

Participatory forestry; Indian experience in Community forestry and Joint Forest management.

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1. Introduction

In India, forests and village commons are subjected to degradation and loss with adverse impacts on biodiversity, natural regeneration and biomass production. The degradation is caused by conversion of forests and village commons to other uses as well as from non-sustainable extraction of biomass. To conserve the forests and to meet the growing biomass demands, a number of policies such as Forest Conservation Act, 1980 and programs e.g. social forestry and farm forestry, promotion of efficient cooking devices, and participatory management of degraded and regenerating forests have been initiated in India.

India is experimenting with diverse management systems for protection, regeneration and biomass production in forests, village commons and degraded lands. Apart from Forest Department (FD) managed systems, Joint Forest Management¹ (JFM), industry promoted forestry, community forestry and farm forestry are promoted and practised. Land reclamation, forest regeneration and afforestation programmes are being implemented at an unprecedented scale. A large diversity of community initiated forest management systems has evolved recently in response to severe degradation of forests and grazing land and biomass shortages. Thus, there is a need to understand and learn from the diversity of community forest management systems along with the emerging JFM system and generate information for policy makers, FDs, NGOs and local communities.

A multi-locational coordinated Ecological and Economics Research Network (EERN) has been initiated in India. EERN is a network of academic institutions and NGOs working in different locations in India with common goals. The Network consists of 11 organizations, of which 5 are academic institutions and 6 are NGOs. The EERN has adopted a shared methodology to study the participatory management systems in different locations or forest types in India. The main goals of the Network are as follows:

1. Identify and study the diverse self-initiated community forest management and joint forest management practices in natural forests, regenerating forests and village commons.
2. Conduct economic, ecological and institutional assessment of community-managed forests, JFM systems, and conventional afforestation systems.
3. Study the sustainability of different practices and models of forest management, particularly the modes and rates of extraction of forest products.

¹ Joint Forest Management is a participatory forest management system between the village community and the State Forest Department which came into effect from June 1990. In this management system, the rules and regulations regarding protection of the forest, the formation of the village protection committee and the sharing of the forest usufructs are laid down by the State Forest Department. In India, out of 30 states and union territories, 20 states have passed the JFM orders in their respective states.

4. Estimate the biomass production and productivity, NTFP flows, marketing and income generation potential.
5. Generate information for decision-making processes at various levels, from policy makers to village communities, to promote sustainable and participatory forest management.
6. Develop a methodology for management issue-oriented economic-ecological research and monitoring.

2. Methodology

Phase I studies of the Network on community forestry and JFM, were largely meant to serve as benchmark or baseline studies to gain a preliminary understanding of the existing institutional arrangements, vegetation status, current firewood and NTFP extraction practices and income generation from protected and managed forests. A broad common methodology was adopted for investigation of institutional, vegetation and NTFP extraction issues.

2.1. Institutional issues

The Self-Initiated Forest Protection Group (SIFPG) or simply Community Forest Management (CFM) and Joint Forest Management (JFM) promoted village forest protection committees were studied to understand the impact of diverse protection and management practices. The structure and functioning of these diverse management systems regarding the formation of protection committees, mode of operation, and efficacy of the management practices were studied in detail.

Assessment of institutional arrangement regarding structure, functioning, regulations and effectiveness of management system was carried out through PRA (Participatory Rural Appraisal) method and group discussions with different sects of people in the village. Household surveys as well as first hand information by local investigators on communities and institutions assisted in the institutional study.

2.2. Ecological/vegetation issues

Parameters such as vegetation regeneration, biodiversity, size distribution of tree species and growing stock of protected forest has been studied to understand the impact of the various management systems on the vegetation status. The current rates of extraction and the rates of firewood extraction have been studied to suggest sustainable modes of extraction and also by some simple thumb rules suggest the harvestable limits of extraction. Vegetation studies were conducted and standard field ecological methods were adopted based on quadrat methods to study the various ecological parameters; biodiversity, DBH (Diameter at Breast Height) distribution of trees, regeneration status, basal area and growing stock.

2.3. Dependence of communities on forests: NTFPs and firewood

NTFPs play a significant role in sustaining the interest of the communities in protecting the forest. The issues addressed to understand the dependence of communities on forests are the extent of dependence of communities on protected and regenerating forests, percentage of households (HHs) extracting forest products, quantity extracted and, the employment and income generation from protected and managed forest.

Assessment of percentage of HHs extracting the diversity of NTFPs, quantities extracted from protected forest, employment and income generation was carried out for sample HHs, using a questionnaire. Few groups, namely, CES in Western Ghats, Seva Mandir, PRAVA and SARTHI

monitored NTFP extraction through trained village youth. Data were recorded by actual field observation of NTFP extraction by the trained village youth. In Kapasgaria, in West Bengal, participatory monitoring was initiated by involving the village committee in recording the flow of NTFPs in the village.

Based on investigation of the above issues, it is proposed to draw some tentative implications for institutional arrangements, vegetation management, sustainable extraction of firewood and NTFPs, and for further research and monitoring.

3. Locations of network studies

Selection of study locations was largely determined by the field locations in which EERN member groups were working. The study locations selected for the network studies are given in Table 1. A total of 27 villages were studied which included 16 JFM and 11CFMs systems.

3.1. Features of the locations

The main occupation of the communities in all the villages is agriculture, except in one study location, where it is NTFP based. The secondary and tertiary occupations are NTFP based such as basket weaving, rope making, leaf plate making, incense stick making etc. Other occupations are agricultural labour, pottery, carpentry, animal husbandry etc. The ethnic composition of the villages vary from homogeneous to heterogeneous caste systems. Indigenous tribal communities, single social and multiple caste communities are existing in the study locations.

4. Results

4.1. Institutional assessments

4.1.1. Protection and management

The majority of the CFM as well as JFM systems covered by the network studies were formed during the post-1980 period (Table 2). It is only in villages of Orissa (Gadabanikilo) and the Western Ghats (Hunasur and Kugwe), that CFM systems have evolved over several decades (Table 2). The area under protection was varied (10 ha to 612 ha). In the study regions, 3 types of village level institutions have been recorded. Firstly, traditional CFMs where management systems have been in existence for long periods of over 50 to 100 years. Secondly, CFMs initiated in the past 5 to 20 years in response to degradation of vegetation and thirdly, VFCs/FPCs initiated formally by the FD under JFM programme.

Motivation for protection seems to vary from location to location, reasons include a sense of belonging to the forests, aesthetic and religious feelings, shortage of biomass, reduction in rainfall, encroachment of lands by village households, by neighbouring village communities and even by the FD for raising social forestry plantations, reduced income flows and promotion by FD and NGOs. In most of the villages, protection was self-initiated by the village community or institutions in response to resource scarcities resulting from forest degradation. Degradation of forests and shortage of biomass (firewood, leaf manure, fodder, other NTFPs) seems to be the dominant motivating factor for protection and management of forests in all the locations.

4.1.2. Features of management institutions

There are major differences in the structure of the organization, mode of selection of management committee members, functions of general body and the management committee, between JFM and CFM. In the case of JFM, the structure, functions, mode of selection of VFC/FPC and of the executive committee members, life of membership are all uniform in an Indian state as dictated by the State Government Order. However, under self-initiated CFM systems, local communities have their own situation specific regulations which have evolved depending on the local socio-economic situations and traditions. Some of the variations under the CFM systems that was recorded in the study locations are as follows:

Size of the executive committee ranges from 7 to 22 in the study locations. The composition of the executive committee varies from village to village, such as, representation from all castes in the village, people with leadership qualities irrespective of caste, representation of falias (hamlets), representation of blocks in the village and in some villages without any bias or basis. Mode of selection of members of committee varies from the consensus approach and inheritance to election. The term of the office of the member varies from one year to flexible period to hereditary. Women are not generally represented in the management committees, though women's representation is there in the general body in some cases. The various decision-making bodies were the management committee, the general body and the president of the committee in the study locations.

4.1.3. Forest protection and management practices.

i. Grazing practice

Indiscriminate livestock grazing is considered one of the factors contributing to the degradation of forests, grasslands and village commons. Generally it is assumed that regulation of grazing is necessary to promote regeneration. In study locations, five types of grazing practices are observed. Open grazing, grazing banned initially for 2 to 3 years and later free grazing permitted, regulated grazing periods, dedicated locations for grazing and ban on grazing.

ii. Forest protection practices and institutional arrangements

Non-sustainable removal of wood and NTFPs, excessive grazing and fire are some of the factors causing forest degradation as well as hampering of forest regeneration. Effective protection and extraction regulation arrangements are necessary to promote forest regeneration and to sustain it. Communities under JFM and CFM have adopted different approaches to protect the regenerating forests and to regulate the extraction of forest products. Some of these practices are, forest protection through groups of members guarding forests daily, each family on compulsory protection duty on rotation basis, paid guard, beneficiaries² along with executive committee members protecting the forests, social fencing³, and physical barriers such as barbed wire fence and cattle-proof trenches.

iii. Firewood extraction regulation

Firewood is the dominant forest product extracted and its unregulated extraction is likely to damage the growing stock as well as regenerating shoots. Firewood extraction is highly regulated in all the selected locations. In all the locations, the communities seem to have no restrictions on collection of fallen dry twigs and dry leaves. The different firewood extraction regulations in practice in the study locations are, collection permitted on selected days on payment of cash or grains, thinning

¹ those who are members of the forest protection committee

² Where the entire community shoulders the responsibility with no patrolling duty

and pruning wastes obtained during FD promoted operations, extraction of fixed quantity of firewood per household, cutting of only selected species allowed and some commercially important species banned, and free access, but no implements allowed. In no location (JFM and CFM) is free or unregulated access to green wood extraction for firewood or poles permitted.

iv. Access and regulations on NTFP collection

NTFPs gathered in the study locations include a wide range of plant components such as leaves, flowers, seeds, fruits, medicinal plants, gum, honey etc. Indiscriminate extraction of NTFPs could lead to degradation of vegetation. However, in most CFM as well as JFM locations there are no regulations on access to most NTFPs. There are restrictions regarding extraction of a few commercially important species. For example, restriction on collection of particular NTFPs such as Mahua (*Madhuca latifolia*) flowers and fruits, Kendu (*Diospyros sps.*) leaves collection, In few locations, the regulation on NTFPs imposed were collection of a fixed quantity per household, collection based on ownership tenure or specific trees allotted to families, equitable sharing and free access to all NTFPs. Community rationale could be that extraction of NTFPs under free access regime may not be currently excessive or potentially leading to any degradation, compared to non-sustainable extraction of firewood or excessive grazing.

v. Mode of enforcing regulations

Success of community organizations lie in enforcing regulations. In villages with CFM arrangements, firewood extraction is completely regulated with practically no abuse of regulations. Even though the protection, grazing and harvest regulations have no legal backing, very few cases of abuse have been reported. Any offense is severely punished and some of the modes of enforcing regulations are, first time offenders are warned and if the offense is repeated they are fined, cash penalty/fine, loss of membership or access to forest and social boycott by the village community in case of repeated offense. The FD is not involved in day to day guarding, protection and supervision in most cases except in 2 study locations.

vi. Threat from “outgroups”

Regenerating forests or plantations often face threats of grazing or indiscriminate extraction by the neighbouring villages. The threat from outgroups, who have no stake, was a feature in many locations particularly so in CFM villages. The village committees do not even have any legal document to claim right to exclude others. Many village communities faced threats to the protected forests as the access for neighbouring villages to the village forests was regulated. In all the cases the village communities have succeeded in entering into informal agreements with neighbouring villages. Some village communities have involved the neighbouring villages in the protection of the forest. Further, they are also included as members of the committee to seek their co-operation in protection.

5. Ecological issues

5.1. Impacts of protection and management on forest regeneration

Protection and management practices include regulated grazing, regulated extraction of forest products and selective retention of tree species. Unregulated grazing and extraction of forest products is expected to lead to degradation and loss of vegetation, often adversely affecting regeneration. The degraded forests in a majority of the study locations have been under protection for differing periods

from 2 to 3 years to over 20 years. The impact of protection on vegetation is assessed in comparison with nearby unprotected land as well as nearby social forestry plantations. Longer the period of protection, higher the species diversity (Table 2) and trees of larger DBH. Selective promotion of species by communities, such as Teak (*Tectona grandis*), Sal (*Shorea robusta*), and Mahua (*Madhuca sps*) was observed. In Midnapore villages “Kath⁴ and “Akath⁵” concept was practised where good timber yielding species were not felled. Plant species diversity was higher in regenerating forests compared to unprotected forests and social forestry plantations in all locations. Comparison between protected and unprotected patches in the same villages have shown that there was no regeneration of trees in unprotected patches which was due to unrestricted grazing. Good regeneration from coppice species (in Sal and teak dominant vegetation types) as well as regeneration from seeds (in the Eastern and Western Ghats) was observed in protected forest.

5.2. Growth rates of biomass in regenerating forests

The growth rates of regenerating forests under protection is given in Table 2. If the protection of the forest is effective, growing stock of the regenerating forest increases with age of the forest and the rate also depends on soil, rainfall and other factors. The relationship of standing biomass and age of the forests gives a fair estimate of the impact of protection. High growing stock is recorded in the protected forests with long history of protection where it is about 210-274 t/ha. In comparison, the standing biomass of social forestry plantations (which are usually monoculture stands) varied from 146 t/ha to 5 t/ha.

The mean annual increment (MAI) of woody biomass in protected forests ranged from 1.6 t/ha/yr in Ritti, Udhampur to 28.6 t/ha/yr in Kaluasar, Midnapore. The average mean annual increment in the study areas is about 8.16 t/ha/yr which is higher than the national average of 0.91 t/ha for natural forests. The MAI of the plantations is in the range of 1 t/ha/yr (Bada Bhilwara) to 26 t/ha/yr (Alalli) and the national mean annual increment is 3.6 t/ha/yr.

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5.3. Current extraction of firewood vs annual biomass production

Forests and particularly growing stock degradation occurs when woody biomass extraction exceeds current annual biomass production, though it is not possible to state exactly what percentage of current annual woody biomass production can be sustainably removed. However, if the current extraction rate is higher than the current annual biomass production, it is a sure indicator of degradation of vegetation.

In the study locations, the range of extraction of firewood from the protected forest varied from no extraction to an extraction rate higher than the annual increment of biomass (Fig 1).

5.4. Demand for firewood and supply from protected forests

⁴ KATH – in West Bengal state locally termed as good timber yielding species

⁵ AKATH – in West Bengal State locally are the less timber yielding species.

⁶ MAI is calculated as the growing stock/no. of years of protection as the biomass of the degraded forest at initiation of protection was negligible.

Meeting the firewood demand sustainably seems to be one of the critical goals of forest protection and management in all the selected locations, under JFM as well as CFM situations. Firewood is obtained from diverse sources including the protected forest in the villages. The proportion of firewood demand that is currently met from the protected patch is presented in Fig 2. In most of the locations the firewood extraction is sustainable which implies effective protection measures.

6. Dependence of communities on forests for NTFP

The main occupation of the villagers in the study areas is agriculture. All socio-economic groups including the large and small farmers and the landless depend on forests for firewood. The HHs extracting NTFPs for basket weaving, rope making, leaf-plate making etc. are dependent on forests for their livelihood. Some products such as vegetables and tubers are collected by the households for direct consumption. Field studies showed that a large diversity of NTFPs are extracted. Some of the dominant NTFP yielding tree species are *Shorea robusta*, *Madhuca latifolia*, *Diospyros sps.*, *Butea sps.* in West Bengal and Orissa states, while in the Western Ghats *Garcinia*, Bamboo and *Terminalia* species are important. In the Eastern Ghats, *Tamarindus*, gum from *Sterculia urens* and leaves of *Bauhinia vahlii* for making plates are the dominant NTFP species. A number of NTFPs are available but not extracted in few locations as the Western Ghats.

6.1. Percentage of households gathering NTFPs

In Sal region the percentage of households gathering NTFPs is high (70-95%). Generally the trend seems to be that the landless and the marginal farmers and tribal communities depend more on the forests for collection of the NTFPs than do the large farmers. In West Bengal areas, landed households also collect significant quantities of NTFPs. In Bada Bhilwara all the households are involved in collection of Mahua flowers and seeds. In other zones, percentage of households gathering NTFPs varies and is lower than in the Sal forest region. However, the large farmers derive higher benefits from the forest by collecting large quantities of leaves for parboiling rice in case of West Bengal and as leaf manure for their areca gardens and poles for fencing in the districts of the Western Ghats.

6.2. Quantity of NTFPs gathered and income flow

One of the motivating factors for protection of forests is the potential flow of income from gathering NTFPs and firewood. The income generated from NTFP and firewood extraction is given in Fig 3. Income from Sal leaves, Sal brush sticks and mushrooms are significant from the Sal-dominated forests. In Rampur (Bharuch district) mushrooms and *Diospyros sps.* leaves are the income generating NTFPs. In the Western Ghats, income from NTFPs is low and leaf manure is the dominant NTFP. In Panchmahals, beedi⁷ leaves generate large incomes. In most of the locations, income flows from the NTFPs are higher than from firewood which is usually fallen dried twigs and branches from the protected areas. The low financial value of NTFPs gathered in few locations is a reflection of the low levels of availability of NTFPs or the lower rates of extraction due to less income returns compared to agricultural wages. In few locations, the regenerating forests are young and not enough tree based products are available. The low financial value of the NTFPs extracted could also be a result of not monetising many products extracted. Some of the products may not have been reflected in the small household survey during the study.

7. Implications of the study

⁷ Locally made cigarettes made by rolling tobacco in *Diospyros* leaves.

Participatory Forest Management, particularly JFM, is already being accepted as an option for managing forests, specifically degraded and regenerating forests. JFM programme is being adopted and implemented at different intensities in different states. There is a need to learn from the experience of implementing JFM in different areas as well as from the SIFPGs or CFMs that have evolved, survived and are effectively functioning. The studies of the EERN were largely exploratory in nature and thus could be termed as preliminary or baseline studies aimed at understanding the institutional, ecological and NTFP extraction aspects in the selected JFM and CFM areas. The studies were restricted to a smaller number of villages and for a limited period of one year. Some of the broader implications of the studies presented here must be viewed in this context.

7.1. Institutional arrangements

CFMs have emerged as an effective management system. It is necessary to formulate policies to formalize the existing CFMs to give them legal status and to recognise their efforts in successful protection and management without disturbing the structure and functional arrangements evolved under CFMs. However, if the CFM management structure does not give adequate representation and decision-making power to women and to the landless, it may be necessary to make it a pre-condition for recognition.

In many CFM areas, despite initial problems, village communities have succeeded in convincing and eliciting co-operation from neighbouring village communities. In some cases protection leading to forest regeneration in one village has led to a “demonstration effect” leading to initiation of protection system in neighbouring villages. NGOs and FD could catalyze the spread of CFM systems involving a cluster of villages rather than an isolated village approach.

Studies showed that in most CFM situations, equal rather than equitable distribution of usufructs was practised. Practically it may be easier to plan and adopt equal access or sharing rather than equitable distribution. One of the options under JFM could be legally enforced equitable distribution, though the practicality is debatable. The right approach could be to leave it to the village committee to decide. However, FD could ensure adequate representation to women, landless, artisans in the decision-making body or a proper representative body which decides on sharing mechanisms. The CFM systems have sustained and have succeeded in enforcing equal sharing of costs and benefits and effective protection. But, women being the dominant firewood and NTFP gatherers, denial of opportunity to them in decision-making processes may lead to conflicts and unsustainable management systems.

7.2. Natural regeneration as an option for revegetation of degraded lands

India has vast areas of degraded or wastelands, estimates of which vary from 42 to 130 Mha, FD has largely adopted the approach of afforestation through monoculture plantations under social forestry programme at a per ha cost of over Rs.15,000. At the current rate of conventional afforestation and budget allocation, vast tracts of degraded lands would continue to get further degraded and biomass shortages are likely to accentuate, apart from the adverse implications for biodiversity. Network studies have clearly shown the potential for promotion of natural regeneration as an option for revegetating degraded lands in diverse situations. Local communities in diverse situations have adopted the approach of protection and promotion of natural regeneration with moderate to high biomass growth rates with negligible cost and added advantage of promotion of biodiversity. Thus, there is a need to seriously consider promotion of natural regeneration as an option for regenerating vast degraded lands.

7.3. Protection and grazing practices

Protection from indiscriminate extraction and regulation of grazing is necessary for promotion of forest regeneration. Restriction of grazing in the initial years 2 to 3 years seems to be necessary for forest regeneration. Network studies have shown that regulation of grazing and green wood extraction is necessary and feasible. If the local communities are genuinely involved, expensive fencing, trench digging and other expensive physical barriers often adopted by the FD are not necessary.

7.4. Sustainability of extraction of firewood

Network studies have clearly shown that regulation on firewood extraction is very critical and communities have realized its importance. It is however difficult to exactly define or prescribe at what stage of forest regeneration communities could start extracting firewood, and what mode and rate of extraction is sustainable. Communities could however use some “thumb rules” (based on MAI or growing stock) to determine extraction rates and monitor the impacts of extraction practice on vegetation and readjust the extraction practice. Further research and monitoring is necessary to define the “thumb rules” for different locations on rates of extraction. Experimental trials may also be required to suggest extraction practices in different forest zones.

7.5. Extraction of NTFPs and sustainability

Interestingly, there are no regulations on extraction of NTFPs in most of the locations investigated. Over-extraction of leaves, seeds, and flowers is likely to affect long-term forest regeneration and sustainability. Currently little or no information is available on the yields of NTFPs, sustainable modes and rates of extraction. Long-term monitoring studies are required to assess the yields and impacts of NTFP extraction practices.

7.6. Adaptive forest management (AFM)

One of the main goals in participatory management of forests is to ensure sustainable flows of woody biomass and NTFPs. Sustainable modes and rates of extraction are going to be location, forest type and even species specific. The response of vegetation to a given practice of extraction will have a long gestation period. Given the large diversity of locations, with socio-economic and ecological variations, the only feasible option is to enable village communities or village forest committee members or village teachers and students to monitor the status of vegetation, develop and adopt practices, and monitor their impacts and accordingly modify them which could be termed as adaptive forest management. There is a need to promote the AFM approach in many locations and by experience determine its potential and feasibility.

To promote adaptive forest management there is a need to develop a simple methodology to enable local community members (FPC/VFC members, school teachers, students) to monitor and assess the impacts of a given protection or extraction practice. A set of indicators and methods have to be developed and communicated to some identified members of the local community.

Table 1: Locations selected for the Phase I studies by the Network.

State	Location District/region	Village	Institution JFM/CFM	Forest type
Andhra Pradesh	Eastern Ghats	Juttadapalem	JFM	Moist mixed deciduous
		Chandrayyapalem	JFM	
		Vondrujola	JFM	
		Kannaram colony	CFM	

Gujarat	Bharuch	Kunbar Rampur Garda	JFM JFM JFM	Moist teak bearing
Gujarat	Panchmahals	Asundariya Baluji Na Muvada	CFM CFM	Dry teak forest
Jammu & Kashmir	Udhampur	Johnu Ritti Mand	JFM JFM CFM	Sub tropical pine
Karnataka	Western Ghats	Alalli Hunasur Kugwe	CFM CFM CFM	Semi evergreen and moist deciduous
Orissa	Nayagarh	Gadabanikilo	CFM	Dry Peninsular Sal
Orissa	Udala	Kutling Nabra	CFM CFM	Dry Peninsular Sal
Rajasthan	Udaipur	Bada Bhilwara	CFM	Dry mixed deciduous
Tripura	Melaghar	Melaghar	JFM	Moist plains Sal region
West Bengal	Midnapore	Kaluasar Kharikamathani Uthannayagram Nemainagar Khanamuri Kapasgaria Bhagawatchowk	JFM JFM JFM JFM JFM JFM JFM	Dry Peninsular Sal

Table 2: Impact of protection and management systems on biodiversity, MAI and annual woody biomass production

Location and region	Area (ha)	Period under protection (Yr)	No. of tree species	Growing stock ¹ (t/ha)	MAI of woody biomass ² (t/ha/yr)	Total annual biomass Production ³ (t/yr)	Current extraction ⁴ (t/yr)	Current demand ⁵ (t/yr)
Gadabanikilo, Orissa	60	50	56	169	3.38	724	0	
Kutling, Orissa	248	14	31	41	2.93	726	892	559
Nabra, Orissa	48	7	23	42	6.00	288	1014	709
Kaluasar, West Bengal	90	6	13	172	28.67	2580		
Kharikamathani, West Bengal	57	3	11	32	10.67	608	87	161
Uthannayagram, West Bengal	546	9		200	22.22	12133		
Kapasgaria, West Bengal	25	5	14	93	18.60	465	8	139
Bhagawatichowk, West Bengal	53	11	15	86	7.82	414	54	176
Asundariya, Gujarat	182	7	36	118	16.86	3068	122	516
Baluji Na Muvada, Gujarat	122	11	31	372	7.44*	908	96	554
Kunbar, Gujarat	188	2	11	15	7.50	1410	99	613
Rampur, Gujarat	120	4	10	23	5.75	690	91	212
Garda, Gujarat	100	5	23	8.3	1.66	166	58	343
Bada Bhilwara, Rajasthan	612	9	20	110	12.22	7480	170	486
Alalli, Karnataka	73	18	32	113	6.28	458	0	416
Hunasur, Karnataka	49	100	62	274	2.74	134	86	496
Kugwe, Karnataka	162	100	43	210	2.10	340	167	697
Mand, Jammu & Kashmir	50	20	23	98	4.90	245		
Johnu, Jammu & Kashmir	10	10	26	27	2.70	27		
Ritti, Jammu & Kashmir	20	5	18	8	1.60	32		

1. Growing stock = $-1.687 + 8.32 (BA) R^2 = 0.5$, where BA (Basal area) = $(GBH)^2/4\pi$, and GBH is the girth of the tree.
 2. MAI = Mean Annual Increment = Growing stock/ Years of protection
 3. Total annual biomass production = Growing stock x Area of protected forest
 4. Current extraction of firewood from the protected forest
 5. Current demand is the firewood required by the village which has been calculated by taking per capita requirement.
- * Estimated using 2% of the growing stock as current MAI

Fig.1. Extraction of fuelwood from protected forest as percentage of annual biomass production

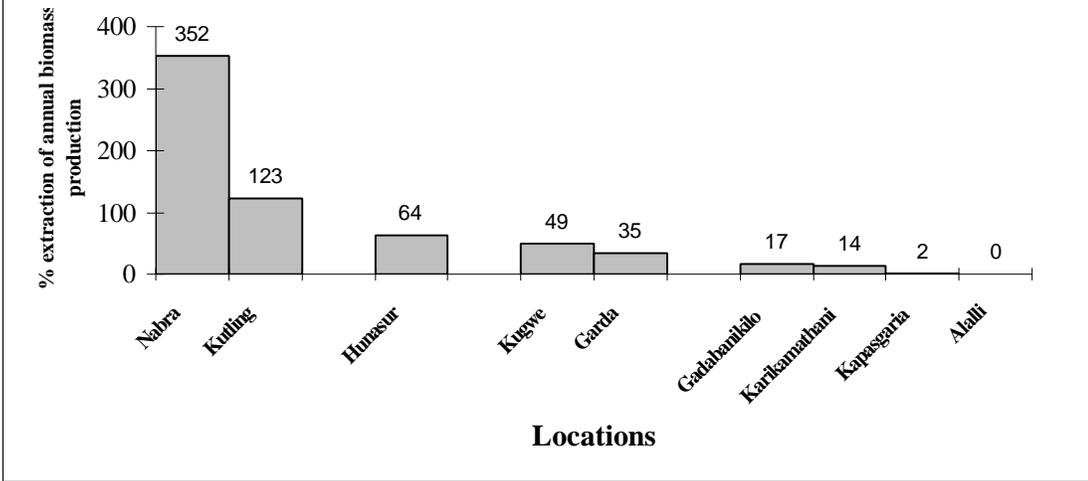


Fig. 2. The demand for firewood and current extraction from the protected forest

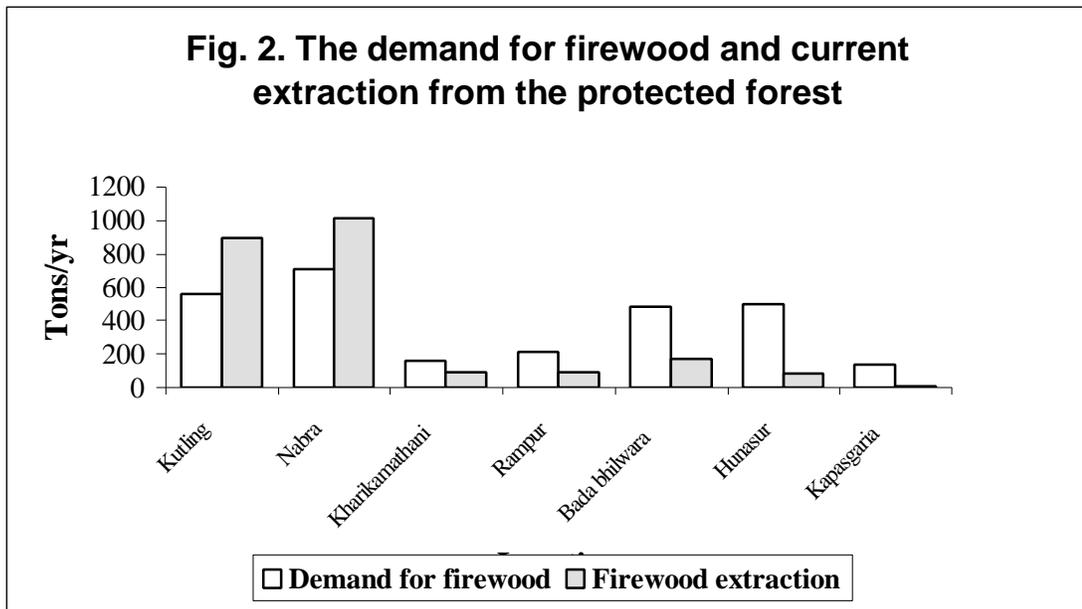


Fig 3: Financial benefit at household level from NTFPs and fuelwood from protected forest

