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Economic dependence of forest fringe communities on threatened and near-threatened medicinal trees of Madhya Pradesh – the largest forest cover state of central India

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Abstract. People have a free access to the Non timber forest produce (NTFP) in the State of Madhya Pradesh, India barring only a few NTFP which are monopolized by the state for collection and trade. Because of such free access tenure, people and the policy makers have little appreciation for the provisional ecosystem services emanating from the state's forests. Hence, a research study was conducted in Madhya Pradesh state of India during 2014–2015.This paper evaluates the dependence of the forest fringe communities on the already Threatened and Near-threatened Medicinal Tree resources (TNMTs) in the forests of the state for their health and livelihood requirements.This study was conducted in all the six eco-regions of the state after selecting the most forested divisions and purposely selected forest compartments and socio-economic surveys were conducted in the villages adjoining these forest compartments. The TNMTs of these compartments were fully enumerated in the selected compartments and their physical conditions were recorded. Focus group discussions and household surveys were conducted to study the dependence of forest fringe communities on TNMTs in the adjoining forests. The results show that contribution of direct forest income to the total annual household income was found to vary from 29.35% to 69.48% in forest divisions located in all the six eco-regions of the state. In all the six eco-regions, the percentage of households found to be dependent on forests for some or the other benefits ranged from 96% to 100%. Almost all the TNMTs encountered during this survey were found facing threat of local extinction due to poor regeneration and many other factors at most of the forest sites. The authors have suggested some corrective measures for sustainable management of forest resources for the benefit of forest fringe community in the article.

Keywords: Threatened and Near-threatened Medicinal Trees (TNMTs), Red listed medicinal trees (RLMTs), Non Timber Forest Produce (NTFP), sustainable harvesting, forest regeneration, forest based income, Eco-regions.

1. Introduction

India is very rich in forest diversity. According to Champion and Seth (1968), there are 16 major forest types and 221 minor forest types in the country. These forests serve as the repository of variety of floral and faunal species, including medicinal plants (Rajpoot & Chaudhry, 2018). About 27% of Indian villages (out of total 0.640 million villages as per 2011 national population census) are located inside or near forests' periphery (MoEFCC, 2006). Though there is no official census figure about the forest dependent population in the country, different estimates put the figures from 275 million (World Bank, 2005) to 400 million (MoEFCC, 2009). Being welfare state in nature, forest fringe communities in India are getting forest based non timber forest products, including medicinal plants, virtually free of cost for their health, livelihood and other socio cultural requirements (Patil & Kumar, 2015a). Medicinal plant resources serve not

only a major resource base for the traditional pharmaceutical and herbal industry but also provide livelihood and health security to a large segment of Indian population especially marginalized farmers andforest fringe communities (Myers, 1991; Lacuna-Richman, 2002).

The commercial demand for botanical raw drugs has put the medicinal plant resources under great stress (Patil & Kumar, 2015b). Madhya Pradesh, the largest forest cover state of India, is no exception and medicinal trees of threatened category growing naturally in the state forests are facing various problems like dwindling natural regeneration of such medicinal trees, forest department's lack of concern as medicinal trees are given lesser priority than timber and other NTFP species, long term gestation period of medicinal trees making them unprofitable proposition for planting by private entrepreneurs, overexploitation of such trees due to lack of knowledge or greediness etc.

Foundation for Revitalization of Local Health Traditions (FRLHT) Bangalore, India; a non-governmental and reputed organization working in medicinal plants sector and Madhya Pradesh State Biodiversity Board, assigned the status of 'near threatened' and above to 50 medicinal plants of the state using IUCN Red list categories and criteria in the year 2006. Out of these 50 Red listed species of medicinal plants, 13 are tree species. Out of these 13 trees, the annual trade of medicinal raw material of 10 trees is more than 100 tonnes (Ved & Goraya, 2008). The details of the Red listed medicinal trees (RLMTs) of the state are given in Table 1.

The findings of FRLHT were based on CAMP (Conservation and Management Prioritization) workshops and it specifically recommended that a quantitative study should be carried out to assess the threat perception of these species before taking up any conservation interventions. Hence, this research study was conducted in order to study the status of the RLMTs in the forests of the state by collecting quantitative data and also to study the degree of dependence of local communities on these natural assets for their health, livelihood and other requirements. The surveys were conducted during 2014–2015.

2. Materials and Methods

The study area of the research was virtually entire Madhya Pradesh, but for the purpose of sampling (as complete enumeration was never possible), the concept of eco-regions for zonation was adopted. Entire state was divided into six eco-regions namely: Satpuda Eco-region, Vindhyn Eco-region, Bundelkhand Eco-region, Central Eco-region, Malwa Eco-region and Chambal Eco-region (Fig. 1).

As, the idea was to study sizable populations of the red listed medicinal trees in their natural niches, it was decided to select the districts with highest forest cover (in terms of %) in each of the eco-regions of the state for the study. In this way, six districts in each eco-region were selected. Out of these six districts, four had only one forest division whereas the other two districts had two forest divisions each. So, the Chief Conservators of Forests in charge of those districts were contacted for the selection of one division for the study. In this selection also, compactness of the forest area (contiguity) – in order to encounter maximum species of the 'Threatened and Near-threatened Medicinal Trees' (TNMT) – was the criteria. The eco-region wise forests divisions finally selected for the study are shown in Table 2.

Household survey was conducted among forest fringe communities in the selected forest divisions, where the respondents were asked in details about their income (in

Table 1. Red Listed Medicinal trees (RLMT) of Madhya Pradesh

No.	Genus & Species	Author	Common Name	Plant Parts Used	Status in M.P.	Trade Volume
1	*Boswellia serrata*	Roxb. Ex Colebr.	Salai	Oleo-Gum Resin	Vulnerable	>100 t/yr.
2	*Cochlospermum religiosum*	DC.	Katira	Gum	Vulnerable	-
3	*Crataeva magna*	(Lour.) DC.	Varuna	Bark (Stem), Leaf, Fruit (Seed)	Vulnerable	-
4	*Litsea glutinosa*	(Lour.) Robinson	Meda Lakdi	Leaf, Bark (Stem)	Vulnerable	>100 t/yr.
5	*Oroxylum indicum*	(L.) Vent.	Shyonak	Bark (Stem, root)	Vulnerable	>100 t/yr.
6	*Phyllanthus emblica*	L.	Aonla	Fruit	Vulnerable	>100 t/yr.
7	*Pterocarpus marsupium*	Roxb.	Bija	Heartwood, Bark (Stem), Resin, Seed	Vulnerable	>100 t/yr.
8	*Salvadora oleoides*	Decne	Pilu	Fruit	Vulnerable	-
9	*Sterculia urens*	Roxb.	Kullu		Vulnerable	>100 t/yr.
10	*Terminalia chebula*	Retz.	Harra, Harad	Fruit	Vulnerable	>100 t/yr.
11	*Buchanania lanzan*	Spreng.	Achar	Fruit (Seed)	Near Threatened	>100 t/yr.
12	*Stereospermum chelonoides*	(L.f.) DC.	Patala, Patalai	Root	Near Threatened	>100 t/yr.
13	*Terminalia arjuna*	(Roxb. ex DC.) Wight &Arn.	Arjun	Bark (Stem), Fruit (Seed)	Near Threatened	>100 t/yr.

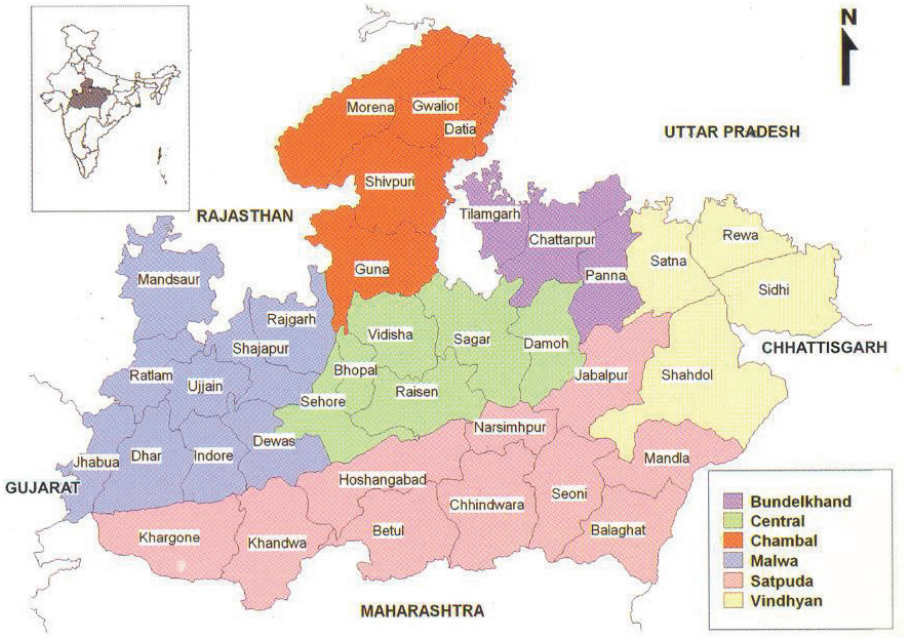

Figure 1. Eco-regions of Madhya Pradesh

terms of cash and kind) from various sources in last one year. In the schedule for this survey, the income was recorded under eight major heads like Wages from forestry works, Direct forest income, Income from own business, Income from agriculture etc. The major income head of Direct Forest Income has further been recorded into minor heads like fire wood, fodder, Tendu (*Diospyros melanoxylon*) leaves, Salai (*Boswellia serrata*) gum, Kullu (*Sterculia urens*) gum, Aonla (*Phyllanthus emblica*), Harra (*Terminalia chebula*) etc. The forest division wise general demographic profile of the surveyed villages in shown in Table 3.

Table 2. Eco-region wise selection of forest divisions for the study

No.	Eco-region	District	Forest Division
1	Bundelkhand	Panna	South Panna
2	Central	Damoh	Damoh
3	Chambal	Sheopur	Sheopur
4	Malwa	Dewas	Dewas
5	Satpuda	Balaghat	North Balaghat
6	Vindhyan	Umaria	Umaria

Table 3. Forest division wise general demographic profile of the surveyed villages

No.	General demographic parameters	Forest Divisions					
		Dewas	Sheopur	Damoh	South Panna	North Balaghat	Umaria
1	No. of villages	10	8	8	6	7	5
2	Main communities	Korku, Gond, Bhil, Bhilala	Saharia, Adwani	Gond, Yadav, Rajgond	Gond, Yadav, Bhumia	Gond, Baiga, Panika	Gond, Baiga, Yadav
3	Avg. size of Household(HH)	6.05	5.85	5.40	5.75	4.64	5.70
4	Avg. no. of households/village	86.8	189.0	101.6	97.8	54.7	81.8
5	Avg. village population	601	818	431	482	318	350
6	Sex ratio	875	806	815	825	836	900
7	Literacy rate	58.7%	48.07%	54.63%	60.00%	62.81%	61.0%
8	Age group < 18 years	38.0%	48.29%	37.03%	37.3%	35.07%	44.4%
9	Age group 18–60 yrs.	55.0%	49.35%	55.09%	56.5%	57.84%	51.7%
10	Age group > 60 years	7.10%	2.13%	7.87%	6.08%	5.33%	3.84%
11	Households owning farmland	79.0%	58.75%	82.50%	93.0%	82.85%	96.0%
12	Avg. agricultural holding (Acres/HH)	4.41	2.32	3.40	4.48	2.64	3.31
13	Households with outstanding debts	44.0%	16.25%	36.25%	11.6%	8.50%	12.0%
14	Avg. size of debt (Rs./HH)	61,409	51,307	25,120	32,500	7,833	13,833

In this research study, as the data on the quantity of the forage generally consumed by the animals on an average basis in the forests has been collected along with its value after deliberate discussions with the villagers, it has been counted as forest income. But, when this value of forest forage is deducted from the gross income from the livestock, the net income turns out negative indicating loss in the enterprise. This may be because of the poor quality of the animal breeds and unprofessional ways of handling the rural animal husbandry (dairy, goatry, poultry etc) enterprise in general. That is why, the income from livestock is shown as nil in the Tables 4–10.

3. Results and Discussion

Table 4 is showing break up of total income in broad categories of sources in the villages of Dewas forest division.

Thus, in Dewas forest division, the largest source of income is Direct Forest Income followed very closely by Agriculture and Income from non-forest wages. But, whereas, 96% households are dependent upon forests for some or the other purpose, the households dependent on agriculture and non-forest wages are 78% and 82% respectively.

Quite contrary to Dewas division, the forest fringe communities in Sheopur division are very heavily dependent on forest for their livelihood. In this division, the bulk of the income of the villagers comes from two heads only – direct forest income and income from non-forest wages (Table 5). In this division, there are large herds of cattle and goats reared by people of Marwadi community (migrated from Marwar region of adjoining Rajasthan State). These animals thrive almost totally on the fodder and grass available in the adjoining forest areas. In addition to the occupation of cattle and goat rearing, villagers also earn substantial income from the collection and sale of Salai gum and a variety of herbs – the tubers of Shatawar being a major source. Almost all the households (96%) are dependent on forests for some or the other reason, whereas, 88% of the households are dependent on non-forest wages. Surprisingly, only 52% households in this division are dependent upon agriculture.

In Damoh district, the villagers earn the highest from direct forest income (43.17%) followed by income from non-forest wages (34%). 100% households depend on direct forest income whereas 93% of the households depend on income from non- forest wages. The third major contributor to the household income is agriculture (13.82%) and 81% households depend on agriculture (Table 6).

Table 4. Break up of total income in broad categories of sources in the villages of Dewas forest division (100 households)

No.	Source of income	Total income (Rs.)	Number of related HH & %	Average income per related HH (Rs.)	Average overall income per HH (Rs.)	% of total income
1	Wages from forestry works	315,550	39 (39%)	8,091	3,155.50	2.83
2	Direct forest income	3,266,905	96 (96%)	34,030	32,669.05	29.35
3	Wild fish & aquaculture	5,025	8 (8%)	628.13	50.25	0.05
4	Income from non-forest wages	3,254,280	82 (82%)	39,686	32,542.80	29.23
5	Income from own business	410,400	7 (7%)	58,629	4,104.00	3.69
6	Income from agriculture	3,255,945	78 (78%)	41,743	32,559.45	29.25
7	Income from livestock	0	82 (82%)	0	0	0
8	Other sources of income	624,600	45 (45%)	13,880	6,246.00	5.61
	Total				111,327.05	100
				HH Size = 6.05	18,401.17	Per capita

Table 5. Break-up of total income in broad categories of sources in the villages of Sheopur Division (80 Households)

No.	Source of income	Total income(Rs.)	Number of related HH & %	Average income per related HH (Rs.)	Average overall income per HH (Rs.)	% of total income
1	Wages from forestry works	198,600	27 (33%)	7,355.56	2,482.50	1.85
2	Direct forest income	7,469,310	77 (96%)	97,004.03	93,366.38	69.48
3	Wild fish & aquaculture	69,750	12 (15%)	5,812.50	871.88	0.65
4	Income from non-forest wages	1,961,690	71 (88%)	27,629.44	24,521.13	18.25
5	Income from own business	54,500	2 (2.5%)	27,250.00	340.63	0.25
6	Income from agriculture	800,815	42 (52%)	19,067.02	10,010.19	7.45
7	Income from livestock	0	45 (56%)	0	0	0
8	Other sources of income	223,000	8 (1%)	27,875.00	2,787.50	2.07
	Total				134,380.21	100
				HH Size = 5.85	Rs 22,971	Per capita

In South Panna division also, the villagers earn the highest from direct forest income (46.2%) followed by income from non-forest wages (29.77%). 100% households depend on direct forest income whereas 93% households depend on income from non-forest wages. The third major source of income in this division is 'Other sources of income' whereas agriculture is at 4th position. 100% and 93% households depend on direct forest income and income from non-forest wages respectively (Table 7).

In North Balaghat Division the direct forest income is highest (46.9%) followed by income non-forest wages (24.58%) and agriculture (13.38%). Almost all the households (98%) depend upon forests for fulfilling some requirement or the other. 84% and 75% of all the households depend on non-forest wages and agriculture respectively (Table 8).

Table 6. Break-up of total income in broad categories of sources in the villages of Damoh Division (80 Households)

No.	Source of income	Total income (Rs.)	Number of related HH & %	Average income per related HH (Rs.)	Average overall income per HH (Rs.)	% of total income
1	Wages from forestry works	310,000	29 (36%)	10,689.66	3,875.00	4.73
2	Direct forest income	2,827,399	80 (100%)	35,342.49	35,342.49	43.17
3	Wild fish & aquaculture	6,000	2 (2.5%)	3,000.00	75.00	0.09
4	Income from non-forest wages	2,226,847	75 (93%)	29,691.29	27,835.59	34.00
5	Income from own business	100,250	3 (3.7%)	33,416.67	1,253.13	1.53
6	Income from agriculture	905,478	65 (81%)	13,930.43	11,318.48	13.82
7	Income from livestock	0	67 (83%)	0	0	0.00
8	Other sources of income	173,600	12 (15%)	14,466.67	2,170.00	2.65
	Total				81,869.68	100.00
				HH Size = 5.4	15,161.05	Per capita

Table 7. Break-up of total income in broad categories of sources in the villages of South Panna Division (60 Households)

No.	Source of income	Total income (Rs.)	Number of related HH & %	Average income per related HH	Average overall income per HH (Rs.)	% of total income
1	Wages from forestry works	105,950	16 (26%)	6,621.88	1,765.83	1.40
2	Direct forest income	3,501,948	60 (100%)	58,365.80	58,365.80	46.20
3	Wild fish & aquaculture	1,000	1 (1.6%)	1,000.00	16.67	0.01
4	Income from non-forest wages	2,256,550	56 (93%)	40,295.54	37,609.17	29.77
5	Income from own business	0	0 (0%)	0.00	0.00	0.00
6	Income from agriculture	632,884	55 (91%)	11,506.98	10,548.07	8.35
7	Income from livestock	0	52 (86%)	0	0	0.00
8	Other sources of income	1,081,000	6 (10%)	180,166.67	18,016.67	14.26
	Total				126,322.20	100.00
				HH Size = 5.75	21,969.08	Per capita

Table 8. Break-up of total income in broad categories of sources in the villages of North Balaghat Division (70 Households)

No.	Source of income	Total income (Rs.)	Number of related HH & %	Average income per related HH (Rs.)	Average overall income per HH (Rs.)	% of total income
1	Wages from forestry works	364,769	34 (48%)	10,728.50	5,210.99	5.55
2	Direct forest income	3,085,105	69 (98%)	44,711.67	44,072.93	46.90
3	Wild fish & aquaculture	7,800	6 (8.5%)	1,300.00	111.43	0.12
4	Income from non-forest wages	1,616,691	59 (84%)	27,401.54	23,095.59	24.58
5	Income from own business	192,750	12 (17%)	16,062.50	2,753.57	2.93
6	Income from agriculture	880,055	53 (75%)	16,604.81	12,572.21	13.38
7	Income from livestock		52 (74%)			0.00
8	Other sources of income	430,300	11 (15.7%)	39,118.18	6,147.14	6.54
	Total				93,963.86	100.00
				HH size = 4.64	20,238.37	Per capita

In case of Umaria division, also, the direct forest income is highest (61.12%) followed by incomes from non-forest wages (23.50%) and agriculture (10.04%). Whereas, 98% households depend upon forests for fulfilling some requirement or the other, 94% and 92% of all the households depend on non-forest wages & agriculture respectively (Table 9).

A comparison of constituent income sources of forest fringe households among all the six eco-regions is presented in Table 10. It is observed that direct forest income constitutes a major portion in average overall income of households amounting to 29.35% (lowest) to 69.48% (highest) in six forest divisions located in six different eco-regions of the state. These findings are more or less in tune with the different studies conducted in the country which have estimated that the income from sale of the forest products for households living in and around forest constitutes 40 to 60% of their total income (Sadashivappa et al., 2006; Mahapatra & Kant, 2005; Bahuguna, 2000).

Dependence of fringe communities on the forests in our study is, however, more than that of Karnataka

Table 9. Break-up of total income in broad categories of sources in the villages of Umaria Division (50 Households)

No.	Source of income	Total income (Rs.)	Number of related HH & %	Average income per related HH (Rs.)	Average overall income per HH (Rs.)	% of total income
1	Wages from forestry works	239,360	36 (72%)	6,648.89	4,787.20	4.11
2	Direct forest income	3,851,286	49 (98%)	78,597.67	67,451.32	57.92
3	Wild fish & aquaculture	20,850	11 (22%)	1,895.45	417.00	0.36
4	Income from non-forest wages	1,480,535	47 (94%)	31,500.74	29,610.70	25.43
5	Income from own business	73,000	1 (2%)	73,000.00	1,460.00	1.25
6	Income from agriculture	632,874	46 (92%)	13,758.13	12,657.48	10.87
7	Income from livestock	0	41 (82%)	0	0	0
8	Other sources of income	6,600	2 (4%)	3,300.00	66.00	0.06
	Total				116,449.70	100.00
				HH Size = 5.70	20,429.77	Per capita

Table 10. Comparison of constituent income sources of forest fringe households among all the six eco-regions

No.	Source of income	Dewas		Sheopur		Damoh		South Panna		North Balaghat		Umaria	
		Average overall income per HH	% of total income	Average overall income per HH	% of total income	Average overall income per HH	% of total income	Average overall income per HH	% of total income	Average overall income per HH	% of total income	Average overall income per HH	% of total income
1	Wages from forestry works	3,155.50	2.83	2,482.50	1.85	3,875.00	4.73	1,765.83	1.40	5,210.99	5.55	4,787.20	4.11
2	Direct forest income	32,669.05	29.35	93,366.38	69.48	35,342.49	43.17	58,365.80	46.20	44,072.93	46.90	67,451.32	57.92
3	Wild fish & aquaculture	50.25	0.05	871.88	0.65	75.00	0.09	16.67	0.01	111.43	0.12	417.00	0.36
4	Income from non-forest wages	32,542.80	29.23	24,521.13	18.25	27,835.59	34.00	37,609.17	29.77	23,095.59	24.58	29,610.70	25.43
5	Income from own business	4,104.00	3.69	340.63	0.25	1,253.13	1.53	0.00	0.00	2,753.57	2.93	1,460.00	1.25
6	Income from agriculture	32,559.45	29.25	10,010.19	7.45	11,318.48	13.82	10,548.07	8.35	12,572.21	13.38	12,657.48	10.87
7	Income from livestock	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	Other sources of income	6,246.00	5.61	2,787.50	2.07	2,170.00	2.65	18,016.67	14.26	6,147.14	6.54	66.00	0.06
	Total	111,327.05	100	134,380	100	81,869.68	100.00	126,322.20	100.00	93,963.86	100.00	116,449.70	100.00
	HH Size	**6.05**		**5.85**		**5.4**		**5.75**		**4.64**		**5.70**	
	Per capita income	18,401.17		22,971.00		15,161.05		21,969.08		20,238.37		20,429.77	

state of Indiastudy conducted at three sites namely Malai Mahadeshwara Hills (MM Hills), Biligiri Rangaswamy Temple Wildlife sanctuary (BR Hills) and Rajiv Gandhi National Park (Nagarahole). The community at BR Hills derived nearly 59% of their total cash income from NTFPs, that in Nagarahole 24% and that of MM Hills 16% (Shaanker et al, 2004). In another study conducted among tribes of Jharkhand state(Ajaz-ul-Islam et al., 2013), forest resources income accounted for 25.05% of overall income, which is again lesser than that of present study.

Another significant finding that has appeared in our study is that almost one hundred percent of households depend on direct forest income. Precisely it is 96% in Dewas and Sheopur forest divisions and 100% in Damoh and South Panna divisions (Table 11). This means that forest NTFPs (precisely threatened and rear-threatened medicinal trees) play a very important livelihood supporting role in forest fringe communities' earnings.

Table 12 shows the different constituents of direct forest income (DFI) among six eco-regions. It can be observed here that fodder and grass collection from forests constitutes maximum % of DFI in all the eco-regions whereas firewood also constitutes a major percentage of DFI. These findings about firewood collection and usage are in tune with the 2011 census report which says that 49% of the households in the country use firewood for cooking. In some states, it is as high as 80%. The forest rich states have higher incidence of firewood collection and usage (Banerjee & Choudhury, 2013). Among other NTFPs, Mahua (flowers and seed) and Tendu leaves (for rolling local cigarettes, called *bidis* locally) also play an important role in DFI.

Among 13 species of TNMT species, only five – namely Achar, Salai, Aonla, Kullu and Harra contributed to the livelihood of the forest communities. (Table 12). The most salient being the fiscal contribution of Salai resin (gum) to the livelihood of the people of Sheopur division. In this division, 58% households are found to be dependent on this forest resource and it is fetching Rs 24,733 per household (averaged over all the surveyed households) per year which is 18.40% of the average annual income of the households and is about 2.5 times the contribution of agriculture in their total annual income. The annual household income from the five TNMTs varied between Rs 375 in North Balaghat division and Rs 25,600 in Sheopur division. The percentage of households dependent upon them varied between zero and 72% and the contribution of this income to the direct forest income varied between 0.8% and 27%. The contribution of TNMT based income to the total annual household income varied between 0.3% and 19% in all the six divisions (eco-regions). The contribution of income from the five TNMT to the average annual household income is minimum (0.39%) in North Balaghat division (Vindhyan Eco-region) and maximum (19.05%) in Sheopur division (Chambal Eco-region). Aonla and Achar contribute to the household income in all the six eco-regions.

Table 11. Comparison of households dependent on different sources of income among all the six eco-regions

No.	Source of income	Dewas (100 HH)		Sheopur (80 HH)		Damoh (80 HH)		South Panna (60 HH)		North Balaghat (70 HH)		Umaria (50 HH)	
		Number of dependent HH	%	Number of dependent HH	%	Number of dependent HH	%	Number of dependent HH	%	Number of dependent HH	%	Number of dependent HH	%
1	Wages from forestry works	39	(39%)	27	(33%)	29	(36%)	16	(26%)	34	(48%)	36	(72%)
2	Direct forest income	96	(96%)	77	(96%)	80	(100%)	60	(100%)	69	(98%)	49	(98%)
3	Wild fish & aquaculture	8	(8%)	12	(15%)	2	(2.5%)	1	(1.6%)	6	(8.5%)	11	(22%)
4	Income from non-forest wages	82	(82%)	71	(88%)	75	(93%)	56	(93%)	59	(84%)	47	(94%)
5	Income from own business	7	(7%)	2	(2.5%)	3	(3.7%)	0	(0%)	12	(17%)	1	(2%)
6	Income from agriculture	78	(78%)	42	(52%)	65	(81%)	55	(91%)	53	(75%)	46	(92%)
7	Income from livestock	82	(82%)	45	(56%)	67	(83%)	52	(86%)	52	(74%)	41	(82%)
8	Other sources of income	45	(45%)	8	(1%)	12	(15%)	6	(10%)	11	(15.7%)	2	(4%)

Table 12. Comparison of constituents of direct forest income among the six eco-regions

No.	Division	Sub heads of DFI	Fire wood	Mahua	Achar	Tendu Patta	Poles	Salai	Kullu	Harra	Shata war	Aonla	Soil	Thorny bushes	Leaves for shed	Fodder and grass	Others	Total Forest Income
1	Dewas	Avg HH Income	7,498	1,936	433	3,098	465	230	30	0	0	113	85	117	27	18,318	316	32,669
		% HH dependent	78	63	35	71	41	6	1	0	0	11	32	13	10	80	22	
		% of DFI	22.9	5.9	1.3	9.4	1.4	0.7	0.1	0	0	0.3	0.2	0.3	0.1	56	0.9	100
2	Sheopur	Avg HH Income	3,168	978	46	2,097	378	2,4733	0	0	5,085	820	43	54	67	49,250	6642	93,366
		% HH dependent	36	27	7.5	57	35	58	0	0	35	43	15	7.5	11	45	58	
		% of DFI	3.3	1.0	0.05	2.2	0.4	26.4	0	0	5.4	0.8	0.04	0.05	0.07	52.7	7.1	100
3	Damoh	Avg HH Income	5,238	2,608	2,301	2,493	591	6.25	0	0	0	1,135	71	44	21	20,746	83	35,342
		% HH dependent	100	77	66	76	67	1.25	0	0	0	72	22	12	6.25	85	10	
		% of DFI	14.8	7.3	6.5	7.0	1.6	0.01	0	0	0	3.2	0.2	0.1	0.06	58.7	0.2	100
4	S Panna	Avg HH Income	8,319	2,275	1,202	1,332	629	0	6.66	0	0	1,956	130	58	3.33	42,267	183	58,366
		% HH dependent	100	73	45	78	70	0	1.66	0	0	58	41	13	1.66	90	33	
		% of DFI	14.2	3.9	2.0	2.2	1.07	0	0..1	0	0	3.3	0.2	0.09	0.005	72.41	0.3	100
5	N Balaghat	Avg HH Income	3,573	3,397	134	1,850	296	4.28	0	207	0	30	28	102	2.85	32,329	2117	44,073
		% HH dependent	98	85	15	71	82	1.42	0	18	0	5	12	15	1.42	77	44	
		% of DFI	8.1	7.7	0.3	4.19	0.6	0.009	0	0.47	0	0.06	0.06	0.2	0.006	73.3	4.8	100
6	Umaria	Avg HH Income	6,922	4,832	266	1,137	509	0	0	6	0	762	4.5	129	35	52,114	731	67,451
		% HH dependent	98	98	40	68	68	0	0	4	0	58	2	16	6	80	54	
		% of DFI	10.2	7.1	0.4	1.6	0.7	0	0	0.008	0	1.1	0.006	0.19	0.05	77.2	1.0	100

3. Conclusion

Forest fringe communities in the state of Madhya Pradesh depend heavily on the forest resources for their health, livelihood and other socio-cultural needs. The contribution of direct forest income to the total annual household income is found to be minimum (29.35%) in Dewas forest division and maximum in Sheopur forest division (69.48%). In all the six divisions, the percentage of households which found to be dependent on forests for some or the other benefits ranged from 96% to 100%. But, when it comes to the TNMTs, it was found that people are financially dependent only on Achar, Salai, Kullu, Harra and Aonla in varying degrees. Barring Katira, Pilu and Varuna, the national trade volume of all the other 10 TNMTs is more than 100 Tons per annum. Among these 10 tree species, the harvesting of herbal raw material in Salai, Maida, Shyonak, Bija, Kullu, Patala and Arjun is quite injurious to the trees as gums or resins (after giving injury to the bark – in Salai and Kullu), bark (as in Maida and Arjun), roots (as in Shyonak and Patala) and timber itself (as in Bija) have to be removed. Hence, species specific strategies are needed to ensure sustained supplies of these botanical raw drugs.

Almost all the RLMTs encountered during this survey are facing the threat of local extinction due to poor regeneration and many other causes at most of the sites. It is strongly recommended that the conservation actions for all the 13 TNMTs should be started without any delay.

Recommendations

1. The non-timber forest produce, including the raw herbs from the TNMTs, play a very vital role in the livelihood of the forest fringe communities. So, if the conservation efforts in forests are stepped up with more resources allocation in the state or federal budgets, then, the forests can help a great deal in improving the standard of life of the rural poor dependent upon them. It may, in fact, reduce the rate of urbanization in the state and the country.
2. Neglect of the naturally growing tree resources like the TNMTs in the wild may lead to their extinction. Hence, peoples' stakes have to be developed in these resources in order to conserve them. The awareness generation and active involvement of the local beneficiary communities in conservation of such resources – in the philosophy of 'Care and Share' – will go a long way in safeguarding these natural resources.
3. Sustainable harvesting protocols need to be developed for all the threatened medicinal trees and the local communities and forest department should collectively ensure their effective implementation in the field. For those species having very few specimen surviving in the forests (Maida, Shyonak, Katiraetc), the propagules should be conserved in National Bank for Plant Genetic Resources (NBPGR), Pusa, New Delhi and efforts should be made for in-situ conservation and resource augmentation of such species.
4. The working plan officers of forest department of the state should pay special attention to the Threatened and Near-Threatened Medicinal Trees of the state. The forest resource survey should collect data, report changes about these species and give sound prescriptions for the conservation & developments of these tree species. The state government should also provide special budget for their conservation.
5. Aonla is supposed to be the richest natural source of vitamin C which is an anti-oxidant and is available in plenty in the forests of the state. Food products of Aonla (like murabba, supari, pachakbadi, aonla candy, chyavanprash etc) should be included in the mid-day meal scheme of the government schools so that the villagers will get good prices for their Aonla collection, more farmers will tend to plant aonla in their farms ensuring conservation of the species and the young generation of the state will reap the health benefits of the natural resource.
6. Creation of plantations of these species is a very costly proposition. Hence, all efforts should be made to ensure in-situ conservation of these species.
7. The field staff of forest department should be specially trained in identification and conservation of these species.
8. The local communities should also be trained in the post harvesting practices of these NTFPs so that the decay and wastage of theses precious resources can be minimized.

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References

Ajaz-ul-Islam M., Quli S.M.S, Rai R. & Sofi P.A., 2013, Livelihood contributions of forest resources to the tribal communities of Jharkhand. Indian Journal of Fundamental and Applied Life Sciences 3(2): 131–144.

Bahuguna V.K., 2000, Forests in the Economy of the Rural Poor: An Estimation of the Dependency Level. Ambio 29(3): 126–129.

Banerjee A. & Choudhury M., 2013, Forest degradation and livelihood of local communities in India: A human rights approach. Journal of Horticulture and Forestry 5(8): 122–129.

Champion H.G. & Seth S.K., 1968, A Revised Survey of Forest Types of India. Manager of Publications, Government of India, Delhi. https://www.worldcat.org/title/revised-survey-of-the-forest-types-of-india/oclc/679918994.

Lacuna-Richman C., 2002, 'The socio economic significance of subsistence non wood forest products in Leyte, Philippines'. Environmental Conservation 29: 253–262.

Mahapatra K. & Kant S., 2005, Tropical Deforestation: A Multinomial Logistic Model and Some Country Specific Policy Prescriptions. Forest Policy and Economics 7: 1–24.

MoEF&CC, 2006, Report of the National Forest Commission. Ministry of Environment and Forests, Government of India, New Delhi, 421 pp.

MoEF&CC, 2009, State of Environment Report. Ministry of Environment and Forest. Government of India, New Delhi.

Myers N., 1991, The world's forests and human population: the environmental interconnections. Population and Development Review 16: 1–15.

Patil A.K. & Kumar V., 2015a, Cost of living near forests: An economic analysis in central India. Journal of Tropical Forestry 31(IV): 1–11.

Patil A.K. & Kumar V., 2015b, Field verification of C.A.M.P workshop's threat assessments: Population study of red listed medicinal trees in the tropical dry forests of central India. Indian Journal of Tropical Biodiversity 23(2): 193–198.

Rajpoot A. & Chaudhry P., 2018, Green economics and value chain analysis of a cultivated medicinal plant (Pipla) from India. Int. J. Green Economics 12(1): 1–17.

Sadashivappa P., Suryaprakash S. & Vijaya Krishna V., 2006, Participation Behavior of Indigenous People in Non-Timber Forest Products Extraction and Marketing in the Dry Deciduous Forests of South India. Conference on International Agricultural Research for Development, October 11–13, Tropentag University of Bonn.

Shaanker R.U., Ganeshaiah K.N., Krishnan S., Ramya R., Meera C., Aravind N.A., Kumar A., Rao D., Vanaraj G., Ramachandra J., Gauthier R., Ghazoul J., Poole N. & Reddy B.V.C., 2004, Livelihood gains and ecological costs of non-timber forest product dependence: assessing the roles of dependence, ecological knowledge and market structure in three contrasting human and ecological setting in south India. Environmental Conservation 31(3): 242–253.

Ved D.K. & Goraya G.S., 2008, Demand and Supply of Medicinal Plants in India. NMPB, New Dehli & FRLHT, Bangalore, India. https://nmpb.nic.in/sites/default/files/publications/Contents.pdf

World Bank, 2005, India – Unlocking opportunities for forest-dependent people in India: Main report. World Bank, Washington, DC. http://documents.worldbank.org/curated/en/373571468268482287/Main-report