Diversity of wild edible plants in Marat Longri Wildlife Sanctuary, Assam

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The present study revealed that 91 species of wild edible plants belonging to 79 genera and 45 families including 2 fern species are consumed by the inhabitants of Marat Longri Wildlife Sanctuary, Assam, India. Karbis consumed highest number of wild plants (91) followed by Nepalis (50) and Dimasas (42); 38 plants have common uses among all the ethnic groups. Wild plants constitute the main source of diet, nutrition, economy and health of the people. Pair wise ranking was performed to evaluate threat factors to wild edible plant resources which indicated agricultural expansion, overgrazing, fuel wood collection and *jhum* practices as major threats.

Keywords: Conservation, Livelihoods, Marat Longri wildlife sanctuary, Wild edible plants.

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Introduction

Wild edible plants (WEPs) are global resource of immense utility for mankind. There is no single definition for WEPs but these usually refer to species that are neither cultivated nor domesticated, but available from their natural habitat and used as sources of food¹. Another view is that WEPs are plant resources that are harvested or collected for human consumption outside agricultural areas in forest, savannah, and other bush land areas². They are indispensable source of food, nutrition, livelihoods and also ethnomedicine in different parts of the world. Many studies have reported WEPs as potential source of household diets, nutrition, food security, medicines and highlighted the implication of WEPs on human wellbeing³⁻¹⁷. Some studies found WEPs to be more nutritious than conventionally eaten crops^{18,19}. Study of people-plant interactions in protected areas have been reported from different parts of the world²⁰⁻²⁴. Besides food and nutrition, utilization of wild foods as coping strategies during scarcity is prevalent, particularly in developing countries where food insecurity is more acute. Diversity of plant foods offers variety in diet and contributes to household food security²⁵⁻²⁸. Potential of WEPs in providing income and livelihoods in rural settings is acknowledged around the world²⁹⁻³². Ethnobotanical study in protected areas can provide vital information

about plant resources, diversity, distribution, pattern of utilization and management practices. The aim of the present study is to assess diversity and threat to WEPs in Marat Longri Wildlife Sanctuary (WLS) through documentation of indigenous knowledge and utilization of plant resources by ethnic groups which can provide information on valued and most exploited species and thus, threat to the species can be assessed.

Materials and Methods

Study area and the people

Marat Longri WLS (25º47'-25º59' N and 93º08'-93⁰21' E) in Karbi Anglong district, Assam was established on 17 April 2003 with a geographical area of 451 km². The sanctuary comprises of 4 reserved forests namely Mijungdisa, Disama, Kaki and Inglongkiri (Plate 1). The sanctuary is an integral part of Dhansiri-Lumding elephant reserve. The protected area is inhabited by 7 ethnic groups namely Karbi, Dimasa, Hmar, Garo, Chakma, Nepali and Adivasi. These communities depend on this forest for food, nutrition, medicines, recreation and livelihood. As agricultural land is scarce most families practice jhum (slash and burn) by clearing forest vegetation. But *jhum* products are not sufficient for the whole year and therefore, people utilize wild plant resources to meet their food and other requirements. The present study was conducted among 3 ethnic groups namely Karbi, Dimasa and Nepali, the Karbis being the dominant group. Agriculture is the main subsistence

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Plate 1-Map of Marat Longri WLS

strategy of the Karbi and Dimasa while cattle rearing is the chief mean of subsistence among the Nepalis.

Data collection and analysis

Field study was undertaken during September 2012 to November 2013 and information on WEPs and their utilization was documented through participatory approach of group discussions, interviews and household visits. Informants were apprised of the objectives of the present work and their consent was obtained. Survey was conducted along forest transects with knowledgeable informants to study the distribution and diversity of edible plants. The specimens were processed as per standard methods³³ and then identified with the help of available literatures³⁴⁻⁴¹. Regular market surveys were undertaken to record WEPs collected from Marat Longri WLS and their economic importance. To understand local peoples' perception on threats to WEPs, pair wise ranking was carried out and the number of possible pairs was calculated using the relation N (N-1)/2, where N is the number of factors (threats).

Results and Discussion

Diversity and dietary use of WEPs

Wild plants form the main component of food basket of ethnic groups in Marat Longri WLS. The study documented 91 WEPs belonging to 79 genera under 45 families including 2 ferns namely *Amphineuron opulentum* (Kaulf.) Holtt. and *Diplazium esculentum* (Retz.) Sw. The family

Araceae, Asteraceae, Cucurbitaceae, Leguminosae and Rutaceae had the highest representation of edible plants with 5 species each followed by Dioscoreaceae (4), Phyllanthaceae (4), Solanaceae (4), Amaranthaceae (3), Clusiaceae (3), Dilleniaceae (3), Lamiaceae (3), Zingiberaceae (3); the remaining families were represented by 1 or 2 plants each. Vernacular names of WEPs along with their uses are presented in Table 1. It was observed that 46 (50.54 %) plants had multiple uses, 25 (27.47 %) plants contributed towards local pharmacopoeia while 24 (26.37 %) plants were used as animal feed. Most of the identified plants are already reported edible elsewhere¹³⁻¹⁷. The growth forms of the reported species include (in ascending order) climbers, trees, herbs and shrubs. Almost all parts, viz. fruits, leaves, tender shoots, inflorescence, tuber, stolon, petiole, stem, bark and seeds are confirmed by the ethnic groups (Plate 2a) under study. Tubers of Dioscorea species are the most extensively collected plant resource during scarcity of staple foods, rice.

Karbis represented highest users of WEPs (91 species) followed by Nepalis (50 species) and Dimasas (42 species) in the study area. About 38 species (41.75 %) had common uses among the 3 ethnic groups. This trend suggests the existence of general knowledge base across cultures when exposed to common resource pool. There is visible similarity in processing and preparation of plant foods between the Karbis and Dimasas than with the Nepalis, which may be due to sharing of same habitat and interactions

	Table 1—Diversity and utilization	ation of WEPs in	n Marat Longri Wildlife Sanc	tuary, Assam (contd.).					
S. No.	Botanical name [Family]	Parts used	Uses							
			Karbi	Dimasa	Nepali					
1.	Acacia pennata (L.) Willd. [Mimosaceae]	Bark	Starter cake	Starter cake						
2.	Acmella paniculata (Wall. ex DC.) R.K. Jansen [Asteraceae]	Inflorescence, tender shoot	Vegetable, medicine for toothache and cough	Chutney	Vegetable, cough					
3.	<i>Aegle marmelos</i> (L.) Corrêa ex Roxb. [Rutaceae]	Fruit	Eaten raw, anti-dysentery, fodder	Eaten raw, fodder	Eaten raw, anti-dysentery, fodder					
4.	Alpinia nigra (Gaertn.) Burtt [Zingiberaceae]	Tender shoot	Vegetable	Vegetable	Vegetable					
5.	Alternanthera philoxeroides (Mart.) Griseb. [Amaranthaceae]	Tender shoot	Vegetable, cattle wounds	Vegetable						
6.	Alternanthera sessilis (L.) R.Br. ex DC. [Amaranthaceae]	Tender shoot	Vegetable, jaundice							
7.	Amblovenatum opulentum J.P. Roux [Thelypteridaceae]	Leaf	Vegetable, insecticides							
8.	Amorphophallus sylvaticus (Roxb.) Kunth [Araceae]	Tuber	Vegetable, fodder							
9.	Antidesma acidum Retz. [Phyllanthaceae]	Leaf	Vegetable							
10.	Artocarpus lacucha BuchHam. [Moraceae]	Bark, leaf	Masticatory	Masticatory	Masticatory, fodder					
11.	Azadirachta indica A. Juss. [Meliaceae]	Leaf	Chutney		Chutney, dermal disease and pimples					
12.	Baccaurea ramiflora Lour. [Phyllanthaceae]	Fruit, leaf	Leaf as vegetable, fruit eaten raw		Eaten raw, fodder					
13.	Bambusa sp. [Poaceae]	Tender shoot, leaf	Vegetable	Vegetable	Vegetable, fodder					
14.	<i>Bauhinia racemosa</i> Lam. [Caesalpiniaceae]	Leaves, tender shoot	Chutney	Chutney	Fodder					
15.	<i>Bauhinia variegata</i> L. [Caesalpiniaceae]	Leaf	Chutney	Chutney	Fodder					
16.	Blumea lanceolaria (Roxb.) Druce [Asteraceae]	Leaf	Vegetable, anti-rheumatic, pain killer							
17.	<i>Callicarpa arborea</i> Roxb. [Lamiaceae]	Bark	Masticatory							
18.	<i>Calotropis gigantea</i> (L.) R. Br. ex Ait. [Apocynaceae]	Leaf	Cooked with alkali and dry fish							
19.	Capsicum annuum L. [Solanaceae]	Fruit, leaf	Vegetable, spice, cough	Spice	Spice, medicine for cough					
20.	<i>Centella asiatica</i> (L.) Urb. [Apiaceae]	Leaf	Vegetable, anti-dysentery	Chutney	Chutney, anti-dysentery					
21.	Cheilocostus speciosus (J.Koenig) C.D.Specht [Costaceae]	Rhizome, stem, leaf	Vegetable, urinary stone, analgesic for earache							
22.	<i>Cinnamomum verum</i> J.Presl [Lauraceae]	Bark	Spice	Spice	Spice					
23.	<i>Citrus maxima</i> (Burm.) Merr. [Rutaceae]	Fruit	Eaten raw	Eaten raw	Eaten raw					
24.	Citrus sp. [Rutaceae]	Fruit	Eaten raw	Eaten raw	Eaten raw					
25.	<i>Clerodendrum glandulosum</i> Lindl. [Lamiaceae]	Tender shoot	Vegetable, hypertension	Vegetable						
26.	<i>Coccinia grandis</i> (L.) Voigt [Cucurbitaceae]	Fruit	Vegetable, eaten raw	Vegetable	Vegetable, fodder					

	Table 1—Diversity and utilize	ation of WEPs in	Marat Longri Wildlife Sanc	ctuary, Assam (conte	<i>l</i> .).					
S. No.	Botanical name [Family]	Parts used	Uses							
			Karbi	Karbi	Karbi					
27.	Coix lacryma-jobi var. stenocarpa Oliv. [Poaceae]	Whole plant, fruit	Famine food, fodder		Fodder					
28.	<i>Colocasia esculenta</i> (L.) Schott [Araceae]	Stolon, petiole, leaf, spathe	Vegetable, fodder	Vegetable, fodder	Vegetable, fodder					
29.	<i>Combretum album</i> Pers. [Combretaceae]	Bark	Masticatory							
30.	<i>Commelina benghalensis</i> L. [Commelinaceae]	Tender shoot	Vegetable	Vegetable	Vegetable, fodder					
31.	Crassocephalum crepidioides (Benth.) S.Moore [Asteraceae]	Tender shoot	Vegetable							
32.	<i>Croton joufra</i> Roxb. [Euphorbiaceae]	Leaf	Starter cake							
33.	<i>Deeringia amaranthoides</i> (Lam.) Merr. [Amaranthaceae]	Tender shoot	Vegetable							
34.	Dillenia indica L. [Dilleniaceae]	Fruit	Vegetable, anti-dysentery	Vegetable	Chutney					
35.	<i>Dillenia pentagyna</i> Roxb. [Dilleniaceae]	Fruit	Eaten raw							
36.	<i>Dillenia scabrella</i> (D.Don) Roxb. ex Wall. [Dilleniaceae]	Fruit	Eaten raw							
37.	<i>Dimocarpus longan</i> Lour. [Sapindaceae]	Fruit	Eaten raw							
38.	Dioscorea alata L. [Dioscoreaceae]	Tuber, leaf	Famine food	Famine food	Famine food, fodder					
39.	Dioscorea esculenta (Lour.) Burkill [Dioscoreaceae]	Tuber, leaf	Famine food	Famine food	Famine food, fodder					
40.	<i>Dioscorea glabra</i> Roxb. [Dioscoreaceae]	Tuber, leaf	Famine food	Famine food	Famine food, fodder					
41.	Dioscorea pentaphylla L. [Dioscoreaceae]	Tuber, leaf	Famine food	Famine food	Famine food, fodder					
42.	<i>Diplazium esculentum</i> (Retz.) Sw. [Athyriaceae]	Leaf	Vegetable	Vegetable	Vegetable					
43.	Enydra fluctuans DC. [Asteraceae]	Tender shoot	Vegetable, anti-dysentery, skin disease, for improving eye sight		Vegetable, fodder					
44.	Etlingera loroglossa (Gagnep.) R.M.Sm. [Zingiberaceae]	Root	Masticatory	Masticatory	Masticatory					
45.	Ficus hispida L.f. [Moraceae]	Leaf	Vegetable							
46.	<i>Garcinia lanceifolia</i> Roxb. [Clusiaceae].	Fruit	Eaten raw							
47.	<i>Garcinia pedunculata</i> Roxb. ex BuchHam. [Clusiaceae]	Fruit	Eaten raw							
48.	<i>Garcinia xanthochymus</i> Hook.f. ex T. Anderson [Clusiaceae]	Fruit	Eaten raw							
49.	Gnetum gnemon L. [Gnetaceae]	Fruit, leaf	Vegetable, fruit eaten roasted							
50.	<i>Gymnopetalum chinense</i> (Lour.) Merr. [Cucurbitaceae]	Fruit, leaf	Chutney		Chutney					
					(contd.)					

S. No.	Botanical name [Family]	Parts used		Uses	
			Karbi	Karbi	Karbi
51.	Hodgsonia macrocarpa (Blume) Cogn. [Cucurbitaceae]	Seed	Chutney		Chutney
52.	Homalomena aromatica (Spreng.) Schott [Araceae]	Leaf, tuber	Vegetable, fodder		
53.	<i>Houttuynia cordata</i> Thunb. [Saururaceae]	Leaf	Vegetable		
54.	<i>Ipomoea aquatica</i> Forssk. [Convolvulaceae]	Tender shoot, leaf	Vegetable, blood purifier	Vegetable	Vegetable, fodder
55.	<i>Laportea interrupta</i> (L.) Chew. [Urticaceae]	Leaf, root	Vegetable, anti-helminthic	Vegetable	Vegetable, fodder
56.	Lasia spinosa (L.) Thw. [Araceae]	Tender leaf	Vegetable	Vegetable	Vegetable
57.	<i>Mangifera sylvatica</i> Roxb. [Anacardiaceae]	Fruit	Eaten raw	Eaten raw	Eaten raw, fodder
58.	<i>Maranta arundinacea</i> L. [Marantaceae]	Tuber	Famine food, galactagogue		
59.	<i>Momordica charantia</i> L. [Cucurbitaceae]	Leaf, fruit	Vegetable, anti-dysentery, starter cake	Chutney	Chutney
60.	<i>Momordica dioica</i> Roxb. ex Willd. [Cucurbitaceae]	Fruit, tender shoot	Vegetable	Vegetable	Vegetable
61.	Monochoria hastata (L.) Solms [Pontederiaceae]	Tender shoot, leaf	Vegetable, antibiotic for caruncle, fodder		Vegetable, fodder
62.	<i>Murraya koenigii</i> (L.) Spreng. [Rutaceae]	Leaf	Vegetable, curry flavour; anti-constipation	Chutney	Chutney
63.	<i>Musa acuminata</i> Colla [Musaceae]	Tender petiole, spathe, fruit	Vegetable, beverage, anti- dysentery	Vegetable	Chutney, anti- dysentery, fodder
64.	<i>Nymphaea lotus</i> L. [Nymphaeaceae]	Root, seed	For piles	Seeds eaten raw	Seeds eaten
65.	<i>Oenanthe javanica</i> (Blume) DC. [Apiaceae]	Tender shoot	Vegetable		
66.	<i>Olax acuminata</i> Wall. ex Benth. [Olacaceae]	Tender shoot	Vegetable		
67.	Oroxylum indicum (L.) Kurz [Bignoniaceae]	Tender shoot, fruit, bark	Vegetable, for jaundice		Jaundice, cattle wound
68.	Oxalis corniculata L. [Oxalidaceae]	Whole plant	Vegetable, snake antidote		Anti-dysentery, fodder
69.	<i>Paederia foetida</i> L. [Rubiaceae]	Tender shoot, leaf	Vegetable, anti- constipation and dysentery		Chutney, fodder
70.	Parabaena sagittata Miers [Menispermaceae]	Leaf, tender shoot	Vegetable		
71.	Parkia timoriana (DC.) Merr. [Leguminosae]	Fruit	Chutney	Chutney	Chutney
72.	Phlogacanthus thyrsiflorus Nees. [Acanthaceae]	Tender shoots, inflorescence	Chutney		Chutney, anti- dysentery
73.	Phyllanthus emblica L. [Phyllanthaceae]	Fruit	Eaten raw, anti-dysentery	Eaten raw, anti-dysentery	Eaten raw, anti- hair fall and dysentery
74.	Physalis peruviana L. [Solanaceae]	Fruit, tender shoot	Vegetable		

S. No.	Botanical name [Family]	Parts used	Uses							
			Karbi	Karbi	Karbi					
75.	Piper thomsonii (C. DC.) Hook.f. [Piperaceae]	Leaf	Eaten with betel nut	Eaten with betel nut						
76.	Pogostemon pubescens Benth. [Lamiaceae]	Tender shoots	Vegetable							
77.	<i>Rhaphidophora calophylla</i> Schott [Araceae]	Leaf	Vegetable							
78.	<i>Rhynchotechum ellipticum</i> (Wall. ex D. Dietr.) A. DC. [Gesneriaceae]	Leaf	Vegetable							
79.	Sapindus mukorossi Gaertn. [Sapindaceae]	Fruit	Eaten raw		Eaten raw					
80.	Sauropus androgynus Merr. [Phyllanthaceae]	Leaf	Vegetable							
81.	<i>Smilax glabra</i> Roxb. [Smilacaceae]	Tuber	Famine food							
82.	<i>Solanum americanum</i> Mill. [Solanaceae]	Tender shoot	Vegetable							
83.	Solanum torvum Sw. [Solanaceae]	Fruit	Vegetable	Vegetable	Chutney					
84.	Spondias pinnata (L. f.) Kurz [Anacardiaceae]	Fruit	Eaten raw	Eaten raw	Eaten raw					
85.	<i>Tabernaemontana divaricata</i> (L.) R.Br. ex Roem. & Schult. [Apocynaceae]	Seed	Eaten roasted							
86.	<i>Tamarindus indica</i> L. [Leguminosae]	Fruit, leaf	Vegetable, fruit eaten raw	Eaten raw	Eaten raw, fodder					
87.	<i>Terminalia chebula</i> Retz. [Combretaceae]	Fruit	Eaten raw	Eaten raw	Eaten raw, cough and dysentery, hair wash					
88.	<i>Xanthium strumarium</i> L. [Asteraceae]	Leaf	Vegetable							
89.	Zanthoxylum oxyphyllum Edgew. [Rutaceae]	Tender shoot	Vegetable							
90.	Zingiber zerumbet (L.) Rose ex Sm. [Zingiberaceae]	Inflorescence	Vegetable							
91.	Ziziphus jujuba Mill. [Rhamnaceae]	Fruit	Eaten raw, curry	Eaten raw, curry	Curry, pickle, eaten raw					

Table 1-Diversity and utilization of WEPs in Marat Longri Wildlife Sanctuary, Assam (contd.)

between the 2 groups through trade or the proximity with one another might have passed on the culture and knowledge of plant use over the years from Dimasas to Karbis and *vice versa*. The Nepali people inhabit a more isolated area and their food requirements do not show significant overlapping with either Karbis or Dimasas.

Socio-economic implications of WEPs

Low income and meagre return from farm products have compelled many families to trade edible plants including WEPs in local markets (Plate 2b) which was physically substantiated by household surveys and study in local markets. Market value of WEPs is not regulated and vendors generally charge ~ 10-20 (depending on availability) for visually measured quantity of plants. Income derived from the sale is of particular importance to the poor marginal households who must supplement food production with cash in order to meet their basic needs besides household food security.

Edible medicinal plants

The blurred boundary between food and medicine is a contentious issue in the study of WEPs, but foodmedicine overlap is natural in traditional food system. Local population in the study area are dependent on wild plants for primary healthcare. Ear and eye sore, fever, cough and cold, rheumatism, diarrhoea, dysentery, burns, cuts, wounds, skin diseases,



Plate 2-(a) Women collecting WEPs and (b) Selling WEPs in local markets

Table 2—Pair wise ranking of factors considered as threats to WEPs.																	
Factors Respondents							Rank										
-	K 1	K2	K3	K4	K5	N1	N2	N3	N4	N5	D1	D2	D3	D4	D5	Total	
Jhum practice	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	15 (105)	1
Forest fire	+	+	+	+	—	—	+	+	+	—	+	—	+	+	—	9 (36)	3
Fuel wood collection	+	—	+	_	+	_	—	+	_	+	—	_	+	+	+	8 (28)	4
Over-grazing	—	+	+	+	_	+	+	+	+	+	—	+	+	+	_	11 (55)	2
Over harvesting	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	15 (105)	1
Key informants- K= Karhi: N= Nepali: D= Dimasa																	

jaundice, etc. are the common health problems. Almost all parts of plants are used in ethnomedicines that are prescribe in different forms such as juice, maceration, decoction, paste, ash, poultice, fumes or vapours, oil, gum, resin, etc. Some plants are used in aroma therapy and as baths. About 25 WEPs (27.47 %) recorded in the study were used in local pharmacopoeia.

Threats to WEPs resource and conservation

Plant resources of Marat Longri WLS face threats from various anthropogenic activities like *jhum*, agricultural expansion, grazing and over harvesting. Pair wise ranking of 5 factors (Jhum practice, over harvesting, overstocking/over grazing, fuel wood collection and uncontrolled fire setting) was conducted to understand local people's perception on threats to WEPs resource (Table 2). The total sum of each factor varied among informants of different groups. Karbis rated jhum practice and over harvesting of plant resources as the principal threat. This is mainly due to increasing demand for arable land by the burgeoning human population. Overgrazing and fuel wood collection ranked second. Dimasas also reported *jhum* practice and over

harvesting followed by fuel wood collection, fire and overstocking fodder or grazing as important factors threatening WEPs. Nepalis consider reduction of grazing land due to agricultural expansion resulting in overstocking of cattle feed creating pressure on local resource in addition to over harvesting of plant resources. They also claimed fuel wood collection as secondary factor that threaten WEPs while forest fire pose minor threats. Respondents indicated it is common practice to burn plant debris during dry season to enhance growth of herbs and grasses and to control tsetse fly, ticks and snakes. It was observed that such fires severely affected tree and shrub stands, some even completely burned. Plants were over browsed and also trampled by livestock causing considerable damage to plant community. All the above factors contributed towards decline of WEPs diversity directly or indirectly. But one positive aspect worth mentioning is that some farmers manage few economic plants like Musa sp., Solanum torvum Sw., Clerodendrum glandulosum Lindl. and Blumea lanceolaria (Roxb.) Druce in their farmland as agroforestry or garden tree suggesting that agrobiodiversity management coupled with economic

benefits could promote local peoples' interest in conservation of locally important plant diversity. Thus, conservation of WEPs must be urgently initiated for human subsistence and biodiversity conservation of Marat Longri WLS.

Conclusion

Inventory of plant resources in protected area helps in documentation of plant diversity, distribution, pattern of utilization and management practices. Balanced interaction between people and forest is the key for success of conservation and sustainable co-existence is pivotal. Domestication of culturally and economically important plants can contribute to conservation as this will ease collection pressure on wild plant populations. Educating people about the ecosystem services provided by biodiversity and benefits arising from conservation can contribute towards sustainable development. Chemical analysis of WEPs will provide nutritional and phytochemical profiles which are useful for assessing health benefits of such foods.

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