



Analysis

Explaining the performance of state–community joint forest management in India

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ABSTRACT

This paper seeks to identify and analyze the factors that explain differential outcomes of joint forest management (JFM) in the Indian state of Andhra Pradesh. Factors affecting the performances of JFM communities are analyzed using an ordered logit model. The results indicate that JFM communities are more likely to perform well when they are smaller in size and when forest resources in the JFM community are scarce. Presence of social capital and high value forests are also likely to promote good forest growth. Effective protection of forests is likely to contribute to the growth of forests. JFM communities that were initiated by NGOs are more likely to manage forests effectively than the one initiated by the Forest Department.

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1. Introduction

In recent years, devolution of forest resource management and access rights to local communities has become an important policy tool for many developing countries. Over the last two decades, a profound change has been witnessed in the area of forest resource management, with countries at least partially devolving rights and responsibilities over their forests to the users (Edmonds, 2002; Larson and Ribot, 2004). The observed change in forest policy from the traditional state-managed top-down approach to the community level is fueled by the recognition of the limitations of government agencies in managing forest resources at the local level, which has resulted in massive degradation of natural resources and of local people's livelihood systems (Edmonds, 2002). The power to local communities has been strengthened either through power-sharing arrangements with the state, more legal access to forest resources, or decentralization within government institutions that ensures more power for local communities.

The main aim of devolution of forest management to local users is to remove the information gap between the state forest department and conditions of local forest and users living therein, which is believed to be the principal cause of government failure in the management of forest resources and build a social fence in order to protect the forests from grazing, fire and illegal logging (Kolavalli, 1995). In principle, devolution of forest management responsibilities from the government agencies to the local communities implies transfer of some important decision-making authorities and powers

in order to promote active involvement of local users in the management of forests. Theoretically, local users have some comparative advantages over the state in the management of local level forest resources (Bulte and Engel, 2006; Agrawal and Chhatre, 2006), specifically with respect to monitoring, enforcement, and adoption to local conditions. In fact, a large number of studies have documented the theoretical advantages of resource management by users (e.g., Bromley, 1992; Ostrom, 1990; Bardhan, 1993; Baland and Platteau, 1996), and show optimism in the potential of user groups for solving forest resource management problems. Experience with the growing promotion of community forest management suggests that these institutions may be successful not only in promoting effective management of forests, but also in contributing to an equitable distribution of benefits derived from the managed forests.

In recent years, many of the decentralization and devolution programs have taken place within an institutional framework of co-management, where state governments share costs and benefits with local communities (for a review on co-management see Baland and Platteau, 1996). India has been at the forefront of devolving natural resource management to the local-community level, particularly in the forestry sector, for nearly two decades (Marothia, 2002). Its 1988 forest policy was a landmark, because for the first time it recognized the importance of local people's involvement in forest management for achieving improvements in community livelihood and the protection of forest resources. In a follow-up document issued in 1990, the central government issued guidelines to all state governments to implement 'joint forest management (henceforth JFM) systems' by transferring everyday forest use and management rights to the community, while keeping the *de jure* rights over forests in the hands of state (Forest Department, henceforth FD). Accordingly, all

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Indian states have formally resolved to implement JFM, making it one of the largest programs in the world¹ (Kumar, 2002). More than 50 million people partner with FD to regenerate and manage around 17 million hectares (27%) of forests (GoI, 2004). The main feature of the JFM policy is the mutual acceptance of responsibilities, rights, and accountability of forest management between the state (FD) and local communities (Kolavalli, 1995).

In such an institutional arrangement, treating collective action at the community level in isolation would be incorrect as the state policies and legal system greatly influence the incentives that the communities experience in extending cooperation. Under the co-management system the state plays an important role in ensuring legal backing to local users and enforcement of rules for resource extraction (Rangan, 1997). However, despite a number of attempts at investigating the complexities of state–community relationships in respect to common resource management² (Guha and Gadgil, 1989; Richards, 1997; Gibson, 2001), we still lack a clear understanding of the relationship and how it affects outcomes of common pool resource management (Agrawal and Chhatre, 2006, 2007). Several theoretical attempts have been made towards understanding the potential of state initiated community resource management. However, the majority of them are unclear about the potential of state-initiated local management (Benhabib and Radner, 1992; Dutta and Sundaram, 1993; Seabright, 1997). Sethi and Somanathan (1996), using a game-theoretic model, showed that government interference in the local resource management regime could destroy the local norms that constrain local use. However, some theoretical findings show optimism in the outcomes of co-management systems (Baland and Platteau, 1996; Ligon and Narain, 1999). The empirical literature on government-initiated community institutions is limited to case studies of a small number of communities (Kumar, 2002; Agarwal, 2001; Ballabh et al., 2002; Behera, 2008). The dominant view of most of these case studies is that the crucial factor that will determine the success of co-management is the structural relationship between the state and the local communities.

Moreover, the design of institutions for forest management at the local level is very complex, especially in heterogeneous societies like India. There is skepticism amongst the researchers that the uniform adoption of local institutional arrangements such as JFM may not lead to sustained collective action by the users, because while implementing JFM the agency may not be able to solve many potential problems of coordination of the users and may overlook the inherent complexities that the users of local communities are facing.³ However, at the outset, the JFM protagonists have invariably assumed that the users are capable of organizing collective action irrespective of their socio-economic and ecological conditions in which they live. The policy makers have ignored the fact that the users sometimes lack incentives and ability to organize themselves for collective action. The apparent question in this context arises as to which factors are more conducive for successful collective actions among the users in a local community. In other words, what are the characteristics of the communities involved in joint forest management that determine the degree to which the users cooperate in the collective action to manage and protect forests? The empirical investigations into the above question have so far provided evidences that are not only enormous but also diverse and sometimes contradictory to each other.⁴ There are several theoretical issues concerning institutions that are still empirically unsettled. For instance, issues such as poverty, population growth, environmental degradation, resource scarcity and institu-

tional change are still under investigation for an empirical settlement (Dasgupta, 2005).

The overall empirical evidence on the outcomes of JFM in India show mixed results. Some studies have shown improvements in outcomes such as increased yields of timber and non-timber forest products (NTFPs), firewood, and fodder (Joshi, 1998; Khare et al., 2000; Ballabh et al., 2002; Behera, 2008). Others indicate a lack of effective control and management of forests by communities (Sundar, 2000; Behera and Engel, 2006; Behera, 2008). It is also argued that the differences in outcomes of JFM may partly be due to the fact that the degree to which specific rights and benefits were actually devolved from the forest department to the local communities differs significantly across states (Sarin, 2001; Agrawal and Ostrom, 2002; Ballabh et al., 2002; Damodaran and Engel, 2003).

The objective of this paper is to identify and analyze the factors that are likely to explain the differences of forest outcomes across JFM communities. The paper is based on a study conducted in 55 JFM communities in the Indian state of Andhra Pradesh.

The remainder of the paper is organized as follows. Section 2 presents a detailed literature review on the determinants of collective action. Description of the study area, data collection and methods are presented in Section 3. Section 4 discusses the variables used in the econometric models and their associated hypotheses. Section 5 presents and discusses the econometric results on determinants of performance of JFM communities. Section 6 concludes and discusses policy implications.

2. Determinants of collective action: review of literature

A large body of literature exists on the factors that may explain differences in performance in common pool resource (CPR) management. It essentially argues that successful community management requires collective action to overcome the free riding problem that is associated with the use and management of natural resources. There are two types of externalities that are generally realized in the process of resource use and management. For resource use, extraction by one user imposes a negative externality by reducing the amount available to others, while for resource management, investment by one user for maintenance generates positive externalities for the entire local community (Bromley, 1992).

Different authors have examined the determinants of collective action in several ways based on their disciplines. Socio-anthropological case studies (e.g., Runge, 1986; Wade, 1988; Ostrom, 1990; Ostrom et al., 1994) and game theoretic models (e.g., Kreps et al., 1982; Baland and Platteau, 1997, 1998, 1999; Lise, 2005) have been used to explain the factors that promote cooperation among the users in the management of natural resources. Agrawal (2001) has produced a comprehensive literature review on the determinants of local institutions for CPR management by synthesizing three major studies (Wade, 1988; Ostrom, 1990; Baland and Platteau, 1996), which are complemented by several other studies in an attempt to come up with a set of variables that promote collective action. This approach has resulted in about 36 variables that seem to be relevant for the successful management of common property resources. We review these works by grouping them into the following major determinants of local institutions for CPR management: (i) formal and informal rules, (2) group size, (3) resource scarcity and dependency, (4) market access, (5) inequality, and (6) community development.

2.1. Formal and informal rules and collective action

The main reason for the collective action problems in the use and management of natural resources lies in the uncoordinated and self-interested attitudes that produce negative externalities for the society as a whole. This point was first reflected in the seminal work of Olson (1965), which highlighted the fact that self-interested human

¹ According to the Annual Report 2004 of the Ministry of Environment and Forests, Government of India, a total of 84632 JFM committees have been formed.

² For a historical perspective on control and management over forest resources in India and conflicts between the State and local communities, see Guha (1989).

³ See, Agarwal (2009a, b, c) for a comprehensive analysis on gender and forest management.

⁴ For a comprehensive review see Agrawal (2001); Baland and Platteau (1996).

behavior precludes cooperation because individual interests often do not match with group interest (the so-called “tragedy of the commons” (Hardin 1968).⁵ Formal or informal institutions are suggested by the researchers as one of the effective policy tools for structuring the destructive non-cooperative actions of individual users. The fact that some communities manage to cooperate while others fail may thus be at least partly attributed to the existence of rules at the community level that induce individuals to cooperate.

According to Wade (1988), Ostrom (1990), Tang (1992), Baland and Platteau (1996), and others, there are several sets of rules concerning the use and management of resources which guide the users of all sections of community towards a successful management of resources and assist the institutions to be effective in the long run. Rules such as sharing of resource benefits and monitoring costs as well as sanctioning the offenders are amongst the important rules that the communities formulate for successful resource management. Particular emphasis is given to the issue of equity in the sharing of costs and benefits. For instance, the share of costs borne by the participants should be proportionate to the benefits that they derive from the resources (Ostrom, 1990).

Whether appropriate formal and informal rules for resource management are adopted is once again an issue of collective action. The conditions underlying such collective action are discussed next.

2.2. Group size and collective action

In the literature on collective action, starting from Olson (1965), it has been hypothesized that small user groups are more likely to cooperate. The main argument is that free riding can more easily be overcome in a small group compared to a large one, as peer monitoring is easier in small groups, while shared norms and patterns of reciprocity in such groups compel users to consider the indirect and long term consequences of their action (Wade, 1988; Ostrom, 1990; Bromley, 1992; Bardhan, 1993; Baland and Platteau, 1999; Poteete and Ostrom, 2003). It is argued that effective rules are less likely to be sustainable when the group size is large. However, some empirical studies on this issue have given contradictory result. In an interesting study on India by Heltberg (2001), it was found that larger villages are more likely to have active management institutions. However, the author could not give a convincing explanation for this phenomenon. A study conducted in community forest management in Nepal also found that larger groups (of over 300 households) were no less effective than smaller groups (of fewer than 100 households) (Hobley and Shah, 1996). The authors argued that a highly factionalized but well represented and managed large group may be more effective than a non-factionalized but non-representative, poorly managed small group. Baland and Platteau (1999) illustrate the impact of group size on the collective provision of public goods which shows that large groups that share common norms and are faced by common challenges may be successful. Besides, they argue, that there may be some positive economies of scale in large groups in the matters of pooling resources and sharing risk. From the above analysis it is clear that group size is one of the key factors affecting resource management outcomes and that the effect is conceptually ambiguous.

2.3. Resource scarcity, dependence and collective action

The relationship between resource scarcity and collective resource management outcomes has been an issue of controversy in the recent CPR literature. Some scholars argue that villagers are more likely to follow joint rules and arrangements to achieve intensely felt needs that could not be met by individual action, which implies a positive relationship between scarcity and community resource management

outcomes (Wade, 1988; Conroy et al., 2002). On the other hand, Bardhan (1993) argues that community resource management outcomes are more likely at moderate levels of resource scarcity. At high levels of scarcity and ecological stress institutional arrangements often break down as people struggle for survival and discount rates increase.

Dependence on the resource also affects the outcomes of collective resource arrangements. Gibson (2001) argues that unless people do not perceive the resource as valuable for their daily livelihoods they are not going to preserve it. It is also argued that a high level of dependence on resources in a subsistence oriented environment is likely to be associated with better management outcomes (Wade, 1988; Varughese and Ostrom, 2001). Baland and Platteau (1996) suggest that when the incomes individuals derive from the resource decline to below subsistence levels while alternative sources are not available, the temptation to violate access and use rules are likely to be irresistible due to survival reasons. Hence, the discussion on the effects of resource scarcity and dependence on community managed resource outcomes is somewhat ambiguous as well.

2.4. Market access and collective action

It is argued, both theoretically as well as empirically, that the openness and stability of the community is a crucial determinant of community resource management outcomes. In particular, the higher the rate of migration, mobility, and market integration, the lower the possibility of voluntary cooperation or organization (Ostrom, 1990). The main argument is that if resource users have relatively lucrative earnings opportunities outside the common resources, this can affect their individual incentives as well as the power of social cohesion to promote collective action. For instance, in the case of JFM, it is often argued that greater market integration for NTFPs is necessary in order to bring more people's cooperation in the JFM program, as middlemen and faulty government policies exploit the rural poor by undervaluing their NTFPs (Bathla, 1999). Agrawal and Chhatre (2006) find that local forest communities that are located close to market are more likely to have better quality forests. Others argue that due to exposure of the rural economy to urban and small town markets, rural households tend to adopt destructive gathering of firewood in the communal forests for their livelihoods (Sundar, 2000; Gorada, 2003).

2.5. Inequality and collective action

The role of heterogeneity in affecting the community resource management outcomes is strongly debated in both the theoretical and empirical studies. It is generally argued that heterogeneity based on social identity (ethnic, political, gender, etc.) can create obstacles to performance of community resource management (Baland and Platteau, 1999; Agrawal, 2001; Agarwal, 2009a,b,c). This is because different ethnic, political and gender groups have different interests in the natural resources, which can make communication and cooperation amongst them difficult. The effects of economic heterogeneity (e.g., inequality in land holding, livestock and/or other endowments) are less clear as empirical evidence on this aspect remains ambiguous (Kanbur, 1992; Baland and Platteau, 1999; Naidu, 2009). One school of thought holds that inequality (based on endowments, e.g., wealth and land distribution) is good for performance of community-based resource management, as those with greater interests may decide to provide for the common good even if the poorly endowed group chooses to free ride (Olson, 1965). Others argue that heterogeneity hampers community resource management outcomes (see for instance, Johnson and Libecap, 1982; Jarayanan, 1981, Easter and Palanisami, 1987; Naidu, 2009).

In an interesting study of 18 forest communities in Nepal it was found that heterogeneity is not a strong predictor of the level of community resource management outcomes (Varughese and Ostrom,

⁵ It should be noted that the ‘tragedy of the commons’ is really a misnomer, as the case described by Hardin (1968) is really one of open access (Dietz et al., 2003).

2001). In another recent study in the Indian state of Himachal Pradesh, Naidu (2009) found that at moderate levels of social diversity forest communities are likely to have low collective management, but at high levels of social diversity, collective management is likely to be high. The study also found that moderate wealth heterogeneity is beneficial for collective management of forests; however, at high levels and in the presence of benefit heterogeneity, it decreases collective management.

As has been mentioned, there are several types of inequality and heterogeneity, each with different implications for cooperation. The location of users, which may not be reflected in wealth and landholding inequality, may also affect collective action. For instance a community with two or more fundamentally different user types can give rise to conflicting uses of a resource (Varughese and Ostrom, 2001). For example, large farmers show more interest in timber oriented plantation that goes against the interest of poor farmers, who depend on NTFP (Kumar, 2002).

Similarly, differences in ability and efficiency of resource extraction will affect cooperative behavior (Johnson and Libecap, 1982). Inequality of interest over the resource among men and women (gender inequality), both within a household and the community, can hinder the prospect of collective action (Agarwal, 1997, 2009a,b,c). Household level benefits from JFM are inextricably associated with household characteristics such as land and livestock holdings, caste, gender, education, ethnicity, political influence and other local influences, which influence the nature and extent of resource appropriation and exploitation (Kumar, 2002).

2.6. Community development and collective action

The impact of community development on community resource management outcomes is another important aspect that has not been fully explored, and it is still empirically unsettled whether development of local communities leads to improved outcomes of resource management and conservation or not. In a study of local institutions for the use of Sariska national park in the Indian state of Rajasthan, Heltberg (2001) found that the community development index is not a significant determinant of local institutional performance. However, Bathla (1999) found in one of the forest divisions that developmental activities (irrigation, drinking water, schools, health center, etc.) have brought an immense public response towards the JFM program. Thus, a conclusion on the relationship between community development and the performance of resource institutions cannot be drawn without sufficient and repeated empirical tests.

2.7. Weaknesses of the existing literature

Both the case study and game theoretic approaches, which most of the above literature is based on, are not free from limitations. The case studies provide a detailed explanation for the phenomenon of collective action in a particular regional and institutional setting. They do not, however, permit a test of the relative importance of hypothesized factors, and the generalizability of results is unclear. One important advantage of game theoretic models is that they provide precise analytical explanations to the phenomenon of collective action problems. However, a drawback is that these models are set up under a very restrictive framework and as a result often fail to capture some important context-specific issues (Bardhan, 2000). Moreover, as was clearly shown from the above summary of the literature, the direction of effects of specific factors is often theoretically ambiguous and can only be determined empirically.

As Agrawal (2001) has stressed, there is a lack of systematic empirical studies based on a large number of sampled communities. Recently a few attempts have been made to rigorously test the relative importance of factors identified in the literature as conditioning the success of local management of common pool resources by using large

sample econometric analysis (e.g., Dayton-Johnson, 2000; Heltberg, 2001; Meinzen-Dick et al., 2002; Gyasi, 2004; Agrawal and Chhatre, 2006; Agarwal, 2009c; Naidu, 2009, Araral, 2009). Another important issue related to this is, as explained earlier, the problem of intermediate effects of local level institutions on common pool resources. In most cases, the factors are often treated in the literature as exogenously determined but in reality the relationship between many of the factors are endogenous (Heltberg, 2001; Agrawal, 2001; Engel, 2004). Particularly, variables that are located within institutional arrangements and the collective choice arena of local institutions are endogenously determined on the basis of users profile and organizations that help promote collective action. Agrawal (2001) has also stressed the importance of defining causal links between various factors, but few studies have tackled this issue explicitly.⁶

3. Study area, sampling methods and data collection

This study is based on the results from a field study conducted in the Indian state of Andhra Pradesh during the period from September 2003 to April 2004. The selection of Andhra Pradesh as the study region is justified on the following grounds. Andhra Pradesh is the fourth largest JFM state in terms of number of JFM communities in India. Moreover, devolution of powers to local communities has been relatively far-reaching in Andhra Pradesh as compared to other Indian states (Behera and Engel, 2006). For example, local communities receive hundred percent of the benefits from the JFM forests in Andhra Pradesh. According to Damodaran and Engel (2003), Andhra Pradesh is regarded as a relatively successful state in terms of various outcomes of the JFM program. Based on these facts, Andhra Pradesh was selected for an in-depth study in order to investigate factors that are likely to influence JFM outcomes.

A two stage sampling method was employed in order to select JFM communities for the study. In the first stage three out of 23 districts of Andhra Pradesh were selected from three different geo-political regions. The districts are Visakhapatnam, Adilabad, and Kadapa which belong to three regions of the state, viz., Coastal, Telengana, and Rayalseema respectively. The main reason for the selection of districts from three different regions of Andhra Pradesh was to represent the three different socio-economic and ecological conditions in the sample. While the Coastal (Visakhapatna) region contains moisture deciduous forests, Telengana (Adilabad) region is dry deciduous forests and Rayalseema (Kadapa) has thorny deciduous shrub forests. According to information provided by the FD, these districts have the highest coverage of area under forests and numbers of JFM communities in their respective region. While Visakhapatnam and Adilabad are predominantly tribal areas covered under the ITDA (Integrated Tribal Development Agency), Kadapa is a non tribal region, except for a few pockets of tribes inhabiting the mountainous region and surroundings. Ecological composition and value of the forests also differ between these districts. Adilabad represents the highest value and livelihood dependence followed by Visakhapatnam and Kadapa. Area under forests is the highest in Adilabad (44% of the total geographical area) followed by Visakhapatnam (39%) and Kadapa (33%). Though Khammam district has the highest proportion of area under forests (53%), Adilabad has the largest number of JFM communities and area covered.

In the second stage, the JFM communities were selected using 'purposive random sampling'⁷ in order to ensure a mixed sample of good-performing and non-performing JFM communities. Sampling was based on forest department performance ratings. A total of 147

⁶ For example, Oakerson (1992) and Heltberg (2001) have discussed elaborately on the issue of endogeneity and the need for an explicit approach to deal with it.

⁷ JFM communities were grouped under two categories such as good performing and non-performing as indicated above and then selected randomly from each group for in-depth study.

JFM communities were visited and informal discussions were held with executive and general body members. The results were used to update the FD statistics.⁸ Finally, 55 JFM communities were selected for detailed analysis. The sampled JFM communities are distributed in three districts in proportion to the total number of JFM communities that were formed in 1997 or before.⁹

Both quantitative and qualitative information in detail on forest use and management and the functioning of JFM communities were gathered. Using a structured questionnaire interview with groups of key informants was conducted in order to elicit information regarding forests, functioning of JFM institutions and other community characteristics. In addition, qualitative methods such as focus group discussions among different groups such as lower caste, women, and landless households were held, transect walks into the forests protected by the JFM communities were conducted to have first hand experience of the impact of JFM institutions on forests, discussions with local FD officials both at the local and divisional level were held on the issues related to various aspects of the functioning of the JFM institutions, and also extensive discussions were held with state and local level NGOs that are involved in JFM activities.

4. Variable description and hypotheses

4.1. The dependent variable

The improvement of forests after the adoption of JFM in the communities is used in this study as the indicator of forest outcome. However, in the absence of baseline information on the forest conditions the exercise of assessing the forest growth over the period of time becomes complicated. The only way to overcome this difficulty is to get an approximate subjective assessment of the forest improvement from the users. This provides an approximate idea of forest growth as the users live very close to the forests. We asked the villagers in our key informants' interview to choose an option from a list of choices regarding the status of forest growth since the JFM community members began protecting it. There were four options given in the questionnaire to choose: the JFM forest has (1) increased substantially, (2) increased somewhat, (3) remained the same, and (4) decreased.¹⁰ Table 1 presents the distribution of these JFM communities across three districts.

4.2. Independent variables and hypothesized effects

Field data was used to compute proxies for each of the theoretically relevant categories of exogenous factors described in Section 2. The details are explained below. Detailed definitions as well as the expected direction of effects are provided in Table 2.

One of the important physical attributes of the forest that needs to be taken into consideration while analyzing the factors determining JFM outcomes is the economic potential of the tree species being grown in the JFM forests. The general presumption is that if the tree species grown (both timber and NTFP) in the JFM forests have high economic and livelihood values, it will provide a strong incentive for the local community at large to manage and protect the forests. Thus,

⁸ Forest Department graded JFM communities as A, B, C, and D on the basis of their performances relating to social participation, economic benefits from forest and forest regeneration and protection. In our field study, we frequently found discrepancies between local realities and what is otherwise mentioned in the FD gradation of the JFM communities.

⁹ The idea of selecting the JFM communities that are formed in 1997 or before was to have the old JFM communities where impacts of JFM institution are expected to be visible.

¹⁰ Only one community has reported that the forest growth has decrease. Since our interest is to identify factors that explain variation in forest regeneration, we have combined this community with the communities that have reported no change.

Table 1
District and performance wise distribution of JFM communities.

District	Increased substantially	Increased somewhat	Remained same	Total
Adilabad	11	7	4	22
Visakhapatna	11	8	2	21
Kadapa	7	5	0	12
Total	29	20	6	55

Table 2
Variables included in the econometric analysis of determinants of JFM forest growth.

Variable	Definition	Expected effects
Forest improvement/growth	Perception of JFM community functionaries on the improvement and/or no change of the density of JFM forests (i.e. (3) increased substantially, (2) increased somewhat, (1) remained the same.	Forest outcomes
Forest value	Dummy variable, = 1 if the JFM forest has valuable tree species; 0 otherwise	+
Log population	Log of total population in the community	-
Log scarcity	Log of population per hectare of JFM forest areas	?
Gini landsize	Gini coefficients of land size of all the households in the community	?
Caste homogeneity	Dummy variable, = 1 if the people living in the community is homogeneous (single caste group); 0 otherwise	+
Social capital	Proxy of number of active community based organization in the village	+
Distance to market	Square root of distance to the nearest market (in km)	?
FD–community interaction	Dummy variable, = 1 if the FD has undermined the decision taken by the local community; 0 otherwise	-
Distance to the FD	Distance to the nearby FD in (km)	?
Formation of JFM community	Dummy variable, = 1 if the JFM community is formed by the FD, 0 otherwise (NGOs, communities)	-
Access rights	Dummy variable, = 1 access rights over JFM forest resources is only for community members, 0 otherwise	+

we have included a variable 'forest value' in the model, which is based on the economic and livelihood value of the tree species in the community forests.¹¹

User group characteristics are hypothesized to have effects on the outcomes of forest management at the local level. There are many potential ways to proxy for user group researchers of common property resources have suggested for group characteristics, and it is not feasible to include all variables in the empirical models due to the small sample size. The few selected variables that are most relevant in the case of JFM are discussed below and subsequently used in the econometric analysis (Table 3).

Following the dominant view in the literature, the size of user groups (here JFM communities) is hypothesized to be negatively relate to the performance of JFM. That is, smaller JFM communities are more likely to cooperate for collective management and protection of forests than larger communities, as free riding problems can more easily be overcome in small groups. Population size is used to represent group size in the econometric model.

Resource scarcity or availability is another important factor hypothesized to influence forest outcomes. Here the per capita availability of forestland is used to represent the extent of scarcity that a JFM community is facing. We expect a positive relation between

¹¹ The value of the JFM forests is considered high if the forest is dominated by the following timber tree and NTFPs species: Teak, Red Sanders, Adda Leaves (*Bahunia Vahili*), Beedi Leaves (*Diosporus Melanoxylan*), Bamboo (*Bambusa Arundinacea*), Japhra.

Table 3
Summary of variables used.

Variable	Obs	Mean	Std. dev.	Min	Max
Forest growth	55	2.42	0.68	1	3
Distance to market	55	2.84	1.01	1	5
Log population	55	5.37	0.72	4.22	7.66
Distance to forest department	55	3.02	1.31	0	5.74
Caste homogeneity	55	0.62	0.49	0	1
Scarcity	55	0.02	0.01	0.01	0.06
Social capital	55	3.84	1.64	1	7
Gini landsize	55	0.48	0.21	0	0.95
FD–community interaction	55	0.56	0.50	0	1
Forest value	55	0.49	0.50	0	1
Formation of JFM community	55	0.75	0.44	0	1
Access rights	55	0.69	0.46	0	1

scarcity of forest resources and collective management of forests, as many case studies on local forest management have found that communities are more likely to collectively manage forests when they are faced with scarcity of forests resources (Conroy et al., 2002). In addition, there are also literatures which suggest that an acute scarcity of resources may lead to breakdown of the local institutions which in turn may result in negative resource outcomes (Bardhan, 1993). Hence, the relationship between resource scarcity and forest outcomes is assumed to be ambiguous.

Social and economic homogeneity, as explained above, is another important factor that is likely to influence local JFM institutions and thereby forest outcomes. The effects of economic heterogeneity on the JFM outcomes are assumed to be ambiguous, as discussed in the literature review. Gini coefficients of inequality in land holding size is used to proxy for economic inequality. On the other hand, the effects of social homogeneity on the JFM outcomes are hypothesized to be positive. Caste of households in the JFM communities is used to proxy for social homogeneity. Social capital among the users in the local community is hypothesized to play a positive role in promoting collective management of forests. Several proxies of indicators have been used in the literature that captures social capital. Here we have used the number of active community-based organizations (CBOs).¹²

The distance of the community to the nearest market is used as a proxy for market access. The effect on the JFM institution and forest outcomes is *a priori* ambiguous. Some argue that the impact of the community's easy access to market on forest outcomes is negative as it can lead to increasing demand for forest resources, which can induce people to increase the harvest of forest products, further increasing pressure on the forest resources. The opposite argument is that access to market can lead to improved agricultural activities and diversifications of people's livelihoods to non-farm activities. This can potentially reduce the use pressure on the forests, which may lead to a positive impact on forest outcomes. However, the literature on the direction of effect is also ambiguous in this case.

Two variables are used to capture the external environment (e.g. FD–JFM community interaction). The first measures whether the FD has undermined the decisions taken by the local communities in any aspects of forest management, which captures the direct interaction between the two parties. When the FD undermines community decisions, community members may be discouraged from cooperating in the protection and management of forests (Agrawal and Chhatre, 2007). Therefore, a negative effect on forest outcomes is expected.

Second, the physical distance to the nearest FD office is used as a proxy for the overall interaction between the two parties (FD and

¹² A variety of local level community associations are present in the sample communities. These include village development committee (VDC), farmers' associations, water user associations (WUA), mothers' committees, school education committees, thrift groups, etc. However, the large variations of the existence of the number of active associations can be attributed to the presence of social capital within the local community that allows these associations to function properly. This in turn is likely to have a positive influence on the performance of JFM outcomes.

Table 4
Ordered logit results of determinants of JFM forest growth.

Variable	Coef.
Distance to market	0.135 (0.36)
Log population	−1.527 (−2.34)**
Distance to FD	0.329 (1.10)
Caste homogeneity	−0.066 (−0.07)
Scarcity	−94.941 (−2.66)***
Social capital	0.494 (2.07)**
Gini landsize	0.638 (0.29)
FD–community interaction	0.159 (0.21)
Forest value	2.566 (2.84)***
Access rights	2.209 (2.34)**
Formation of JFM community	−1.439 (−1.42)
Log likelihood	−30.942245
Number of obs	55
LR chi ² (11)	42.29
Prob > chi ²	0.000
Pseudo R ²	0.4059

Note: *** = <0.01, ** = <0.5, * = <0.10.

communities) on the issues related to forest protection and management. Two different arguments are possible on the impact of distance to the local FD on the outcomes of forests. First, a community located close to the FD is likely to perform well under the constant supervision of the FD. Second, when the community is located far away from the FD, it will enable them to take decisions more independently, which may promote collective action and positive forest outcomes. Here, the second argument is expected to be the dominant one.

Based on the literature and field experience two variables related to institutional aspects of JFM are included in the model: formation of JFM community and access rights. It is hypothesized that JFM communities that are initiated by NGOs and/or communities themselves are more likely to perform better than those initiated by the FD (Agrawal and Chhatre, 2007). Finally, it is hypothesized that when the JFM forest is fenced and forest access and use rights are confined to only JFM members the likelihood of good forest growth increases.

To test these hypotheses, we have employed ordered logit model. Since our dependent variable is based on scaling of forest growth, ordered logit estimation model was considered appropriate to be used to identify the determinants of JFM performance. Simple binary logit model fails to capture this scaled measurement. In addition, the conventional literature on deforestation generally assumes that given factors have linear relation with forest outcomes such as forest improvement and/or decline in forest condition (Reddy et al., 2001). However, this assumption has been questioned by researchers in recent times (Chhatre and Agrawal, 2008). In fact, it is pointed out that there can be possibility that the influence of one factor on any forest outcomes varies with changes in the value of other factors (ibid), in which case the relationship between factors and forest outcomes becomes non-linear. As Chhatre and Agrawal (2008) argued that the degree of subsistence dependence, for instance, may have different associations with degradation and regeneration. Therefore, it is important to understand how each factor relates to forest outcomes keeping in mind the other factors that affect forest conditions.

5. Results and discussion

Table 4 present the results of the ordered logit regression model of the determinants of forest growth across JFM communities. Overall, the model is significant at the level of 1%.¹³ Concerning the individual

¹³ In order to ensure that the ordered logit model does not violate the proportional odds assumption we have carried out both Brant Test and Likelihood-ratio Test. The results of both the tests are not significant, which indicates that the model is not violating the assumption of proportional odds.

variables in the model all the variables show the expected signs. The coefficient on forest value is positive and significant at the level of 1%, indicating that when the people in the JFM community realize that their forests have high economic value, they tend to be more likely to organize themselves to protect the forests for collective present and future benefits.

The size of the JFM community (log population) has a negative and significant (at the level of 5%) effect on the forest growth, indicating that small group size communities are more likely to have better managed forests than the larger size, because smaller JFM communities are more likely to cooperate for collective management and protection of forests than larger communities, as free riding problems can more easily be overcome in small groups (Wade, 1988; Ostrom, 1990; Bromley, 1992; Bardhan, 1993).

Scarcity (Population per hectare of JFM forest area) has negative effects on the forest growth, and the effect is highly significant, meaning that in a condition of high scarcity of forests the communities are less likely to contribute to the forest growth. A similar finding has been reported in Bardhan (1993) where it is argued that at a higher level of scarcity local institutions that govern natural resources is likely to breakdown as people scramble over limited resources may result in resource degradation. But, a vast majority of empirical studies have indicated that scarcity of natural resources is more likely to compel communities to organize themselves as a collective institution for the management of natural resources (Wade, 1988; Conroy et al., 2002; Araral, 2009), which is the contrary to our findings.

Social capital, proxied by the number of active community-based organizations, has a positive effect on forest growth outcomes and is significant at the 5%. This indicates that communities with high social capital are more likely to effectively manage their forests and contribute to forest growth. The literature on the role of social capital in promoting economic prosperity in general and in natural resource management at community level in particular is being frequently found (see, Fukuyama, 1995; Bodin and Crona, 2008; Naidu, 2009). Studies have confirmed that social capital at the community level play a very crucial role in effective and sustainable management and use of natural resources (Ballet et al., 2007; Petty, 2003).

The formation of JFM community has a negative effect on forest growth (but significant only at the level of 15%) which indicates that JFM communities that are self-initiated or initiated by non-governmental organizations are more likely to have better forest growth. Thus, it appears that the JFM approach is likely to be more successful if it follows a demand-driven approach rather than a government supply or sponsor-driven approach.

Finally, the variable access rights is positively related to forest growth and significant at the level of 5% which indicates that JFM communities with restricted access to forests to only community members are more likely to have better forest growth.

Contrary to our expectation two variables on FD–community interaction (e.g. FD–community interaction and distance to the FD) did not turn up significant, although the signs of their coefficients are theoretically consistent. This may be due to the fact that except dealing with financial matters FD might not have engaged themselves sufficiently enough to have any sort of impact on JFM communities and thereby forest outcomes. In fact, many studies have pointed that the FD has failed to provide administrative, legal (e.g. resolving conflicts among villagers over forest access rights) and technical (e.g. technical know-how) support to JFM communities (Behera and Engel, 2006; Behera, 2008).

6. Conclusions and policy implications

In this paper the determinants of differential outcomes of JFM communities were analyzed for a specific forest outcome (forest

growth). The analysis was carried out within a conceptual framework of determinants of collective action in natural resource management.

The results provide evidence that most of the hypothesized factors explain different aspects of collective forest management. The economic value of the JFM forests appears to play a crucial role in promoting collective management of forests. Hence, promoting collective forest management in a severely degraded forest may not provide adequate economic incentives for the local communities. In such cases efforts must be made to provide enough economic incentives¹⁴ to encourage collective regeneration of degraded forests and at the same time allow JFM in good forest areas, as management of good forests are still largely under the control of the FD despite the fact that latest JFM guidelines allows JFM in good forest.

Population per hectare of JFM forestland has positive effects on the forest outcomes. This indicates that the amount of forest areas allocated to local communities is crucial in the effective management and protection of forests.¹⁵ The selection and size of JFM forest is largely predetermined and the area to be allocated and demarcation of forests is decided by the FD. Hence, a flexible approach is needed on the part of the FD while allotting and demarcating forests areas to the JFM community in order to ensure that the allotted forest is sufficient to meet the daily needs of all the members.

Presence of social capital in the community promotes collective management of forests. The obvious policy implication of this is that the FD should include the social capital aspect while selecting the community for the JFM program to achieve efficiency and sustainability. Experience from the field shows that most of the JFM communities that are selected by the FD for the implementation of JFM are not based on proper assessment of the potential of the JFM communities for collective action. As a consequence many JFM communities have failed to organize themselves as an institution, leading to unsuccessful forest management and protection, wasting a large sum of public and donor funds.

The result also indicates that the more successful communities in terms of forest growth are more often self-initiated or initiated by non-governmental organization than the less successful ones. Therefore, the JFM approach is likely to be more successful if it follows a demand driven approach rather than a government supply/sponsor JFM approach.

Resource boundedness (access rights) has positive effects on the forest growth. Communities with better growth of forests are generally those where the access of JFM forests is restricted to JFM community members only. Hence, NGOs and the FD should make an effort to persuade JFM communities to restrict the use and access of JFM forests within the members of local communities and discourage attempts to allow unauthorized use of forests by people who are not part of the JFM. In this regard, the role of FD is very crucial. In many cases, the violation of JFM rules takes place because of lack of adequate legal and administrative support from the FD (Behera, 2008). Hence, it is imperative that the FD must extend these supports to JFM communities which are very much essential in order to strengthen the protection of JFM forests. In this connection, the role of NGOs can be very crucial in assisting the local JFM communities to detect and report large scale illegal use of JFM forests by unauthorized agents.

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¹⁴ The government can provide subsidies to JFM communities in the form of cooking gas connections, providing food and non-food goods, etc. that may help communities to reduce their dependency on forests substantially.

¹⁵ We assume that the quality of forests is similar across JFM communities. This is to a large extent true because JFM institutions are formed largely in degraded forests.

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References

- Agarwal, B., 1997. Environmental action, gender equity, and women's participation. *Development and Change* 28, 1–44.
- Agarwal, B., 2001. Participatory exclusions, community forestry, and gender: an analysis for south Asia and conceptual framework. *World Development* 29 (10), 1623–1648.
- Agarwal, B., 2009a. Gender and forest conservation: the impact of women's participation in community forest governance. *Ecological Economics*. doi:10.1016/j.ecolecon.2009.04.025.
- Agarwal, B., 2009b. Rule making in community forestry institutions: the difference women make. *Ecological Economics* 68, 2296–2308.
- Agarwal, B., 2009c. Does women's proportional strength affect their participation? Governing local forests in South Asia. *World Development*. doi:10.1016/j.worlddev.2009.04.001.
- Agrawal, A., 2001. Common property institutions and sustainable governance of resources. *World Development* 29 (10), 1649–1672.
- Agrawal, A., Ostrom, E., 2002. Collective action, property rights, and decentralization in resource use in India and Nepal. *Politics and Society* 29 (4), 485–514.
- Agrawal, A., Chhatre, A., 2006. Explaining success on the commons: community forest governance in the Indian Himalaya. *World Development* 34 (1), 149–166.
- Agrawal, A., Chhatre, A., 2007. State involvement and forest co-governance: evidence from the Indian Himalayas. *Studies in Comparative International Development* 42 (1–2), 67–86.
- Araral, E., 2009. What explains collective action in the commons? Theory and evidence from the Philippines. *World Development* 37 (3), 687–697.
- Ballabh, V., Balooni, K., Dave, S., 2002. Why local resource management institution decline: a comparative analysis of Van (forest) panchayats and forest protection committees in India. *World Development* 30 (12), 2153–2167.
- Baland, J.M., Platteau, J.P., 1996. Halting Degradation of Natural Resources. Is There a Role for Rural Communities? Clarendon Press, Oxford.
- Baland, J.M., Platteau, J.P., 1997. Wealth inequality and efficiency in the commons part I: the unregulated case. *Oxford Economic Papers* 49 (3), 451–482.
- Baland, J.M., Platteau, J.P., 1998. Wealth inequality and efficiency in the commons part II: the regulated case. *Oxford Economic Papers* 50 (1), 1–22.
- Baland, J.M., Platteau, J.P., 1999. The ambiguous impact of inequality and on local resource management. *World Development* 27 (4), 773–788.
- Ballet, J., Sirven, N., Desjardins, M., 2007. Social capital and natural resource management: a critical perspective. *The Journal of Environment and Development* 16 (4), 355–374.
- Bardhan, P., 1993. Analytics of institutions of informal cooperation in rural development. *World Development* 21 (4), 633–639.
- Bardhan, P., 2000. Irrigation and cooperation: an empirical analysis of 48 irrigation communities in south India. *Economic Development and Cultural Change* 48 (4), 847–865.
- Bathla, S., 1999. Externalities Impinging on Participatory Forest Management in India. Policy and Joint Forest Management Series-4. World Wild Fund for Nature, India.
- Behera, B., Engel, S., 2006. Institutional analysis of evolution of joint forest management (JFM) in India: a new institutional economics (NIE) approach. *Forest Policy and Economics* 8 (4), 350–362.
- Behera, B., 2008. Institutional dynamics and natural resource management: a study of JFM in Andhra Pradesh. *Journal of Rural Development* 27 (4), 575–606.
- Benhabib, J., Radner, R., 1992. The joint exploitation of a productive asset: a game theoretic approach. *Economic Theory* 2 (2), 155–190.
- Bodin, O., Crona, B., 2008. Management of natural resources at the community level: exploring the role of social capital and leadership in a rural fishing community. *World Development* 36 (12), 2763–2779.
- Bromley, D. (Ed.), 1992. *Making the Commons Work: Theory, Practice and Policy*. In: *Institute for Contemporary Studies Press*, San Francisco, CA.
- Bulte, E., Engel, S., 2006. Conservation of tropical forests: addressing market failure. In: López, R., Stiglitz, J., Toman, M. (Eds.), *Sustainable Development: New Options and Policies*. Oxford University Press, New York.
- Chhatre, A., Agrawal, A., 2008. Forest Commons and Local Enforcement. The National Academy of Sciences of the USA. available at: www.pnas.org/cgi/doi/10.1073/pnas.0803399105, accessed on 13.07.2009.
- Conroy, C., Mishra, A., Rai, A., 2002. Learning from self-initiated community forest management in Orissa, India. *Forest Policy and Economics* 4 (3), 227–237.
- Damodaran, A., Engel, S., 2003. Joint forest management in India: assessment of performance and evaluation of impacts. ZEF-Discussion Papers on Development Policy, vol. 77. Center for Development Research, Bonn.
- Dasgupta, P., 2005. Common property resources: economic analytics. *Economic and Political Weekly* 40 (16), 1610–1622.
- Dayton-Johnson, J., 2000. Determinants of collective action on the local commons: a model with evidence from Mexico. *Journal of Development Economics* 62 (1), 181–208.
- Dietz, T., Ostrom, E., Stern, P.C., 2003. The struggle to govern the commons. *Science* 302 (5652), 1907–1912.
- Dutta, P., Sundaram, R., 1993. The tragedy of commons. *Economic Theory* 3 (3), 413–426.
- Easter, K.W., Palanisami, K., 1987. Small scale surface (tank) irrigation in Asia. *Water Resources Research* 23 (1), 774–780.
- Edmonds, E., 2002. Government-initiated community resource management and local resource extraction from Nepal's forest. *Journal of Development Economics* 68 (1), 89–115.
- Engel, S., 2004. *Designing Institutions for Sustainable Resource Management and Environmental Protection*, Habilitationsschrift, Landwirtschaftliche Fakultät der Rheinischen Friedrich-Wilhelms-Universität Bonn, October.
- Fukuyama, F., 1995. *Trust: The Social Virtues and the Creation of Prosperity*. Hamish Hamilton, London.
- Gibson, C., 2001. Forest resources: institutions for local governance in Guatemala. In: Burger, E., Ostrom, E., Norgaard, R.B., Policansky, D., Goldstein, B.D. (Eds.), *Protecting the Commons: A Framework for Natural Resource Management in the Americas*. Island Press, Washington, D.C.
- Gol., 2004. *Annual Report 2003–2004*, Ministry of Environment and Forests. Government of India, New Delhi.
- Gorada, P., 2003. Joint forest management in Eastern Ghats of Andhra Pradesh: a study of stakeholders' participation. Ph.D. dissertation, University of Hyderabad, Hyderabad, India.
- Guha, R., 1989. *The Unquiet Woods*. Oxford University Press, New Delhi, India.
- Guha, R., Gadgil, M., 1989. State forests and social conflicts in British India: past and present. *Journal of Historical Studies* 123, 143–177.
- Gyasi, O., 2004. Determinants of success of collective action on local commons: an empirical analysis of community based irrigation management in Northern Ghana. Ph.D. dissertation, submitted to the University of Bonn, Bonn, Germany.
- Hardin, G., 1968. The tragedy of the commons. *Science* 162, 1243–1248.
- Heltberg, R., 2001. Determinants and impacts of local institutions for common resource management. *Environment and Development Economics* 6 (2), 183–208.
- Hobley, M., Shah, K., 1996. What makes a local organization robust? Evidence from India and Nepal. *Natural Resource Perspective*, Number-11. Oversea Development Institute, London.
- Jarayaman, T.K., 1981. Farmers' organizations in the surface irrigation project: two empirical studies from Gujarat. *Economics and Political Weekly* 16, A89–A98.
- Johnson, R.N., Libecap, G.D., 1982. Contracting problems and regulations: the case of the fisheries. *American Economic Review* 72 (2), 1005–1023.
- Joshi, A., 1998. *Progressive Bureaucracy: An Oxymoron? The Case of Joint Forest Management in India*. Rural Development Forestry Network. Oversea Development Institute, London.
- Khare, A., Sarin, M., Saxena, N.C., Palit, S., Bathla, S., Vania, F., Satyanarayana, M., 2000. *Joint Forest Management: Policy, Practice and Prospects, Policy that Works for Forest and People Series No: 3*, World Wide Fund for Nature-India and IIED London.
- Kanbur, R., 1992. Heterogeneity, Distribution and Cooperation in Commons Property Management. Background Paper for the 1992 World Development Report. World Bank, Washington D. C.
- Kolavalli, S., 1995. Joint forest management: superior property rights? *Economic and Political Weekly* 1933–1938.
- Kreps, D.M., Milgrom, P., Roberts, J., Wilson, R., 1982. Rational cooperation in the finitely repeated prisoner's dilemma. *Journal of Economic Theory* 27 (2), 245–252.
- Kumar, S., 2002. Does participation in common pool resource management help the poor? A social cost–benefit analysis of joint forest management in Jharkhand, India. *World Development* 30 (5), 763–782.
- Larson, A.M., Ribot, J.C., 2004. Democratic decentralization through a natural resource lens: an introduction. *The European Journal of Development Research* 16 (1), 1–25.
- Ligon, E., Narain, U., 1999. Government management of village commons: comparing two forest policies. *Journal of Environmental Economics and Management* 37 (3), 272–289.
- Lise, W., 2005. A game model of people's participation in forest management in Northern India. *Environment and Development Economics* 10 (2), 217–240.
- Marothia, D.K. (Ed.), 2002. *Institutionalizing Common Pool Resources*. Concept Publishing Company, New Delhi.
- Meinzen-Dick, R., Raju, K.V., Gulati, A., 2002. What affects organization and collective action for managing resources? Evidence from canal irrigation systems in India. *World Development* 30 (4), 649–666.
- Naidu, C.S., 2009. Heterogeneity and collective management: evidence from common forests in Himachal Pradesh, India. *World Development* 37 (3), 676–686.
- Oakerson, R.J., 1992. Analyzing the commons: A Framework. In: Daniel, Bromely (Ed.), *Making the Commons Work: Theory, Practice, and Policy*. ICS Press, San Francisco, pp. 41–59.
- Olson, M., 1965. *The Logic of Collective Action: Public Goods and Theory of Groups*. Harvard University Press, Cambridge, MA.
- Ostrom, E., 1990. *Governing the Commons: The Evolutions of Institutions for Collective Action*. Cambridge University Press, New York.
- Ostrom, E., Gardner, R., Walker, J., 1994. *Rules, Games and Common-Pool Resources*. University of Michigan Press, Ann Arbor, Mich.
- Petty, J., 2003. Social capital and the collective management of natural resources. *Science*, 302 (5652), 1912–1914.
- Poteete, A., Ostrom, E., 2003. Institutional mediation of group characteristics and the consequences for collective action. Working Paper No. W03-12. Workshop in Political Theory and Policy Analysis Indiana University, Bloomington, IN.
- Rangan, H., 1997. Property versus control: the state and forest management in the Indian Himalaya. *Development and Change*, 28 (1), 71–94.
- Reddy, V., Ratna, Behera, Bhagirath, Mohan Rao, D., 2001. Forest degradation in India: extent and determinants. *Indian Journal of Agricultural Economics* 56 (4), 631–651.
- Richards, M., 1997. Common property resource institutions and forest management in Latin America. *Development and Change* 28 (1), 95–117.
- Runge, C.F., 1986. Common property and collective action in economic development. *World Development* 14 (5), 623–635.

- Sarin, M., 2001. Disempowering in the Name of Participatory Forestry? Village Forests Joint Management in Uttarakhand, Forest, Trees, and People Newsletter No. 44.
- Seabright, P., 1997. Is co-operation habit forming? In: Dasgupta, P., Maler, K.G. (Eds.), *The Environment and Emerging Development Issues*, vol. 2. Clarendon Press Oxford.
- Sethi, R., Somanathan, E., 1996. The evolution of social norms in common property resource use. *American Economic Review*, 86 (4), 766–788.
- Sundar, N., 2000. Unpacking the 'joint' in joint forest management. *Development and Change* 31, 255–279.
- Tang, S.Y., 1992. *Institutions and Collective Action: Self-Governance in Irrigation*. Institute of Contemporary Studies, San Francisco.
- Varughese, G., Ostrom, E., 2001. The contested role of heterogeneity in collective action: some evidence from community forestry in Nepal. *World Development* 29 (5).
- Wade, R., 1988. *Village Republic: Economic Condition for Collective Action in South India*. Cambridge University Press.