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Assessment of Livelihoods of Local Communities and Forest Conservation - A Case Study from India

Azra Musavi

Wildlife Institute of India, Chandrabani, Dehradun 248001. India.
Current Address: *Department of Economics, Aligarh Muslim University, Aligarh 202002. India*.
E-mail: musaviazra21@gmail.com

ABSTRACT

Protected areas in India are being affected due to dependence of local communities. Patterns of resource dependence by local communities on forest resources and associated livelihoods issues in Melghat Tiger Reserve and Bori Wildlife Sanctuary in Central India were examined through questionnaire based surveys. Data on dependence was collected from 318 households in15 villages. The forest was classified into disturbed and undisturbed forest. Tree cutting and lopping pressure was assessed by laying circular plots of 10 m radius. The result of the study revealed that fuel wood was the only source of energy in both study sites. Most non-timber forest products (NTFP) were collected for livelihood needs by rural communities whereas agro-pastoralist households in Bori, collected these primarily for income generation. Two of the economically important tree species used by people – *Madhuca indica* and *Buchanania lanzan* showed low recruitment. Tree cutting, lopping, grazing by livestock and weeds had affected >25% of the sampling areas in disturbed forests. Overall impact of anthropogenic pressure was significantly higher ($p<0.01$) in disturbed forests. Restocking of forests with species used by people and regulation on grazing and livestock numbers inside PAs may reduce human impact.

Key Words: Dependence; Livelihood; Forest Resources; Impact; Conservation

INTRODUCTION

Forests provide sustenance, livelihood (Guha 1994, Mamo et al. 2007, Babulo et al. 2008, Mitra and Mishra 2011, Angelsen et al. 2014) and also a safety net in times of scarcity (Reardon and Vosti 1995, McSweeney 2004, Belcher et al. 2015) to over a billion poor people living in rural areas in tropical regions (Campbell and Luckert 2002, Sunderlin et al. 2005, Vedeld et al. 2007, Zenteno et al. 2013). Seven per cent of India's rural population is living in 'extreme poverty' with high incidence of poverty among the tribal population (India Rural Development Report 2013-14) especially among rural occupational groups of agricultural labour (40%), other labour (33%) and 22% of self-employed in agriculture (Tewari 2015).Tropical regions are however facing deforestation and forest degradation not only due to heavy dependence of rural poor on these forests, but also due to diversion to agriculture, river valley projects, mining, industries, encroachments and infrastructure projects (Davidar et al. 2010, ICFRE 2010, Azra 2012, Sinu et al. 2012). In Tropical Asia about 14% of forests were lost during 1850 to 1950 (Thapa and Weber 1990) and 70% during 1960 to 1990 (Mohapatra 1999). In India, the annual loss of forest cover was about 13,000 km^2 during 1975 to 1982, a further decline of 0.4% in the forest cover was recorded during 1989 to 1999 (Azra 2012). India's forest cover has however increased during 2001-2011 mainly on account of 10.1% increase in open forests compared to 2.2% increase in dense forests (FSI 2001 and 2009, Azra 2012).

To counter the loss of forests and biodiversity, protected area networks were established across the world (Myres et al. 2000, Nagendra et al. 2010, Rastogi et al. 2012). More than 500 protected areas were established in India, from 1975 to 1998, with most of

these located in densely populated areas (Nagendra et al. 2006). Establishment of protected areas in most developing countries like India, have been based on exclusionary conservation policies (Kashwan 2013). These policies have curtailed traditional rights of forest-based communities and at times even deprived them of rights to land leading to increased park – people conflicts (Rastogi et al. 2012, Kashwan 2013) and thereby changing park-people relationship. The marginalised forest based communities have also been negatively affected due to erosion of the resource-base on which they depend for their livelihood (Sunderlin et al. 2005). Forest conservation policies have however, often not taken into consideration livelihood strategies adopted by tropical forest based communities (Nagendra et al. 2006, Zenteno et al. 2013).

Zenteno et al. (2013) have pointed out that most studies on forest dependence among rural households assume it to be determined by homogeneous local conditions and very little information is available about local differences in contribution of forests in the livelihood strategies of forest communities. As far as India is concerned, given the highly populated protected area landscapes (Nagendra et al. 2006) case specific studies are required to develop an understanding of how dependence of local communities influence park-people relationships as well as to find the way forward for formulation of conservation goals and inclusive policies for protected areas.

This paper is based on a study carried out at the Wildlife Institute of India for developing management guidelines for biodiversity conservation of Satpura Conservation Area (SCA). Melghat Tiger reserve (MTR) and Bori Wildlife Sanctuary (BWLS) were selected for intensive study under the project. Although the protected areas (PAs) have conservation potential, there are a large number of villages located inside and even a larger number within 10 km of their boundaries. There is however hardly any study on anthropogenic dependence on these two PAs. The paper is an attempt to understand- (1) patterns of forest dependence of local communities, (2) park-people relationship and (3) implications for conservation of these forests.

STUDY AREA

The Satpura Conservation Area (SCA) is situated in the Deccan Bio-geographic Zone of Peninsular India (Rodgers et al. 2000). The Satpuras are a range of hills running from east to west along the boundary between the states of Madhya Pradesh and Maharashtra in India. The SCA was protected under a cluster of four protected areas – Melghat Tiger Reserve, Bori Wildlife Sanctuary, Satpura National Park and Pachmarhi Wildlife Sanctuary (Figure 1). These are one of the oldest reserved forests in India and are dominated by teak (*Tectona grandis* L.f.) and are valuable habitat for endangered species such as the tiger (*Panthera tigris* Linnaeus), leopard (*Panthera pardus* Linnaeus) and gaur (*Bos gaurus* CH Smith). MTR and BWLS were selected for the study as they were different in terms of- forest types, number of villages and accessibility. Majority of the population in both PAs belonged to various central Indian scheduled tribes (80%) and non-tribal population comprising of scheduled and backward castes (5%) and agro-pastoralists (15%). The agro-pastoralists had moved into the PAs from adjoining areas due to depleting resource base outside the PAs (Sawarkar et al. 2000).The local people were dependent on these forests for subsistence, fuel-wood, wage employment and grazing their livestock.

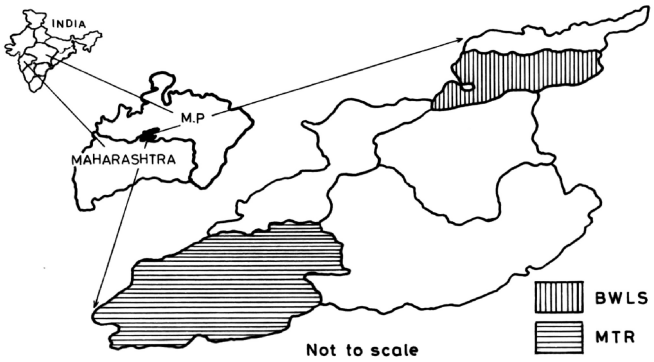

Figure 1. Location of Melghat Tiger Reserve (MTR) and Bori Wildlife Sanctuary (BWLS) in Satpura Conservation Area

Melghat Tiger Reserve

Melghat Tiger Reserve is located in southern SCA (Figure 2) in Amravati district of Maharashtra State. It lies between 21° 15′ N to 21° 45′ N latitude and 76° 57′ E to 77° 30′ E longitude. It was declared as a Tiger Reserve in 1973 and covers an area of 2768.52 km^2. It includes 1500.50 km^2 of Critical Tiger Habitat (CTH) which comprises of Gugamal National Park (362.80 km^2), the Sanctuary along with Tourism Zone (1137.70 km^2) and1268.02 km^2 of the buffer zone. Most of the reserve, except the southern portion, is well connected by roads with adjoining towns of Parathwada and

Dharni. The region consists of a succession of hills and valleys, which become more rugged in the south where Gugamal National Park is located. Five major tributaries of river Tapti, along with several streams flow through MTR. The average temperature variesfrom12° C to 43° C and the annual rainfall varies from 1000 mm to 2250 mm. MTR represents Central Indian dry deciduous forest type (Champion and Seth 1968) with 650 naturalised plant species, out of which 90 are tree species (Dhore and Joshi 1988). These forests also support endangered species like wild dog, hyena, sloth bear, several deer and antelope species, in addition to 250 species of birds and 21 species of reptiles (Gogate 1988).There were 61 revenue villages inside the Tiger reserve out of which 22 were located in the CTH and 39 in the Multiple-Use Area within the newly created Buffer area. With the stoppage of forestry operations within MTR, a major source of wage employment for the people was lost.

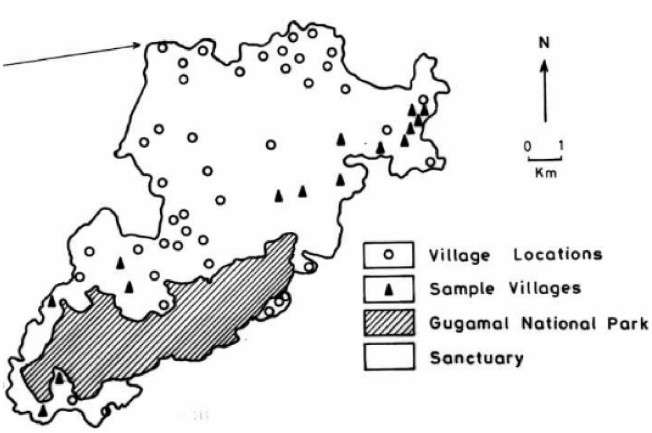

Figure 2. Location of villages in Melghat Tiger Reserve

Bori Wildlife Sanctuary

BWLS is located in the northern part of SCA (Figure 3) in Hoshangabad district of Madhya Pradesh between 22° 19′ N to 22° 30′ N latitude and 77° 56′ E to 78° 20′ E longitude. It was notified as a sanctuary in 1975 and covers an area of 518 km^2. It forms part CTH of Bori-Satpura Tiger Reserve. BWLS has an undulating terrain and forms the catchment of river Narmada and its tributaries. The temperature in BWLS varies from 40° C to 22° C and annual rainfall varies between 1200 to 3200 mm. Bori experiences heavy dew until March and therefore these forests remain green for a longer period than other Teak forests in Madhya Pradesh. Bori represents South Indian Moist Deciduous Forest (Champion and Seth 1968).These forests are inhabited by 14 endangered species of mammals including sloth bears, flying squirrel (*Petaurista petaurista*), Indian giant squirrel (*Ratufa indica* Erxleben) and several deer species in addition to a large number of birds and reptiles (Sawarkar and Panwar 1987). There were 17 forest villages in addition to 4 villages within a distance of 10 km of the southern boundary. Bori was quite remote and did not have proper roads connecting it to nearby towns or villages. Prior to stopping of logging, majority of local communities were engaged as labour in forestry operations. Due to lack of alternative wage employment, local communities heavily depended on subsistence agriculture and forest produce.

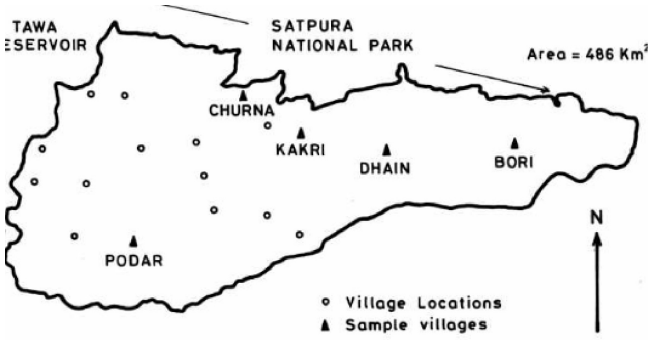

Figure 3. Location of villages in Bori Wildlife Sanctuary

METHODOLOGY

Dependence on Forest and Park-People Relationship

Villages within the two PAs were stratified on the basis of human and livestock populations into three categories on the basis of secondary information on human and livestock populations collected from Forest departments. More than 20% of the villages and households were sampled in both PAs (Table 1). Households were randomly selected from each sample village. Data on socio-economic status, dependence and park-people relationship was collected using questionnaires. Both open- and closed-ended questions were included to collect detailed and quantifiable information.

For the purpose of data analysis, the sampled households were placed into three community groups, based on similarities in lifestyles (Musavi 1999):
Community A: Scheduled tribes traditionally engaged in forestry related wage labour and subsistence agriculture included Korku, Thatia, Gond, Burad and Rathiya tribes.

Community B: Scheduled and backward classes engaged in agriculture, jobs or trade included Balai, Bunkar, Vanjari, Gaolan and Lohar castes.
Community C: Agro-pastoralists traditionally engaged in livestock rearing and dairy included Gawli community. Spearman's rank correlation (r_s) and Chi-square (χ^2) were used to test for associations and differences.

(1) *Fuelwood*: Per capita fuelwood consumption for cooking purposes was calculated following Mishra and Ramakrishnan (1982). Per capita fuelwood consumption was calculated as: PF = DF / AU, where PF = Daily per capita fuelwood consumption; DF = Daily fuelwood consumption per household; AU = Total adult units in a family; and AF = PF × N where, AF = Annual per capita fuelwood consumption; PF = Daily per capita fuelwood consumption; N = 365 (Number of days in a year). The mean quantity of wood required for heating houses (during monsoon and winter months from July to March was 9 months) per household was calculated as follows: AW = W × N, where, AW = Quantity of wood consumed annually per household; W = Quantity of wood consumed per family per day; N = Number of days = 270 (i.e., 9 months ×30 days).

(2) *Non-timber forest produce:* Data were collected on types of NTFP collected, quantities consumed and sold each year, as well as the prices at which each family sold NTFP items. Local market prices of NTFPs or equivalent prices for 2015 were used for calculating market value. For the purpose of analysis the NTFP items were grouped into major categories viz., commercial, semi-commercial and non-commercial. Values of non-marketed items were calculated by using equivalent prices.

Impact of Anthropogenic Dependence on Forest

Dependence of local people on the forests for fuelwood, grazing by livestock, fodder, grass collection, small timber has an impact on the forest in terms of tree cutting / felling, lopping, reduced ground cover, soil erosion and compaction, proliferation of weeds, etc. Sampling was done in forest around sample villages as it was considered disturbed (DF: DF1 in MTR and DF2 in BWLS) Gugamal National Park and Tourism Zone (undisturbed forest: UF) constituted the control as they were free of biotic pressures. Sample size was calculated using Species-Area curve (Greig-Smith 1983) and 5.36 ha in DF and 1.97 ha in UF were sampled. Data on tree layer were collected in circular plots (of 10 m radius each) at every 200 m interval along village trails and along random transects in undisturbed forest. Seedlings and ground cover were measured in 4 random quadrates of 50 × 50 cm within the circular plots.

Data were collected on tree species, percentage of cutting/ lopping, weed abundance, grazing signs, number of seedlings and percentage of ground cover. Plots and quadrats were categorised for impact on the basis of percentage of trees and ground cover affected, using a scale of 0 to 3 where 0 = no pressure (0% area affected); 1 = low pressure (<25% area affected); 2= moderate pressure (25to ≤50% area affected); 3 =high pressure (≥50% area affected). Non-parametric tests were used to compare the impact of resource-use between disturbed (DF1 and DF2) and undisturbed (UF) forests.

RESULTS

Livelihood Pattern and Dependence on Protected Area Forests

The two study sites were different in terms of type of villages, landholding size, income and occupation pattern and access to markets. MTR had revenue villages while BWLS had forest villages. The average landholding size varied between 2.5 ha (MTR) and 1 ha (BWLS). More than 30% families in Melghat were landless, >49% owned marginal to small landholdings (<2 ha) and >50% families owned medium to large landholdings (>2 ha). In Bori while 8% families were landless, >89% were marginal and small landholders and only 10% were medium and large landholders (Table 1). Wage employment contributed >70% of income for ST and SC in Melghat while contribution from dairy activities was >80% to income of agro-pastoralists in MTR. In Bori wage employment contributed >50% to income of ST families while dairy contributed >20% of income. The difference in contribution from the two sources was even narrower for AP families in BWLS with dairy contributing >40% and wage employment contributing >30%. Contribution of 'other' income sources (including jobs or trade) was 10% to 20% for SC households in MTR and for both communities in BWLS (Figure 4).

Wood was used as the only source of energy by all sample households for cooking. Although fuel wood was collected primarily for domestic consumption by all communities in both PAs, < 2% was also sold by ST and SC families in MTR. Fuel wood consumption was higher

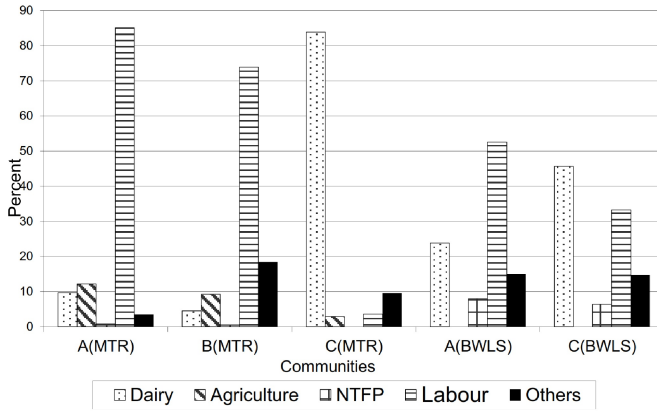

Figure 4. Income pattern across communities in Melghat Tiger Reserve (MTR) and Bori Wildife Sanctuary (BWLS). A=Scheduled tribes; B=Scheduled and backward classes; C=Agro-pastoralists; NTFP=Non-timber forest produce

for all communities in MTR compared to BWLS, with annual household consumption varying between 2738.8 kg to 4621.3 kg (Table 2). Significant difference at p-value < 0.01was also seen in per capita daily (χ^2 = 63.3167) and annual (χ^2 = 63.0798) fuelwood consumption) being highest for community B (scheduled castes) in MTR (daily: 2.76 kg ± 0.19; annual: 1007.86 ± 68.58 kg). Annual fuel wood collection was positively correlated to family size and landholding for tribal households (r_s=0.330 and r_s=0.317 respectively at p-value <0.001). The daily and annual fuel wood consumption also showed positive correlation to land holding size (r_s=0.317, r_s=0.256 respectively at p-value < 0.05) Wood was also used for heating water and houses during monsoon and winter when large logs of wood were left burning round the clock.

Livestock holding of cattle was common in both study sites with more than 80% of the families owning livestock. Significant difference was observed in livestock ownership / family between communities in both PAs (χ^2 = 38.4193 at p-value < 0.01) varying from 4 to 5 animals for scheduled tribe and scheduled caste households and >19 animals for agro-pastoralists. Number of milk cattle in livestock holdings of scheduled tribe and scheduled caste families was much lower as dairy products were primarily for domestic consumption, whereas the number was much larger for agro-pastoralists. ST and SC communities kept bulls for agricultural activities. Although all livestock was free ranging, cattle belonging to agro-pastoralist community

Table 1. Basic socio-economic information of Melghat Tiger Reserve and Bori Wildlife Sanctuary. MTR=Melghat Tiger Reserve, BWLS=Bori Wildlife Sanctuary, PA=Protected Area.

Parameters	MTR	BWLS
Number of villages	61 (15 sampled)	17 (5 sampled)
Type of villages	Revenue	Forest
Human population	25196	4000
Livestock population	30,000	7500
Major communities	Scheduled Tribes / Scheduled & Backward Castes/Agro-pastoralists	Scheduled Tribes / Agro-pastoralists
Households sampled	243 (22.9%)	75 (37.5%)
% of tribal households in sample	69.13	85.0%
Average landholding / family (ha)	2.5	1
% of landless households	30.86	8
% of households (landholding ≤2 ha)	49.5	89.9
% of households (landholding >2 ha)	50.5	10.1
Livestock holders	210 (86.4%)	67 (89.3%)
Mean livestock holding / family	7.24	10.76
Biomass collection	Fuel wood, Timber, NTFP, Fodder, Grasses	Fuel wood, Timber, NTFP, Fodder, Grasses
Occupational pattern	Wage labor, Subsistence agriculture, Dairying	Wage labor, Subsistence agriculture, Dairying
Access to markets	Yes	No
All-weather roads	Yes	No
Healthcare facilities within PA	Yes	No

Source: Records of the revenue department (Maharashtra) and forest departments of Melghat Tiger Reserve and Bori Wildlife Sanctuary.

Table 2. Collection of forest resources for consumption and sale by households per year in Melghat Tiger Reserve and Bori Wildlife Sanctuary.

NTFP= Non-timber forest produce. NC=Not collected; NS=Not specified; MTR = Melghat Tiger Reserve, BWLS = Bori Wildlife Sanctuary, A = Scheduled Tribes, B = Scheduled Castes and Backward Classes, C = Agro-pastoralists.

Forest Produce	Community A-MTR		Community B -MTR		Community C-MTR		Community A-BWLS		Community C-BWLS	
	kg	$	kg	$	kg	$	kg	$	kg	$
Fuel wood collected	4695.79	575.72	4502.47	552.02	3673.98	450.44	2738.81	335.79	3193.41	391.52
Fuel wood sold	74.46	9.12	35.71	4.37	-	-	-	-	-	-
Fuel wood consumed	4621.34	566.60	4466.76	547.65	3673.99	450.45	2738.81	335.79	3193.42	391.53
NTFP - Commercial										
Emblica officinalis fruit	NC	-	NC	-	NC	-	10.84	3.25	NC	-
Terminalia chebula seeds	0.22	0.12	2.08	1.14	NC	-	NC	-	NC	-
Chlorophytum tuberosum roots	5.38	16.16	NC	-	NC	-	NS	-	NS	-
Diospyros melanaxylon leaves	13.57	3.39	20.83	5.20	NC	-	557.52	139.37	1289.54	322.38
NTFP - Semi-commercial										
Madhuca indica flower sold	28.23	9.74	30.94	10.67	NC	-	12.66	4.36	128.18	44.22
*Madhuca indica*consumed	64.37	22.20	47.69	16.21	NC	-	100.77	34.26	30.45	10.35
Madhuca indica seed sold	0.42	0.14	-	-	NC	-	10.86	3.58	-	-
*Madhuca indica*consumed	6.89	2.27	5.92	1.95	NC	-	6.57	2.16	1.45	0.47
Buchanania lanzan seed sold	0.33	0.25	-	-	NC	-	3.67	2.75	-	-
Buchanania lanzan consumed	0.20	0.15	4.17	3.12	NC	-	0.28	0.21	9.09	6.81
Fish sold -	-	13.44	18.13	NC	-	-	-	-	-	
Fish consumed	1.11	1.51	3.23	4.35	NC	-	-	-	-	-
NTFP - Non-commercial										
Food items	3.78	5.06	13.77	6.55	0.24	0.11	7.62	5.62	NS	-
Grass (head loads)#	5.58	1.84	NC	-	NC	-	NC	-	NC	-

Source: Market prices of products at rates in 2015, taken from Forest Department and publications of Tribal Co-operative Marketing Development Federation of India, Ltd., GOI., Forestry Statistics India, Global Forest Resources Assessment Country Report –FAO.

All values are average quantity collected / household and value of fuel wood and NTFP items annually sold or consumed / household in Dollars at Aug-Sept. 2015 exchange rate of $1= Rupees 65.25.

* = bundles of leaves; # = Head load=10kg

spent more time in the forest often camping at night close to water bodies. *Terminalia tomentosa* and *Ficus glomerata* leaves were collected from the forest to stall feed young calves and bulls as they were usually not sent to the forest for grazing. Grasses were cut and stored for summer by tribal households in MTR.

Six major tree species were used by people. *Anogeissus latifolia* (Dhaora), and *Ougeinia oojeinensis* (Roxb.) Hochr. (tiwas) were used for fuelwood. *Terminalia tomentosa* (Saj) provided fuel wood, small timber and also fodder. *Madhuca indica* (Mahua), *Diospyros melanoxylon* (Tendu) and *Buchanania lanzan* (Chironji) were most important NTFP species. More than ten different types of NTFPs were collected by local communities from the forests (Table 2). A few of these NTFPs were collected only for sale. Annual earnings from sale of commercial NTFPs ranged from $6.34 to $19.67 for ST and SC households in MTR. In BWLS, *Diospyros melanaxylon* leaves (Tendu *patta*) were the only commercial NTFP collected by both tribal and agro-pastoralist households for which they earned $139.37 to $322.38 annually. Most NTFPs were primarily for subsistence or for exchanging in the local market for other essential commodities; *Madhuca indica* (Mahua) flowers were the most important NTFP used by scheduled tribe and scheduled caste households in both PAs. It was used for food, as well as, for making country liquor. Per household annual collection varied from 78.624 kg to 113 kg. The agro-pastoralist households in BWLS collected highest quantity of mahua flowers (158.635 kg) but most of it was sold, annually earning $44.22 per household (Table 2). Some NTFPs like forest greens, bamboo shoots, mushrooms, roots and tubers were collected only for subsistence during lean periods mostly by STs and SCs (Table 2).

Landholding size of tribal households in MTR was positively correlated with the amount of some of the NTFPs collected - *Madhuca* flower (r_s=0.248, p-value <0.05), forest greens (r_s=0.332, p-value <0.001)and bamboo shoots (r_s=0.153, p-value <0.05). In BWLS landholding size of tribal households showed positive correlation with amounts of - *Diospyros* leaves (r_s=0.400, p-value <0.001) and *Madhuca* seeds (r_s=0.270, p-value <0.05). Also the family size of tribal households in BWLS was positively correlated with the amount of *Diospyros melanoxylon* leaves collected (r_s=0.407, p-value <0.001). For communities B and C no significant correlation was found between landholding size and NTFPs collected.

Table 3. Park-people issues of local communities in MTR and BWLS*.

Issues	Melghat Tiger Reserve			Bori Wildlife Sanctuary	
`	A	B	C	A	C
LEO	63.47	85.42	14.29	90.63	81.82
IAL	8.98	22.92	3.57	57.81	90.91
CR	71.85	56.25	28.57	90.63	100.00
LP	5.39	12.5	7.14	56.25	54.55
PAWP	71.86	68.75	35.71	51.56	36.36
PAWL	56.87	54.17	53.57	43.75	9.09
LPR	11.98	25.00	7.14	76.56	90.91
LMF	25.75	33.33	28.57	89.06	100.00

LEO=Lack of employment opportunities; IAL=Insufficient agricultural landholding; CR=Crop raiding bywild herbivores; LP=Livestock predation by wild animals; PAWP=Poor access to drinking water for people; PAWL=Poor access to drinking water for livestock; LPR=Lack of proper Roads; LMF=Lack of medical facilities; A=Scheduled tribes, B=Scheduled castes and backward classes, and C=Agro-pastoralists.

*The figures are percentages of families in each community group.

Park-People Issues

Unavailability of wage employment was a major issue faced by > 60%ST and SC households in MTR and >80% households in BWLS. The other major issue was insufficient agricultural landholdings especially for >50% of households in BWLS; landholdings of some families in the PA had come under submergence of the backwaters of Tawa reservoir. Crop damage (>50% of ST and SC in MTR and >90% of all households in BWLS) and livestock predation (> 50% of households in BWLS) by wild animals also caused problems for the people. Both factors not only affected livelihoods of rural communities but also created park-people conflicts in the PAs. The other issues were lack of drinking water for people (>50% of ST and SC in both PAs) and livestock (>50% of families in MTR), poor- roads (>70% of households in BWLS) and medical facilities (>80% of households in BWLS) within the PAs (Table 3).

Anthropogenic Impact on Protected Area Forests

Two of the economically important tree species used by local communities- *Madhuca indica* and *Buchanania lanzan* showed low recruitment (of <1% of total stems) in disturbed as well as undisturbed forests. Tree cutting and lopping pressure had affected 25% - 50% of forests in both PA's while <25% of undisturbed forest (UF) was affected. Grazing and weeds had affected > 50% of disturbed forests and <25% of undisturbed forest. Ground cover was <25% in forests around villages, whereas it was > 50% in undisturbed forest. Disturbance scores showed significant difference (p-value < 0.01) in disturbed and undisturbed forests (Table 4).

Table 4. Mean disturbance scores (±S.E.) in disturbed and undisturbed forests of Melghat Tiger Reserve and Bori Wildlife Sanctuary. DF1=Disturbed forest of Melghat Tiger Reserve, UF=Undisturbed forest of Gugamal National Park and Tourism Zone in Melghat Tiger Reserve, DF2=Disturbed forest of Bori Wildlife Sanctuary.

Parameters	DF1	UF	DF2	χ^2	p values
Cutting and Lopping	1.56±0.1	0.03±0.02	2.32±0.1	139.7218	(p-value <0.01)
Grazing and Weeds	2.14±0.1	0.19±0.1	2.03±0.1	131.6469	(p-value <0.01)
Ground cover	1.64±0.04	2.31±0.1	1.43±0.1	115.93	(p-value < 0.01)

DISCUSSION

The scheduled tribes and castes were mostly dependent on wage employment while agro-pastoralists were dependent on sale of milk and other dairy products. Most landholders practised subsistence agriculture and worked as wage labor in nearby towns to supplement their incomes. Families in BWLS however could not find wage employment easily due to the remoteness and inaccessibility of the area. This further marginalized them and made their dependence on forest more acute. Similar findings were reported for the interior villages of Tadoba Andhari Tiger Reserve (Nagendra et al. 2006) and Kedarnath Wildlife Sanctuary (Malik et al. 2014).

Livestock formed stored wealth for ST and SC households and provided milk for domestic consumption while bulls were used in agricultural activities. For agro-pastoralists livestock formed the basis of their economy. In BWLS however, both communities had a more diversified income portfolio.

Apart from dependence on land and livestock, forest produce provided sustenance to the local communities in both MTR and BWLS, especially during the lean periods when it acted as a safety net. Vedeld et al. (2007) and Zenteno et al. (2013) too had found that forest-based income played an important role in rural households in developing countries. In BWLS collection of Tendu patta (*Diospyros melanaxylon* leaves) was managed by the forest department and therefore remoteness of the area did not affect earnings from it. However, the earnings were far greater for agro-pastoralists, a case of higher income households monopolizing off-farm income (Hogarth et al. 2013). *Madhuca indica* flowers were most important NTFP collected in terms of quantity and major proportion of it was used for domestic consumption by ST and SC households. For agro-pastoralists in BWLS it formed an additional source of income.

Fuelwood was major forest resource collected by all families in both PAs as there were no alternative sources of energy. In MTR it was also sold by ST and SC households to local tea shops catering to tourists as well as in nearby townships. Davidar et al. (2010) have reported similar findings for Kogar, Bandipur National Park and Simlipal Tiger Reserve. In BWLS fuel wood was only collected for domestic consumption. Nagendra et al. (2006) had also found that compared to peripheral villagers, those residing inside Tadoba Andhari Tiger Reserve collected forest resources primarily for domestic consumption.

One of the major park-people issues was lack of employment opportunities which resulted in increasing their dependence on the forest resource and pushing them further into poverty. The situation was further compounded due to crop raiding and livestock predation. While there was no compensation for crop raiding, compensation for livestock killing was not adequate and often was delayed in BWLS. Consequently, local people's perceptions of their problems associated with the PA were also influenced by how they were impacted by the PA (Baral and Heinen 2007) or their relationship with the PA managers. Villages in BWLS were also left out of most developmental and income-generation schemes. Majority of households also identified poor availability of drinking water for people and livestock in both PAs. Poor roads and medical facilities were considered a problem by most households in BWLS which was completely inundated during monsoons and lacked basic medical facilities.

The study shows that anthropogenic activities in the PAs had resulted in biotic pressure on forests of MTR and BWLS as seen in the form of higher incidences of cutting and lopping of trees, high weed proliferation and lower ground cover in the forests around villages in both PAs. Several studies (Adhikari 1988, Silori and Mishra 2001, Madhusudan 2005, Davidar, 2010) had found that intensive livestock grazing by domestic livestock and use of fuel wood caused forest degradation. The overall impact of biotic pressure on the forest was in the form of lower ground cover, higher weed abundance, and low seedling densities in both the disturbed forests (DF1 and DF2) of MTR and BWLS. In the long run the degradation of forest and inadequate regeneration is likely to impede the survival of good quality forest and adversely affect not only the conservation status of these forests, but would worsen the condition of local communities due to the erosion of their resource base.

Implications for protected area management

Being part of larger forested landscapes inter-spersed with human habitations, MTR and BWLS cannot be protected using exclusionary policies. Forestry laws and regulations in many countries including India had allowed privileged access to timber wealth while preventing its use by the poor (Sunderlin et al. 2005). Forest Rights Act 2006 has proposed more inclusive forest policies (GOI 2006, Bhullar 2008) whereby giving tenure rights to local communities (Reddy and Chakravarti 1999, Sunderlin et al. 2005, Kashwan 2013) can go a long way in making agriculture more productive thereby reducing dependence on forest resources.

Creating more off-farm employment opportunities and also making alternative sources of income more remunerable and sustainable can reduce availability of wage labour for forest exploitation (Sunderlin et al. 2005). Technical and financial support under eco-development and tribal development schemes should be provided for enhancing agricultural productivity, developing horticulture and other off-farm activities like poultry farming and fish-culture. These programmes could help in reducing forest dependence. Public works programmes for providing- water for drinking and better roads could also be taken up under various employment and income generation schemes of the government, however, these are not a permanent solution. Adopting more inclusive Rights-Based Approach (Kashwan 2013) may involve local communities in achieving conservation goals of the two PAs. Restocking of forests with species used by people and regulation of grazing and livestock numbers inside the PAs may reduce the adverse impact of grazing. These approaches can be implemented and monitored to study the outcomes for changes in forest dependence and status of conservation in the two study sites.

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