of cases. The mean depth of forest use penetration into the Reserve is 1.9 km, but extends up to 5.5 km, providing an indication to what extent human activity is disturbing wildlife. In addition, 74 per cent of respondents in the household survey said distance to fuelwood resources had increased compared to 20–25 years back.

For purposes of the regression analysis in section 7, a composite measure called *Forest Degradation Index* was constructed as the sum of forest damage, forest condition relative to earlier, and use penetration. All three variables are coded so that increasing values show higher levels of forest degradation, they are comparable in magnitude so that each component has a substantive impact on the index, and they are positively correlated. The major advantage of the *Forest Degradation Index* as a measure of environmental outcomes is that it captures the quality of the vegetative cover, and not just its area, based on a field visit by an experienced forester; the disadvantage is that the index relies on subjective judgement.

5. Local management institutions

In this section it is described how different actors implement, monitor and enforce access and conservation rules pertaining to Reserve and village commons. First, the record of the state as manager of the Reserve is described; second, recent joint forest management initiatives are gauged; third, villages' informal NRM is assessed; and, fourth, determinants of institutions are analysed econometrically.

5.1 The state as resource manager—the Reserve area

Before Independence, Alwar was a Princely State ruled by a Maharaja who owned the forests. Throughout Rajasthan local landlords (*jagirdars* and *zamindars*) owned and regulated the use of forests and commons, for example by levying a number of taxes on villagers' consumption of forest produce (Jodha, 1985; Shanmugaratnam, 1996). Today, the Reserve is managed by the State Wildlife Department. The Reserve Management imposes a number of restrictions on villagers' forest use, intended to ensure non-degrading use practices. Sharp implements are prohibited inside the Reserve. The collection of dry and fallen wood is allowed, but it may only be headloaded, that is, motor and animal-powered transportation of forest products is prohibited. There are restrictions on where animals can be grazed. Commercial forest products, including timber, fuelwood, and animal manure cannot be exported out of the Reserve. This is an attempt to ban commercial exploitation of the Reserve, while conceding to villagers' subsistence needs.

Enforcement of the restrictions on resource use is weak. Illicit felling, grazing, encroachment, and export of forest products appear to be rather widespread, while poaching is more rare. A number of unarmed forest guards patrol the Reserve. They can impose fines and register court cases against offenders. In 1995, an average of five cases of illegal use of the Reserve were registered per village, corresponding to 630 cases for the entire Reserve. Road check-points into the core Reserve area are used to enforce the ban on commercial exploitation and to charge entrance fees for tourists. The effectiveness of the check points appears compromised by corruption.

The weak monitoring and enforcement of rules is mostly caused by institutional problems in the civil service. One reason is the inadequate pay, education, and equipment of forest guards, and the fact that single unarmed guards often live in villages they are supposed to control making them vulnerable to violent threats. Conflicts between local people and the Reserve Management sometimes escalate into violence, and have in the past resulted in murdered forest guards. A second reason is the failure to formally settle the rights of local villages. This prevents the registration of Sariska Tiger Reserve as a National Park, in which case utilization would be much more restricted. At present, not all villagers appear to be aware of the rules.[3] A third reason is the slow and corrupt legal system in India. Court cases are delayed for years, and rumours say judges can be bribed. This makes the sanctioning mechanism available to the Reserve Management ineffective. A fourth reason relates to motivation and corruption of civil servants. The Reserve employs a fairly large but low-paid staff. Job performance is not a major criteria for employment and promotion. Rapid changes of post, promotion schemes, and institutionalized corruption thwart the performance incentives of civil servants (Wade, 1985).

The Reserve Management invests in forest maintenance and improvement by establishing plantations, by fencing off hillsides to allow natural regeneration of vegetation, and by creating wildlife water points. These schemes clearly result in improved vegetation. When plantations and fenced areas are reopened, though, all too often household use-pressure results in renewed degradation. And wildlife water points are used by household livestock. In sum, the Reserve Management has enacted access and conservation rules intended to fulfill the management tasks 1–4 described in section 2, but its ability to ensure compliance is weak.

5.2 Joint Forest Management

Villages have two kinds of formal management institutions: (1) village forest protection committees set up under Joint Forest Management (JFM), and (2) village *panchayats* (local governments), which only exceptionally engage in NRM. The failure of traditional top–down forest management led India to adopt JFM, which emphasizes the participation of local users in forest protection, development, and management. The main advantage of involving

[3] Among the respondents in the household survey 15 per cent thought they had legal rights to graze livestock in the Reserve and 7 per cent thought they had rights to collect fuelwood from the Reserve. In fact, none has such rights.

local user groups is their ability to establish low-cost self-monitoring (Kolawalli, 1995). Normally, a management contract is specified between the participating village and the Forest Department in which villagers promise to protect the forest in exchange for a share in forest revenues. A Village Forest Protection Committee (VFPC) containing both villagers and a Forest Officer is set up to administer and enforce the agreement.

JFM is tailored towards conservation of state forest, and does not adequately address conservation of protected areas. Committees managing protected areas do not get a share in forest revenue, unlike committees involved with other forest. This is because protected areas are managed for biodiversity conservation, and often do not sell timber. Tourist revenue is not shared with VFPCs. In fact, the only incentive for people in protected areas to participate in JFM is that it may improve the availability of nearby biomass.

JFM has not been successful in the study area. Since 1991 when JFM was initiated, VFPCs were started in 14 out of 37 sample villages (see table 1). But at the time of the survey in late 1996, the committees of four villages were already defunct, and the committees of another six villages had minimal activity. Only in four villages were committees still active—that is, holding meetings, establishing rules, and imposing fines on violators.[4] VFPCs primarily seek to manage the Reserve, but are sometimes also concerned with village commons and other state forest. With a few notable exceptions, the climate between Reserve Management and local residents is marked by misunderstandings, alienation, and mistrust. Forest staff are neither trained nor accustomed to collaboration with villagers. Cases of well-functioning committees often resulted from extraordinary good cooperation between villagers and a dedicated forest guard.

5.3 Informal village institutions

In a number of instances, villagers seek to manage local forests through informal institutions (users' committees, mutual understanding, etc). A

Table 1. *Village institutions for resource management*

	Number of villages	*In percent*[a]
Panchayat is active in resource management	2	1.2%
JFM has been started	14	31.9%
JFM is still active	4	10.3%
Outsiders often use the village commons	18	60.8%
Informal management institutions are active	9	31.2%
Either JFM or informal management	13	41.5%
Village has a Temple land	7	12.6%
Total villages	37	

Notes: [a]In percent of valid responses using sampling weights.
Source: Village survey.

[4] The high share of committees that only exist on paper appears common throughout India, and has been attributed to forest departments' orientation towards achieving technical and quantifiable targets (Arora, 1994).

simple access rule, that only village residents are allowed to use resources within the village domain, is quite widespread. Villagers stand united in their anger against outsiders intruding on their domain, but they are not always able to exclude them. In 60.8 per cent of villages outsiders frequently use the village domain, mostly for animal grazing and fuelwood collection (see table 1). The inability to enforce access rules is not due to lack of want, but appears to be caused by lack of strength and power *vis-à-vis* the intruders. Thus, the villages where outsiders intrude have a lower mean population size than others, and the partial correlation coefficient between village population and a dummy variable for exclusion is positive and significant.

Informal village management institutions—beyond the attempt to exclude outsiders—are found in 31.2 per cent of villages. These institutions are neither recognized, nor supported, by the Forest Department and other authorities. They formulate and enforce conservation rules such as not to fell trees, not to take sharp implements into the forest, to avoid excessive lopping, to regulate grazing, to stop encroachment, or to demarcate land in the commons reserved for individual households. Rules apply mainly to village commons, but sometimes also to the Reserve. This is interesting because villagers have no formal legal rights inside the Reserve. Villages rely on self-monitoring of rules and do not employ guards. Violations are often punished with fines.

There was hardly any case in which villagers collectively or individually undertook investment to improve the productivity of the commons or the Reserve. Grazing rotation, for example, is not practised. Grazing rotation is a simple conservation measure that would keep hillsides ungrazed for a few years, allowing natural regrowth, thereby substantially improving biomass productivity.[5] Temple Lands (*oran*) exist in 12.6 per cent of villages. Temple Lands are green patches of forest on otherwise barren hillsides used by the villagers for grazing and other purposes. Temple Lands (which do not necessarily contain a temple) are preserved by religious taboos against cutting down trees, and are clearly less degraded than other commons. The problems of *de facto* privatisation and of tree cutting seem to be much less pronounced on Temple Lands. Although of varying size, Temple Lands tend to be relatively small. Temple Land is a traditional institution in this area, that appears to be quite old and to be taken as given in the day-to-day discussions and management conflicts of villagers. This motivates the treatment of the Temple Land institution in this paper as an exogenous instrument.

The conclusion is that the extent of collective action is low, but varies substantially between villages and between tasks. The surprisingly low levels of collective action for establishing conservation rules and for invest-

[5] In addition, 23 villages have a *village fund* that spends money for various purposes. There is also a degree of mutual understanding, and sometimes bargaining, involved in distributing canal water (managed by the Irrigation Department) between farmers. Other informal institutions such as the common irrigators and crop guards described by Wade (1988) were not encountered in the study area.

ment are in contrast to the united stand taken against outsiders using village resources. This may reflect the fact that conservation rules, involving restraint in the short term, are more difficult to impose and enforce than access rules that do not involve self-restraint (Baland and Platteau, 1996).

No single reason for collective inaction can be pin-pointed. State policies play a role. The involvement of the Forest Department in management of the Reserve can make it difficult for villagers to exert authority over resources in the Reserve. At the same time, JFM has been unsuccessful and *panchayats* are largely inactive in NRM. But villagers are also to blame. Distrust and conflicts in the villages divide them and often block cooperation. Causes of conflict include encroachment on village commons and caste antagonism, although collective inaction extends to tribal villages composed of a single ethnic group. Lack of traditions and norms supporting cooperation and conservation also seem to limit village CPR management. Gender issues may play a role in the male dominated public sphere. While women and children exploit forests and commons, and the main benefit of improved NRM is a time saving for them, it is men who would make decisions about management.

5.4 Determinants of collective action

Local-level collective action has recently become an area of active research, drawing mostly on game theory and detailed socio-anthropological case studies (see for example National Research Council, 1986; Seabright, 1993; Ostrom *et al*., 1994), but so far there has been little econometric work (an exception is Chopra and Gulati, 1998). The number of villages operating conservation rules is documented in table 1. As can be seen from table 1, JFM is active in four villages and nine villages have informal NRM institutions. In other words, 13 out of 37 sample villages actively attempt to manage their commons,[6] while the rest take no effort whatsoever to conserve or improve their natural resources. This is a low level of collective action. The role of key variables in explaining inter-village differences in collective action (or inaction) can be analysed econometrically. A better understanding of these factors is potentially important for policies aiming to promote local NRM institutions.

A long list of potential explanatory variables for the determinants of collective action and institutional arrangements (the T variables in the framework of section 3) have been suggested by different authors. Only a fraction of those variables can be included in the regression due to the small sample size and to insufficient variation across villages (e.g. the 'boundedness' of local forests and commons is constant across villages). The analysis in this paper therefore concentrates on the impact of a few key explanatory variables, whose importance have been highlighted in the theoretical literature. Those variables are

(1) Size of the user group, measured as the log of village population. Starting with the work of Olson (1965) it has been hypothesized that

[6] Temple Lands and exclusion of outsiders are not included in this count.

small user groups are more likely to cooperate as free-riding can easier be overcome.

(2) Resource scarcity measured as the log of village population relative to the area of forest and commons. Wade (1987) concludes that 'villagers are likely to follow joint rules and arrangements only to achieve intensely felt needs that could not be met by individual actions', seeming to imply a positive relationship between scarcity and collective action. Bardhan (1993) argues that the likelihood of collective action is largest at moderate levels of natural resource scarcity, while at high levels of scarcity and ecological stress institutional arrangements break down as people scramble for survival and discount rates increase. This implies a nonlinear relationship.

(3) Population growth, measured as the village population growth rate per annum over the 1971–91 period, which Dasgupta (1995) among others hypothesized to negatively affect the likelihood of collective action.

(4) Infrastructure development is measured with the *Development Index*, an index of different types of infrastructure available in the village.[7] This may help show the impact of development (in the infrastructure sense) on collective action.

(5) Prior experience in the village with institutional cooperation is measured with a dummy variable for the existence of a *Temple Land*. It should have a positive sign to the extent organizational experience matters, as suggested by Baland and Platteau (1996).

Two different logit models are estimated. Results are shown in table 2, along with the means and standard deviations of the variables used. First the determinants of informal and formal institutions are analysed jointly in column A of table 2, where the endogenous variable takes the value 1 in villages where conservation rules are actively imposed through either formal or informal institutions and 0 in others. Second, the determinants of informal institutions are assessed separately in column B of table 2, where the endogenous variable is a dummy variable for those villages where conservation rules are imposed through informal institutions. The parameter values can be interpreted as marginal changes in the probability of encountering an NRM institution within the sample frame. After exclusion of observations with missing data points, 31 observations are left, of which 23 and 25 are correctly predicted by regression A and regression B, respectively.

Interestingly, the results are not as expected from collective action theory. In fact, many of the parameters are signed opposite of what was expected. The logarithm of village population size has a positive parameter value, significant at the 5 per cent and 10 per cent level of significance in model A and model B, respectively. That is, given that other factors are accounted for, larger villages in this area are more likely to have active management institutions contrary to Olson's (1965) 'Logic of Collective Action'. There is no obvious explanation why group size increases the likelihood of collective action.

The logarithm of village population density with respect to size of

[7] *Development Index* is the sum of schools (at various levels), bank, fair price shop, electricity, irrigation facility, health centre, etc. existing in the village.

Table 2. *Logit regressions of collective action*

	Model A: Formal or informal management active[a]		*Model B: Informal management active*[b]		*Mean of X*	*Standard deviation of X*
	Coefficient	*t-ratio*	*Coefficient*	*t-ratio*		
Constant	−28.37	−1.82*	−31.96	−1.63		
Log population	5.75	1.98**	6.14	1.71*	6.61	1.36
Log population/ (forest + commons)	−0.60	−0.63	−2.42	−1.78*	0.66	1.42
Population growth rate	−0.39	−0.61	−0.54	−0.75	2.45	1.63
Development Index	−2.85	−2.36**	−2.29	−1.64*	3.08	2.45
Temple Land	−7.95	−1.95*	−8.86	−1.86*	0.10	0.3
Sample size	31		31			
Log likelihood	−10.03		−8.78			
Chi-squared (5)	22.88**		23.09**			

Actual and predicted values

	Predicted				*Predicted*		
Actual	0	1	*Total*	*Actual*	0	1	*Total*
0	16	4	20	0	19	4	23
1	4	7	11	1	2	6	8
Total	20	11	31	*Total*	21	10	31

Notes: **Significant at the 5 per cent level.
*Significant at the 10 per cent level.
Source: Village survey.
[a]Mean of $Y = 0.45$; S.D. = 0.51
[b]Mean of $Y = 0.34$; S.D. = 0.48.

forests and commons has a negative parameter, which is significant at the 10 per cent level in model B and insignificant in model A, respectively. The implication is that scarcity of resources, as measured by people per unit of resource, does not appear to encourage formation of management institutions. While the precise reason for this result is hard to know, it is interesting since it implies that spontaneous formation of local institutions cannot be relied upon in situations of mounting resource scarcity. Population growth is not a significant determinant in these data. The *Development Index* has a negative influence on the probability of collective action, significant at the 2 per cent level in Model A and at the 10 per cent level in Model B. The more developed (less poor) villages are therefore less likely to manage resources other things given. The interpretation of this is not straightforward, however, as infrastructure development may capture many different things, including wealth, political importance, remoteness, and access to outside markets. The presence of a Temple Land in the village has a negative parameter sign, significant at the 5 per cent and 7 per cent level in Models A and B, respectively, meaning that villages with Temple Lands, despite their prior institutional experiences, are significantly less likely to operate management rules for the remaining commons.

These results run counter to some of the current thinking on collective action and NRM. The results tentatively suggest that lessons from theory

and laboratory experiments have less practical relevance on the ground than sometimes posited, for example as regards such key variables as population size, resource scarcity, and interaction between formal and informal institutions. More empirical work on NRM institutions is necessary, based on sufficiently large random samples of villages.

6. Use pressure

The subject of this section is use pressure on the Reserve. First, land-use changes in the survey villages are documented. Following this, patterns of household dependency on the Reserve for biomass needs are analysed using household survey data. Some conclusions related to the poverty–environment discussion are discussed at the end.

6.1 Land use

In 1991, per capita availability of farm land and commons in the study villages averaged 0.47 and 0.61 hectares, respectively. In table 3, changes in legal classification of village lands between 1971 and 1991 are shown. Note that legal classification may not reflect actual land use. Over the last two decades, the commons declined from 57 to 46 per cent of the total area; almost all villages experienced a loss of common lands. Meanwhile, area legally designated as forest (Reserve and state forest) increased from 6 to 20 per cent. This reflects the process of designating revenue lands as state forest, thereby increasing forest cover in official statistics (not always on the ground). The decline in village commons has not been matched by any effort to improve their management and productivity and increases the dependency of local people on the Reserve.

In order to gain information on *de facto* land use, respondents in the household survey were asked the source of their land (inherited, bought, allotted under land reform or acquired from 'other sources'). Probing made it clear that 'other sources' meant encroachment, i.e. occupation without legal title. As can be seen from table 4, 13 per cent of total farm land is encroached, providing a significant addition to farmed area. Encroachment takes place on all categories of land, including Reserve, state forest, and commons. Encroachment for agriculture was mentioned

Table 3. *Changes in land classification 1971–1991*

	% of total land in villages		
Type of land	*1971*	*1981*	*1991*
Forest	6.5	9.6	20.1
Farm land	36.0	36.4	33.8
of which:			
irigated	10.4	14.1	12.8
rainfed	25.6	22.3	21
Village commons	57.5	54	46.1
of which:			
cultivable wasteland	11.4	10.9	9.5
uncultivable wasteland	46.1	43.1	36.6

Source: Secondary village information.

Table 4. *Sources of farm land*

	Share of total cropped area	*Number of farmers involved*
Inherited	72.1%	134
Bought	10.7%	27
Allotted in land reform	3.8%	7
Others sources—encroached	13.4%	30
All land	100%	163[a]

Note: [a]163 out of 180 sample households owned land.
Source: Household survey in 4 villages.

in most villages as the major reason for declining commons. Encroachment exacerbates the inequality of the land distribution and in fact half the encroached area is operated by farmers in the top decile of land owners. Encroachment creates bitterness and conflicts that negatively affect the likelihood of collective action among villagers. *De facto* privatisation of the commons does therefore not appear to be a feasible solution: it is inequitable and too controversial.

Privatization of the commons also results from land reform, the purpose of which is to abolish landlordism and to redistribute land to the landless. Among 180 households surveyed, seven benefited from allotments under land reform. They were all among the largest 50 per cent of landowners, and the two households that received most land ended up in the top decile of landowners, and received among them almost half the land allotted to survey households. In conclusion, state policies (and their implementation) have neither improved the sustainability nor the equity of natural resource use.

6.2 Household biomass dependency

People depend on collection in the commons and state-owned forests for a variety of needs, including energy, animal fodder, fibre, building material, medicine, fruit, and food. Household forest use may or may not be degrading depending on the quantity and technique of use. Grazing, unless carefully managed, prevents regrowth of perennials. Fuelwood collection is not degrading when confined to dry wood, but collection of green wood is, except when measures are taken to replant or to permit natural regrowth. Forest use pressure is not a linear function of the surrounding population, but is conditioned by a range of factors, which can be influenced by institutions and policies. Households' strategies of biomass provision entail a choice between production of biomass on the farm or collection from Reserve, other forests, and commons. In the following, household dependency on the Reserve for grazing, fuelwood, and other forest produce is analysed.

Livestock

The Reserve and commons are important sources of animal feed, provided through grazing, lopping of trees (cutting of branches) and cut-and-carry

fodder collection. In table 5, respondents in the household survey are stratified according to landholding, a close proxy for wealth.[8] The relative dependency on the Reserve is largest for the poorest tercile of households, who have little or no access to farm biomass resources for animal feed. Yet the big landowners exert heavier grazing pressure on the Reserve in absolute terms as they own larger animal herds[9] and bring more livestock for grazing onto the Reserve. Free grazing on the Reserve therefore asymmetrically benefit large farmers.

A number of villages outside the Reserve border have now got dairy collection points. Sale of milk and *ghee* (purified butter) is an important source of cash income, especially for households in the two upper terciles. Good market opportunities, small milk input costs due to free grazing and the

Table 5. *Resource dependency by farm size*

	Farm size by tercile			*All*
	Smallest	*Medium*	*Largest*	*sample*
Animal ownership: number of livestock units	4.4	8.3	10.6	7.3
Animals grazed in Reserves, shares in:				
rainy season	73%	69%	67%	70%
summer	19%	4%	10%	11%
winter	64%	52%	54%	56%
Annual milk production, in kg	962	1,335	1,608	1,284
Milk sellers, share of	35%	52%	48%	43%
Gross annual income from milk and ghee sales, Rs	2,856	4,184	4,695	3,767
Total domestic energy supply, share of:				
fuelwood from Reserve	64%	55%	34%	52%
fuelwood from commons	12%	9%	2%	8%
private sources[a]	24%	37%	63%	39%
Number of trees on farm	5.4	10.6	16.4	10.1
Fuelwood sellers, shares of	22%	7%	2%	12%
Households collecting other produce from Reserve:				
medicinal herbs	6%	7%	2%	5%
edible plants	68%	50%	38%	54%
thatching material	87%	72%	66%	77%
other material	28%	35%	39%	33%
Land holding, ha	0.30	1.12	2.92	1.32

Notes: Data refer either to group proportions or to group means.
[a]Private energy sources weighted as follows (energy content): dung = 82.6% of fuelwood; crop residues = 107.7% of fuelwood.
Source: Household survey.

[8] When calculating land holding, unirrigated land was weighted half of irrigated land, corresponding to the approximate yield difference.
[9] The partial correlation coefficient between farm size and number of livestock units owned is 0.51 and highly significant (see also table 5).

Table 6. *Household dependency on the Reserve for biomass (IV regression)*

	A: Grazing dependency[a]		*B: Fuelwood dependency*[b]		*Mean*	*S.D.*
	Coefficient	*t-ratio*	*Coefficient*	*t-ratio*	*of X*	*of X*
Constant	0.08	0.66	0.68	14.7**		
Log land	−0.13	−4.50**	−0.19	−15.9**	−0.83	0.87
Log livestock units	0.21	6.08**	–	–	1.77	0.74
Household size	−0.001	−0.17	−0.001	−0.33	7.84	3.83
Population/(forest + commons)	−0.021	−2.08**	−0.033	−6.69**	3.41	2.01
Management Institutions	−0.026	−0.91	−0.052	−3.70**	2.15	0.69
Improved stove dummy	–	–	−0.071	−2.07**	0.09	0.68
Sample size	175		175			
Model fit F-test (F5, 169])	9.64**		68.23**			

Notes: **Significant at the 5% level [a]Mean of Y = 0.45; S.D. = 0.29.
*Significant at the 10% level.[b]Mean of Y = 0.60; S.D. = 0.22.
Source: Household and village survey.

even seasonal distribution of milk revenue combine to make milk production attractive and increase stocking rates. Around 40 per cent of milk production is marketed.

Instrumental variables regression analysis of the determinants of households' dependency on the Reserve for grazing reveal that the major explanatory factors are land and livestock holdings, which are both highly significant, as well as population pressure, which is significant at the 3 per cent level. In column A of table 6 the endogenous variable is the number of livestock grazed per household on the Reserve (mean over all seasons). As expected grazing dependency on the Reserve is decreasing in the log of farm size once livestock holding is controlled for, and increasing in the log of livestock units once farm size is controlled for. With the positive correlation between livestock holding and farm size already mentioned, this confirms that grazing pressure in absolute terms rises with farm size. Grazing dependency is negatively related to population pressure, indicating that forest scarcity induces substitution towards private resources. Household size is not significant. The extent of village forest and commons management institutions has a negative but insignificant impact on grazing dependency. *Management institutions* is here (in the context of the household data) measured in a more detailed manner than in other sections. Based on the more thorough knowledge gained on that sub-sample of survey villages in which household surveys were carried out (four out of 37) *management institutions* is given a value of 1 in the village of Pauta, where there are no management institutions, it is 2 in Indok and Toda Jayasinghpura, which have limited institutional arrangements, and 3 in Tilwarh where somewhat more effective management institutions were seen to be operating. The excluded instruments used to predict management institutions is presence of a Temple Land, which as already argued is a predetermined, slowly changing institutional variable and the *Development Index*, which captures infrastructure investment decisions that are largely exogenous to the village. As was also found in table 2 (in the context of the village survey data), *Temple Land* and the village *Development Index* appear to be good instruments for management institutions.

Fuelwood

Fuelwood, used for cooking and heating of water and rooms, is collected from the Reserve and from village commons by women and girls. Crop residues, dried animal dung, and wood from trees on the farm provide additional sources of domestic energy. The degree of fuelwood scarcity varies between villages. Use of animal dung and crop residues for burning is an indicator of fuelwood shortage, as these materials have alternative uses for manure and animal fodder. The share of fuelwood from Reserve and commons in total domestic energy supply declines markedly with landholding strata (table 5). Larger landowners generate an increasing share of domestic energy fuels from privately owned farm resources, that is wood from trees on the farm, crop residues, and animal dung. Markets for fuelwood are either absent or thin—only in seven out of 37 villages is fuelwood traded. Twelve per cent of surveyed households sell fuelwood, predominantly to small-scale businesses and food stalls. Most fuelwood

sellers are poor: in the lowest tercile 22 per cent of households sell wood, as compared to 2 per cent in the highest tercile. Market sales represent a mere 4 per cent of all forest fuelwood collected. Hence, fuelwood markets are not an important factor behind forest degradation in this area, in contrast to common beliefs about deforestation in India (Heltberg, Arndt and Sekhar, 2000).

The results of an instrumental variables regression of households' dependency on the Reserve for fuelwood collection are reported in column B of table 6. The endogenous variable is the share of domestic energy collected on the Reserve (average over all seasons). All explanatory variables have the expected sign. Dependency decreases significantly with both land holding and with village population density relative to forests and commons, indicating substitution towards private fuels by larger farmers and by farmers in resource scarce villages. The ownership of an improved stove is associated with less consumption of fuelwood gathered from the public sphere, significant at the 5 per cent level. Household size appears insignificant, no doubt because the endogenous variable is the share and not the absolute amount of fuelwood from forests and commons. Extent of village management institutions is found to have a highly significant negative effect on forest fuelwood collection. The excluded instruments are again *Temple Land* and *Development Index.*

The results for improved stoves and institutions are encouraging because they indicate a potentially positive role for public policy in promoting local management institutions and disseminating improved stoves. An improved stove appears to decrease the share of energy from forest and commons by 7 percentage points while the average effect of the most active management institution relative to no institution is a 10 percentage point decline. It may be concluded that local management institutions and improved stoves appear to be potentially useful, but not sufficient, policies to address degradation of the commons. These results are part of growing evidence that local NRM institutions, even where they exist, sometimes are incapable of preventing over exploitation of biomass resources (Lopez, 1997; Ahuja, 1998).

Other forest produce

Information on collection of other forest produce is available from the household survey. It can be seen from table 5 that three-quarters of households collect thatching material from the Reserve, half collect various edible plants, a third collect other materials, such as small timber and grass, while only few collect medicinal plants. Except for thatching material, dependence on the Reserve is larger, the poorer is the household. Since the demand for these products is basically subsistence oriented, their collection is not likely to be a major factor in forest degradation.

Modest-sized stone mines are located in the periphery of the Reserve, but none were found within the Reserve border. Mines tend to be located on state-owned revenue lands. They are owned by urban-based outsiders with good political connections, who can help secure cheap mining concessions. Although local residents in some cases benefit through employment in the mines, they also incur losses due to reduced commons

and blocked paths. Although not a prime culprit of forest degradation in the study area, mines have an adverse ecological impact. Sometimes they block access routes to the Reserve for wildlife and livestock and frequent dynamite blasts scare away wildlife.

6.3 Poverty and environment

The poverty-environment nexus should not be interpreted to mean that the poor necessarily apply more degrading use practises as compared to the non-poor. Although poor households are relatively more dependent on Reserve and commons for fuelwood collection, the big farmers graze more animals inside the Reserve and sell more milk, which has good market opportunities (see also Jodha, 1995). It is difficult to say whether fuelwood collection or grazing is ecologically worse. Also, it is primarily the large landowners who encroach on forests and commons. Mine owners are wealthy and well-connected urban business people. In conclusion, the data do not support the hypothesis that poor people are the primary agents of resource destruction. These results are in line with findings from other studies that, compared to the non-poor, the poor may depend more on the commons in relatively terms, but in absolute terms their dependence is lower, particularly for resources with good market opportunities (Dasgupta, 1993).

Another aspect related to poverty is the role of the low-yielding farm technology. Low crop yields exacerbate dependence on the forest for biomass that otherwise could be produced with farm resources. If crop yields were to increase substantially, for example due to introduction of a high-yielding grain variety, more crop residues would be available for grazing and fuel, reducing pressure on the Reserve. Higher agricultural productivity and incomes would increase the opportunity cost of time, making it unattractive to exploit distant and low-productive forests.

A different situation would arise, though, if crop yields remain low, but livestock milk (or meat) yields improve. If milk was produced for subsistence, less animals would be needed. In most villages, however, milk is sold to outside markets and a higher price-to-cost ratio will result in larger animal stocks, leading to more pressure on common grazing areas (Repetto and Holmes, 1983). Milk markets play an important role for forest degradation. With ample grazing resources available free of financial cost, milk production offers a substantial income source for farmers on the periphery of the Reserve. Regular collection of milk by the dairy plant induces farmers to increase animal stocks and leads to overgrazing of Reserve and commons due to inadequate management.

7. Forest outcomes

In this section the impact on forest outcomes of NRM institutions and other key variables is assessed econometrically. The endogenous variable is the log of *Forest Degradation Index* (recall this is increasing in the extent of forest degradation). Explanatory variables are characteristics of resources and users as well as of the presence of formal or informal management institutions. Instruments used to account for the endogeneity of NRM institutions are *Temple Land* and *Development Index*. As already

Table 7. *IV-regression of forest outcomes*

Endogenous: log of Forest Degradation Index[a]	*A*		*B*		*C*		*Mean*	*S.D.*
	Coefficient	*t-ratio*	*Coefficient*	*t-ratio*	*Coefficient*	*t-ratio*	*of X*	*of X*
Constant	0.76	2.48**	1.08	4.09**	1.10	3.91**		
Management active	−0.41	−1.66*	−0.18	−1.31	−0.22	−1.82*	0.47	0.49
Distance to Reserve	−0.09	−1.81*	−0.09	−1.88*	−0.10	−2.0**	0.53	1.12
Log population size	0.07	1.13	0.15	3.84**	0.15	3.64**	6.55	1.35
Log livestock units	0.13	1.88*	–	–	–	–	6.71	1.15
Population growth	–	–	−0.019	−0.73	–	–	2.30	1.95
Population/(forest + commons)	–	–	–	–	−0.0005	−0.06	3.66	5.31
Model F-test:	3.89**		3.15*		2.35*			
Sample size	35		32		32			

Notes: **Significant at the 5% level. [a]Mean of Y = 1.9; S.D. = 0.23.
*Significant at the 10% level.
Source: Village survey.

mentioned, instruments are predetermined in the sense that forest outcomes do not influence them, at least in the short run, yet they are significantly correlated with management institutions as found in table 2.

Results for three different specifications are reported in table 7. *Management active* is a dummy variable taking the value 1 in the 13 villages with active (formal or informal) conservation rules and 0 otherwise. *Management active* has the expected negative sign, i.e. this variable is associated with a smaller extent of forest degradation; it is significant at the 10 per cent level or better in the specifications in column A and C, but is insignificant in column B. These results demonstrate that local management institutions, although no panacea for halting forest degradation, may have a positive role to play in improved management. Distance from village to the Reserve has a negative parameter, significant at the 5 per cent level or better, meaning that villages located close to the reserve border or inside cause more severe forest degradation everything else being equal.[10] In two of the specifications the log of village population has a highly significant positive parameter. This shows that more users mean greater degradation of resources. The parameter for population reduces in magnitude (and loses its significance), in the specification where livestock units are included because of the close correlation between human and livestock populations across villages. Hence, at this level of analysis it is difficult to distinguish whether it is the people or their livestock that is causing the damage. In column A, the logarithm of livestock population has a positive parameter, significant at the 7 per cent level. This is consistent with a detrimental ecological impact from animal grazing. The specification in column B shows the effect of population growth on forest degradation. Contrary to expectations it has a negative sign, but is far from being significant. In the last column population relative to forest and commons is included as a measure of resource scarcity. This variable is also signed opposite of expectations, but is insignificant.

8. Conclusions and policy implications

This article has analysed the determinants and impact of local institutions for management of forest and commons in relation to biodiversity conservation. The analysis was conducted within an explicit framework of how characteristics of users (especially population size, poverty, population growth, and resource scarcity), institutions, use pressure, and environmental outcomes are related to each other, and account was taken of the endogeneity of management institutions.

The results question a number of current assumptions about household resource use and management institutions. It was found that:

(1) The impact of key explanatory variables on the likelihood of collective action was not always as posited by theory. For example, village population size was found to have a positive effect and prior institutional

[10] The caveat is important; villages inside the Reserve are mostly small and may therefore pose less of a conservation problem than imagined by management authorities.

experience a negative impact on the probability of collective action, contrary to the theoretical priors.

(2) Efforts at improving natural resource management should not be confined to the poorest resource users. Large landowners are heavily involved in degrading use practises.

(3) Fuelwood markets are not a major cause of forest degradation in the study area, but milk markets may be. While fuelwood is mostly sold by the poor, the large farmers sell more milk.

(4) Formal and informal village resource management institutions in the area play a positive role in promoting private biomass production, reducing biomass dependency on the commons and improving forest outcomes.

The impact of such endogenous institutional responses, however, appears much too small to prevent large-scale degradation of forests and commons. Complementary policy measures are needed.

There is no easy fix for improved common resource management. Cooperation between Forest Departments and villagers needs to be improved, and conservation and management interventions should focus on win–win options that can transform the policy dilemma beyond the uncomfortable livelihood-vs-biodiversity trade-off. Win–win options available include (1) promotion of biomass substitution, that is, on-farm generation of biomass presently collected from forests and commons; (2) improved technologies for private lands; (3) improved technologies for the commons; and (4) improved management of commons and forests.

Policies to induce fuel substitution could target private lands, aiming to increase the number and the productivity of trees, encourage on-farm production of fodder crops and promote improved crop technologies. Also more efficient cooking technologies, such as improved stoves, biogas plants, and solar cookers, are potential technological substitutes for forest fuelwood that have to be considered. Policymakers should stop neglecting the commons. A comprehensive approach to developing the commons should be adopted, incorporating both improved technology and better management. This would include higher-yielding tree and grass species, water and soil management practices targeted to the commons, and improved management institutions. Tree planting on commons and state-owned land could be pursued in concert with efforts at improving their management. Policies should not be based on naïve optimism about the ability of local users to spontaneously organize collective action, but need to include official encouragement of collective action through enhanced cooperation between Forest Departments and villages.

If it is to become an effective vehicle for institutional change, Joint Forest Management needs restructuring. For example, rather than establishing new institutional structures in all project villages, existing local institutions could be involved to a larger extent, as could NGOs. This might help enhance the credibility and effectiveness of JFM and reduce the number of committees existing merely on paper. Incentives and education for joint management need to be targeted also to villages exploiting protected areas. The Forest Departments will need a long-term

commitment to closely monitor and support the work of village management institutions and more effectively help villagers overcome obstacles for collective action, including encroachments. The role of forest staff should be extended from technical experts and guards to fair and reliable promoters of village management. For this, changes in skills and attitudes are required, and staff motivation and corruption need to be addressed.

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