Assessment of Local Dependency on Selected Wild Edible Plants and Fruits from Senapati district, Manipur, Northeast India

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Research

Abstract

Market and household surveys were conducted in four locations in Senapati district, Manipur, Northeast India. Thirty-two common wild edible plants belonging to 25 families were identified. On average 73% of households surveyed are involved in collecting some edible plants, and 38% collect edible fruits. 32% use the collected plant materials for both household consumption and market trade. On average collectors share in 63% of the sales price of wild edible plants. A comparison of total monetary value generated per annum from different wild edible plants showed that *Lentinula lateritia* (Berk.) Pegler and *Docynia indica* (Wall.) Decne. contributed the greatest value.

Introduction

Wild food plants are important in many indigenous communities around the world (Reyes-Garcia *et al*. 2005, Tiruneh & Herbert 2008). Wild edible plants (WEPs) play a vital role providing nourishment and variety in the diet (Grivetti & Ogle 2000) and contribute to health maintenance as functional or medicinal foods (Pieroni & Price 2005). Analyses of the nutritional content has been done in a number of studies (Maundu *et al*. 1999, Nordeide *et al*. 1996, Orech *et al*. 2007, Shackleton *et al*. 1998, Sundriyal & Sundriyal 2001). The nutritional value of many traditional leafy vegetables is higher than several known common cultivated vegetables. The International Institute for Environmental and Development (1995) reported that many WEPs can supplement nutritional requirements, especially vitamins and micronutrients. Dependence on WEPs is more significant for the poor and marginalized rural families. WEPs also provide rural households with supplemental income opportunities through collection and sale in local markets (Moreno-Black & Price 1993). However, the magnitude of the income derived from wild plant resources is not well known due to lack of systematic data collection and analysis. Local economic surveys of biological resources need to be supplemented with assessment of plant and animal products sold in the local markets (Bennett 1992, Wells & Brandon 1992).

Although traditional leafy vegetables have the potential for income generation, lack of awareness may not allow them to compete with exotic vegetable crops (Jansen van Rensburg *et al*. 2004, Maikhuri *et al*. 2003, Maikhuri *et al*. 2004). Documentation of WEPs with an ethnobotanical approach that includes assessment of diversity and availability, as well as extraction sustainability is important for conservation and management of these resources. In this study we have collected, identified diversity of the WEPs available in local markets, and have assessed local household dependence on selected species. It is expected that this data will give impetus for policy makers, NGOs, and local communities to take up issues on biodiversity conservation through sustainable use and management of WEPs. Further analysis of nutritional contents of some of these species may help to identified and priori-

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Ethnobotany Research & Applications 10:357-367 (2012)

Published: August 18, 2012

www.ethnobotanyjournal.org/vol10/i1547-3465-10-357.pdf

tize species that could be included in agricultural or agro-forestry systems based on their dietary value.

Materials and Methods

Study site

Senapati district, Manipur, north-eastern India is between 24º37" and 25° 25" N latitudes and 93° 45" and 94° 29" E longitudes. Senapati district is 3271 km^2 in area. The district falls in the Indo-Burma global biodiversity hotspot (Mittermeier *et al*. 2004, Myers *et al*. 2000) with tropical to sub-tropical and temperate forests.

Market survey

Market surveys were conducted in four locations (Mao Gate, Senapati (district HQ), Kangpokpi and Motbung) (Figure 1). Data was collected from plant collectors and vendors during weekly market days on wild edible plants. The survey was conducted 6 times in two consecutive years, i.e., March-April, July-August, and December, 2008; January-February, August-September, and December, 2009. This was done to identify wild food plant species seasonally available in the markets. Data collected about plants included: local name, place of collection, rate per unit in Rs./kg, varieties of edible species collected, local availability status according to informant's perception, age and sex of the collectors/vendors. Photographs were also taken. Market data (particularly prices of the vegetable items) was supplemented through interviews with a number of key informants. Altogether, 69 informants (21 collectors, 48 vendors) consisting of 56 women and 13 men were interviewed.

Household survey, a case study

Household surveys were conducted in three localities in the villages of Kayinu and Emeifiithumei of Mao community in order to assess local dependency on selected WEPs during the period from January-2009 to December-2009. A pre-prepared survey was distributed to each household in each location along with instructions on how to enter and keep track of data. The survey inquired about plant names, total quantity collected, quantity used for household consumption, quantity marketed (and market location), rate per unit in Rs./kg, quantity used for other purposes. Data from each household was collected on a monthly basis by a literature person from the same location who was engaged by the authors. This person had been trained in the process of filling out the forms. Retrieved data was then entered by the authors into a format suitable for analysis.

Figure 1. Senapati district, Manipur, Northeast India. Study sites are in Senapati, Kangpokpi, Motbung, Okhro-Ekhro, Kayinu, and Emeifiithumei.

Plant collection

Herbarium and bottle specimens of all the plants identified by informants in the surveys were collected and compared with specimens in the Botanical Survey of India, Eastern Regional Centre herbarium (ASSAM). Botanical literature consulted included Haridasan & Raghavendra Roa (1985, 1987) and Singh *et al*. (2000). Identified voucher specimens were then deposited in ASSAM.

Calculation of mean prices and profit shares

The mean value of the selling prices reported by collectors and vendors for a particular WEP was calculated as follows using MS Office Excel 2007:

$$\text{Mean value, MV} = \sum A f_a + B f_b + C f_c \ldots Z f_z / N$$

Where, A, B, C…..Z, represents the different selling prices (rates) of a particular WEP (Rs./kg); f_a, f_b, f_c… f_z are the frequencies of particular prices of a WEP and N indicates the total number of collectors and vendors interviewed for that particular item. Percent of profit sharing from the sale of WEPs between the collectors and sellers was calculated (Bisht *et al*. 2005).

Results

Informant diversity

During the survey, a total of 48 local vendors were interviewed of which 44 (92%) are female. The average age of the vendors is 44 years. Out of a total 218 households in two villages, 126 (58%) were surveyed.

Food plant diversity

Thirty two species of common WEPs (11 fruits (34%) and 21 other plants (66%)) were recorded from four markets. These are classified in 25 families (Table 1).

Analysis of collected data

Local tribal people studied are dependent on selected WEPs (Tables 2-5). They collect these not only for household consumption but also to be sold to local vegetable vendors, generating household income. On average collectors share in 63% of the selling price from WEPs and 57% from fruit with vendors receiving the balance. Therefore, collectors and sellers more or less equally shared in sales to consumers in the local markets.

Assessment of household dependency

Local people depend on wild sources for 100% of certain species of WEPs (e.g., *Oenanthe stolonifera* (Roxb.) DC., *Musa* sp.) On average about 73% of households collect WEPs and 38% collect wild edible fruits. Bee pupae, honey, silkworms, moth caterpillars, grasshoppers, etc. are also collected and sold in local markets. Similarly, from the total number of households recorded for collection about 32% for edible plants and 32% for edible fruits used the collection both for household consumption as well as for selling in the local markets. These households are mostly from low economic profile and marginalized families whose main occupation is the traditional shifting cultivation. Similar reports are available for Amazonian forests (Browder 1990, Phillips 1993). The marketed quantity of the collection in percent for both WEPs are 50% and 63%. The remaining percent used the collection only for household consumption. The collectors sell their collection either directly in the local markets such as Mao Gate, Tadubi and in some cases to middleman who buy the collections in bulk from different collectors and sell the same to nearby towns like Kohima (state capital of Nagaland), Senapati (district headquarter) and Imphal (state capital of Manipur). Moreover, a small quantity (9.9%) of edible plants and 4.8% of edible fruits were recorded to be used for other purposes such as offering to relatives or neighbors, or used for animal feed, e.g., *Musa* sp.

Gross income generated per annum in 2009 for the three different localities (Figure 2) in terms of the value of the total collection showed that Emeifiithumei has generated the highest gross income for WEPs. This is because of the proximity and easy accessibility of the villagers to forest areas where resources are more available. Also the village is further away (about 10 km) from national highway NH-39 which in turn leads to those less dependent on outside vegetable products due to lower accessibility to markets. *Lentinula lateritia* (Berk.) Pegler with 53.0% and *Docynia indica* (Wall.) Decne. with 28.8% contributed the highest gross income per annum of the WEPs selected (Figures 3, 4).

Preference and quantum of extraction

Our study did not show why local people prefer to extract more of the selected species nor the volume of plant materials available in markets. However, discussions with informants (collectors and village elders) and vendors revealed that the volume of any particular species extracted depends mainly on the following criteria:

1. duration and local availability,
2. ease of accessibility,
3. palatability, and
4. lower accessibility to local market products.

Because of palatability and nutritious food value, there is a high local demand for edible mushrooms (e.g., *L. lateritia*, *Auricularia delicata* (Mont.) Henn., *Schizophyllum commune* Fr.) that are sold in the local markets at relatively high prices. Limited availability is due to short growth duration coupled with lower accessibility and limited growing habitats (mostly dead wood in forests of *Alnus nepalensis* D.Don, *Quercus serrata* Thunb., *Quercus griffithii* Hook. f. & Thomson ex Miq., and *Castanopsis* spp.). As such,

Table 1. Wild edible plant species for sale in local markets in Senapati district, Manipur, Northeast India.

Edible fruit source	Botanical family	Edible plant species	Vernacular names (NR-Not recorded due to lack of local name)		Voucher (M-Mao, P- Poumei, K-Kuki)
			Mao	Kuki	
	Amaranthaceae	*Chenopodium album* L.	**Oruo**	**Houche**	126-MPK
Yes	Anacardiaceae	*Rhus semialata* Murray	**Emoshi**	**Khongma**	023-MPK
	Apiaceae	*Centella asiatica* L.	**Koreio**	**Changkon-gcha**	133-MPK
		Oenanthe stolonifera (Roxb.) DC.	**Ekhrou**	**Andum**	009-MP
Yes	Arecaceae	*Calamus floribundus* Griff.	**Okhrashi**	**Tingpi**	115-MPK
	Auriculariaceae	*Auricularia delicata* (Mont.) Henn.	**Ozenabi**	**Pachop**	127-MPK
	Cucurbitaceae	*Trichosanthes cordata* Roxb.	**Eleo-vu**	**Anthrul**	017-MPK
Yes	Elaeocarpaceae	*Elaeocarpus floribundus* Blume	**Shikishi**	**Zonmot**	073-MPK
	Euphorbiaceae	*Emblica officinalis* Gaernt.	**Shihroshi**	**Sohlu**	080-MPK
	Gesneriaceae	*Rhynchotechum ellipticum* (Wall. ex D. Dietr.) A. DC.	**Kosabio**	**Chenkup**	175-MPK
Yes	Juglandaceae	*Juglans regia* L.	**Okhushi**	**Khaga**	162-PK
	Lauraceae	*Litsea citrata* Blume	**Shungu-nosii**	**Thing-Thing**	064-MPK
	Marasmiaceae	*Lentinula lateritia* (Berk.) Pegler	**Papinii**	**Cipa**	141-MPK
Yes	Anacardiaceae	Spondias pinnata (L.f.) Kurz	**Shilashi**	**Theikhong-chom**	146-MP
Yes	Moraceae	*Ficus auriculata* Lour.	**Chidoshi**	**Theichong**	082-MPK
	Musaceae	*Musa* sp.	**Ovii**	**Changlong**	136-MPK
	Pentaphylacaceae	*Eurya acuminata* DC.	**Moriisii**	**Shizou**	106-MK
Yes	Phyllanthaceae	*Baccaurea sapida* (Roxb.) Müll. Arg.	NR	**Heipan**	199-K
	Poaceae	*Chimonobambusa callosa* (Munro) Nakai	**Chiteba**	**Leivah**	128-MPK
		Chimonobambusa callosa (Munro) Nakai	**Chiteba**	**Leivah or Vitou**	144-MP
Yes	Rosaceae	*Docynia indica* (Wall.) Decne.	**Chiphoshi**	**Theithup**	135-MPK
Yes		*Prunus nepalensis* Ser.	**Mokhoshi**	**148-MP**	6
Yes		*Prunus persica* (L.) Batsch	**Mikriashi**	**Veisohlu**	049-MPK
	Rubiaceae	*Wendlandia glabrata* DC.	**Houkhusii**	**Ahthipung**	114-MPK
	Saururaceae	*Houttuynia cordata* Thunb.	**Eshakama**	**Aithanglou**	035-MPK
	Schizophyllaceae	*Schizophyllum commune* Fr.	NR	**Pashi**	171-MPK
	Urticaceae	*Elatostema sessile* J.R. Forst. & G. Forst.	**Edeiovu**	**Solunche**	140-MPK
	Woodsiaceae	*Diplazium esculentum* (Retz.) Sw.	**Pfochou chojii**	**Nigrou**	106-MPK
	Zingiberaceae	*Alpinia nigra* (Gaertn.) B.L. Burtt.	**Kashapro**	**Aigidon**	113-MPK
		Curcuma angustifolia Roxb.	**Kodziiapa**	NR	170-MPK

Table 1 (cont.). Wild edible fruit species for sale in local markets in Senapati district, Manipur, Northeast India.

Edible plant species	Collectors								Vendors								% share	
	#	Selling rates						Mean value (Rs./kg)	#	Selling rates						Mean value (Rs./kg)		
		Value (Rs./kg)			Frequency					Value (Rs./kg)			Frequency					
		A	B	C	*f*a	*f*b	*f*c			A	B	C	*f*a	*f*b	*f*c		Collector	Vendor
C. album	4	8	10		1	3	0	10	4	15	18	0	2	2		17	58	42
R. semialata	6	30	35	40	2	3	1	34	9	50	65	70	3	4	2	61	56	44
C. asiatica	8	25	28	30	3	3	2	27	6	35	40	45	1	3	2	41	67	33
O. stolonifera	9	8	10	0	3	5	0	8	12	15	18	2	3	2	7	19	45	55
C. floribundus	4	13	15	0	2	2	0	14	4	22	25	0	3	1	0	23	62	38
A. delicata	4	300	350	0	1	3	0	338	5	450	500	0	3	2	0	470	72	28
T. cordata	4	15	18	0	3	1	0	16	7	20	25	0	4	3	0	21	75	26
E. floribundus	3	12	14	0	2	1	0	13	4	20	25	0	3	1	0	21	60	40
E. officinalis	6	10	12	15	3	2	1	12	10	20	23	25	3	2	5	23	50	50
R. ellipticum	5	8	10	0	3	2	0	8	5	15	18	0	3	2	0	16	51	49
J. regia	6	9	12	15	2	4	1	14	8	18	20	25	2	5	1	20	67	33
L. citrata	4	80	90	0	2	2	0	85	6	120	130	0	3	3	0	125	68	32
L. lateritia	6	160	170	180	2	3	1	168	6	220	230	250	1	2	3	238	71	29
S. pinnata	4	8	9	0	3	2	0	11	5	12	15	0	3	2	0	13	80	20
F. auriculata	5	8	10	12	2	2	1	10	7	15	18	20	2	3	2	18	54	46
Musa sp.	8	4	5	0	3	5	0	5	10	8	9	10	2	3	5	9	50	50
E. acuminata	5	8	9	10	1	1	3	9	9	15	20	0	6	3	0	17	56	44
B. sapida	4	12	15	0	2	2	0	14	5	22	25	0	3	2	0	23	58	42
C. callosa	5	13	15	30	1	3	1	18	6	20	25	0	3	3	0	23	78	22
C. callosa	5	6	8	0	2	3	0	7	6	10	12	15	2	3	2	12	59	41
D. indica	8	4	5	6	3	3	2	5	9	8	10	12	3	5	2	11	45	55
P. nepalensis	10	12	14	3	2	1	11	9	25	28	30	2	3	5	32	36	64	36
P. persica	5	7	8	0	2	3	0	8	5	12	14	0	3	2	0	13	59	41
W. glabrata	6	35	40	0	3	3	0	38	8	50	55	60	2	4	2	55	68	32
H. cordata	5	25	30	0	2	3	0	28	8	40	45	50	2	2	4	47	61	39
S. commune	5	170	185	200	2	1	2	185	5	280	300	0	2	3	0	292	63	37
E. sessile	6	10	12	15	3	2	1	12	8	20	22	25	5	2	1	21	54	46
D. esculentum	4	12	15		3	1	0	13	5	18	20	0	3	2	0	19	68	32
A. nigra	4	15	18	0	3	1	0	16	5	20	24	0	2	3	0	22	70	30
C. angustifolia	5	10	12	0	3	2	0	11	5	15	16	0	3	2	0	15	70	30

Table 2. Household (HH) dependence assessment of selected wild edible plants in Okhro-Ekhro, Senapati, Manipur, Northeast India (January-December 2009). Village households, N=78. Households surveyed, n=45 (58% surveyed).

Plants	Extraction			HH use		Marketing						Income		Total value
	HH		Quantity			HH		Marketed		Rs./ kg	Mean	Quantity		Rs./ year
	#	%	kg	kg	%	#	%	kg	%		Rs.	kg	%	
Castanopsis tribuloides (Sm.) A. DC.	15	33	13	13	100	--	--	--	--	23	--	--	--	293
Docynia indica (Wall.) Decne.	21	47	428	62	14	13	62	366	86	5	1782	--	--	2,084
Elaeocarpus floribundus Blume	9	20	40	13	33	3	33	27	67	13	335	--	--	500
Emblica officinalis Gaernt.	13	29	65	31	48	7	54	29	45	12	334	5	8	748
Ficus auriculata Lour.	15	33	95	51	54	5	33	44	46	10	418	--	--	907
Prunus persica (L.) Batsch	22	49	68	20	29	3	13	48	71	8	360	--	--	510
Wild edible fruits														**5,042**
Chimonobambusa callosa (Munro) Nakai	24	53	123	57	46	5	21	67	54	7	479	--	--	886
Elatostema sessile J.R. Forst. & G. Forst.	23	51	91	48	53	7	30	43	47	12	495	--	--	1047
Houttuynia cordata Thunb.	45	100	105	63	60	9	20	42	40	28	1174	--	--	2,940
Lentinula lateritia (Berk.) Pegler	9	20	39	15	37	3	33	25	63	168	4124	--	--	6,565
Musa sp.	45	100	1210	162	13	11	24	628	52	5	2901	420	35	5,590
Oenanthe stolonifera (Roxb.) DC.	45	100	213	106	50	13	29	108	50	8	884	--	--	1,751
Trichosanthes cordata Roxb.	21	47	124	43	35	9	43	81	65	16	1276	--	--	1,953
Other wild edible plants														**20,731**
Total value of wild edible plants														**25,773**

Figure 3. Household (HH) dependence assessment of selected wild edible plants in Kayinu, Senapati, Manipur, Northeast India (January-December 2009). Village households, N=95. Households surveyed, n=43 (45%).

Plants	Extraction			HH use		Marketing						Income		Total value
	HH		Quantity			HH		Marketed		Rs./ kg	Mean	Quantity		Rs./ year
	#	%	kg	kg	%	#	%	kg	%		Rs.	kg	%	
Castanopsis tribuloides (Sm.) A. DC.	24	56	16	9	38	3	13	7	44	23	158	--	--	360
Docynia indica (Wall.) Decne.	13	30	271	63	23	9	69	208	77	5	1320	--	--	1,320
Elaeocarpus floribundus Blume	9	21	22	22	100	--		--	--	13	--	--	--	272
Emblica officinalis Gaernt.	11	26	32	15	46	3	27	18	54	12	374	--	--	374
Ficus auriculata Lour.	18	42	84	59	70	2	11	25	30	10	806	--	--	806
Prunus persica (L.) Batsch	27	63	104	47	45	5	19	57	55	8	776	--	--	776
Wild edible fruits														**3,908**
Chimonobambusa callosa (Munro) Nakai	28	65	95	61	64	4	14	28	29	7	202	6	6	684

Plants	Extraction			HH use		Marketing						Income		Total value
	HH		Quantity			HH		Marketed		Rs./ kg	Mean	Quantity		Rs./ year
	#	%	kg	kg	%	#	%	kg	%		Rs.	kg	%	
Elatostema sessile J.R. Forst. & G. Forst.	19	44	64	34	54	9	47	28	43	12	316	2	3	730
Houttuynia cordata Thunb.	31	72	79	53	67	11	35	21	26	28	574	6	7	2,198
Lentinula lateritia (Berk.) Pegler	11	26	56	22	39	5	45	31	55	168	5218	3	5	9,426
Musa sp.	43	100	1029	176	17	21	49	586	57	5	2707	267	26	4,752
Oenanthe stolonifera (Roxb.) DC.	43	100	168	92	54	15	35	77	46	8	629	--	--	1,381
Trichosanthes cordata Roxb.	18	42	70	31	45	8	44	39	55	16	606	--	--	1,095
Other wild edible plants														**20,266**
Total value of wild edible plants														**24,174**

Table 4. Household (HH) dependence assessment of selected wild edible plants in Emeifitithumei, Senapati, Manipur, Northeast India (January-December 2009). Village households, N=45. Households surveyed, n=38 (84%).

Plants	Extraction			HH use		Marketing						Income		Total value
	HH		Quantity			HH		Market		Rs./ kg	Mean	Quantity		Rs./ year
	#	%	kg	kg	%	#	%	kg	%		Rs.	kg	%	
Castanopsis tribuloides (Sm.) A. DC.	15	39	101	19	19	6	40	82	81	23	1845	--	----	2273
Docynia indica (Wall.) Decne.	23	61	539	86	16	13	57	451	84	5	2196	2	0.37	2625
Elaeocarpus floribundus Blume	5	13	33	13	39	3	60	20	61	13	253	--	---	418
Emblica officinalis Gaernt.	25	66	203	104	51	11	44	89	44	12	1018	10	4.94	2329
Ficus auriculata Lour.	32	82	160	88	55	6	19	62	39	10	595	4	2.5	1536
Juglans regia L.	12	32	144	14	10	4	33	130	90	14	1755	--	----	1944
Prunus persica (L.) Batsch	23	61	120	29	24	5	22	90	75	8	675	--	-----	896
Wild edible fruits														**12,020**
Chimonobambusa callosa (Munro) Nakai	38	100	180	78	43	9	24	103	57	7	742	--	----	1296
Elatostema sessile J.R. Forst. & G. Forst.	33	87	223	72	32	14	42	146	65	12	1673	6	2.46	2565
Houttuynia cordata Thunb.	38	100	109	63	58	11	29	46	42	28	1288	--	----	3052
Lentinula lateritia (Berk.) Pegler	17	45	187	48	26	8	47	132	71	168	22135	7	3.75	31394
Musa sp.	38	100	1528	251	16	7	18	111	7	5	513	1174	76.85	7057
Oenanthe stolonifera (Roxb.) DC.	38	100	161	84	52	13	34	78	48	8	637	--	----	1323
Trichosanthes cordata Roxb.	33	87	114	51	45	6	18	59	52	16	921	4	3.52	1788
Other wild edible plants														**48,474**
Total value of wild edible plants														**60,494**

Table 5. Overall household (HH) dependence assessment of selected wild edible plants in Okhro-Ekhro, Kayinu and Emeifiithumei, Senapati district, Manipur, Northeast India (January-December 2009). Village households, N=218. Households surveyed, n=126 (58%). NR = Not reported

Plants	Extraction			HH use		Marketing						Income		Total value
	HH		Quantity			HH		Marketed		Rs./ kg	Mean	Quantity		Rs./ year
	#	%	kg	kg	%	#	%	kg	%		Rs.	kg	%	
Castanopsis tribuloides (Sm.) A. DC.	54	43	130	41	32	9	17	89	68	23	2003	NR	---	2,925
Docynia indica (Wall.) Decne.	57	45	1238	211	17	35	71	1027	83	4.9	5001	NR	---	6,029
Elaeocarpus floribundus Blume	23	18	94	48	41	6	27	61	52	13	766	7.5	6.5	1,190
Emblica officinalis Gaernt.	49	39	300	150	50	21	38	135	45	12	1551	15	5	3,450
Ficus auriculata Lour.	65	52	339	198	55	13	20	131	39	10	1253	10	2.9	3,250
Juglans regia L.	12	10	144	14	10	4	33	130	90	14	1755	NR	---	1,944
Prunus persica (L.) Batsch	72	57	291	95	33	13	18	195	67	7.5	1459	NR	---	2,183
Wild edible fruits means		**38**			**34**		**32**		**63**		**20970**		**4.8**	
Chimonobambusa callosa (Munro) Nakai	90	71	398	195	49	18	20	198	50	7.2	1422	5.5	1.4	2,866
Elatostema sessile J.R. Forst. & G. Forst.	75	60	378	154	41	30	40	216	57	12	2484	7.5	2	4,341
Houttuynia cordata Thunb.	114	91	293	179	61	31	27	109	37	28	3038	5.5	1.9	8,190
Lentinula lateritia (Berk.) Pegler	37	29	282	85	30	16	43	187	66	168	31478	10	3.6	
Musa spp.	126	100	3766	588	16	39	31	1325	35	4.6	6122	1853	49	
Oenanthe stolonifera (Roxb.) DC.	126	100	542	281	52	41	33	262	48	8	2150	NR	---	4,455
Trichosanthes cordata Roxb.	72	57	307	125	41	23	32	178	58	16	2804	4	1.3	4,835
Other wild edible plant means		73			41		32		50				10	89,471

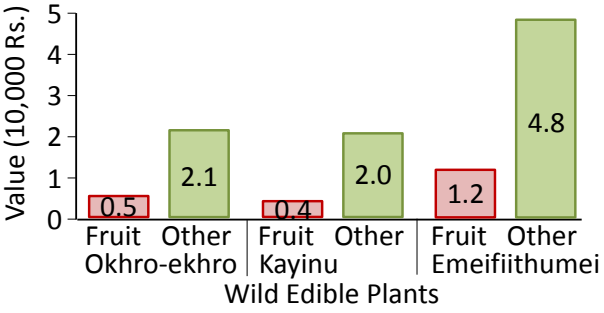

Figure 2. Gross annual income from selected wild edible plants in Okhro-ekhro, Kayinu, and Emeifiithumei, Senapati district, Manipur, Northeast India.

the local supply cannot meet local demand. It was also observed during market surveys that a number of WEPs such as *Elatostema sessile* J.R. Forst. & G. Forst., *Musa* spp., *Oenanthe stolonifera* (Roxb.) DC., *Chimonobambusa callosa* (Munro) Nakai, *D. indica*, *Emblica officinalis* Gaernt., *Prunus nepalensis* (Ser.) Steud., and *Rhus semialata* Murray were sold in relatively high quantities during the growing seasons in all of the surveyed market places. Very few species (e.g., *Musa* sp.) are extracted not only for household consumption and sale in the local markets but also used as animal feed. Informants further revealed that with few exceptions (collection of mushrooms and leafy vegetables in forests), collection was mostly done by women during their field work.

Threats and conservation status

All of the WEP species listed in Tables 1 & 2 are collected from their natural habitats in forest areas near villages and in traditional shifting agricultural lands. At present there are no conservation or protection measures applied in these areas by government, NGOs, nor

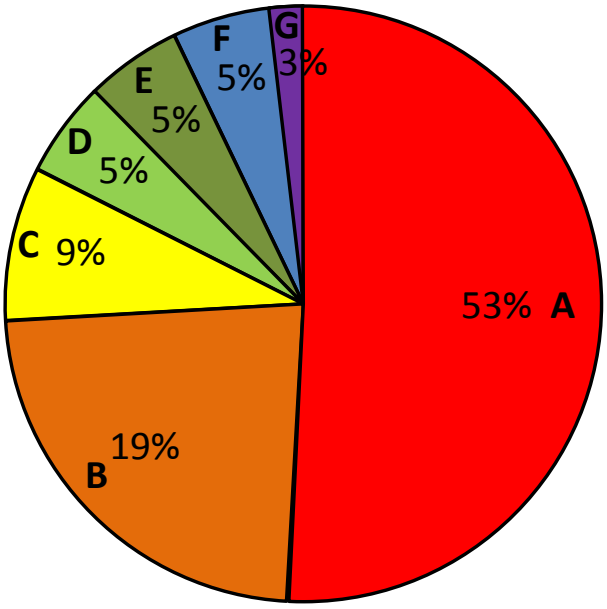

Figure 3. Percent of annual monetary value of selected wild edible plants in the three localities in Kayinu, Senapati district, Manipur, Northeast India. **A**: *Chimonobambusa callosa* (Munro) Nakai; **B**: *Musa* spp.; **C**: *Houttuynia cordata* Thunb.; **D**: *Trichosanthes cordata* Roxb.; **E**: *Oenanthe stolonifera* (Roxb.) DC.; **F**: *Elatostema sessile* J.R. Forst. & G. Forst.; **G**: *Chimonobambusa callosa* (Munro) Nakai.

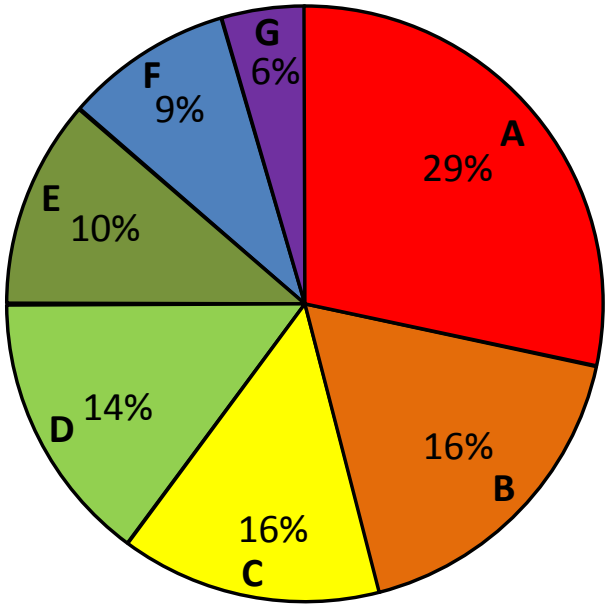

Figure 4. Percent of annual monetary value of selected wild edible fruits in the three localities in Kayinu, Senapati district, Manipur, Northeast India. **A**: *Docynia indica* (Wall.) Decne.; **B**: *Emblica officinalis* Gaernt.; **C**: *Ficus auriculata* Lour.; **D**: *Castanopsis tribuloides* (Sm.) A. DC.; **E**: *Prunus persica* (L.) Batsch; **F**: *Juglans regia* L.; **G**: *Elaeocarpus floribundus* Blume.

local communities. Informants revealed that there has been tremendous pressure from anthropogenic activities (unsustainable harvesting, expansion of agricultural land because of traditional shifting cultivation, and forest fires). Since collection of WEPs is a free access without paying any royalty to the state government it partly encourages over exploitation of some species. Identification and prioritization of potentially threatened species is important. We need to explore the possibility of integrating them into the agro-forestry system used by local communities as a conservation strategy to maintain the region's biodiversity. Moreover derivation of economic benefits from cultivation will definitely encourage the interest of the local communities to conserve and manage their resources (Balemie & Kebebew 2006).

Discussion and Conclusions

Marketing plays an important role in the socio-economic development of any area as it helps to serve the people and the region (Berry 1967). Although market surveys and listings of uses of WEPs have been reported by some workers from Manipur and elsewhere in the region (Devi *et al*. 2010, Kayang 2007, Samant & Dhar 1997, Sarma *et al*. 2010, Singh *et al*. 1988, Singh & Singh 1985, Sundriyal & Sundriyal 2004) detailed evaluations of household dependency on leafy WEPs have not been reported earlier.

Local elders and young individuals indicated that traditional knowledge of the use of these WEP resources is eroding among the younger generation. Increasing socio-economic conditions, influence on contemporary western life styles, lack of documented records, changing occupations among younger generations, and introduction of new/better nutritional varieties of agricultural crops are all reasons given for loss of traditional knowledge. Similar observations have been made elsewhere (Lindeberg *et al*. 2003, Maikhuri *et al*. 2004). With exception of some common and well known species, younger people are unaware of lesser known edible leafy vegetables (*Rhynchotechum ellipticum* (Wall. ex D. Dietr.) A. DC., *Chenopodium album* L., *Diplazium esculentum* (Retz.) Sw., *Eurya japonica* Thunb., *Wendlandia glabrata* DC.). This is a serious concern for preservation and transmission of traditional knowledge on the one hand, and conservation and management of the region's biodiversity resources on the other. The concept of biodiversity conservation will be more meaningful when both traditional knowledge about the use of the local flora is aligned with preservation and management plans. A number of authors (Grivetti & Ogle 2000, Kala 2007, Maikhuri *et al*. 2000, Ogoye-Ndegwa & Aagaard-Hansen 2003,) have emphasized the importance of the diversity of WEPs and their traditional knowledge in the search for new sources of food. Therefore it is expected that the present study will assist in understanding the role of WEPs in the local economy. Policy makers

may apply this for development of conservation strategies for these species.

Acknowledgements

The authors are grateful to Botanical Survey of India (BSI), Eastern Circle, Shillong for providing herbarium facilities and also helping in the identification of plants. We are also grateful to University Grant Commission (UGC), New Delhi for providing financial assistance in the form of a Rajiv Gandhi National Scholarship for SC/ST candidates. Our sincere thanks also goes to those villagers and supervisors particularly in Emeifiithumei and Kayinu who sincerely cooperated with us in filling out the information in the data sheets provided to them. Last, but not the least, we are also very much indebted to those vegetable vendors who readily helped us to provide the required information during the market field survey.

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