Article

Role of Monitoring in Institutional Performance: Forest Management in Maharashtra, India

Rucha Ghate and Harini Nagendra

Abstract: *In this article we examine the role of 'monitoring', believed to be crucial for effective participatory common property management. While governing a common pool resource such as forests, there may be conditions that tempt individuals to cheat and gain substantially higher benefits. This is disadvantageous for other participants, and can adversely affect resource condition. Monitoring includes ensuring rule compliance, dealing with infractions and guarding forest areas against outsider entry. Here we examine the impact of institutional structure on monitoring and, consequently, on the effectiveness of forest management. We examine the three most frequent approaches in India, namely community-initiated management, non-governmental organisation (NGO) promoted forest management, and state-sponsored Joint Forest Management (JFM). Through a comparison of 3 case studies in the Gadchiroli district of Maharashtra in central India, we conducted a detailed comparison of forests that are situated in similar bioclimatic conditions and similar social environments. We assess community approaches to monitoring using detailed social interviews with communities and integrate this with an analysis of forest condition at the tree, sapling and seedling level using forest plot data. Our findings indicate that local enforcement has been most effective in the case where forest management was initiated by the community, with*

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better regeneration, and negligible evidence of grazing and fire. Inefficient monitoring was apparent in the state-initiated JFM village, with uncontrolled grazing and fire, leading to heavy damage to the forest. In the third case, with NGO-promoted forest management, greater importance was given to protecting the resource from outsiders, while neglecting the overuse of forest products by the community members.

Keywords: institutions, rule compliance, forest condition, monitoring, India

INTRODUCTION

THE CRUCIAL ROLE played by institutions in the context of resource governance is increasingly being recognised in development studies. Institutions, viewed as a 'set of rules actually used' (Ostrom 1992:19) or 'rules of the game in society' (North 1990: 3) are important transaction cost-minimising arrangements. In situations such as those widespread in the developing tropics, where human beings and forests co-exist in an intricately intertwined web of interdependencies, the sustainability of resource extraction largely depends upon the existence of, as well as adherence to, rules governing the common property resource (Gibson et al. 2005). As rule structures, community-based institutions minimise transaction cost because people themselves develop the 'do's and don'ts' suitable for particular situations.

Forest ownership and management in most parts of India are entrusted with the state (Guha 1983). Yet, a significant fraction of local communities who are dependent on the forest have developed *de facto* arrangements for use and management of forests over very long periods of time (Gadgil and Guha 1992; Gadgil and Subash Chandran 1992). It is only recently, however, that participation of communities in forest management has received *de jure* acceptability. Participatory policies are now being considered relevant and consistent with India's overall development strategy of reducing poverty and protecting the environment. But this understanding has come after a prolonged experience of dwindling forest cover under centralised forest management (CSE 1982).

With the introduction of Joint Forest Management (JFM) in 1990, a dramatic shift took place in the approach of the government towards the forest-dwelling communities. It changed the expectations as well as the relationship between the communities and the Forest Department. Much before JFM became a programme of the government, however, community-initiated and NGO-promoted 'collective action'-based resource management had emerged sporadically throughout the country. Studies in different parts of the country (Gadgil and Berkes 1991; Gadgil and Guha 1992; Gadgil and Subhash Chandran 1992; Ghate 2000, 2003, 2004; Pathak and Gour-Broome 2001, to cite just a few) point to the existence of communities that were consciously maintaining and man-

aging the forests within their village boundaries, with or without *de jure* rights.

All communities do not act collectively to protect their natural resources—neither do all those who chose to do so succeed in their task (Gibson et al. 2002; Dietz et al. 2003; Ghate 2004). However, repeated studies in different parts of the world have shown that when the users of a common-pool resource organise themselves to devise and enforce some of their own basic rules, they tend to manage local resources more efficiently than when rules are externally imposed on them (Tang 1992; Wade 1994; Baland and Platteau 1996). This has raised interest amongst scholars regarding factors that are most important in achieving successful management of local resources. A number of variables have been identified as being associated with high level of sustainable management of resources (Agrawal 2001). Successful institutions depend on the ability of users to devise rules for access to and maintenance of a common-pool resource (Stern et al. 2002). Compliance to rules is also found to be extremely important for effective functioning of an institution. Forest protection and enforcement of rules are considered key factors in the improvement of forest condition (Yadav et al. 2003). There is compelling evidence that subjects voluntarily contribute resources to monitor and sanction others who are non-cooperative in collective action because rule enforcement is necessary to maintain cooperation (Tang 1992; Lam 1998; Gibson et al. 2005).

Monitoring includes aspects such as ensuring rule compliance, dealing with infraction, and guarding/patrolling forest area from outsiders. Three large-N meta-analyses of research on the commons have identified monitoring to be a crucial factor that determines institutional effectiveness. Wade (1988, 1994) suggested that ease of monitoring and enforcement are critical conditions that determine the effectiveness of rules. Ostrom (1990) included monitoring as a critical component that accounts for institutional effectiveness. Finally, in the third of these influential, large-N reviews of literature on the commons, Baland and Platteau (1996) have also stated that effective enforcement mechanisms are necessary to achieve cooperation.

Effective monitoring, however, is not easily achieved. Substantial investment has to be provided by the local communities in terms of manpower and money. Communities also need to have developed an effective idea about what they are monitoring, and select quantitative or qualitative indicators to evaluate changes in ecological condition. In this article, we present a study of three communities (namely Deulgaon, Ranvahi and Markegaon) located within different institutional structures (namely community-initiated, NGO-supported and JFM-sponsored) and evaluate how these institutional regimes have adopted different monitoring strategies, and what their impact has been on forest condition. Although all the three communities are presently covered under JFM, forest protection and development of rule structure were different for the three communities. Using field-based indicators of forest condition to assess the state of their forests, we relate these to the nature of monitoring ac-

tivities. Our objective is to assess which of these institutional approaches has succeeded in protecting its resource base more effectively. In addition, since factors such as population size, per capita forest area available, socio-economic and cultural factors, property rights regime, dependence on the resource, and distance from the market can influence collective action as well as the state of the resource, we have tried to ensure the comparability of these variables across our case studies (Table 1).

METHODS

The data for the study has been collected through research instruments developed by the International Forestry Resources and Institutions (IFRI) research programme (see Gibson et al. 2000; Poteete and Ostrom 2004). IFRI, based at the Workshop in Policy Analysis, Indiana University, USA, has developed a set of ten research instruments to facilitate collection of information about demographic, economic and cultural characteristics of communities dependent on forests. IFRI uses rigorous forestry techniques to measure the impact of institutions regulating the use of forest products. Given the inherent difficulties involved with creating and collecting standardised data sets for monitoring forest conditions in developing countries (Danielsen et al. 2000), a data set of this kind provides a valuable opportunity to analyse forest conditions using information collected based on a uniform protocol (Nagendra 2002).

Biophysical data determining forest condition and indicating the success of monitoring in the three respective institutional structures was collected from 30 temporary forest plots[1] laid in each of the three forests. The distribution of plots was carefully determined, keeping in mind the major objective of the study, i.e. to assess variation in forest condition. A team of researchers, consisting of economists, sociologists, botanists and three local villagers, stayed in each of the three villages for a week to collect the information through IFRI protocols.

A sub-set of this data is used for analysis in this paper. We first provide a summary of the history of development and institutional characteristics of the three communities with emphasis on monitoring. This is followed by an analysis of the data on forest condition and structure. By linking the information on changes in forest condition with our indicators of human interference and extraction, we have assessed the effectiveness of the different institutions.

Monitoring and Forest Condition

Frequency of infractions, compliance with harvesting rules and the strictness in dealing with infractions were used to assess the level of efficiency of monitoring in each of the three villages. A well-organised and competent monitoring mechanism has been adopted in Deulgaon. The first instance of rule-breaking is met with relatively harsh punishment, which further increases in severity when offences are repeated. In contrast, penalties are mild, and rule compliance is limited in the other two communities.

Table 1

Basic details about the study villages

Villages	Deulgaon (Self-initiated)	Ranvahi (NGO-promoted)	Markegaon (JFM-sponsored)
Latitude Longitude Mean sea level	20°15′16.0′ N 80°11′41.4′ E 230 meters ASL	N 20°30′22.8′ N 80°21′37.7′ E 250 meters ASL	20°14′42.3′ N 80°19′59.6′ E 250 meters ASL
Location	18 km from Dhanora, the sub-district (Taluka) of Gadchiroli district of Maharashtra	25 km from Kurkheda town, the Sub-district of Gadchiroli district of Maharashtra	5 km from the sub-district center that is Dhanora in Gadchiroli district of Maharashtra
Geographical area	718.48 ha	924.43 ha	530.29 ha
Forest area	601.37 ha	641.71 ha	431.44 ha
Per capita forest	3.5 ha	2.4 ha	2.7 ha
Population	173	393	161
Number of households	33	81	32
Three main ethinc/caste groups	70% = *Gond* (tribals) 30% = *kunbi* (OBC)	96% = *Gond*, 1% = Scheduled Caste, 1% = nomadic tribe, 2% = Others	*Gond* = 100%
Languages spoken	Marathi and Gondi	Marathi and Gondi	Marathi and Gondi
Literacy	51%	62.84%	48%
Houses	Mud and brick with tiled or thatched roofs	Mud and brick & concrete houses with tiled roofs	Mud and brick with tiled or thatched roofs.
Main occupation	Agriculture	Agriculture	Agriculture
Land owners	33 households	62 households	30 households
Land holding (average)	3 acres	4 acres	3.72 acres
Crops grown	Paddy, *tur, lakhori* (pulse), *jawar, chana*, etc	Paddy, *chana* and *tur, cilliy* (cash crop)	Paddy, *tur, mung, urad*, beans, *kurat*
Own crop consumed	8–9 months	8–9 months	8 months
Forest dependence	Fuelwood, fodder, timber, wildlife, minor forest products like *awala*, *hirda*, *moha*, *Tendu* leaves, *char*, etc.	Fuelwood, fodder, timber, bushes, grasses, leaves (*tendu*), water, wildlife, fruits, vegetables, bamboo, *Moha* flower, gum, etc.	Fuelwood, fodder, timber bushes, grasses, leaves (*tendu*), water, wildlife, agricultural implements, hunting gears, herbs to make pesticides for crops, storage utensils, kitchen implements, livestock sheds, furniture, toys, headgears for marriage purposes and other items like carved pillars made especially for marriages, grain crushing implements, etc.

Has better monitoring in Deulgaon resulted in an improvement in the forest quality? We conducted a quantitative evaluation of forest mensuration data to understand the relationship between monitoring and forest condition. A suite of botanical indicators were employed for this purpose. Tree height and diameter at breast height (DBH) were used to indicate the maturity of the forest. Species diversity, frequency, density and abundance of trees and saplings were used to determine the relative performance of a particular species, and assess overall forest quality. We analysed the impact of monitoring on forest regeneration as evidenced by the number of seedlings, saplings and young trees. Finally, we compared the degree of destructive or extractive human and livestock impact on forest plots sampled in all the three study sites. Forest data was collected from thirty circular plots laid in each study village.

Vegetation data was quantitatively analysed for frequency, density and abundance (Mishra 1968). Relative frequency, relative density and relative abundance were determined following Phillips' (1959) method[2]. Species richness was treated simply as the number of species per unit area (Whittaker 1972).

Study Sites

Gadchiroli is one of the eleven districts of Vidarbha, in Maharashtra State (India). Most of the forest in the state is concentrated here. Yet, the per capita income of Gadchiroli district is 48% less than the State average. The total geographical area of the district is 14,412 km^2, which works out to 4.68% of the State. Of the total forest yield, 61.34% comes from this district. Population density of the region is very low, only 0.99% of the state's population resides in this district, and 38% of it is tribal population. More than half the population of the district is below the poverty line despite being surrounded by rich forest resources.

As the three villages fall under the same bio-climatic zone, there are no perceivable differences in climatic conditions. The region receives around 1420 mm of rainfall annually. The forests belong to the dry deciduous category. The dominant floral species include *Cliestanthus collinus (garadi), Anogeissus latifolia (dhawda), Tectona grandis (sagwaan)* and *Terminalia alata (ain).* The soil type and condition does not vary much among the three forests. The soil was found to be uniformly shallow and severely pest-infected in all the forests. Soil type varies from sandy silty loam to clay in Ranvahi, from sandy loam to silty clay loam in Deulgaon and from loam to silty sandy clay loam in Markegaon. The Deulgaon forest is located on uniformly flat land, while Ranvahi has a moderate topography with gently sloping landscape, and the Markegaon forest is on much higher elevation with low gradient slopes.

The three forests have different histories. While the Markegaon forest is still a part of a larger forest with little human pressure to deal with, Deulgaon

forest was a highly degraded forest even a decade ago. The Ranvahi forest, though slightly better than the Deulgaon forest, too was in a degraded state when the community started its protection efforts with the help of an NGO. Thus, the starting points of protection for all three communities are different. The variation in terrains and location has also created differences in circumstances for the forests and the forest management institutions. The Markegaon forest, located in hilly and rough terrain, is relatively inaccessible to outsiders. Hence, even though the harvesting rules and monitoring are not undertaken very sincerely in the village, the forest has retained old and full-grown trees of vast girths. In case of Deulgaon and Ranvahi, however, the human pressure both from inside and from neighbouring villages is very high as quite a few of villages with no or very little forests of their own are located around these forests. In addition, both the forests are close to the highway, making it easier for unauthorised harvesters to approach, cut trees and remove them from the landscape without being caught. Under such circumstances, the efforts on the part of the community need to be doubled to protect the forest that is vulnerable to threats.

RESULTS

The Three Case Study Villages

Three case studies have been selected, each representing one of the three institutional structures. The Deulgaon community members initiated forest management themselves, while in Ranvahi, forest management began after initiation and support from a local NGO. In the case of the Markegaon forest, protection began after the forest was included within the JFM programme. We present here a brief account of the genesis of collective action in forest management, and a discussion of other institutional factors including evolution of rules, methods to deal with rule infractions, monitoring and benefit sharing.

The Deulgaon Community

Conceiving the idea of forest protection—from within the community

Perceptions of salience and scarcity of the forest as a critical resource and awareness of the impact of forest degradation in limiting water availability, prompted a local movement towards forest conservation in this village. The indiscriminate felling of trees by neighbouring villages had had an impact on the Deulgaon forest. In addition, the loss of employment opportunities traditionally provided by forest contractors for harvesting *tendu* leaves (*Diospyros melanoxylon)* created additional problems.

There was initial uncertainty whether the Deulgaon forest was within their village boundary or not since no land survey had taken place after 1922. In

1988, shortly after a new land survey was conducted demonstrating that the forest was located within the village boundary, the local police *'Patil'* (a person nominated by the Police Department) Raoji Dev Madavi and a local resident Marutrao Kaluram Gedam were successful in building a consensus in the community to halt all the activities that led to deforestation. In 1990, following several informal meetings, the community decided to stop neighbouring villagers from harvesting from the Deulgaon forest, as well as to impose restrictions on themselves.

A unanimous decision was taken to allow each household to harvest for internal use, and to disallow additional extraction for sale. This was the first simple rule introduced by the community. No formal forest association was formed. Gradually additional operational rules were formulated, to define the quantity of forest products that could be harvested sustainably, monitor compliance to rules, sanction rule breakers and arbitrate dispute among local users. Daytime patrolling by the community members was started where two persons (male and female) were sent from two households everyday, throughout the year on a rotational basis.

Maturing of the institution

These informal efforts of the community towards forest protection continued, enabling natural regeneration. The village lacked access to funding or technical support for planting or maintenance activities to increase the stock and quality of the resource. In 1998 a formal Forest Protection Committee (FPC) was constituted, with an executive committee and a general body, where the office-bearers and the members of the executive body held office for a year. In 2000, this FPC was formally registered as a JFM user group under the name of *'Samyukt Van Vyavasthapan Samiti'* (Joint Forest Management Committee).

Formulating rules for forest governance

Following registration in 2000, the general body of the association consists of one male and one female member from each household. All members are eligible to participate in the meeting that is held once a month, and on an average is well attended. The decisions related to forests are taken only in the general body meeting, as was the case before the JFM committee was formed. No separate executive committee meeting takes place. Forest patrolling is conducted strictly. Independent of the rules under JFM, the community continues to follow the rule structure they had previously developed regarding harvesting, monitoring and sanctioning. There are restrictions on the felling of some trees even for self-consumption, e.g. species like *tendu*, *moha*, gums that have traditional value and are regular suppliers of leaves, flowers and fruits. Similarly, there are restrictions also on harvesting trees below a certain minimum

girth. Only dead wood and fallen branches are allowed to be collected for fuel. Sale of timber, fuelwood and fodder is not allowed. In case a household asks to harvest more than the permitted requirement, it has to submit the request at the monthly meeting, where a decision is taken unanimously. During the general body meetings, suggestions from all members are invited, discussed and implemented only if accepted unanimously.

Monitoring

Monitoring of rule conformance by the community members and protection of the resource from outsiders are essential for effective forest management. This community undertakes both these activities seriously. The community strictly protects its forest from outsiders, and there have been several instances when the village guards have caught people in the process of stealing forest products. Implements used for felling trees and bullock carts used for transporting the timber have been confiscated. There have also been instances of verbal and physical fights wherein the police had to be summoned.

Interestingly, even after formation of the FPC under JFM, members of Deulgaon village prefer to approach the police rather than the Forest Department, since communication and coordination with the Forest Department is not satisfactory. In the past three years, on a couple of occasions when the Deulgaon FPC had caught timber poachers in their forest and reported the incidents to the Forest Department office, no action was taken against the poachers. Therefore, now the community deals with poaching by itself and even imposes fines. The fine money, in turn, is ploughed back into forest protection work. This is done informally without any legal authority of the community.

Instances of rule infraction by community members are few and have decreased over the years as the community has developed an increased sense of purpose and responsibility. Since the rules were strictly implemented with monetary sanctions right from the beginning, compliance has been increasing. A graduated penalty structure has been built wherein the fine increases with the frequency of the infraction. These penalties are decided by the vote of the executive committee members and are enforced by an official of the association. The rules and regulations formed have been developed by the community over the years, and modified based on experience. Almost everyone in the community is aware of these rules and considers them as clear to understand, flexible to the needs of the people, fair and legitimate.

The Ranvahi Community

Conceiving the idea of forest protection—through NGO effort

In this village the seeds of the idea for forest protection were sown by a local NGO called, '*Amhi Amchya Arogya Sathi*' (AAA). It all started from a '*Sakhi*

mela' (an all women get-together) that was organised in 1995 by AAA. Umakantabai, of the Ranvahi community was impressed by the experiences of other villages that had taken initiatives towards forest protection. She along with some fellow villagers collectively decided to work towards convincing the community to take up forest protection. Simultaneously, efforts by the NGO also continued. Convinced of the need for forest protection, the Ranvahi community applied to the Forest Department for being included in JFM, thereby ensuring constitutional backing to their activities.

Inspired by the NGO, the Ranvahi community had already started protection work on its own. Protection was needed mainly from the poachers belonging to the neighbouring villages, who lacked access to forest resources of their own. While these poachers and other non-residents were prevented successfully from harvesting from this forest, excessive harvesting by the Ranvahi community continued unchecked. Estimations by some villagers found a great deal of overharvesting—for instance, each household harvested 20 cartloads of fuelwood on average, which is almost three times the present rate.

The community then decided to limit excessive harvesting. Such decisions were taken either in the '*Gram Sabhas*' (village meetings) that were held on regular intervals, or in informal meetings held in response to local needs. Since the membership of these committees was initially all-male, AAA further suggested and encouraged participation by the women. The community started 24 hour patrolling before the formal constitution of an FPC. Protection of the forest from external and internal users was the only forest management activity, and banning excessive timber and fuelwood was the only rule till 1998. After this, the application to register under JFM was finally accepted and a FPC (with two members, one man and one woman from each household) was informally constituted. In 2001 it was formally registered under JFM.

Maturing of the institution

Under the JFM arrangement, an executive committee consisting of seven members was formed along with the general body wherein one man and one woman from each household became members. The executive body has a term of five years. Even today, the functioning of the association remains as it was before the introduction of JFM. Conventionally, all decisions are taken unanimously. FPC meetings usually discuss requests put forward by households for additional timber extraction for house construction. Revenue earned through forest contracts is distributed by the association among households according to the work done.

Formulating rules for forest governance

In the past five years, the association has coordinated activities like forest protection, determining the quantity of forest products that can be harvested, de-

termining who is authorised to harvest these forest products, monitoring the condition of the forest, monitoring conformance to rules and sanctioning rule breakers. To ensure smooth functioning of the forest-related activities, the association has framed rules, with the guidance of the AAA. The community is aware of the rules that govern the association, and considers them easy to understand and unambiguous in defining infractions. The rules are kept flexible in the interest of the community, taking into consideration times of emergency and the changing needs of its members. Pole harvesting for household construction is generally limited to ten per year, but this can be increased based on local need, subject to payment. No trees can be felled for fuelwood. For fodder, there is no limit fixed on the quantity that can be harvested and open grazing is generally practised. The sixty-hectare plantation set up under JFM is however closed to grazing.

Monitoring

For rule infractions, the provision is to pardon the offender on the first and second occasion either with a warning or with a small penalty. But on the third occasion, there is a provision to expel the member from the association. The kinds of penalties to be imposed are normally decided by a vote in the user group, and the members of the executive committee impose the fine. In case a person refuses to pay the fine, there is a provision that his harvesting rights can be totally withdrawn. By apologising publicly in one of the association meetings, it can restore the offender's rights. The community does not call on Forest Department officials to enforce penalties on the community members.

The FPC does not deal with the infractions within the community severely. This lenient attitude is at the instigation of the AAA which does not want to antagonise community members as it has planned other projects in the village for which it requires local support. The consequence of this leniency is increased rule infraction amongst the community. If a member goes unpunished even after repeated offences, those members who follow the rules find it unjust as the rule breaker ends up in an advantageous position. Thus, some members now express an increasing sense of discontent with the organisation.

While internal infractions remain unpunished, the community takes strict action against external offenders. Poachers from neighbouring villagers are taken to the nearest forest office when caught, where a fine is imposed, and a certain percentage is given to their association. However, non-conformance of rules by the members of the community is affecting the institution. Open grazing is also evident in the forest.

The Markegaon Community

Conceiving the idea of forest protection—an influence of JFM

Markegaon started forest management activities with the JFM programme in 1997, by setting up a formal FPC. Only a few residents felt the need for forest protection, and the community was not united on this issue, although difficulties in harvesting forest products and rising conflicts with intruders rose continuously. It took two years for Chatura Halami, a committed local resident, to convince the community of the need to protect the forest for the benefit of present as well as the future generations. A consensus to this effect was slowly developed. Subsequently the FPC was formed under JFM in 1997, and the forest association registered in 2000. An executive committee of the association was formed where eight men and three women were elected from the general body (constituted by one male and one female member from each household). In the first meeting of the FPC, the villagers decided on three types of restrictions: restriction on free grazing ('*Charai Bandi'*), restriction on liquor consumption ('*Nasha Bandi'*) and restriction on tree felling ('*Kurhad Bandi'*). Under the JFM scheme, the local office of the Forest Department promised to provide funds for plantation and soil-conservation.

Maturing of the institution

After the initial phase of experimentation and exploration, the meetings of the association are held once a month where all members are eligible to participate. The attendance in these meetings is normally fifty per cent, despite a provision of fine of two rupees for every member who does not attend consecutive meetings. Decisions in these meetings are normally taken regarding the poaching of bamboo and thefts in the plantation areas. Such instances are brought to the notice of the persons responsible for patrolling the forest. Suggestions are invited from members for improvements to be made in the vigilance or in restrictive rules. Payment of fines also takes place in these meetings.

Formulating rules for forest governance

The association has a written statement of its mission and objectives, which is based on the Forest Policy of the Government of India 1988, and the World Bank-funded Government of Maharashtra JFM programme. However, the community itself is mostly unaware of these provisions and has developed *de facto* rules that are in force. For forest-related activities, the villagers are paid on a daily basis, while protection work is done voluntarily. Three persons from three households go everyday for a twelve-hour vigil from eight in the morning till eight at night. No over-night patrolling is considered necessary, as the villagers believe that thefts are not possible at night due to the difficult terrain of the forest.

There are well-defined provisions to meet various forest-related requirements of the community. New trees are not allowed to be cut for timber, especially valuable trees like *tendu (Diospyros melanoxylon)*, *awla (Phyllanthus emblica)*, *moha (Madhuca longifolia)*, which are of use for their leaves, flowers and fruits. Only one pole per year per family is allowed for house construction. Only fallen wood and stems can be harvested for fuelwood. One cartload of fuelwood in a year is free and Rs 5 is charged per additional cartload harvested. For all extra requirements, an application has to be submitted to the FPC. To meet grazing requirements, open-grazing for nine months of the year has been allowed, except in the plantation area. For this purpose, each household has to carry a livestock-grazing permit for which one rupee per year is charged.

Monitoring

Of the three communities, the Markegaon FPC is the most lenient in terms of monitoring, rule compliance and patrolling against outside poachers. Despite the presence of a complex and elaborate rule structure, a large number of infractions take place. Households often exceed the permitted limits of extraction. However, penalties are not strictly imposed and the offender(s) is let off in the first couple of infractions. The incidence of anyone losing his/her harvesting rights has not occurred as yet. These rules have been developed by a few enthusiasts in the community and have not been unanimously adopted in general body meetings, as was the case with Deulgaon and Ranhavi. Therefore many members and even the Forest Department are unaware of the rules. The Forest Department does not play any role in framing the rules, fixing penalties or dealing with infractions.

Protection of the forest from outsiders has also been unsuccessful in the last four years. Neighbouring villagers poach bamboo from the Markegaon forest area, as their forests lack bamboo. This act is however overlooked by the FPC. Since Markegaon has started protecting its forest before it could get highly degraded, little efforts have paid high dividends for the community. Difficult terrain and distance from all-weather roads are factors that have proved to be the natural protectors of the Markegaon forest. The impact of uncontrolled grazing and tree felling is however clearly visible in the forest.

Forest Data

Analysis of mature trees

The trees in Markegaon have a significantly larger DBH on average compared to Deulgaon and Ranvahi (Mann–Whitney U test $p < 0.05$). The difference between trees in Ranvahi and Deulgaon was not statistically significant. The tallest trees were found in Markegaon, followed by Ranvahi, and Deulgaon—these differences were also statistically significant (Mann–Whitney U test

$p < 0.05$). Figures 1a and 1b show the differences in mean DBH and mean height organised by species for the dominant tree species in the forest, and shows that similar patterns hold across all species, with the largest and tallest trees generally found in Markegaon. The Deulgaon forest had the greatest diversity of tree species, followed by Ranvahi, and by Markegaon (significant using Mann–Whitney *U* test $p < 0.05$).

Figures 2a, 2b and 2c respectively indicate that relative frequency, relative density and relative abundance for most tree species are greater in Markegaon compared to the other two forests. However, *Terminalia alata* and *Cliestanthus collinus* (used frequently for house construction) prove an exception to this general rule, with higher relative frequency, relative density and relative abundance in Ranvahi, and lower levels in Markegaon and Deulgaon.

Figure 1

(a) Tree DBH (b) Tree height

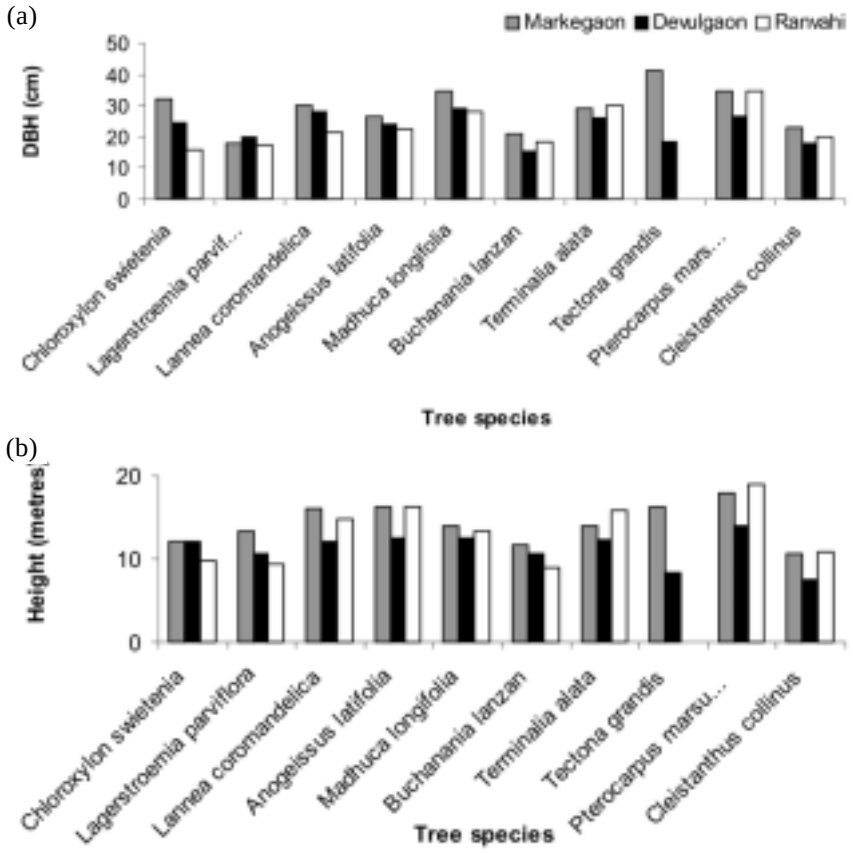
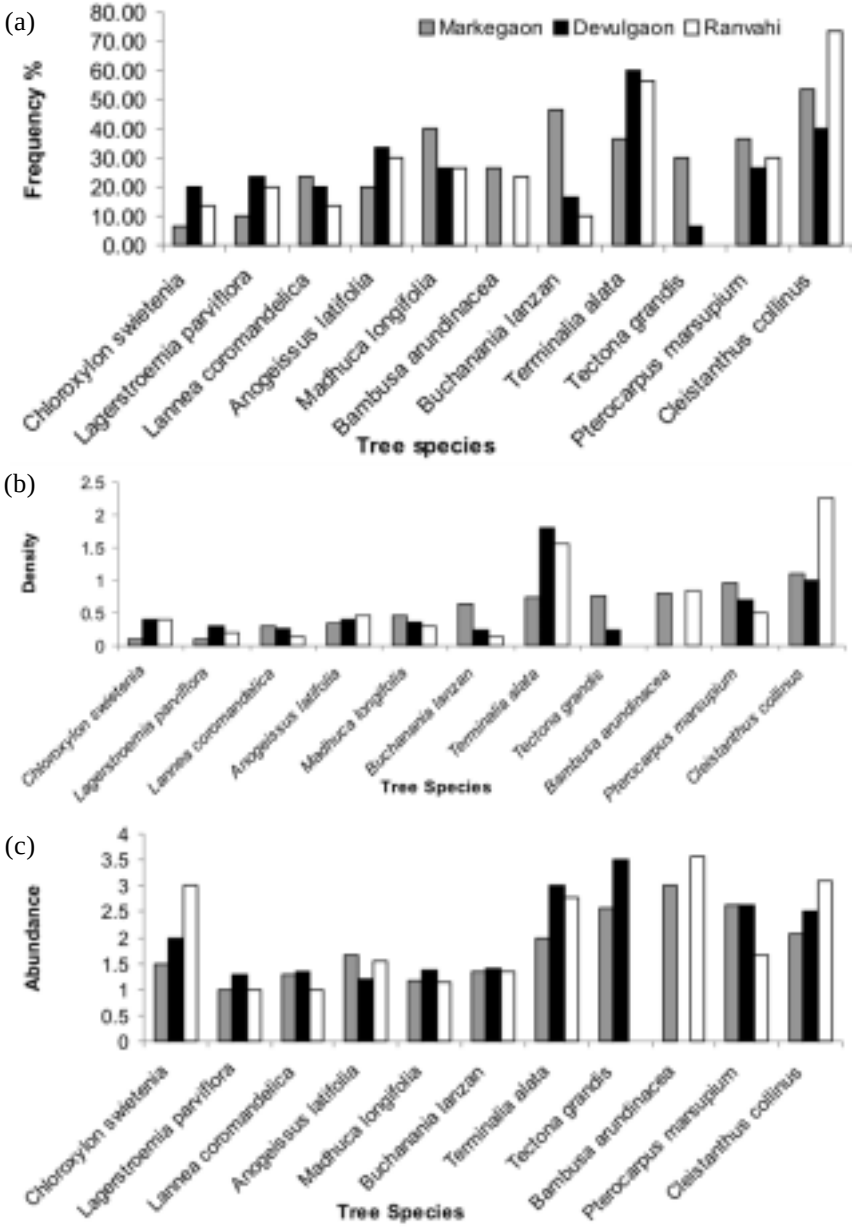


Figure 2

(a) Relative frequency, (b) density and (c) relative abundance of trees



Note: Frequency % = No. of Plots in which particular species occurred *100/Total no. plots studied. Density = Total no. of individuals of particular species occurred/Total no. of plots studied.

Regeneration

The number of trees inside the DBH class of 10–20 cm is an additional indicator of the status of forest protection. Ranvahi had significantly more young trees compared to Deulgaon and Markegaon (Mann–Whitney U test $p < 0.05$). The ratio of young trees to saplings in Deulgaon is 0.14, much higher than in Ranvahi (0.09), and in Markegaon (0.08). Markegaon had significantly fewer young tree species per plot than Deulgaon—however, sapling density and diversity levels were significantly higher in Markegaon than in the other forests (Mann–Whitney U test $p < 0.05$). Markegaon has higher relative frequency levels for most sapling species, with the exception of *Terminalia alata,* which is most frequent in Deulgaon (Figure 3a). The total absence of saplings of *Chloroxylon swietenia, Pterocarpus marsupium, Tectona grandis* and *Lannea coromandelica* in Ranvahi is to be noted. For most sapling species, relative sapling density levels are highest in Deulgaon followed closely by Markegaon and Ranvahi (Figure 3b). Saplings of *Terminalia alata, Madhuca longifolia* and *Buchanania lanzan* are especially dense in Deulgaon, while *Tectona grandis* and *Lannea coromandelica* are absent. Clumps of *Bambusa* and *Cliestanthus* are common in Markegaon. Though the density of almost all sapling species is low in Ranvahi, the overall density is high due to the large numbers of *Cliestanthus collinus* saplings. Sapling abundance varies across species (Figure 3c). While some species such as *Chloroxylon swietenia* and *Tectona grandis* are more abundant in Markegaon, others such as *Terminalia alata* and *Cliestanthus collinus* are more abundant in Ranvahi.

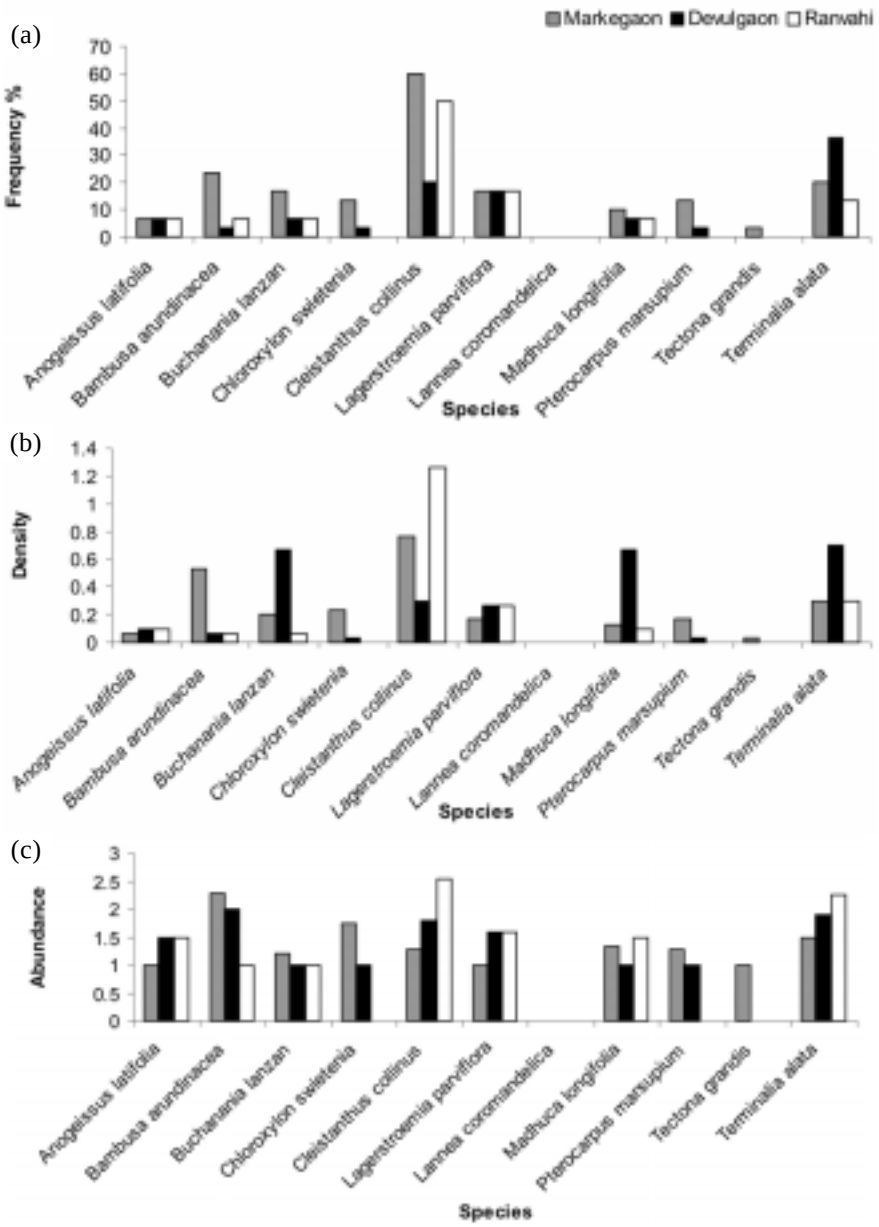
In Markegaon, the ratio of saplings to seedlings is 0.24, while in Deulgaon and Ranvahi it is much lower (0.08 and 0.06 respectively). The number of seedlings was maximum in Deulgaon (almost double those in the other two forests, Figure 4), followed by Ranvahi and Markegaon (Mann–Whitney U test $p < 0.05$). Similar trends were observed for species diversity, with Deulgaon having significantly greater seedling diversity levels compared to the other two forests, and Markegaon having the lowest levels of seedling diversity.

Disturbance

We found evidence of high intensities of grazing, in 66% of the Markegaon plots and in 87% of the Ranvahi plots, while only 20% of the Deulgaon plots were affected by grazing (Table 2). Similarly, the evidence of fire was observed in only 3% of the Deulgaon plots, compared to 17% in Ranvahi and 27% in Markegaon. A few instances of charcoal burning were recorded in Ranvahi and Markegaon, though not in Deulgaon. 40% of the plots in Ranvahi and 37% of the plots in Markegaon had evidence of tree felling, but we did not find any such evidence in Deulgaon (Table 2).

Figure 3

(a) Relative frequency, (b) density and (c) relative abundance of saplings



Note: Frequency % = No. of Plots in which particular species occurred *100/Total no. plots studied. Density = Total no. of individuals of particular species occurred/Total no. of plots studied.

Figure 4

Trees, saplings and seedlings per hectare

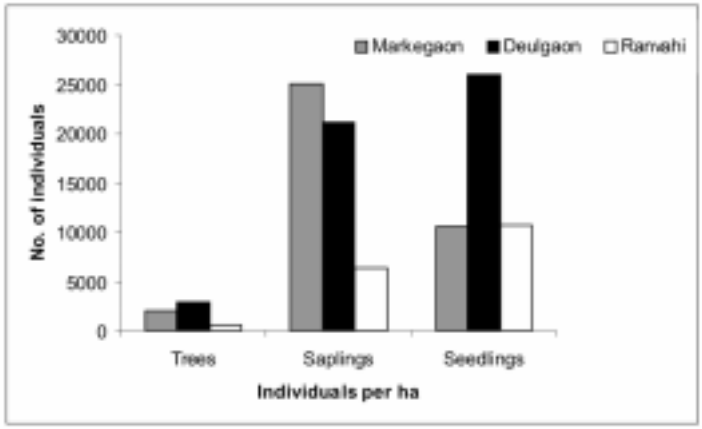


Table 2
Nature and extent of human disturbance in the three forests

Disturbance	**Number of affected plots**		
	Markegaon	**Deulgaon**	**Ranvahi**
Grazing	20	6	26
Tree felling (by the community or by outsiders)	11	–	12*
Charcoal burning	2	–	1
Fire damage	8	1	5

Note: *Two out of the twelve plots had evidence of bamboo cutting.

DISCUSSION

Direct Implications of Analysis

Deulgaon, the community where collective action was self-initiated, has the highest levels of monitoring—correlated with the highest levels of regeneration. In the two other villages, despite the existence of restrictions on forest extraction and sanctions for rule-breakers, the lack of enforcement of these rules has severely affected the effectiveness of monitoring. Our conversations with the communities in Deulgaon indicated that the forest in this region was severely degraded. We also find that these trees have lower DBH and heights on average, demonstrating that this forest has been steadily denuded of large trees through years of extraction. The perception of scarcity in a salient forest resource appears to have been a crucial factor motivating the community to

organise and protect the forest (Gibson et al. 2005). The absence of any signs of tree felling in the forest plots indicates that forest protection is effective.

For most sapling species, relative sapling density levels are highest in Deulgaon, indicating the impact of effective protection which will lead to the eventual regrowth of a dense tree canopy, if current efforts towards forest protection continue. However, it is important to note that the distribution of *Anogeissus latifolia, Chloroxylon swietenia, Madhuca longifolia* and *Pterocarpus marsupium* in the sapling layer is on the decline, while *Lannea coromandelica* and *Tectona grandis* appear to be severely impacted. *Lagerstroemia parviflora, Cleistanthus collinus, Terminalia alata* and *Bambusa arundinacea* are however found to have increased in number relative to other species, indicating that changes in community structure may be taking place. Given the relatively recent protection of the forest, however, it is not surprising that perhaps the most visible evidence of effective protection can be observed in the seedling layer. Deulgaon forest has almost twice the density of seedlings as in the other two forests, as well as a significantly greater diversity of seedling species. Thus, the time scale over which the forests of Deulgaon and Ranvahi have been protected has not been enough to ensure sustained survival of the seedlings into the sapling stage. This must be ensured if these forests are to achieve sustainable levels of regeneration. We found that grazing, fire and charcoal burning were found even in Deulgaon, in spite of efforts towards forest monitoring and ban on grazing.

In Deulgaon forest, which was in a highly degraded state a decade ago, the presence of a large number of individuals and species of young trees, sapling and seedlings demonstrates the impact of successful conservation efforts by the community, and is an indicator of a healthy, sustainable forest in the future. Most of the plots here show evidence of being highly degraded a decade ago. The potential that the forest now shows can therefore be attributed entirely to the efforts of the community institution, as the community did not have a very rich forest to begin with. The impact of strict monitoring, sanctioning and protection in Deulgaon is paying rich dividends and is an indicator of a dense, successfully regenerated and healthy forest for the future.

In Markegaon, the relative inaccessibility of the forest has acted to preserve it from severe degradation. As a consequence, although an FPC has been constituted through impetus from the JFM programme, a large fraction of the community does not perceive the forest to be a scarce resource. The FPC user group finds it difficult to build consensus on the need to restrict forest extraction and preserve the forest. The protection efforts in this forest appear to be limited to a prohibition on cutting down older trees. The largest and tallest trees are therefore found in this forest. The fact that Markegaon has a lower tree diversity despite having a larger number of mature trees and a thicker canopy can be explained by the selective extraction of certain high value tree species and lower regeneration levels due to lack of effective protection against fire, grazing and timber lopping (Table 2). While the relative fre-

quency of most mature tree species is greater in Markegaon, *Terminalia alata* and *Cliestanthus collinus* (used frequently for house construction) have lower relative frequencies. Thus, it appears that the lack of effective monitoring in Markegaon has led to selective extraction of high value timber.

Finally, in the third community, Ranvahi, the impetus to organise and protect the forest has been provided by a local NGO. While this community has been active in preventing timber poaching by outsiders, the NGO discourages sanctioning of internal offences by community members, which has led to dissent within the community. The impact of this is evident on the forest, which has retained some high value timber trees after the ban on poaching, but has limited regeneration because of their inability to limit grazing and fires. The high relative frequency of *Terminalia alata* and *Cliestanthus collinus* trees indicates the results of this community's strenuous efforts against timber poaching. However, the low overall density of saplings and the total absence of saplings of *Chloroxylon swietenia, Pterocarpus marsupium, Tectona grandis* and *Lannea coromandelica* is a sign of concern for the future of the forest in the absence of a new generation of these formerly dominant species. Grazing, fire and charcoal burning was evident in a large number of the forest plots in Ranvahi, even though *Charai Bandi* (ban on grazing inside the forest) has been adopted as a major resolution of the FPC. This can explain the decrease in seedling regeneration in this forest compared to Deulgaon.

Lessons and Policy Inputs

Our findings indicate the crucial role played by monitoring in impacting the cohesiveness of institutions, as well as the success of forest management initiatives. It is clearly essential to ensure rule compliance by community members, as well as protection from poaching by outsiders, in order to ensure effective management of degraded and dense forests. Monitoring is a necessary condition for the long-term sustainability of participatory CPR regimes, in order to guard against conditions that tempt individuals to cheat and gain benefits to the disadvantage of others (Ostrom 2000). When sanctions are strictly enforced, they prevent the spread of free-riding behaviour, thereby instilling a sense of trust in the community. It is essential to provide conditions that facilitate a sense of justice and fair play in the participants, by ensuring that all individuals who break the rules will be sanctioned irrespective of their position in the community.

The impact of monitoring by communities depends critically on the state of the forest at the time of handing over of management to communities. If a community is assigned a forest in poor condition, it would be difficult to assess the impact of rule conformance in the short-run (Nagendra 2002). It is clear from the example of Deulgaon that it takes a much longer period and greater effort on the part of the community to rejuvenate a degraded forest. It is difficult for the community, however, to sacrifice short-term benefits for

longer term and uncertain future benefits. The degraded forestlands close to villages in India show dependence of the rural communities on the forest and their inability to reduce it, in the absence of alternatives. Since provision of alternatives to forest products is expensive, the Forest Department needs to provide the necessary motivation for the communities to take up forest protection. Restriction of self-consumption needs to be awarded with some incentive.

In contrast, the study in Markegaon shows that if the community has a well-stocked resource to begin with, a little protection can generate substantial benefits. In such a case, the collective efforts of the community can be put to optimum use, as the natural regenerative capacity of the forest is already at its best. Thus, even though monitoring is weak and not very effective in Markegaon, the little protection that the community has provided has resulted in maintaining richness of the forest; it has not adequately ensured regeneration in the seedling layer. In these situations, the Forest Department has a crucial role to play. Apart from creating awareness among the community, it needs to create effective incentive structures for the community to protect the resource. In the absence of such attention by the Forest Department, these dense forests might be reduced to a completely degraded state before they are provided protection.

The study of Ranvahi establishes the importance of the role of NGOs as co-ordinating and facilitating agencies between the state and the community. The efforts of formal and informal institutions can often be synchronised by an NGO. As stated earlier, out of the three villages, Ranvahi maintains the best relationship with the Forest Department owing to its association with AAA. This has been useful in implementing the JFM resolutions. However, total reliance on NGOs, who might have their own agenda or objectives, is not desirable for sustainability and independence of any institution. Our results thus indicate the need for a proactive role by the state both in supporting community-initiated forest protection efforts and in motivating the communities for participation in such efforts. NGOs can play a useful role in catalysing this process, and encouraging coordination between the protection efforts of the communities and the forest department.

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Notes

1. The purpose of the *Forest Plot Form* was to record names, extent of cover and the size of plant species within each forest. The information collected on each plot was aggregated to describe the forest as a whole. Important values of tree species based on density, frequency and dominance, as well as diversity indices, could be readily calculated from this data. Biodiversity, size class structure, and abundance of plants ranked as priority species by local user groups could also be calculated. This method required placing a grid over a map of the forest and, using a random number table, selecting coordinates of a 'random point' in the forest. Using the table of random numbers, three nested plots were located, with an outermost circular plot of 10 m radius used to collect information on the tree layer, an inner plot of 5 m radius to collect information on the shrub and sapling layer, and an innermost 1 m plot used to sample the herb layer. The team located the random points in the forest by using established landmarks such as streams, trails, or large trees that have been marked on the map. For this study, a Geographical Positioning System (GPS) was used for identifying the marked plots. Once the pre-determined plot was reached, the centre was marked with a stick or surveying flag, and a boundary of the 1-m radius circle was also marked. The other two circles were marked by walking around the centre stake at radial distances of 3 and 10 m. Once the plot was demarcated, measuring and counting plants started in the small circle, working outward. Ground cover included species of grass and other ground cover. In the 3-m circle all the saplings, the diameter at breast height (DBH) and height was taken, and in the 10-m radius circle, DBH and height was enumerated for all trees with the help of a clinometer.
2. The relative frequency of a species is defined here as the percentage of sampling units (forest plots) in which the species is encountered.
3. Relative frequency = Number of plots in which the species occurred × 100/Total number of plots studied.
4. Relative density is the density of the sapling/tree species under consideration over the density of saplings/trees of all other species.
5. Relative abundance is calculated by dividing the density of a particular species by its frequency.
6. Relative abundance = Total number of individuals (tree or sapling) of a particular species (density)/total number of plots in which the particular species occurred (frequency).

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