

Contribution of Non-Timber Forest Products (NTFPs) To Livelihood Economy of the People Living In Forest Fringes in Changlang District Of Arunachal Pradesh, India

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ABSTRACT

The forests of Arunachal Pradesh support rich diversity of timber as well as non-timber yielding species. The non-timber forest products (NTFPs) possess imperative part of the traditional life style in Arunachal Pradesh and utilisation of these products has been contributing much to the local livelihood. NTFPs such as fuelwood, house building materials, wild edible vegetables and medicinal plants are mostly collected from natural habit. The total contribution of NTFPs to annual household income was maximum (23% of the total income) in the villages of Miao circle followed by Diyun circle (21% of the total income) and Nampong circle and Vijaunagar circle (19% and 18% of the total income respectively). It was recorded minimum (11% of the total income) in the villages of Bordumsa circle.

Key Words: Non-timber forest products, livelihood, socio-economy, commercial potential, Changlang district, Arunachal Pradesh.

INTRODUCTION

Forests provide significant social and economic benefits at all levels, especially in developing countries. Economics of people living in forest finger have traditionally been dominated by subsistence agriculture. However, non-timber forest products (NTFPs) play vital role among the tribal people and provide a source of income and subsistence living (Peters *et al.*, 1989; Hegde *et al.*, 1996). NTFPs like fuel-wood, medicinal plants, wild edible vegetables, house building materials etc. are integral part of day-to-day livelihood activities especially for tribal people (Sarmah, 2006). Since the early 1990s the role of NTFPs for sustainable forest use and poverty alleviation has received increased attention (Peters *et al.*, 1989). The socio-economic importance and the value of NTFPs in the economics of tropical countries are now well recognized (Gupta and Gularis, 1982; FAO, 1995). In almost all tropical countries, the collection of NTFPs is a major economic activity (Chopra, 1993; Sharma, 1995; Alexander *et al.*, 2001; Ambrose, 2003) and about 500 million people living in or near forests being depended upon them for meeting their livelihood needs (Alexander *et al.*, 2002).

The rich natural heritage of the Eastern Himalayas particularly foothills of Himalayas falls within one of the biodiversity “Hotspot” zone that supports species richness (Myers *et al.*, 2000). The forests of Arunachal Pradesh support rich diversity of both timber as well as non-timber yielding species. The non-timber forest products (NTFPs) possess imperative part of the traditional life style in Arunachal Pradesh (Sarmah *et al.*, 2008). The forests of the state are rich in important drug

yielding plants, including many species of aromatic and spices plants (Haridasan and Beniwal, 1994; Pandey, 1998, Sarmah, 2010). Traditional and ancient knowledge about utilization of natural resources still exists in many parts of the state. The present study was carried out in five different circles of the Changlang district located in the eastern corner of the state and inhabited by different tribes. The ‘Lisu’ tribe, who is mainly dependent on the wild plants for its survival, is little known among the tribes of Arunachal Pradesh. It is concentrated at Gandhigram and vicinity under Vijoynagar circle and is still under explored.

NTFPs, especially medicinal plants, rattans and bamboos are the alternative sources of income for these people (Sarmah *et al.*, 2004, 2006a, 2006b; Sarmah 2010). Nevertheless, agriculture is the major source of livelihood in the study area. Here people are primarily dependent on various combinations of agriculture, gathering of forest products and daily wage. However, livestock is an integrated component of their farming systems. NTFPs have always been important to the income earning potential and subsistence livelihood of people. The present paper focuses on contribution of NTFPs to household economy of the people of Changlang district of Arunachal Pradesh. Socio-ecological status of the villages was also studied.

MATERIALS AND METHODS

The study was carried out in the Changlang district (latitude 26°40′ to 27°40′ N and longitude 95°11′ to

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97°10'E and altitude ranges from 200 to 4571 m msl) located in the eastern corner of Arunachal Pradesh, which is bounded by Myanmar in the east and south, Lohit district of Arunachal Pradesh in the north and Tirap district of Arunachal Pradesh and Tinsukia district of Assam in the west with an geographical area 4662 km² of which 1985 km² (about 42% of the total geography area) is covered by Namdapha national park (Fig. 1). The area experiences both tropical and sub-tropical conditions and is well known for excessive rainfall (250-400 cm per annum) and varying temperature ranging with relation to changing altitude, i.e. from 4°C to 35°C. The temperature usually falls below freezing point during winter, the relative humidity remains high and varies from 47% to 93%.

Household and Market Survey

For this study extensive field surveys were made during 2002-2005. Five circles (site I-Vijonagar circle, site II-Miao circle, site III- Diyun circle, site IV- Bordumsa circle and site V- Nampong circle) of the district and six villages from each circle were selected for the study. Detailed household surveys using a semi-structured questionnaire emphasizing on the used pattern of NTFPs were done. 10 percent households in each selected villages were sampled randomly. Information on NTFP plant species and their utilization pattern were collected through personal interview with the village headman and other villagers of different age group and sex. The information gathered was again crosschecked with the other villagers of same tribe. Official information was collected from the forest department as well as from the civil administration. Fuelwood consumption was estimated separately in two different seasons viz. winter (October to March) and summer (April to September). The monetary value was calculated by multiplying the quantity consumed with the average market price of that particular product prevailing at nearest local market. Market surveys were conducted by periodic visit to the local markets in all selected sites. Quantities of the supplied NTFPs with their local market values were recorded separately.

Quantification of the extracted forest products was done by weighing the head load; and per capita per day consumption was calculated by the following formula (Khanduri *et al.*, 2002)-

Per capita per day consumption =

$$\frac{\text{Quantity consumed per household per day}}{\text{No. of persons in that household}}$$

Averages house building materials required by per household per year were calculated by the given formula-

$$= \frac{\text{Sum of required particular material in all sample households of the village}}{\text{No. of households sampled in that particular village}}$$

NTFP yielding plant species were collected for herbarium and identification of the plant specimens were done by consulting herbarium located at State Forest Research Institute, Itanagar and learned taxonomist of the region.

RESULTS

Contribution of Fuelwood

One of the most important NTFPs for daily life is fuelwood, the only means of energy source of the rural people. Every surveyed household requires fuelwood for preparing food and also to gain warmth during winter. Per capita per day fuelwood consumption was estimated 1.64±0.20 kg to 2.97±0.50 kg during winter and 1.14±0.15 kg to 2.0±0.36 kg during summer. The consumption of fuelwood per household per year recorded maximum (7617.00 kg) at 52 mile village and minimum (3582.00) at Rima village. Likewise, the monetary value of consumed fuelwood that contributed to the household income estimated a minimum of Rs 2758.00 household⁻¹year⁻¹ at New Putak village and a maximum of Rs 5892.00 household⁻¹year⁻¹ at Bordumsa village (Table 2).

Contribution of House Building Materials

House building materials especially bamboos, canes, thatching materials (Leaves of *Zalacca secunda* and *Livistona jenkinsiana*) have another set of NTFPs that play important role in socio-economic development. It has been estimated that the monetary value of house building materials viz. bamboos provides a range of Rs 1620 to Rs 2346 household⁻¹years⁻¹. Among the thatching materials, leaves of *Zalacca secunda* play a key role. Roofs in all the sampled households in site II were covered with *Zalacca secunda* leaves. It supports about Rs 1200 household⁻¹years⁻¹. Besides bamboos and *Zalacca secunda* leaves, leaves of *Livistona jenkinsiana* and cane also contributed significantly to the household income (Table 3).

Contribution of Wild Edible Forest Products

Wild edible NTFPs that includes mainly leafy vegetables, bamboo and cane shoots, wild edible mushrooms and honey, which are commonly collected from the forests for self subsistence as well as for cash generation. Monetary value of consumed wild vegetable has been estimated to the range of Rs 1229.00 household⁻¹years⁻¹ at Lamabasti to Rs 9546.00 household⁻¹years⁻¹ at Bhudhisatta village (Table 4). Market survey at different local markets stripped that leafy vegetables, bamboo and

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cane shoots, wild edible mushrooms and honey play a significant contribution for cash generation. Annual market supplying bamboo shoots and wild edible mushrooms were recorded maximum (1622 ± 301 kg and 1767 ± 229 kg respectively) at Diyun market while leafy vegetable was higher (3478 ± 564 kg) at Miao market (Table 5). Besides, wild edible forest products like the broom grass (*Thysanolaena maxima*) is another important NTFP, with estimated annual market return of minimum Rs 13150.00 at Nampong market and maximum Rs 63882.00 at Diyun market. Honey the animal origin NTFP, commonly collected from wild and sold at local market, fetched them from Rs 15990.00 to Rs 67938.00 per annum (Table 6).

DISCUSSION

Sources and Utilization Pattern of NTFPs

Fuelwood, the basic NTFP was collected from reserve forests as well as from protected areas in all the sampled households. Sometimes people of Mio circle visited to Namdapha national park for collection of fuelwood. Interestingly, two villages (38 mile and 52 mile) under Vijoynagar circle situated in the core zone of Namdapha national park and the people are totally dependent on the park for their livelihood. Fuelwood was generally used for cooking of food materials, preparation of food for cattle and pig, and to keep the houses warm during winter season. The consumption of fuelwood was found to fluctuate through seasons (Table 2). Consumption of fuelwood recorded higher during winter. The per capita per day consumption of fuelwood was much higher (2.97 ± 0.05 kg in winter and 2 ± 0.36 kg in summer, table 2) than people used in Jammu region (1.67 kg in winter and 1.49 kg in summer; Gupta *et al.*, 1999). In high altitude villages of Rudrapryog district of Garhwal Himalayas where per capita per day were recorded 1.93 ± 0.01 kg to 2.09 ± 0.13 kg in winter and 1.14 ± 0.21 to 1.23 ± 0.16 kg in summer (Khanduri *et al.*, 2002). The higher quantity of fuelwood requirement is only due to lack of alternative source of energy supply such as kerosene, LPG etc. According to Eve (1997), 20 kg of fuelwood has a volume of approximately 0.08 m^3 that lead to estimate annual fuelwood demand of 14.33 m^3 to 30.46 m^3 per household which is almost similar to the values (8.9 m^3 to 31.03 m^3) consumed by the people living around Bach Ma National park of Vietnam (Lan *et al.*, 2002). Nevertheless, the per capita consumption of fuelwood was higher ($7617.00 \text{ kg household}^{-1}\text{year}^{-1}$) in 52 mile village but due to higher market price the monetary value was estimated maximum (Rs 5892.00 $\text{household}^{-1}\text{year}^{-1}$) at Bordumsa village (Table 2).

House building materials especially bamboos, thatching leaves (*Zalacca secunda*, *Livistona jenkinsiana*) and

canes acts as an integrated part in socio-cultural activities of the people. Houses were generally made up of bamboos and roofing with either *Zalacca secunda* leaves or *Livistona jenkinsiana*. The average use of bamboos and roofing materials were more or less similar in all households. The monetary value of bamboos used for house building materials was estimated maximum (Rs 2346 $\text{household}^{-1}\text{year}^{-1}$) at Miao circle and minimum (Rs 1612 $\text{household}^{-1}\text{year}^{-1}$) at Vijaynagar circle. Similar cases have also observed for *Zalacca secunda* leaves. Due to unavailability of modern rope, the people of Vijoynagar circle used cane for tightening the house and other domestic material. This is responsible for maximum utilization of cane. Its market price was estimated at around Rs. 1200.00 $\text{household}^{-1}\text{year}^{-1}$ (Table 3).

Wild edible vegetables are common NTFPs that have been extracted widely throughout the district. The Chakma villages especially Abhyapur under Diyun circle and Bhudhisatta under Miao circle, where people generally practices both settled as well as intensive *jhum* cultivation and gather huge quantities of wild edible vegetables which has been estimated of Rs 9700.00 $\text{household}^{-1}\text{year}^{-1}$ (Table 4). In addition, medicinal plants and wild edible fruits were also found playing important role in day-to-day life of the local people.

On an average, the total contribution of NTFPs to annual household income was maximum (23% of the total income) in the villages of Miao circle followed by Diyun circle (21% of the total income), Nampong circle and Vijaunagar circle (19% and 18% of the total income respectively). It was recorded minimum (11% of the total income) in the villages of Bordumsa circle (Fig. 2)

The scope of boosting incomes through commercialization of NTFPs has been found very high but most of the forest-dwelling people of the district still depend on NTFPs for subsistence level. Several studies conducted on the socio-economic development of rural people in developing countries have highlighted that the extraction of NTFPs from the natural forests has limited potential for improving household economies (Wunder, 2001; Arnoled, 2002; Ellis, 1998). Various socio-economic conditions those which affect the role of NTFPs in people's livelihoods are, availability of alternative employment opportunities, access to market, availability of products with established market, agricultural development, the degree of linkage with urban areas etc. *Thysanolaena maxima*, *Zalacca secunda*, wild edible mushrooms like *Auricularia auricul*, *Cantharallus cubarius*, *Heridium ernaceus*, *Laetiporus suphurus*, *Schizophyllum commune*, *Saparassis crispa* etc. and honey remains always in high demand in local, regional and national level markets.. Different

Table 1. Socio-ecological structure of the villages studied under the project.

Name of villaves	Tribe	No. of households	Family size	Population			Literacy % age
				Male	Female	Total	
Vijaynagar circle							
Dawdi	Lisu	28	9.96	143	136	279	28.21
52 Mile	Lisu	20	7.5	83	67	150	11
38 Mile	Lisu	25	5.2	70	60	130	10.53
Hozolo	Lisu	32	8.75	137	143	280	35.08
Gandhigram	Lisu	300	6.67	1132	868	2000	38.11
Chiddikhu	Lisu	25	7.32	95	88	183	21.4
Miao circle							
Lama basti	Lama	23	5.3	70	52	122	29
Bhudhisatta	Chakma	56	5.23	152	141	293	35.84
Anandapur I	Chakma	55	5.73	157	158	315	32.38
Anandapur II	Chakma	38	5.68	114	102	216	25.93
M' Pen I	Chakma	95	6.16	288	296	585	24.48
M' Pen II	Chakma	78	5.86	235	222	457	25.06
Diyun circle							
Santipur	Chakma	135	6.35	414	443	857	43.68
Moytripur	Chakma	289	6.08	904	853	1757	46.2
Kamakhyapur	Chakma	85	5.87	260	239	499	37.64
Dumpathar II	Chakma	79	5.3	242	177	419	39.37
Rajnagar	Chakma	66	6.39	208	214	422	52.15
Abhyapur	Chakma	290	5.62	839	791	1630	38.73
Bordumsa circle							
Gelenja singpho	Singpho	82	4.74	205	184	389	52.69
Kusumpathar	Singpho	30	5.13	75	79	154	61.68
Gidding	Singpho	75	5.13	204	181	385	48
Podumoni	Singpho	17	6.35	59	49	108	56.5
Bordumsa village	Singpho	253	5.62	759	663	1422	58.5
Balijan	Singpho	35	6.06	116	79	212	44.8
Nampong circle							
Rima	Tangsa	22	5.54	65	57	122	34.28
Tikhak Khamlang	Tangsa	9	6	30	24	54	33.33
Longpong	Tangsa	49	6.53	162	158	320	52.8
Mossang putak	Tangsa	12	4.08	24	25	49	46.9
Tengpum	Tangsa	35	5	95	80	175	28.87
New putak	Tangsa	20	6.85	70	67	137	42.33

Table 2. Consumption of fuelwood with monetary values

Name of the Village	Winter		Summer		Annual	
	kg capita ⁻¹ day ⁻¹	kg capita ⁻¹ season ⁻¹	kg capita ⁻¹ day ⁻¹	kg capita ⁻¹ season ⁻¹	kg household ⁻¹ year ⁻¹	Rupees household ⁻¹ year ⁻¹
Vijaynagar circle						
Dawdi	1.89 ± 0.30	344.48 ± 68.8	1.26 ± 0.23	229.04 ± 41.3	5712.00	4227.00
52 Mile	2.97 ± 0.50	541.24 ± 103	1.99 ± 0.35	362.32 ± 68.5	7617.00	4743.00
38 Mile	2.60 ± 0.50	473.80 ± 59.5	2.00 ± 0.36	365.00 ± 62.4	6099.00	4513.00
Hozolo	2.73 ± 0.53	497.43 ± 95.3	1.62 ± 0.43	296.48 ± 57.6	6946.00	3877.00
Gandhigram	1.83 ± 0.29	333.81 ± 52.8	1.63 ± 0.30	298.24 ± 47.8	4740.00	3507.00
Chiddikhu	1.94 ± 0.37	354.03 ± 62.3	1.45 ± 0.22	264.28 ± 41.0	4526.00	3349.00
Miao circle						
Lama basti	1.94 ± 0.39	354.67 ± 46.8	1.49 ± 0.27	272.03 ± 45.0	4553.00	5373.00
Bhudhisatta	2.08 ± 0.34	380.35 ± 49.3	1.40 ± 0.20	254.73 ± 41.6	4763.00	5621.00
Anandapur I	1.82 ± 0.16	331.24 ± 63.8	1.17 ± 0.12	213.39 ± 36.6	3986.00	4585.00
Anandapur II	2.04 ± 0.14	372.71 ± 67.7	1.65 ± 0.29	302.02 ± 52.9	4946.00	5837.00
M' Pen I	1.77 ± 0.20	322.93 ± 53.2	1.40 ± 0.23	254.79 ± 40.3	4332.00	5156.00
M' Pen II	1.81 ± 0.21	330.12 ± 51.8	1.42 ± 0.20	258.49 ± 45.0	4308.00	5127.00
Diyun circle						
Santipur	1.83 ± 0.28	333.39 ± 55.9	1.29 ± 0.27	235.67 ± 44.7	4080.00	5019.00
Moytripur	1.91 ± 0.32	348.19 ± 61.3	1.38 ± 0.13	252.14 ± 47.6	4502.00	3917.00
Kamakhyapur	1.69 ± 0.21	307.79 ± 47.3	1.38 ± 0.20	251.83 ± 50.8	4096.00	5121.00
Dumpathar	1.96 ± 0.34	358.11 ± 66.8	1.45 ± 0.14	265.14 ± 48.0	4503.00	5539.00
Rajnagar	1.72 ± 0.29	314.16 ± 57.7	1.31 ± 0.15	239.91 ± 43.4	4155.00	5111.00
Abhyapur	1.83 ± 0.20	334.48 ± 40.6	1.30 ± 0.23	237.06 ± 37.6	4183.00	5188.00
Bordumsa circle						
Gelenja singpho	1.94 ± 0.24	354.22 ± 67.3	1.50 ± 0.27	273.36 ± 53.5	4564.00	5843.00
Kusumpathar	1.93 ± 0.19	352.19 ± 64.0	1.21 ± 0.18	220.57 ± 38.7	4295.00	5541.00
Gidding	1.83 ± 0.17	334.41 ± 52.2	1.42 ± 0.14	259.70 ± 50.5	4348.00	5567.00
Podumoni	1.64 ± 0.20	298.90 ± 56.5	1.21 ± 0.21	221.30 ± 32.4	3758.00	4886.00
Bordumsa vill.	2.12 ± 0.31	386.43 ± 73.0	1.25 ± 0.14	227.31 ± 41.0	4603.00	5892.00
Balijan	1.75 ± 0.22	319.22 ± 52.8	1.14 ± 0.15	207.80 ± 32.3	3857.00	4938.00

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Nampong circle

Rima	2.01 ± 0.39	367.09 ± 64.9	1.53 ± 0.31	279.49 ± 55.6	3582.00	3455.00
Tikhak Khamlang	1.97 ± 0.23	358.92 ± 52.8	1.63 ± 0.28	298.08 ± 56.9	4835.00	3385.00
Longpong	2.37 ± 0.47	433.19 ± 76.8	1.50 ± 0.19	273.89 ± 41.2	5303.00	3659.00
Mossang putak	1.97 ± 0.34	360.13 ± 62.6	1.36 ± 0.23	248.20 ± 39.5	4430.00	3878.00
Tengpum	2.16 ± 0.35	394.20 ± 76.3	1.82 ± 0.28	332.15 ± 65.4	5316.00	3722.00
New putak	1.77 ± 0.30	322.37 ± 55.6	1.18 ± 0.17	215.80 ± 36.5	3939.00	2758.00

('±' SD, n=10%)

Table 3. Monetary values of house building materials (Rs. household⁻¹year⁻¹)

	Vijaynagar circle	Miao circle	Diyun circle	Bordumsa circle	Nampong circle
Bamboos	1649 ± 318	2346 ± 345	1620 ± 250	2040 ± 316	1738 ± 257
<i>Zalacca secunda</i>	243 ± 41	1214 ± 109	516 ± 92	239 ± 44	386 ± 75
<i>Livistoia jenkinsiana</i>	369 ± 61	0 ± 0	148 ± 23	768 ± 128	292 ± 45
Cane	1251 ± 204	847 ± 134	664 ± 110	839 ± 165	1203 ± 234

('±' SD, n=100)

Table 4. Contributions by wild edible vegetables

Village	Kg household ⁻¹ year ⁻¹		Rs. household ⁻¹ year ⁻¹	
Vijaynagar circle				
Dawdi	522 ±	63	4251	±675
52 Mile	607 ±	104	4501	±587
38 Mile	572 ±	101	4455	±659
Hozolo	477 ±	69	4277	±453
Gandhigram	780 ±	121	6372	±860
Chiddikhu	516 ±	98	4474	±457
Miao circle				
Lama basti	133 ±	021	1229	±195
Bhudhisatta	1012	± 175	9546	±812
Anandapur I	976 ±	123	9199	±879
Anandapur II	949 ±	163	8988	±732
M' Pen I	1067	± 130	9933	±610
M' Pen II	822 ±	114	7748	±583
Diyun circle				
Santipur	648 ±	95	6401	±687
Moytripur	338 ±	55	3043	±558
Kamakhyaapur	760 ±	126	7118	±608
Dumpathar	942 ±	140	8949	±959
Rajnagar	651 ±	110	6581	±510
Abhyapur	1164	± 155	9700	±770
Bordumsa circle				
Gelenja singpho	447 ±	78	3799	±585
Kusumpathar	621 ±	102	5644	±633

Contd...

Gidding	460 ±	80	3955	±520
Podumoni	413 ±	55	3667	±437
Bordumsa village	351 ±	51	3505	±402
Balijan	402 ±	64	3753	±459
Nampong circle				
Rima	440 ±	67	3776	±694
Tikhak Khamlang	447 ±	54	3419	±632
Longpong	498 ±	97	4109	±723
Mossang putak	552 ±	92	4290	±592
Tengpum	507 ±	79	4577	±827
New putak	389 ±	51	3268	±354

(‘±’ SD, n=10%)

Table 5. NTFPs in local market (Kg yr⁻¹)

NTFPs	Vijaynagar circle	Miao circle	Diyun circle	Bordumsa circle	Nampong circle
Bamboo shoots	494 ±73	670 ±133	1622 ±301	874 ±168	621 ±121
Wild leafy vegetables	1186 ±114	3478 ±564	2980 ±434	2733 ±386	848 ±115
Wild edible mushrooms	405 ±75	579 ±97.6	1767 ±229	1463 ±188	517 ±103
Cane shoots	465 ±85	676 ±122	712 ±136	578 ±111	481 ±94
Broom grass (<i>Thysanolaena maxima</i>)	- -	1287 ±180	3042 ±467	2337 ±382	774 ±123
Honey	- -	533 ±74	871 ±148	344 ±57	267 ±34
Bushmeat	437 ±69	- -	- -	- -	- -

(‘±’ SD, n=12)

Table 6. Monetary values of NTFPs in local market (Rs. yr⁻¹)

NTFPs	Vijaynagar circle	Miao circle	Diyun circle	Bordumsa circle	Nampong circle
Bamboo shoots	3458.00	5021.00	13460.00	5245.00	3103.00
Wild leafy vegetables	10320.00	32931.00	27716.00	21866.00	6616.00
Wild edible mushrooms	12870.00	12727.00	38868.00	26325.00	5425.00
Cane shoots	2788.00	6760.00	7829.00	7520.00	3367.00
Broom grass	-	29610.00	63882.00	35051.00	13150.00
Honey	-	39975.00	67938.00	31025.00	1600.00
Bushmeat	43700.00	2700.00	3200.00	-	2800.00

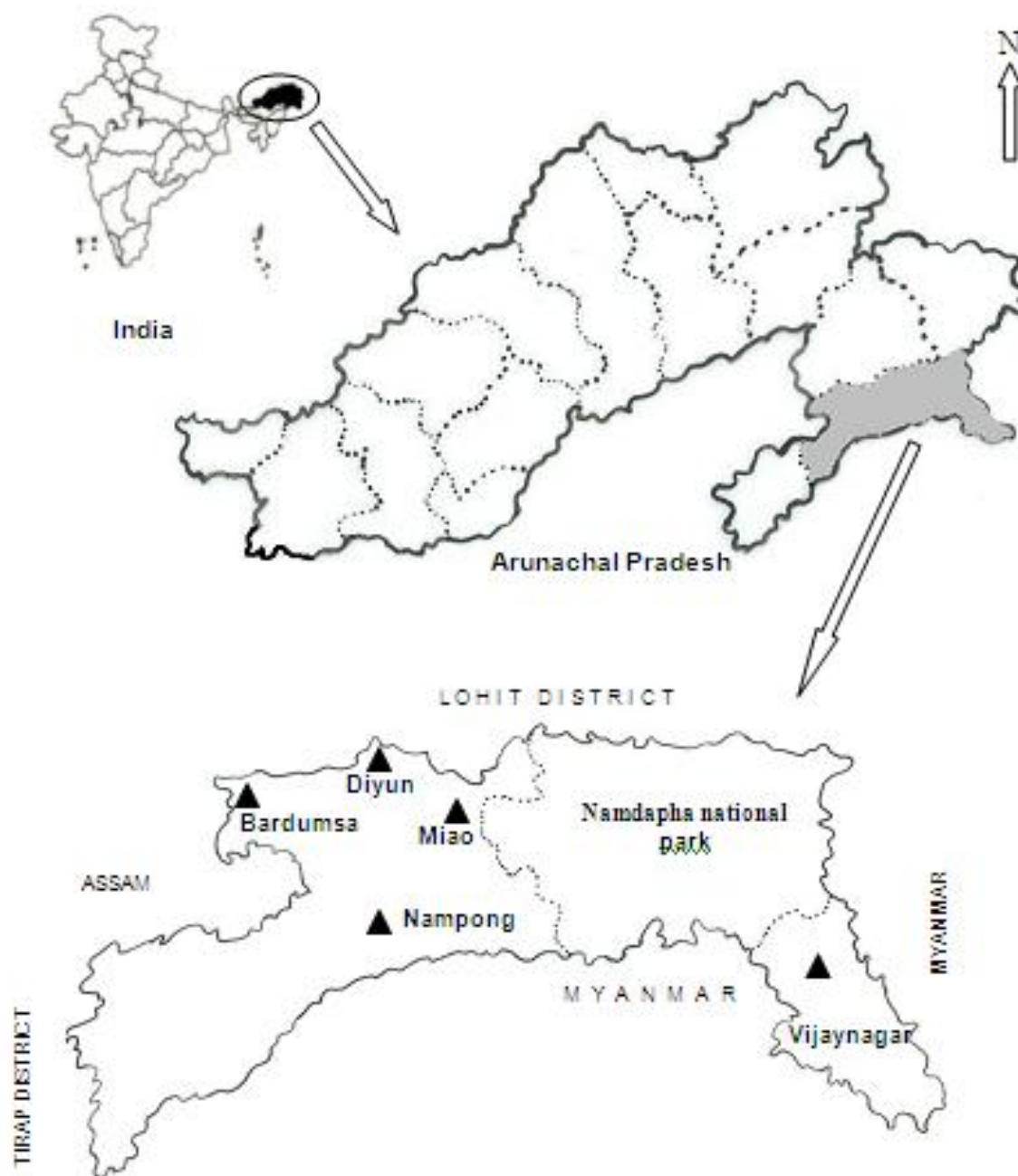


Figure 1. Map of Changlang district showing the study sites

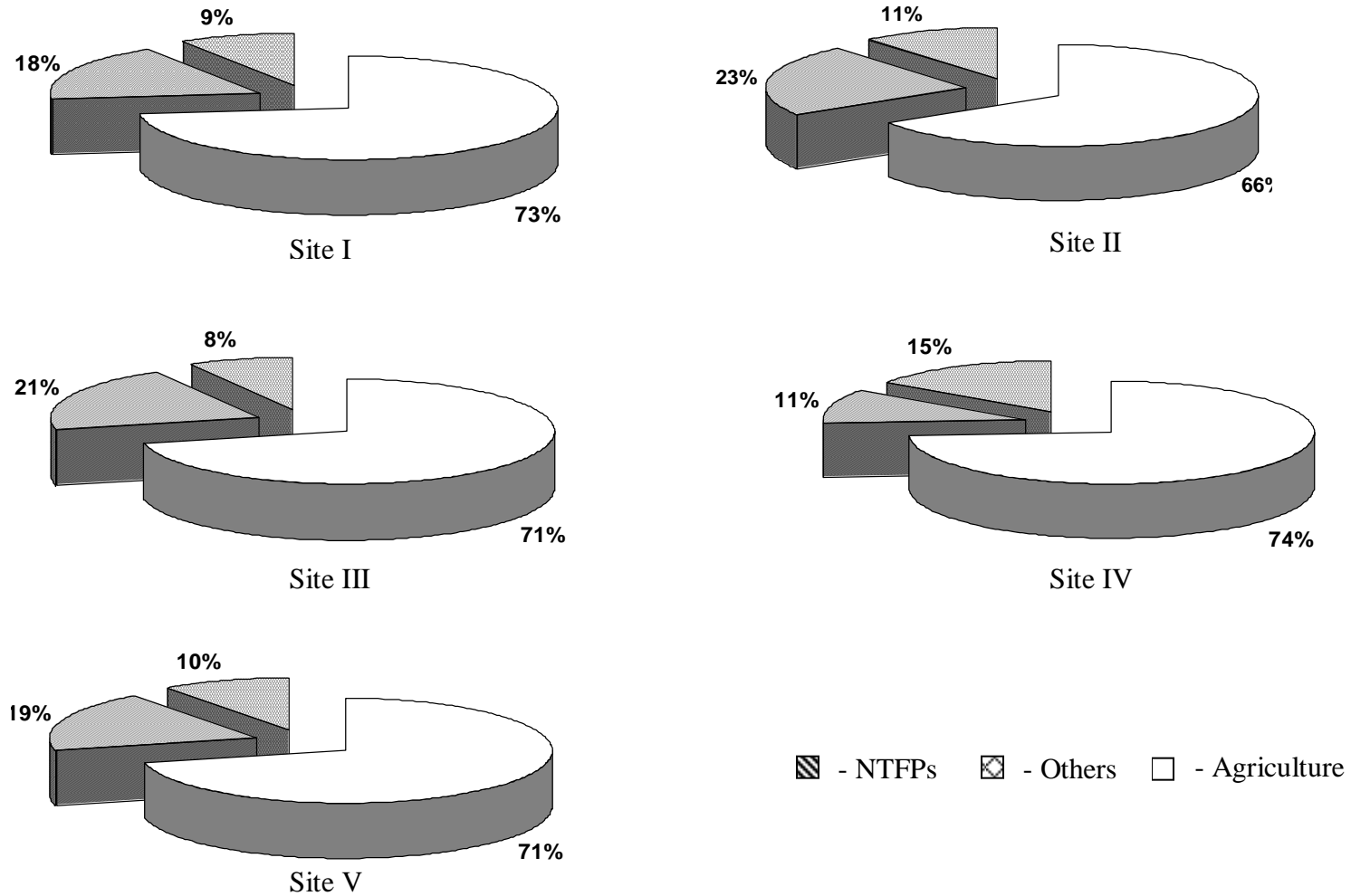


Figure 2. Contributions of NTFPs to household income

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types of bamboo and cane furniture, baskets, and decorative items are the integral part of traditional lifestyle of the people that have always been supplied at national and international markets. China's economy output from bamboo sector is estimated to be over 2.1 billion US\$ per annum (Haridasan, 2000). Studies made by Uma Shankar *et al.* (2001) at Darjeeling reveal that the monetary return of *Thysanolaena maxima* from per hectare was 2336.56 US \$ within 6 years of plantation. Thus, the potentiality of NTFPs in socio-economic development as well as in national income can not be ignored.

Nevertheless, Arunachal Pradesh in general and Changlang district in particular have plenty of forest resources. However, the people of Gandhigram village of the district have to walk 2-3 k.m. for fuelwood collection. Similar case has also been observed in the villages of Miao circle for *Zalacca secunda* leaves and bamboos. On the other hand, *Thysanolaena maxima* is still collected from natural habit that may lead to decreased species diversity in the natural stands (Terry and Cunningham, 1993; Karki, 1995, 2001; Wiersum, 1997a; Van Dijk and Wiersum, 1999). Thus it is quite necessary to maintain the ecological balance for near future. As far as fuelwood consumption is concerned, as there is no alternative source of energy available, so harvesting pattern should be in sustainable manner. Instead of cutting down the whole plant, cutting of branches and twigs are recommended. Cultivation of other commercially important NTFP yielding species such as *Thysanolaena maxima*, bamboos and cane, medicinal plants etc. should be done in man-made forests and in other land use systems. Similarly apiculture could be promoted to strengthen additional income sources of the indigenous communities.

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REFERENCES

Alexander SJ, McLain RJ and Blanter KA (2001). Socioeconomic research on non-timber forest products in

the Pacific Northwest. *Journal of Sustainable Forestry* **13** 95-105.

Alexander SJ, Weber NS, Brown ED and Rockwell VA (2002). Mushrooms, trees, and money: Value estimates of commercial mushrooms and timber in the Pacific Northwest. *Environmental management* **30** 129-141.

Ambrose-Oji B (2003). The contribution of NTFPs to the livelihoods of the forest poor: evidence from the tropical forest zone of south-west Cameroon. *International Forestry Review* **5** 106-117.

Arnoled M (2002). Clarifying the links between forests and poverty reduction. *International Forestry Review* **4** 231-233.

Chopra K (1993). The value of non-timber forest products: an estimation for tropical deciduous forests in India. *Economic Botany* **47** 251-57.

Ellis (1998). Household strategies and rural livelihood diversification. *Journal of Development Studies* **35** 1-38.

FAO (1995). Non-wood forest products for rural income and sustainable forestry. *Non-Wood Forest Products* 7, Rome, Italy.

Gupta T and Gularia A (1982). *Non-wood forest products in India: economic potentials*. CMA monograph no. 87, Oxford & IBH Publishing Co. Pvt., Ltd. New Delhi.

Gupta T, Kaushal PS, Rana U, Gupta RK and Pathania MS (1999). A study on fuel consumption pattern in Jammu region of Jammu and Kashmir, *Range Management and Agroforestry* **20** 177-183.

Haridasan K (2000). Bamboo based socioeconomic revolution in rural south eastern China -Relevance to north east India. *Arunachal Forest News* **18** 41-45.

Haridasan K and Beniwal BS (1994). Pipili: An Important income generating eco-friendly non-wood forest product. SFRI information bulletin No. 3. State Forest Research Institute, Van Vihar, Itanagar, Arunachal Pradesh.

Hegde R, Suryaprakash S, Achoth L and Bawa KS. (1996). Extraction of non-timber forest products in the forests of Biligiri Rangan Hills, India: 1. contribution to rural income. *Economic Botany* **50** 243-251.

Karki JBS (1995). Use, availability, and marketing of non-timber forest products in eastern Nepal. In: Fox, J., Donovan, D. and DeCoursey, M (eds.) *Voices from the field: sixth workshop on community management of forest lands*. East-West Center, Honolulu, Hawaii. 64-82.

Karki M (2001). Institutional and socioeconomic factors and enabling policies for non-timber forest products-

based development in northeast India. *IFAD Rome Report* No. 1145-IN.

Khanduri VP, Sharma CM, Ghildiyal SK and Puspwan KS (2002). Forest composition in relation to socio-economic status of people at three high altitudinal villages of a part of Grahwal Himalayas. *Indian Forester* **128** 1335-1345.

Lan le V, Ziegler S Grever T (2002). Utilization of forest products and environmental services in Bach Ma national park, Vietnam. Report of the work on Bach Ma national park, Vietnam.

Myers N, Muttermeier RA, Muttermeier CG, Fonseca GAB and Kents J (2000). Biodiversity hot-spots for conservation priorities. *Nature* **403** 853-858.

Nautiyal S and Kaul AK (2003). *Non-timber forest products of India*. Jeyoti publisher and distributors, Dehradun, India.

Pandey HC (1998). Some healing herbs of the Mons amongst the minor forest produce. *Arunachal Forest News* **6** 1-10.

Peters CM, Gentry AH and Mendelsohn RO (1989). Valuation of an Amazonian rainforest. *Nature* **339** 655-656.

Sarmah A, Haridasan K and Bisht NS (2000). Development of medicinal plants as an economic venture in Arunachal Pradesh: prospects and constraints. *Arunachal Forest News* **18** 85-90.

Sarmah R (2006). Non-timber forest products and their utilization pattern in Changlang district of Arunachal Pradesh. PhD thesis, Rajiv Gandhi University, Itanagar, India.

Sarmah R (2010). Commonly used non-timber forest products (NTFPs) by the Lisu tribe in Changlang district of Arunachal Pradesh, India. *Sibsagar college teachers research journal* **05** 68-77.

Sarmah R, Adhikari D, Majumder M and Arunachalam A (2006b). Indigenous technical knowledge of Lisus with reference to natural resource utilization in the far-eastern villages of Arunachal Pradesh India. *Indian Journal of Traditional Knowledge* **5** 51-56.

Sarmah R, Adhikari D, Majumder M, Arunachalam A, Upadhyaya N and Tapasvi SK (2004). Institutional arrangement for forest management in Arunachal Pradesh: A case study from Namdapha national park. *Arunachal University Research Journal* **7** 15-26.

Sarmah R, Arunachalam A, Arunachalam K, Adhikari D and Majumder M (2008). Production and Marketing of Agricultural and Non-timber Forest Products around Namdapha National Park in Arunachal Pradesh. In: *Biodiversity: Utilization & Conservation*, edited by Arunachalam A and Arunachalam K (Aavishkar Publishers, Jaipur) 252-257.

Sarmah R, Arunachalam A, Majumder M, Melkania U and Adhikari D (2006a). Ethno-medico-botany of Chakmas in Arunachal Pradesh, India. *The Indian Forester* **132** 474-484.

Sharma P (1995). Non-wood forest products and integrated mountain development: observations from Nepal. *Non-Wood Forest Products*, FAO, Rome, Italy. 157-166.

Terry ME and Cunningham AB (1993). Impact of commercial marketing on the basketry of southern Africa. *Journal of Museum Ethnography* **4** 25-48.

Uma Shankar, Lama SD and Bawa KS (2001). Ecology and economics of domestication of non-timber forest products: an illustration of broom-grass in Darjeeling Himalaya. *Journal of Tropical forest Science* **13** 171-191.

Van Dijik JFW and Wiersum F (1999). Non-timber forest product resource management as an option for multiple-use forest management in south Cameroon. In: Ros-Tonen, M.A.F. (ed.) *Seminar proceedings, non-timber forest products research in the Tropenbos Programme: result and perspectives*. 28 January, Wageningen, The Tropenbos Foundation.

Wiersum KF (1997a). Indigenous exploitation and management of tropical forest resources: an evolutionary continuum in forest-people interactions. *Agriculture, Ecosystem and Environment* **63** 1-16.

Wunder GE (2001). Management issues for development of non-timber forest products. *Unasylva* **165** 3-8.