Diversity of Non-Timber Forest Products (NTFPs): A Provisioning Ecosystem Services among the Marwet Community, Ri-Bhoi District, Meghalaya

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Abstract-A natural ecosystem provides a wide range of goods and services to human society and plays a vital role in sustaining livelihood of the indigenous community. Non-Timber Forest Products (NTFPs) is a good source of income especially for the tribal communities. The objective of this study is to investigate the diversity of Non-Timber Forest Products (NTFPs) in Raid-Marwet Region, Ri-bhoi district of Meghalaya, India. Data was collected and analyzed from 36 trees, 46 herbs/shrubs/climbers and 10 grass species, using a systematic sampling method through laying quadrat along the transect of 100 m^2 for trees, 25 m^2 nested (sub) quadrat for counting herbaceous plants, and 1m^2 nested (sub) quadrat for counting grasses in three differentiated study sites i.e. North Raid-Marwet (S1), South Raid-Marwet (S2), and Nongthomai Garo community forest (S3-control). Five different types of NTFPs are mainly extracted from the forest by the tribes that include plant species for Ethno botanical use, fuel-wood, animal fodder, construction materials, and edible forest products. The average Shannon-Wiener Index of Diversity (H′) among the three different sites, were 2.488 (Control site3), 2.128 (Site 1), and 2.113 (Site2), indicating that Nongthamai Garo community forest (control site3) has higher importance and diversity values in comparison to the Site 1 and Site2. Rapid deforestation due traditional shifting cultivation (site2), and hill cutting (Site1) in the region have relatively affected the diversity of NTFPs. Based on the study, it be inferred that the diversity of NTFPs resources can be used as a measure for sustainable management of the forest by involving and allowing the local community to utilize the NTFPs rather than involving in timber harvesting or conversion of existing forest land into other land use forms.

Index Terms- IVI, Non-Timber Forest Products (NTFPs), Quadrat, Shannon Diversity Index

I. INTRODUCTION

Non-Timber Forest Products (NTFPs) refers to a broad range of resources in the forest. The natural forests all over the world are disappearing at an alarming rate. Even before two to three decades from now the utilization of Non-Timber Forest Products (NTFPs) was one possibility to address the need for conservation of forest remnants and simultaneously contributing to local community livelihoods (Arnold & Perez 2001). NTFPs are often considered as the black box of integrated forest management (Davidson-Hunt et al 1999), and along with ecotourism, promote as a means to revamp economic development with biodiversity conservation as reported by Vance & Thomas (1997). The NTFPs of a country also play substantial roles in food security and poverty alleviation for a large number of communities in that country (Vivero 2002). For instance, over 80% of the population of Ethiopia depends on herbal/wild medicines for their primary health care, while over 90% of the rural community depends on fuel wood (firewood and charcoal) for their energy demand (EFAP 1994,Vivero 2002). Non-Timber Forest Products (NTFP's) have been advocated as a means to promote forest conservation and community development because of their widespread use and values, as well as their purported potential for sustainable harvesting with few adverse effects on other flora and fauna (Nepsted & Schwartzman 1992). The NTFPs are a good source of incomes for especially the indigenous tribes living in and around the forest ecosystem

Due to increasing anthropogenic pressure, which directly affects the bio-diversity of the region, have an adverse impact on the diversity of NTFPs as well. Based on this concept, a proper management of the natural forests of Raid-Marwet region can be proposed for the production of NTFPs, so that the indigenous people can sustainably utilize it to raise their economic condition. NTFPs production may lead to both economic upliftment and biodiversity conservation in the area which is evident from the type of forest and productivity of NTFPs in the region. However, very limited studies have been conducted to document the diversity, and other ecological aspects of NTFPs resources in the natural forests of Raid-Marwet. Therefore, the objectives of this study was to identify NTFPs bearing species and study their diversity and Importance value index (IVI) in Raid-Marwet Region and assess the types of NTFPs currently utilized by the indigenous people.

II. MATERIALS AND METHODS

A. The study site

Ri-Bhoi District is one of the Seven Districts of Meghalaya, carved out from East Khasi Hills District on 4th June 1992. It is bounded in the North by the Kamrup District of Assam, East by the Karbi-Anglong District of Assam, South by the East Khasi Hills and West by the West Khasi Hills District.

Ri-Bhoi District covers an area of 2448 Km^2 with a population of 258,380 (2011 census). It lies between $90^0$55' to $92^0$05' E Latitude and $25^0$40' to $26^0$20'N Longitude. Raid-Marwet with total area of 155.318 Km^2. is located between $91^0$43' to $91^0$53' E Latitude and $25^0$57' to $26^0$07' N Longitude. The region constitute 83 villages (4991 households) with total population of approximately 25521 with 13071 male and 12450 female population (Census 2011).This region is characterized by rugged and irregular land surface. It includes a series of hill ranges which gradually sloped towards the North and finally joins the Brahmaputra Valley (Figure 1).

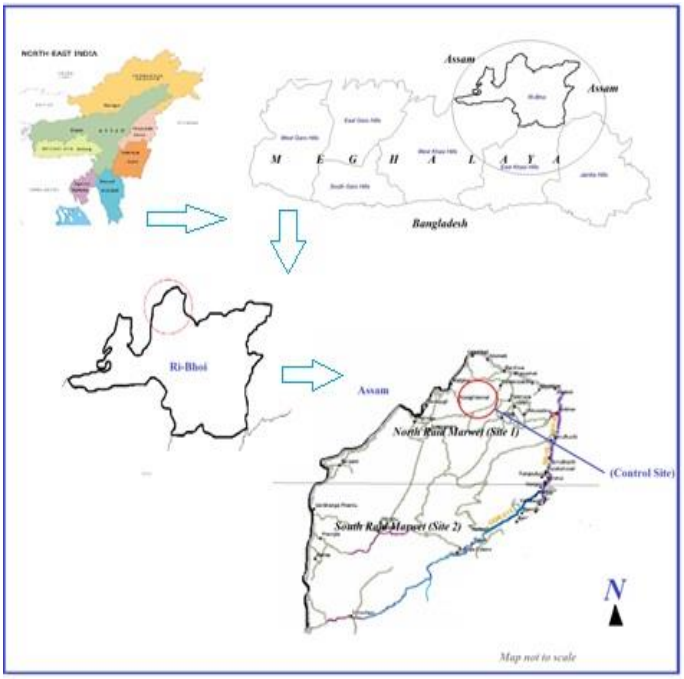

Figure 1: Study area

B. Methods of data collections

For the sake of convenience the entire study area was divided into three sites two disturbed site (S1 & S2) and undisturbed or control site (S3). Vegetation data were collected using a systematic sampling scheme by laying quadrat along the transect (Barbour et al 1999; Singh & Singh 1992). $100m^2$ quadrat each were placed along the transect at 150m vertical interval from each other, also 25 m^2 nested (sub) quadrat for counting herbaceous plants, and $1m^2$ nested (sub) quadrat for counting grasses in three differentiated study sites (S1, S2 and S3-control). In all the quadrat and sub-quadrat all woody, herbaceous, and grass species found and their numbers were recorded. 60 quadrat i.e. 20 on each site were established in the entire region. Key informants (knowledgeable and/or elderly resident) were used to provide information about the species bearing NTFPs, hence proper identification was done using the help of taxonomist and the available literature (Kanjilal et al 1934-40; Hooker J. D. 1872-97). A checklist of NTFPs plants species were recorded in each quadrat and from the data of each plot were analyzed for species diversity based on (Shannon and Wiener, 1963) and Importance Value Index (IVI).

III. RESULTS AND DISCUSSION

About 92 plant species were recorded in the entire Raid-Marwet region and these are considered as NTFPs of the region. Out of this, 36 species (39%) were recorded to be woody plants, 46 species (50%) herbaceous and 10 species (11%) are grasses. The average Shannon-Wiener Index of Diversity (H′) among the three different sites, were 2.488(Control site3), 2.128 (Site 1), and 2.113 (Site2), indicating that (Site3) has higher diversity values in comparison to the Site1 and 2. It is seen that the control site (Nongthamai Garo community forest) is least disturbed in the whole region, and is managed by the tribal community, whereas, Site 1 and 2 are undergoing diverse anthropogenic pressure. Hill cutting is prominent in Site1, whereas shifting cultivation is prominent in Site2 (Figure 2).

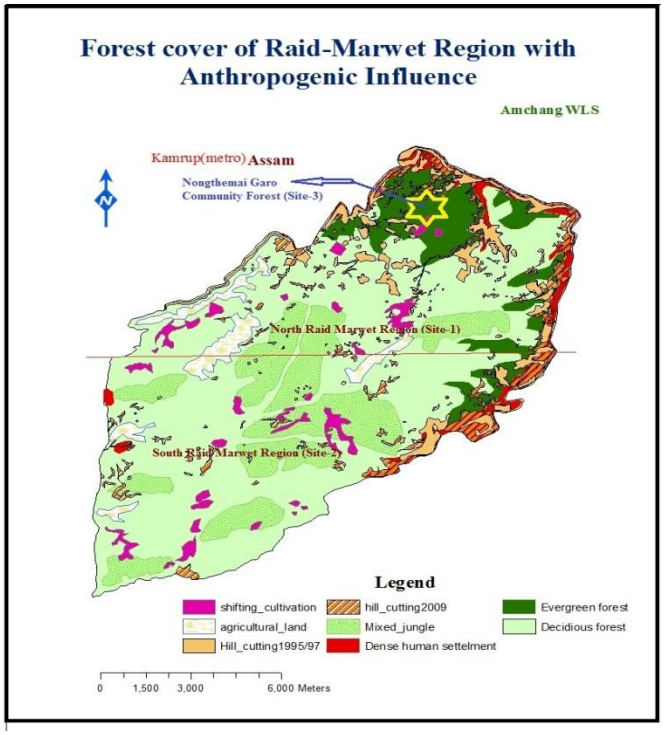

Figure 2: Forest Cover with major anthropogenic pressure in the study area.

Hill cutting and shifting cultivation both result on deforestation in large scale in the area and are the major anthropogenic activities. Figure 3 quantifies the extent of both hill cutting and shifting cultivation in the region. Private, government, and community forest exist in the study area with either evergreen, semi-evergreen, and deciduous types. This provides ample goods and services to the tribal community to surplus their livelihood standards. Tiwari & Campbell (1995) reported that 35% of the income of a tribal household in India comes from the collection

of NTFPs. Their also exist series of anthropogenic disturbances in the region, which will affect the biodiversity of the region and the goods and services which they provide.

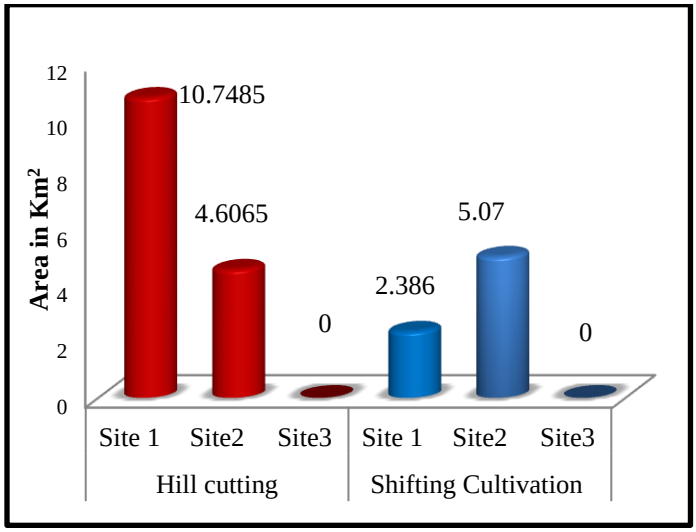

Figure 3: Major anthropogenic influence in the study area.

Five different types of NTFPs of socio-economic significance to the local community living in and around the forest of Raid-Marwet region were identified as edible plants species, ethno medicinal plant species, animal fodder, fuel-wood species and construction material were recorded. The Raid-Marwet area records 18 Tress, 09 Herbs, 04 Shrubs and 01 climber species to have ethno medicinal importance (Table 1). Species having both high diversity and high Importance value in all the different sites are, *Asparagus racemosus, Musa paradisiaca, Mesua ferrea, Albizia lebbeck, Gmelina arborea, Alstonia scholaris, Zingiber officinale,* and *Michelia champaca.* The region harbors wide range of medicinal plants which could provide monetary benefits if harvested sustainably. Balick & Mendelsohn (1992) reported that current value of medicinal plant harvesting in western Belize was $ 726/ha. Similar Socio-economic evaluation, is done for the Raid-Marwet region, would definitely come up with encouraging result.

13 trees species and 26 species belonging to either herbs/shrubs/climbers were identified in the entire forest of Raid-Marwet, providing edible plant materials to the indigenous community Among the 39 species, *Artocarpus chama, Baccaurea ramiflora, Coix lacryma-jobi, Bauhinia purpurea, Ficus hispida, Artocarpus hetrophyllus, Calamus erectus, Myrica esculenta,* and *Gynocardia odorata* has the highest diversity and important value in the study area (Table 2).. Documentation of such wild edible plants is important for understanding the traditional indigenous knowledge systems of the community.

Few species were also identified as animal fodder which is one of the major provisioning services to sustain cattle farms in the region. Most of the animal fodder belongs to herbs/shrubs category, followed by grasses. Among the 32 species of animal fodder plants listed, the following species have the highest diversity and importance values, *Aquilaria malaccensis, Maesa indica, Shorea robusta, Mangifera sylvatica, Hydrocotyle japonica, Panicum maximum, Cynodon dactylon, Imperata cylindrica, Cyperus rotundus, Bambusa* sp., *Adiantum caudatum, Galinsoga parviflora, and Polypodium* sp. (Table 3).The all India average value of fodder is 183.5 `/ha (Haripriya et al 2005). So, the region can be claimed to have a potential in fodder production.

In the study area, it has also been observed that certain plant species are used for furniture and house construction materials for house building and boundary fencing (Table 4). Importance value and diversity of following species were observed to be highest, *Mesua ferrea, Shorea assamica, Gmelina arborea, Michelia champaca, Artocarpus heterophyllus, and Dipterocarpus retusus.* The natural forest of the study area is the main source of energy for the people living in and around the forest. About 14 plant species are currently utilized by the community for fuel wood purpose (Table 5). Among them the species having high diversity and importance value are *Mesua ferrea, Gmelina arborea, Albizia lebbeck, Pinus insularis, Michelia champaca, Schima wallachii, Artocarpus heterophyllus,* and *Chukrasia tabularis.* These species are of high demand in the market; private forest owners sometimes harvest it in large scale for economic benefit. It also seen that, many people are locally involved in selling such materials in the form of small bundles to support their livelihood. Bhatt & Sachan (2004) studied the consumption of firewood by the Khasi, Jaintia and Garo communities and found that it is highest in the Khasi community (5.81 kg/capita/day), followed by the Garo (5.32 kg/capita/day) and Jaintia (3.90 kg/capita/day), irrespective of their socio-economic status. Also as per the State Forest Department and the district council's reports, extraction of firewood for market purpose sale comes mainly from the Ri-Bhoi district. Occasionally in few areas these species are also used in traditional charcoal formation. After the ban on timber logging by the Supreme Court in December 1996, the people have taken up charcoal making as an alternate livelihood opportunity. This activity is very popular in the Ri-Bhoi District but less prominent in the study area. It can be mentioned that the Garo community of the region is involved in such activities.

Table 1: Important Ethno Botanical plant species in Raid-Marwet region									
	Site1			Site2			Site 3		
TREES	**n**	**IVI**	***PilnPi***	**n**	**IVI**	***PlnPi***	**n**	**IVI**	***PilnPi***
Aegle marmelos Correa	2	9.68	0.0805	1	7.3504	0.0527	3	10.73	0.115
Albizia lebbeck (L.) Benth.	10	28.21	0.0475	6	21.59	0.1885	20	37.52	0.337
Alstonia scholaris (L.) R. Br.	16	39.36	0.2986	12	34.893	0.278	4	13.2	0.141
Bombax ceiba L.	1	6.71	0.0475				2	8.26	0.086
Bauhinia variegate L.	2	11.51	0.0805	1	7.3528	0.0527	6	16.51	0.183
Cinnamomum zeylanicum Bl.	1	6.71	0.0475	4	17.304	0.1449	3	10.73	0.115
Clerodendrum viscosum Vent.	2	9.68	0.0805				2	8.26	0.086
Phyllanthus emblica L.	1	6.71	0.0475	2	10.669	0.0889	4	12.67	0.141
Ficus banghalensis L.	1	6.71	0.0475				2	8.26	0.086
Gmelina arborea Roxb.	18	43.56	0.3138	8	26.098	0.224	16	33.9	0.31
Holarrhena antidysentrica Wall.				2	10.673	0.0889			
Mallotus philippensis (Lamk.)Muell,-Arg.	5	17.23	0.1539	5	19.053	0.1679	2	8.26	0.086
Mangifera indica L.	12	31.54	0.0259	10	30.608	0.2533	4	12.67	0.141
Mesua ferrea L.	8	23.53	0.207	11	33.254	0.2662	26	45.34	0.36
Michelia champaca L.	11	29.87	0.248	9	28.572	0.2393	14	32.04	0.292
Myrica esculenta Buch-Ham.	2	9.68	0.0805	5	20.293	0.1679	4	12.67	0.141
Terminalia bellirica (Gaertn.)Roxb.	1	6.71	0.0475	2	10.673	0.0889	4	13.25	0.141
Terminalia chebula Retz.	3	12.6	0.1084	6	21.587	0.1885	5	15.74	0.163
Total	96		1.9626*	84		2.4906*	121		2.922*
HERBS									
Ageratum conyzoides L.	4	22.91	0.1806	16	54.545	0.0805	5	22.75	0.163
Abelmoschus esculentus (L.) Moench				3	9.9025	0.126			
Asparagus racemosus Willd. *(climber)*	12	50.53	0.0782				25	65.55	0.358
Cannabis sativa L.	3	18.97	0.1497	1	17.992	0.056	5	22.75	0.163
Datura stramonium L.	2	16.01	0.1133				2	13.25	0.086
Justica adhatoda L.	4	19.58	0.1805				4	19.1	0.141
Mimosa pudica L.				12	45.31	0.2896	5	23.46	0.163
Musa paradisiaca L.	9	41.05	0.2846	18	59.75	0.3397	15	46.01	0.302
Rauvolfia serpentina Benth.	8	36.72	0.2686	2	13.58	0.0948	14	43.22	0.292
Saxifrage sp.	1	9.79	0.0683				5	24.96	0.163
SHRUBS									
Gossypium herbaceum L.	5	26.63	0.207	1	9.9016	0.056	2	8.24	0.086
Panax ginseng Meg.	12	54.46	0.0782				3	11.28	0.115
Thea assamica Masters				4	22.401	0.1536			
Zingiber officinale Rosc.				20	66.612	0.35			
Total	60		1.6090*	77		1.5462*	85		2.031*
*Shannon Diversity Index (H′) =Σ*PilnPi*, n=total number of individual species, IVI= Importance Value Index									

Table 2: Edible plants in Raid-Marwet region									
	Site1			Site2			Site 3		
TREES	**n**	**IVI**	***PilnPi***	**n**	**IVI**	***PilnPi***	**n**	**IVI**	***PilnPi***
Artocarpus chama Buch-Ham.	16	64.12	0.32	8	39.02	0.29	12	57.7	0.87
Artocarpus hetrophyllus Lamk.	8	37.66	0.266	6	31.85	0.25	5	31.31	0.23
Baccaurea ramiflora Lour.	18	67.47	0.36	8	40.13	0.29	12	57.08	0.87
Bauhinia purpurea L.							6	35.28	0.25
Dillenia indica L.	1	10.46	0.066	5	28.23	0.22			
Ficus hispida L.	2	15.55	0.11257				6	34.99	0.25

Gynocardia odorata R. Br.	3	19.88	0.1478	8	38.74	0.29	2	17.33	0.13
Moringa olifera Lamk.				4	25.65	0.20			
Myricae sculenta Buch-Ham.	7	34.36	0.2487	3	20.63	0.16	5	31.31	0.23
Phyllanthus emblica L.				2	15.61	0.12	1	12.18	0.22
Phyllanthus acidus (L.) Skeels.	2	15.55	0.11257	4	24.24	0.20	3	19.88	0.10
Pyrus communis L.	2	17.48	0.11257	2	15.61	0.12			
Rhodenderon arboretum Sm.	2	17.48	0.11257	3	20.27	0.16			
Total	61		1.86*	53		2.29*	52		3.13*
HERBS/ SHRUBS CLIMBERS	**n**	**IVI**	***PilnPi***	**n**	**IVI**	***PilnPi***	**n**	**IVI**	***PilnPi***
Argyreia nervosa (Burm.f.) Bojer	2	7.53	0.0597				6	13.86	0.14
Cucurbita moschata Duch. & (Lam.) Desh. ex Poir	8	17.13	0.1632	2	9.652	0.08	6	13.85	0.14
Hodgsonia macrocarpa (Bl.) Cogn.							1	4.79	0.19
Luffa cylindrica (L.) M. Roem.	2	7.53	0.0597	5	17.32	0.15			
Luffa acutangula (L.) Roxb.							1	4.95	0.19
Diplazium esculentum (Retz.) Sw.	8	17.09	0.1614	4	14.93	0.13	2	6.88	0.06
Coix lacryma-jobi L. [grass]	12	21.59	0.2095	23	49.74	0.34	28	40.7	0.32
Begonia josephi A. DC.	5	12.03	0.1173	1	6.399	0.23	6	13.8	0.14
Centella asiatica (L.) Urban	19	30.53	0.2703						
Elaeagnus caudata Schl. ex Msun.	8	16.44	0.1614	5	16.96	0.15	16	27.34	0.24
Fagopyrum dibotrys D. Don.	3	8.67	0.0811	6	18.99	0.17	5	12.23	0.12
Gomphogyne cassiformis Griff.	1	4.55	0.1878	6	19.70	0.17	4	10.59	0.10
Ixeris gracilis (Dc.) Stabbins							4	10.59	0.10
Oxalis corniculata L.	2	6.82	0.0597	6	18.99	0.17			
Piper diffusum Vahl.	2	6.82	0.0597				3	8.966	0.08
Persicaria chinensis Linn.	2	5.53	0.0597	4	14.94	0.13	8	16.67	0.17
Persicari amuricatum H.K.F.	4	10.56	0.1001	6	18.99	0.17	1	15.81	0.19
Persicaria nepalensis Meisn.	6	13.92	0.1353	2	9.66	0.08	5	13.12	0.12
Persicaria orientale Linn.	1	4.55	0.1878						
Solanum xanthocarpum Schrad. &Wendl.							1	4.956	0.19
Taxus baccata Linn.	8	16.43	0.1632	14	33.838	0.27	12	22.3	0.21
Zanthoxylum khasianum Hook. f.	4	10.56	0.1001	1	6.3967	0.23	5	12.45	0.12
Calamus erectus Roxb.	24	35.50	0.3012	16	37.118	0.29			
Croton tiglium L.	15	25.28	0.2378				16	27.34	0.24
Flemingia vestita Benth.	1	4.55	0.1878				2	6.88	0.06
Gaultheria fragrantissima Wall	2	6.82	0.0597	1	6.3967	0.23	5	12.23	0.12
Oxyspora paniculata (D.Don)Dc.	2	7.53	0.0597						
Total	141		3.183*	102		2.95*	137		3.26*
*Shannon Diversity Index (H′) =Σ*PilnPi*, n=total number of individual species, IVI= Importance Value Index									

Table 3:Fodder plants species in Raid-Marwet region

	Site1			Site2			Site 3		
TREES	**n**	**IVI**	***PilnPi***	**n**	**IVI**	***PilnPi***	**n**	**IVI**	***PilnPi***
Aquilaria malaccensis Lamk.				8	89.053	0.3646	12	91.84	0.36785
Maesa indica (Roxb.) DC.	5	76.37	0.8896				8	69.62	0.34353
Mangifera sylvatica Roxb.	2	43.28	0.2236	4	54.872	0.2932	5	51.08	0.2859
Shorea robusta C. F. Gaertn.	2	43.71	0.2236	8	91.579	0.3646	6	58.66	0.30995
Tectona grandis L.f.	12	136.63	0.3199	5	64.514	0.3219	2	28.80	0.16991
Total	21		1.6567*	25		1.344*	33		1.4771*
HERBS/SHRUBS/ CLIMBERS	**n**	**IVI**	***PilnPi***	**n**	**IVI**	***PilnPi***	**n**	**IVI**	***PilnPi***
Bauhinias acuminate L.	10	22.42	0.1926	9	30.749	0.2141	10	15.78	0.1431
Chromolaena odorata (L.) K. & R.	19	34.92	0.2752	25	60.135	0.3446	7	12.51	0.1118

Selaginella kraussiana	9	20.51	0.1794						
Angiopteris evecta G.Forst.	8	19.06	0.1669	12	36.468	0.2517	16	21.71	0.1939
Lygodium japonicum Thunb.	9	20.49	0.1794				18	23.77	0.2082
Lygodium microphyllum (Cav.)R. Br.	6	15.71	0.1374	6	23.274	0.1666			
Polypodium sp.	8	19.09	0.1669				19	24.55	0.215
Carex baccans Nees.	11	23.39	0.20357				14	20.06	0.1784
Blechnum orientale L.	18	33.02	0.2673				15	21.23	0.1863
Adiantum caudatum Linn.				15	42.187	0.2819	23	28.09	0.2397
Croton tiglium L.				11	34.344	0.24	15	21.23	0.1863
Datura stramonium L.	1	5.44	0.0347				4	8.85	0.0743
Floscopa scandens Lour.				15	42.699	0.2819	11	16.72	0.1526
Galinsoga parviflora Cav.	9	21.11	0.1794				18	23.20	0.2082
Pogostemon benghalensis (Burm.f)O. Kuntze	12	25.77	0.2138				16	21.54	0.1939
Pouzolzia indica (L.) G. Benn.	9	20.49	0.1794				12	17.95	0.1615
Stemona tuberosa Lour.	7	18.53	0.1517	9	30.118	0.2141	16	21.54	0.1939
Total	136		2.5276*	102		1.995*	214		2.647*
GRASS	**n**	**IVI**	***PilnPi***	**n**	**IVI**	***PilnPi***	**n**	**IVI**	***PilnPi***
Bambusa sp.	18	28.91	0.31	11	31.449	0.2179	14	19.68	0.1844
Cynodon dactylon (L.) Pers.	22	60.04	0.334	15	35.957	0.2588	25	36.88	0.278
Cyperus rotundus Linn.	15	46.18	0.286	8	24.777	0.1795	22	31.71	0.2408
Hydrocotyle japonica Makino				15	37.738	0.2588	33	41.67	0.2953
Imperata cylindrica L.	15	48.60	0.286	12	32.617	0.2292	24	33.41	0.2524
Melocanna baccifera (Roxb.) Kurz				13	32.763	0.2396	12	21.39	0.1672
Panicum maximum Jacq.	20	61.22	0.3231	21	45.54	0.3039	33	41.67	0.2953
Phragmites karka (Retz.) Trin. Ex Steud.				12	31.166	0.2292	16	26.06	0.2002
Merremia vitifolia Burm.f				8	23.86	0.1795	9	19.63	0.1381
Piper nigrum L.	9	40.89	0.218	6	19.303	0.1489	15	26.35	0.1925
Total	99		1.757*	121		2.245*	203		2.244*
*Shannon Diversity Index (H′) =Σ*PilnPi*, n=total number of individual species, IVI= Importance Value Index									

Table 4: Important construction material in Raid-Marwet region

	Site1			Site2			Site 3		
TREES	**n**	**IVI**	***PilnPi***	**n**	**IVI**	***PilnPi***	**n**	**IVI**	***PilnPi***
Artocarpus heterophyllus Lamk	18	44.42	0.31	9	45.57	0.30	12	30.27	0.23
Chukrasia tabularis A.Juss	7	23.47	0.19	2	24.53	0.12	5	17.55	0.13
Dipterocarpus retusus Bl.	6	29.29	0.17	9	46.35	0.30	8	23.32	0.18
Duabanga grandiflora (Roxb. Ex DC.)Walp.	5	18.92	0.15	2	17.24	0.12	6	20.12	0.15
Gmelina arborea Roxb.	18	44.68	0.31	8	41.90	0.28	16	36.60	0.27
Mesua ferrea L.	8	25.62	0.20	11	52.49	0.32	26	51.58	0.33
Michelia champaca L.	11	31.65	0.24	9	45.41	0.30	14	33.24	0.25
Phoebe goalparenis Hutch.	6	21.35	0.17	4	26.50	0.19	8	23.34	0.18
Shorea assamica Dyer	16	40.99	0.29				19	41.28	0.29
Terminalia myricarpa Heurck et Muell	5	19.61	0.15				7	22.69	0.16
Total	100		2.18*	54		1.94*	121		2.17*
*Shannon Diversity Index (H′) =Σ*PilnPi*, n=total number of individual species, IVI= Importance Value Index									

Table 5: Important Fuel-wood species in Raid-Marwet region

	Site1			Site2			Site 3		
SPECIES	**n**	**IVI**	**PilnPi**	**n**	**IVI**	**PilnPi**	**n**	**IVI**	**PilnPi**
Albizia lebbeck (L.) Benth.	10	22.9102	0.1936	6	20.22	0.18	20	31.20	0.26
Amoora wallichii King	6	16.746	0.1391	3	13.04	0.11	4	11.14	0.09
Artocarpus heterophyllus Lamk	18	34.1377	0.2696	9	27.16	0.23	12	22.37	0.19
Chukrasia tabularis A. Juss	7	19.5035	0.1541	2	10.42	0.08	5	13.13	0.10
Dipterocarpus retusus Bl.	6	16.2908	0.1391	9	27.81	0.23	8	16.75	0.15
Dipterocarpus turbinatus Gaertn				5	19.37	0.16	12	22.37	0.19
Gmelina arborea Roxb.	18	34.6564	0.2696	8	25.13	0.21	16	35.09	0.23
Mesua ferrea L.	8	21.2236	0.1682	11	32.17	0.05	26	37.22	0.29
Michelia champaca L.	11	23.2855	0.2052	9	22.29	0.23	14	26.19	0.21
Phoebe goalparensis Hutch.	6	16.746	0.1391	4	16.39	0.14	8	18.59	0.15
Pinus insularis Endl.	6	16.2908	0.1391	9	20.17	0.23	17	27.69	0.23
Quercus floribunda Rehder	8	19.6654	0.1682	2	10.42	0.08			
Schima wallachii(D.C.)Kuntz	25	43.8427	0.3133	16	41.49	0.30	15	25.37	0.29
Terminalia myricarpa Heurck et Muell	5	14.7013	0.1227				7	12.90	0.13
Total	134		2.421*	93		2.22*	164		2.51*

*Shannon Diversity Index (H′) =Σ*PilnPi*, n=total number of individual species, IVI= Importance Value Index

IV.CONCLUSION

From the foregoing study, it is evident that in the Raid Marwet area, Pristine site (i.e. Site 3) is in a better state as compared to Site 1 and Site 2. The average Shannon-Wiener Index of Diversity (H′) among the three different sites, were 2.488 (Control site3), 2.128 (Site 1), and 2.113 (Site2), indicating that Nongthamai Garo community forest (control site3) has higher importance and diversity values in comparison to the Site 1 and Site2. Anthropogenic pressure (hill cutting and shifting cultivation) in S1 and S2 respectively is affecting the diversity of the NTFPs, which is having impact in livelihood of the indigenous community. There is abundant evidence that ecosystem people settled for long in a locality and in full control of their own resources base, exhibits a number of cultural practices that promotes sustainable use of biological resources and conservation of biodiversity (Gadgil & Berkes 1991, Gadgil et al 1993). In West Bangal, it has been reported that NTFPs, including fuel and fodder contribute to 22% cash income of the village households living in the forest fringe areas (Malhotra et al 1991). In this study there are numerous big and small cattle farms in the fringe area of the region, which are dependent directly on the forest for animal fodder and fuel-wood. Similar auditing can be done in the study area that would help in restoring the health of the ecosystem of the area. Thus, it may be concluded that the diversity of NTFPs resources can be used as a measure for sustainable management of the forest by involving and allowing the local community to utilize the NTFPs rather than involving in large scale timber harvesting or conversion of existing forest land into other land use forms.

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