Assessment of non-timber forest products (NTFPs) in Behali Reserve Forest, Assam, Northeast India

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Research

Abstract

Background: Non-timber forest products (NTFPs) are defined as all biological materials other than timber, which are extracted from forests for human use. Uses of various NTFPs have shown significant progress in cultural subsistence, commercial purposes, bioprospecting and sustainable support to forest biodiversity. The present research was conducted in a protected area to document NTFPs of plant origin with their relative importance, to record information for future investigation and discovery of novelty in drug use, and to edify the local communities on sustainable forest management.

Methods: The study was aimed to assess the Non-timber forest products of Behali Reserve Forest of Assam. Data was collected from 67 households belonging to two communities, the Karbi and Munda, covering almost 50% of the total households of the studied area using semi-structured questionnaires, personal interviews, group discussions and transect walks from 2017 to 2019.

Results: A total of 100 plants falling under 87 genera and 56 families were reported. Urticaceae with 6 species was the most dominant family. Trees with 35% were the most dominant group, followed by shrubs (28%), climbers (22%) and herbs (15%). Out of the reported NTFPs, 51 species (51%) were edibles, 23 species (23%) had ethnomedicinal importance, and 48 species (48%) are treated as having miscellaneous uses. Use value of all the reported species ranged from 0.01 to 0.13. Zanthoxylum oxyphyllum, Hodgsonia macrocarpa, Aristolochia cathcartii and Aristolochia assamica have high UV indicating that these species are most important for the studied population. Informant consensus factor was calculated for the different ailments recorded and a total of seven species were found to have above 70% fidelity level values, showing high reliance of the forest dependent people on these species.

Conclusions: The study illustrates a high diversity of NTFPs in the area as well as an intricate relation with the people residing in the fringes of the forest. Anthropogenic activities such as construction of roads, cutting of forests for jhum (shifting) cultivation, natural calamities like landslides etc., were observed to be serious threats to native biodiversity. It is recommended to provide skill development trainings and financial support for the installation of renewable and alternative energy technologies to minimize the use of forest resources in Behali Reserve Forest for better forest sustainability.

Key words: Assam, Assessment, Behali Reserve Forest, Non-timber forest products, quantitative approach, bio-resources

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Background

Non-timber forest products (NTFPs) are defined as all biological materials other than timber, which are extracted from forests for human use, with exclusions made for sand, stones, water, and ecotourism (De Beer & McDermott 1989, Chandrasekharan 1995). But with due course and time, many other definitions were proposed (Chamberlain & Hammett 2002, Grivins 2016, Leßmeister et al. 2016), still there is no single or definite definition of NTFPs; hence the concept or classification varies by use or by origin (Ahenkan & Boon 2011). Plants with their diverse use products have long played important roles in the emerging progress of human civilization. The explicit study of these plants has proven to be a powerful tool in understanding how different indigenous communities around the globe relate to natural resources, notably for medicine, food, shelter, additional income, fodder etc. (Albuquerque & Hanazaki 2009). NTFPs also come in handy in case of emergency situations and hardships such as crop failure, economic crisis, war conflicts, and floods as emergency sustenance measures (Sunderlin & Ba 2005). Uses of various NTFPs have shown significant progress in cultural subsistence, commercial purposes, bioprospecting and sustainable support to forest biodiversity (Cocksedge 2009).

India is counted in the countries with a growing market for aromatic and medicinal plants (Martinez 2004). The total number of NTFPs in India is accounted, for about 3000 plant species (Pradhan & Badola 2008, Pradhan & Singh 2019). Northeastern India, falling under the realm of two major biodiversity hotspots (The Himalayas and the Indo-Burma) is considered as one of the most diverse regions of the world in terms of its culture, people and biodiversity (Paul et al. 2005). And it holds the majority of the NTFP species, evident from the studies of Pandit et al. (2014). A total of 145 tribal communities reside in the terrains of Northeast (Vaiphei 2014). Being mainly forest dwellers the tribal population has a surplus amount of knowledge and is heavily dependent on the forest and its products (Dattaagupta et al. 2010). Assam, the heart of the Northeastern region of India is a land of cultural, traditional, racial and ethnic diversity. The folk culture in the region is still alive and most tribal communities in the remote areas depend on NTFPs for their traditional system of medicine, household materials, cultural need, etc. (Saikia et al. 2017). Assam, on the other hand, is the most studied among the northeastern states in terms of Ethnobotanical knowledge but, a comprehensive study of the documentation of NTFPs wealth in different areas is still lacking.

Over the last century, quantitative approach in relation to people-plants in a multidisciplinary manner using not only ethnobotany, but also ecology, economics, public policy, pharmacology, public health, and other disciplines have gained considerable attention (Balick & Cox 1996, Reyes-Garcia 2006). The advantage of using such method helps to produce quality information, which in turn supplies substantially to resource conservation and development (Hossain & Rahman 2018). The present research was conducted in a protected area to document NTFPs of plants origin with their relative importance, to record information for future investigation and discovery of novelty in drug use, and to edify the local communities on sustainable forest management.

Materials and Methods

Study area

The study was conducted in the fringe villages of Behali Reserve Forest (BRF), the last remaining patch of pristine forest in the entire Biswanath district of Assam (Figure 1, Figure 2A). It is located between 26° 52' and 26° 57' North longitudes and 93° 15' and 93° 25' East latitudes. The total geographical area is about 140.16 km² and the elevation of the area ranges between 90 to 110 meters. The temperature ranges between 13°- 37°C and the mean annual rainfall is 1800 mm (Upadhyaya 2016-17). The area is surrounded by Buri River in the east, Singljian Reserve Forest in the west, Papum Reserve forest in the north and several Tea plantations and human habitations in the south (Sarma et al. 2009). The forest type is identified as a tropical semi-evergreen as per Champion and Seth (Champion & Seth 1968). Agriculture is present in almost all sides of the reserve forest and degradation has severely hampered its boundaries. Shifting cultivation is seen in the North boundaries, whereas settled agriculture is predominant in the south and the east.

Data collection

For the present study, field investigation was conducted from 2017 to 2019 from four villages in the fringes of Behali reserve forest falling under Behali Development Block, namely: Serelia Bongaon, Sialmari Bongaon, Bihumari Bongaon and Rampur. These villages were purposively selected for their tendency to use both timber and non-timber forest resources from the reserve forest. Selection of respondents was done through purposive stratified sampling from those villagers who accepted the request for an interview voluntarily. A total of 67 households, covering almost 50% of the total households, present in these villages were covered for data collection. The selected respondents were
those who frequently accesses the forest, village heads, traditional healers, old folks etc., belonging to two tribal communities of the state, the Karbi and Munda. Information regarding NTFPs harvest were collected from the sample households through interviews by various participatory rural appraisal tools such as semi-structured questionnaires, personal interviews, group discussions and transect walk were organized with the core respondents for field validation (Martin 1995). Collection of plant species belonging to NTFPs was done in the company of respondents and was later processed following the methods of Jain & Rao (1977). It was then identified using relevant literatures (Kanjial et al. 1934–1940, Hooker 1872–1897), and consulting voucher specimens present in regional herbaria (ARUN, ASSAM) and submitted in HAU (Herbarium of Rajiv Gandhi University, Arunachal Pradesh).

**Data analysis**

The collected data was analyzed using four quantitative indices: Use Value (UV), Use Report (UR), Informant Consensus factor (ICF), and Fidelity Level (FL).

Use Value (UV) is calculated using the following formula:

\[
UV = \frac{U}{n}
\]

Where, \( U \) is the number of use reports cited by every respondent for a given species and \( n \) is the total number of respondents interviewed.

The Informant Consensus Factor (ICF) was calculated as:

\[
ICF = \frac{(Nur-Ns)}{(Nur-1)}
\]

where ‘Nur’ is the number of use reports for a particular use category and ‘Ns’ is the number of species used, for each category mentioned by all respondents (Trotter & Logan 1986). ICF gives information about the consensus of respondents regarding the utilization of a certain use category.

Fidelity Level (FL) was calculated as:

\[
FL \% = \frac{Np}{N} \times 100
\]

where, ‘Np’ is the number of respondents that claim to use a plant species for treating a particular disease and \( N \) is the number of respondents that use the plants as a medicine to treat any given disease (Alexiades & Sheldon 1996)

**Results**

The study reported a total of 100 plants falling under 87 genera and 56 families used by the Karbi and the
Munda communities settled in the fringe villages of BRF (Table 2). Among the 56 recorded families, Urticaceae with 6 species was the most dominant, followed by 5 families (Fabaceae, Lamiaceae, Moraceae, Phyllanthaceae, Rutaceae) with 4 species each, 5 families (Acanthaceae, Asteraceae, Cucurbitaceae, Lauraceae, Malvaceae) with 3 species each, 14 families with 2 species each, and the rest 31 families with 1 species each. As per the habit groups, the plants were broadly divided with trees being most dominant (35%), followed by shrubs (28%), climbers (22%) and herbs (15%). Out of the reported 100 NTFPs, 51 species (51%) were edibles, 23 species (23%) had ethnomedicinal importance, and 48 species (48%) are treated as having miscellaneous uses (rituals and customs, construction, utensils etc.), with cross linked uses. Table 2 presents the plants with validated names using (http://www.worldfloraonline.org/, https://www.tropicos.org/home, http://www.worldfloraonline.org/) along with their families, voucher numbers, local names, habit, uses, parts used as well as use values. It has been seen that among the four villages, a total of 76 species has been used by the people of Serelia Bongaon, 25 species by Sialmari and Bihumari Bongaon each and 24 species by Rampur (Table 1). The number of native plants reported here is 81, 8 were exotic and 1 is doubtful (POWO 2019).

Table 1. Relative number of plants used by people of different fringe villages recorded in the study area.

| Name of the fringe village | Number of plants used |
|---------------------------|----------------------|
| Serelia Bongaon           | 26                   |
| Sialmari Bongaon          | 22                   |
| Bihumari Bongaon          | 24                   |
| Rampur                    | 24                   |

Use value (UV) of all the 100 reported species ranges from 0.01 to 0.13. The species like Zanthoxylum oxyphyllum, Hodgsonia macrocarpa, Aristolochia cathcartii and Aristolochia assamica have high UV indicating that these species are most important for the studied population (Table 2). The ICF value for traditional medicine used in BRF varied from 0.57 to 1.00, with an average value of 0.91 (Table 3). Among the ailments, eight of them have the highest ICF value of 1 viz., Antidote against dog bite, Antidote against leech bite, Antidote against stings of wasp and nettle leaves, Blood dysentery, Vomiting, Internal injuries, Jaundice and Loss of hearing due to single number of reported species. Dental infections have the ICF of value 0.98 with 60 use-reports for 2 species, followed by Stomach pain (ICF=0.96; 62 use-reports, 3 species), Cut-wounds (ICF=0.95; 64 use-reports, 4 species), Malaria (ICF=0.92; 57 use-reports, 5 species), Dysentery (ICF=0.92; 55 use-reports, 5 species) etc. (Table 3). The highest ICF value with more than a species reported for a particular ailment, is for Dental infections (Acemia paniculata & Croton caudatus). Similarly, species responsible for the high consensus for Stomach pain are Aristolochia assamica, Aristolochia cathcartii and Garcinia xanthochymus; Cut-wounds are Chromolaena odorata, Clerodendrum infortunatum, Mikania micrantha and Thunbergia grandiflora; Malaria are Alstonia scholaris, Hodgsonia macrocarpa, Zanthoxylum oxyphyllum, Aristolochia cathcartii and Aristolochia assamica; Dysentery are Aristolochia cathcartii, Aristolochia assamica, Dillenia indica, Hodgsonia macrocarpa and Zanthoxylum oxyphyllum. The least agreement between the informants was observed for plants used for Cough, Swells, Urinary tract infections etc.

A total of seven species were found to have above 70% FL values, showing the cultural importance of these species (Table 4). The high value of FL (%) is taken for selecting the most preferred plant species that have one or more species responsible for treating that particular ailment category (Uddin & Hassan 2014). The result revealed that a single species, Clerodendrum colebrookeanum was responsible for treating high blood Pressure showing highest FL value of 97% with 65 use reports. Whereas, out of the 4 species with high values of ICF for treating cut-wounds, Chromolaena odorata is the most commonly used species in the study area (ICF=0.95) with 62 use report and FL value (92%). Similarly, Aristolochia assamica is the most widely used species for treating stomach pain with 61 use report and FL value (91%), followed by Croton caudatus with 59 use report and FL value (88%) for dental infections, Solanum myriacanthum with 55 use report and FL value (82%) for antidote against leech bite, and Aristolochia cathcartii with 55 use report and FL value (82%) for malaria (Table 4).

Discussion

Edible plants

A large number of edible species has been recorded from the present study. It was perceived that majority of the people living in those fringe areas yield some kind of edible plant products in most of their visits to the forest. Plants like Gnetum gnemon, Lepionurus sylvestris, Dillenia indica, Diplazium esculentum, etc. were the most preferred wild edible plants.

Among the reported plants, Gnetum gnemon, is in great demand during the flowering season i.e. the summers. One hundred gram of G. gnemon cones can price up to 100 Indian rupees (INR). Fruits of Dillenia indica, young fronds of Diplazium
esculentum are also sold in the markets throughout the year fetching minimal price (INR 20/kg and INR 20/bundle). The local market price of such wild edible plant products somehow ranges the same in the entire North eastern part of the country, indicating the abundance and high suitability areas for introduction of those underutilized plants in the homegardens of these regions (Terangpi et al. 2013). Documentation of the wild edible plants, along with the study of their availability and preference in an area can act as a reserve zone for large scale production in future to support food shortage calamities.

Table 2. List of NTFPs used by the people residing in fringe villages of Behali Reserve Forest. (Abbreviations used: Ba - Bark, Fl - Flowers, Fr - Fruits, I - Inflorescence, L - Leaves, P - Petiole, R - Roots, Re - Resin, Rh - Rhizome, Se - Seeds, St - Stem, Tu - Tuber, Tw - Twigs, WP - Whole Plant; S - Shrub, T - Tree, C - Climber, H - Herb)

| Species | Family | Voucher number | Vernacular name | Habit (Parts used) | Use and application | Use value |
|---------|--------|----------------|-----------------|-------------------|---------------------|-----------|
| Phlogacanthus curviflorus (Wall.) Nees | Acanthaceae | 3011 | Bam chouk, Tita phul | S (Fl, Tw) | Edible: Flowers are boiled then fried; Medicine: High blood Pressure (29); Eaten after boiled: Oral; Miscellaneous: Chujun | 0.044 |
| Strobilanthes paniculiformis J.R.I.Wood | Acanthaceae | 1015 | Mehek sou | S (Fl) | Miscellaneous: Aesthetic value | 0.014 |
| Thunbergia grandiflora (Roxb. ex Rottler) Roxb. | Acanthaceae | 3022 | Nonong | C (Tw) | Medicine: Cut-wounds (10); Topical: Paste, with Phil it (Clerodendrum infortunatum) | 0.014 |
| Miliusa dioeca (Roxb.) Caowasku & Kessler | Araceae | 4011 | Thengleng kung | T (St) | Miscellaneous: Firewood | 0.014 |
| Polyalthisia similurum (Buch.-Ham. ex Hook. f. & Thomson) Benth. ex Hook. f. & Thomson | Annonaceae | 5010 | Mengsuri, Kaari | T (St, Ba) | Miscellaneous: Construction (Rope), Firewood, Rongker | 0.014 |
| Hoya verticillata (Vahl) G.Don | Apocynaceae | 6655 | Methan adei | C (L) | Medicine: Loss of hearing (2), Antidote against dog bite (2); Paste: Topical | 0.029 |
| Alstonia scholaris (L.) R. Br. | Apocynaceae | 1088 | Thengnu (Sotian), Thengnu | T (Tw, L, Ba) | Medicine: Jaundice (2), Malaria (12): Paste: Topical; Miscellaneous: Dwi Krali | 0.044 |
| Lasia spinosa (L.) Thwaites | Araceae | 7091 | Sengmora | H (L, I) | Edible: Young leaves and spathe are fried | 0.014 |
| Rhipidophora gauca (Wall.) Schott | Araceae | 1136 | Lolap | C (L) | Edible: Young leaves are boiled; Miscellaneous: Plates | 0.029 |
| Eleutherococcus trifoliatus (L.) S.Y. Hu. | Araliaceae | 1023 | Ingsu so | S (WP) | Miscellaneous: Fence | 0.014 |
| Pinanga gracilis Blume | Arecaeae | 1022 | Koib enlo, Koib ir | T (Fr, L) | Edible: Fruits are eaten raw with beetle leaves; Miscellaneous: Construction (Roofing) | 0.029 |
| Aristolochia assamica D. Borah & T.V. Do | Aristolochiaceae | 3013 | Rui etso/ Pet bix lota | C (Tu) | Medicine: Stomach pain (61), Malaria (54), Dysentry (50), High blood pressure (17), Body pain (12), Urinary tract infections (4), Headache (13), Cough (2); Paste (with Hanthar, Jajur, Rui etpi) are mixed with Porcupines pit to make a tablet of the normal size: Oral | 0.119 |
| Aristolochia saccata Wall. | Aristolochiaceae | 1112 | Rui etpi | C (Tu) | Medicine: Stomach pain (59), Malaria (55) | 0.119 |
| Scientific Name                  | Family             | Common Name | Medicinal Uses                                                                 |
|---------------------------------|--------------------|-------------|--------------------------------------------------------------------------------|
| Dracaena petiolata Hook.f.       | Asparagaceae       | Chorleng    | Miscellaneous: Chujun                                                          |
| Diplazium esculentum (Retz.) Sw. | Aspleniaceae       | Dungkei,    | Edible: Young shoots are boiled                                                 |
|                                  |                    | Dhekia      |                                                                                |
| Acmella paniculata (Wall. ex DC.)| Asteraceae         | Bap suki    | Medicine: Dental infections (28): Applied after chewed: Oral                   |
|                                  |                    | H (Fl)      |                                                                                |
| Chromolaena odorata (L.) R.M.King & H.Rob. | Asteraceae   | Bap jarman  | Medicine: Cut-wounds (62): Paste: Topical                                       |
|                                 |                    | S (L)       |                                                                                |
| Mikania micrantha Kunth          | Asteraceae         | Babro kei,  | Medicine: Cut-wounds (60): Paste: Topical                                       |
|                                 |                    | Mekani Iota, China Iota |                                      |
| Begonia silhetensis (A.DC.) C.B.Clarke | Begoniaceae     | Suat        | Edible: Petioles are eaten as chutney; Medicine: Antidote against stings of wasp and neetle leaves (12): Paste: Topical |
|                                 |                    | H (P, R)    |                                                                                |
| Oroxylum indicum (L.) Kurz       | Bignoniaceae       | Nopak ban   | Edible: Flowers are fried; Medicine: Headache (18): Paste: Topical             |
|                                 |                    | T (Ba, Fl)  |                                                                                |
| Stereospermum chelonoides (L.f.) DC. | Bignoniaceae     | Inghet,    | Miscellaneous: Firewood                                                        |
|                                  |                    | Paroli      |                                                                                |
|                                  |                    | T (St)      |                                                                                |
| Canarium resiniferum Bruce ex King | Burseraceae      | Hijung      | Miscellaneous: Fragrance                                                       |
|                                  |                    | T (Re)      |                                                                                |
| Frema orientalis (L.) Blume      | Cannabaceae        | Rampaat     | Miscellaneous: Construction (Poles)                                            |
|                                 |                    | T (St)      |                                                                                |
| Chloranthus elator Link          | Chloranthaceae     | Jok anseu   | Miscellaneous: Fodder                                                          |
|                                 |                    | S (Tw)      |                                                                                |
| Garcinia xanthochymus Hook.f. ex T.Anderson | Oliaceae    | Phe          | Edible: Fruits are eaten raw; Medicine: Stomach pain (12): Eaten directly: Oral |
|                                  |                      | Thei champre, Thekera tanga |                                      |
|                                  |                      | T (Fr)      |                                                                                |
| Amsichotolype hookeri (Hassk.) H.Hara | Commelinaceae     | Chehe lubor | Miscellaneous: Chujun                                                          |
|                                  |                      | H (WP)      |                                                                                |
| Cheilocostus speciosus (J.Koenig) C.D.Specht | Costaceae    | Ai oppo, Ai eupou | Medicine: Vomiting (4): Paste: Oral                                             |
|                                  |                      | H (Rh)      |                                                                                |
| Solena heterophylla Lour.        | Cucurbitaceae      | Khrai khruk, Khrai khrup Akibi | Edible: Fruits are fried                                                       |
|                                 |                      | C (Fr)      |                                                                                |
| Hodgsonia macrocarpa (Blume) Cogn. | Cucurbitaceae | Han thar    | Edible: Roasted seeds are eaten; Medicine: Malaria (20), Dysentry (23), High blood pressure (18), Body pain (2), Urinary tract infections (2), Headache (12), Cough (2): Paste (with Rui-etso, Jajur, Rui-etpi) are mixed with Porcupines pit to make a tablet of the normal size: Oral |
|                                 |                      | C (Se)      |                                                                                |
| Momordica sp.                    | Cucurbitaceae      | Han pinu,   | Edible: Young leaves are boiled, flower and fruits are fried; Medicine: Swells |
|                                 |                      | Khrai khrut |                                                                                |
|                                 |                      | C (L, Fl, Fr, Se) |                                      |
| Scientific Name | Family | Common Name | Habitat | Uses |
|----------------|--------|-------------|---------|------|
| Dillenia indica L. | Dilleniaceae | Plim plam, Chalta tenga, ou tenga | T (Fr) |
| Tetracera sarmontosa (L.) Vahl | Dilleniaceae | Samphat | C (St) |
| Elaeocarpus rugosus Roxb. ex G.Don | Elaeocarpaceae | Mir choubey | T (St) |
| Sloanea sterculiacea var. assamica (Benth.) Coode | Elaeocarpaceae | Phongrong ke-er | T (St) |
| Sloanea sterculiacea (Fr) | Elaeocarpaceae | Su ik | S (St) |
| Macaranga denticulata (Blume) Müll.Arg. | Euphorbiaceae | Lopoklok, Lobonglong | T (L) |
| Bauhinia variegata L. | Fabaceae | Koina saag/ Kanchan | T (L) |
| Dalhousia bracteata (Roxb.) Benth. | Fabaceae | Lou jongthu | S (L) |
| Bauhinia scandens (L.) | Fabaceae | Sarai lata | C (St) |
| Caesalpinia enneaphylla Roxb. | Fabaceae | Sir hup, Sulu | C (Tw) |
| Castanopsis indica (Roxb. ex Lindl.) A.DC. | Fagaceae | Phongrong kemong | T (L, Se) |
| Castanopsis lanceolata (Oerst.) Hickel & A.Camus | Fagaceae | Phongrong jamphru | T (Tw) |
| Rhynchotechum ellipticum (Wall. ex D.Dietr.) A.DC. | Gesneriaceae | Mehek tarkong | S (L) |
| Gnetum gnemon L. | Gnetaceae | Han thu, Letera, Letra | S (L, I, Se) |
| Molineria crassifolia Baker | Hypoxidaceae | Bati long | H (L) |
| Clerodendrum glandulosum Lindl. | Lamiaceae | Cler klum, Poto saag | S (L) |
| Callicarpa arborea Roxb. | Lamiaceae | Arhi | T (St) |
| Callicarpa vestita Wall. ex C.B.Clarke | Lamiaceae | Arhi kelok | T (Tw) |
| Clerodendrum infortunatum L. | Lamiaceae | Phil it, Phler ik | S (L) |
| Cinnamomum beijolghota (Buch.-Hamm.) Sweet | Lauraceae | Tezpat | T (L) |
| Litsea khaysana Meisn. | Lauraceae | Tingkrong, Pong jatsao | S (Sh) |
| Litsea monopetala (Roxb.) Pers. | Lauraceae | Pongket | T (St) |
| Magnolia hodgsonii (Hook.f. & Thomson) H.Keng | Magnoliaceae | Borhom thart | T (St) |
| Scientific Name | Family | Page No. | Place Name | Part(s) | Uses |
|-----------------|--------|----------|------------|---------|------|
| Pterospermum acenfolium (L.) Wild. | Malvaceae | 2374 | Mukchun | T (St) | Miscellaneous: Construction (Poles), Firewood |
| Sterculia hamiltonii Adelb. | Malvaceae | 3004 | Konkilo | S (Se) | Edible: Seeds are roasted |
| Sterculia villosa Roxb. | Malvaceae | 2570 | Jintekong | T (St, Ba) | Miscellaneous: Construction (Rope), Firewood |
| Phrynium pubinerve Blume | Marantaceae | 2232 | Loru | H (L) | Miscellaneous: Plates |
| Melastoma malabathricum L. | Melastomataceae | 7092 | Bik bik | S (T, Fr) | Edible: Young twigs are boiled, Fruits are eaten raw |
| Parabaena sagittata Miers | Menispermaceae | 3,010 | Han risang, Hangrisai | C (L) | Edible: Young leaves are eaten with pulses |
| Stephanias rotunda | Moraceae | 7082 | Saam kothal, Phong | T (Fr) | Edible: Fruits are eaten raw |
| Artocarpus chama Buch.-Ham. | Moraceae | 4022 | Kempty | S (Fr) | Edible: Fruits are eaten raw |
| Artocarpus lacucha Buch.-Ham. | Moraceae | 4039 | Chiri So | C (L) | Miscellaneous: Dwi Krai |
| Ficus auriculata | Moraceae | 4029 | Han pilu | C (L) | Edible: Young leaves are boiled |
| Ficus hederacea | Moraceae | 4032 | Dampijuk, Dampijuk athe, Letku | S (L, Fr) | Edible: Fruits are eaten raw |
| Musa velutina | Musaceae | 2379 | Lorop | H (WP) | Miscellaneous: Chujun |
| Morus alba (Hook.f.) Warb. | Myrtaceae | 7083 | Han risang, Hangrisai | S (L, Fl) | Miscellaneous: Fire wood |
| Syzygium cumini (L.) Skeels | Myrtaceae | 4019 | Karabeng | T (Fr) | Edible: Fruits are eaten raw |
| Erythrophalum scandens Blume | Olacaceae | 1107 | Han pilu | C (L) | Edible: Young leaves are boiled, Miscellaneous: Plates |
| Lepionurus sylvestris Blume | Opiliaceae | 4032 | Han Botar, Han votar, Rimil ful, Rimil saag | S (L, Fr) | Edible: Leaves and Flowers are boiled |
| Baccaraea ramiflora Lour. | Phyllanthaceae | 3032 | Dampijuk, Dampijuk athe, Letku | T (Fr) | Edible: Fruits are eaten raw |
| Sauropus androgynus (L.) Merr. | Phyllanthaceae | 3026 | Han wot, Munga saag, Jangli Munga | S (L) | Edible: Leaves are boiled |
| Bridelia stipularis (L.) Blume | Phyllanthaceae | 1126 | Thebi e | C (St) | Miscellaneous: Fire wood |
| Phyllanthus assamicus Müll.Arg. | Phyllanthaceae | 1085 | Phongrong su, Tamsir | T (Sh) | Miscellaneous: Fire wood |
| Opismenus burmanni (Retz.) P. Beauv. | Poaceae | 1120 | Tipli | H (WP) | Miscellaneous: Fodder |
| Persicaria hydropiper (L.) Delattre | Polygonaceae | 4022 | None hiru | H (WP) | Miscellaneous: Fishing |
| Persicaria praetemissia (Hook.f.) H.Hara | Polygonaceae | 3035 | Oksimor okpo, Pisol saag, Okhima Rokpo | H (L, Fr) | Edible: Leaves and flowers are boiled, fruits are eaten raw |
| Rhamnus napalensis (Wall.) M.A. Lawson | Rhamnaceae | 1115 | Thengki ik | S (St) | Miscellaneous: Fire wood |
| Rubus buergeri Miq. | Rosaceae | 1032 | Sumohar, Sarpi sarhi | S (Fr) | Edible: Fruits are eaten raw |
| Paederia foetida L. | Rubiaceae | 3012 | Akai nangthu/ Rikang anghu, R. nengho, Padri Lata | C (L) | Medicine: Swells (2): Paste: Topical: Edible: Leaves are fried |
| Mussaenda roxburghii Hook.f. | Rubiaceae | 1120 | Uso bibang, Osopi Ban | S (L) | Edible: Young leaves are boiled |
| Citrus indica Yu.Tanaka | Rutaceae | 7085 | Kamla tenga, Jangli Kamla | S (Fr) | Edible: Fruits are eaten raw |
| Scientific Name | Family     | Code  | Common Name | Use                          | Notes                                                                 |
|-----------------|------------|-------|-------------|------------------------------|----------------------------------------------------------------------|
| Zanthoxylum rhetsa DC. | Rutaceae   | 7094  | Jabrang T (Se) | Edible: Seeds are used as spice |                                                                     |
| Citrus medica L. | Rutaceae   | 4016  | Tumeng, Nimbu tenga S (Fr) | Edible: Fruits are eaten raw |                                                                     |
| Zanthoxylum oxyphyllum Edgew. | Rutaceae   | 3023  | Jajur C (L, R, Ba) | Edible: Leaves are used as spice; Medicine: Malaria (19), Dysentery (21), High blood pressure (13), Body pain (4), Urinary tract infections (2), Headache (7), Cough (2); Paste (with Hanthar, Rui etso, Rui etpi) are mixed with Porcupines pit to make a tablet of the normal size: Oral; Miscellaneous: Fishing | 0.134 |
| Melosma simplicifolia (Roxb.) Walp. | Sabiaceae  | 1038  | Theng kangduk, Thengpi koba T (L) | Edible: Young leaves are boiled |                                                                     |
| Melosma pinnata (Roxb.) Maxim | Sabiaceae  | 3016  | Thengsi kobu, Thengpi koba T (L) | Edible: Young leaves are boiled; Miscellaneous: Dwi Krai | 0.029 |
| Lepisanthes senegalensis (Poir.) Leenh. | Sapindaceae | 5007  | Khranti ek, Thengsu, Bandardima, Jamur, Thekang Tang S (Fr) | Edible: Fruits are eaten raw | 0.014 |
| Picrasma javanica | Simaroubaceae | 5015 | Chabalu T (St) | Miscellaneous: Firewood | 0.014 |
| Smilax aspera L. | Smilacaceae | 1007  | Phri langphung C (L) | Edible: Young leaves are boiled | 0.014 |
| Solanum myriacanthum Dunal | Solanaceae | 3021  | Hipi dua1, Bengna S (R, Fr) | Medicine: Internal injuries (2), Antidote against leech bites (30); Paste, with Kochu (Colocasia sp.)and gul moris (Piper longum); Oral | 0.029 |
| Solanum stramonifolium Jacq. | Solanaceae | 3030  | Theso rongman, Theso kumbang S (Fr) | Edible: Fruits are boiled and made into chutney | 0.014 |
| Dalrymplea pumifera Roxb. | Staphyleaceae | 2391 | Thekejoi T (St) | Miscellaneous: Firewood | 0.014 |
| Pyrenaria khasiana var. lahipmurensis Odyuo & D.K. Roy | Theaceae | 2393  | Jangli chah S (St) | Miscellaneous: Firewood | 0.014 |
| Boehmeria penduillorea Wedd. ex D.G. Long | Urticaceae | 3041  | Seram hou S (L) | Edible: Young leaves are boiled | 0.014 |
| Dendrocnide sinuata (Blume) Chew | Urticaceae | 7086  | Bap kansam, Kuliki, Surat paat S (L) | Edible: Young leaves and flowers are boiled | 0.014 |
| Elatostema parvum (Blume) Blume ex Miq. | Urticaceae | 7089  | Longle mehek H (L) | Edible: Young leaves are eaten with pulses | 0.014 |
| Laportea interrupta (L.) Chew | Urticaceae | 8977  | Termei, Tinipotia H (L) | Edible: Young leaves are boiled | 0.014 |
| Poikilospermum suaveolens (Blume) Merr. | Urticaceae | 1088  | Arlong sirim C (T, L, St) | Edible: Young twigs and leaves are boiled; Miscellaneous: Construction (Rope), The stem cut is used for drinking water | 0.029 |
| Pouzolzia sanguinea (Blume) Merr. | Urticaceae | 1006  | Han thai C (L) | Edible: Young leaves are boiled | 0.014 |
| Alpinia nigra (Gaertn.) Burtt | Zingiberaceae | 7081  | Tara, Tarani, Torani, Bororu H (L, Tw) | Edible: Young shoots are boiled; Miscellaneous: Used in Rongker; | 0.029 |
Table 3. Consensus of agreement on the uses of medicinal plants among informants

| Category of indigenous use                        | Number of use report (Nur) | Number of species (Ns) | Consensus factor (ICF) |
|--------------------------------------------------|-----------------------------|------------------------|------------------------|
| Antidote against dog bite                        | 2                           | 1                      | 1                      |
| Antidote against leech bite                      | 30                          | 1                      | 1                      |
| Antidote against slings of wasp and nettle leaves| 12                          | 1                      | 1                      |
| Blood dysentery                                  | 10                          | 1                      | 1                      |
| Body pain                                        | 30                          | 4                      | 0.896                  |
| Cough                                            | 8                           | 4                      | 0.571                  |
| Cuts-wounds                                      | 64                          | 4                      | 0.952                  |
| Dental infections                                | 60                          | 2                      | 0.983                  |
| Dysentery                                        | 55                          | 5                      | 0.925                  |
| Headache                                         | 30                          | 5                      | 0.862                  |
| High blood pressure                              | 65                          | 6                      | 0.921                  |
| Internal injuries                                | 2                           | 1                      | 1                      |
| Jaundice                                         | 2                           | 1                      | 1                      |
| Loss of hearing                                  | 2                           | 1                      | 1                      |
| Malaria                                          | 57                          | 5                      | 0.928                  |
| Stomach pain                                     | 62                          | 3                      | 0.967                  |
| Swells                                           | 4                           | 2                      | 0.666                  |
| Urinary tract infections                         | 12                          | 4                      | 0.727                  |
| Vomiting                                         | 4                           | 1                      | 1                      |

Table 4. Fidelity level (FL %) of frequently cited plant species with major uses

| Botanical name                                  | Categories                  | Citation for particular disease (use report) | Fidelity level (%) |
|-------------------------------------------------|-----------------------------|---------------------------------------------|--------------------|
| Clerodendrum colebrookeanum                      | High blood Pressure         | 65                                          | 97                 |
| Chromolaena odorata                             | Cut-wounds                  | 62                                          | 92                 |
| Aristolochia assamica                           | Stomach pain                | 61                                          | 91                 |
| Croton caudatus                                 | Dental infections           | 59                                          | 88                 |
| Solanum myriacanthum                            | Antidote against leech bite | 55                                          | 82                 |
| Aristolochia cathcartii                         | Malaria                     | 55                                          | 82                 |
| Aristolochia assamica                           | Dysentery                   | 50                                          | 74                 |

Traditional medicine

Traditional medicine plays an important role in the forest fringe communities of BRF. But due to the quick access to modern health facilities provided by the government lately, the reliance on traditional medicine is seen to be diminishing for any forest community. Hence, the number of plants reported to be used as medicine as well as people’s knowledge on it is low as compared to other studies conducted on the Karbi’s of Karbi-Anglong district of Assam (Mipun et al. 2019). Among the 23 reported ethnomedicinal plants, 14 (Alstonia scholaris, Aristolochia assamica, Aristolochia cathcartii, Begonia silletensis, Clerodendrum colebrookeanum, Croton caudatus, Dillenia indica, Garcinia xanthochymus, Gnetum gnomon, Hoya verticillata, Momordica sp., Phlogacanthus curviflorus, Solanum myriacanthum, Zanthoxylum oxyphyllum) were new ethnobotanical records for the Karbi community (Terangpi et al. 2014, Mipun et al. 2019, Teron 2019), which might be due to the isolation of the tribal population in different pockets of the region.

The study on such traditional knowledge by the indigenous communities in different geographical zone can serve as a base line research for many new discoveries of important drugs (Shakya 2016). Furthermore, such new and continuous study can improve and help survive the concept of traditional knowledge, which is under threat, and its protection.
is the need of the hour. The factors that pose threat on the survival of traditional communities and knowledge are commercialization of biodiversity, disruption of the interrelationship between traditional knowledge generators and their resources, industrialization and many more (Bala 2011). Moreover, lack of documentation of traditional knowledge and non-technical documentation also leads to bio piracy.

Plants used in other uses
The people’s daily dependency on the forest can be mainly seen in terms of firewood. Generally, firewood are collected from the dominant trees in the accessible areas, such as Borhom thari (Magnolia hodgsonii), Chabalu (Picrasma javanica), Inghet (Stereospermum chelonoideus), Jangli Chah (Pyrenaria khasiana var. fakhimpurensis), etc. Plants which are rare in the forest are sparsely collected and find no names in their dialect.

Community fishing was known to be a favorite game and time pass for the locals in off seasons and is known to be a part and parcel of life apart from agriculture (Yunnam & Tripathi 2013). Apart from using nets and other modern techniques, some of the tribal populations were still seen using the indigenous techniques for fishing. In the present study, two plants have been reported to be used: whole plants of Nune hiru (Persicaria hydropiper) and bark of Jajur (Zanthoxylum oxyphyllum). They are smashed and spread in blocked rivulet, and the fishes are either stupefied or killed in response. These environmentally friendly techniques are seen to be lost in due time.

Even two species of lianas Samphat (Tetracera sarmentosa) and Arlong Sirim (Poikilospermum suaveolens) were used to drink water within the dense forests, where there is no other water source. Cuts are made and then the water within them is used as they are believed to be pure. Spiny plants such as Ingsu-so (Eleutherococcus trifoliatus var. trifoliatus) are used as fence, which is quite evident.

Plants used in Rituals and Festivals
The Karbi’s of BRF celebrates many festivals and rituals in accordance to their customs. Even this isolated population from the mainland stock maintain the original fragrance of their rites. Rongker, Chujun, Arnam Pharo, Dwi Krai and Chomangkan are some of them. Most of their rituals are related to elimination of the evil spirits in a single household or for the community. Rongker celebrated in the month of December is a community festival. Whereas, Chujun (Figure 2C) and Chomangkan (Death ceremony) are hosted by a single family, and the whole community participates. Arnam Pharo (Figure 2B) and Dwi Krai, on the other hand, are restricted within few individuals of the family. The importance of plants in these rituals are manifold, either the ones procured from the wild or the household commons. Plants of Fagaceae, Zingiberaceae, Poaceae and Piperaceae are found to be common in used for religious festivals and offerings by different communities of the Northeast (Nongbri et al. 2017).

Knowledge of the Karbi and the Munda on medicinal plant uses and its quantitative analysis
In the Karbi and the Munda, almost every family have a rich traditional knowledge on the use of medicinal plant species due to remoteness. The knowledge of traditional medicinal plants of these two groups was similar and most of the medicinal plant species reported were used to treat the prevalent diseases. Thus, the two group not only share the ecological area but are living in a symbiotic relation. Data obtained using quantitative based studies have shown the significance of these plants among the tribes. The plants (Aristolochia assamica, Aristolochia cathcartii, Hodgsonia macrocarpa and Zanthoxylum oxyphyllum) with the highest UV are considered most important for the local people due to their multiple use reports and are therefore specifically conserved (Albuquerque 2006). The ICF value for each of the 20 ailment categories ranged from 0.57 to 1.00. Categories like antidote against dog bite, leech bite, stings of wasp and nettle leaves, blood dysentery, vomiting, internal injuries, jaundice and loss of hearing shows ICF value of 1. It is because only one species for each category were used by the respondents. The plants associated with higher ICF value of ≥0.80 (Aristolochia assamica, Aristolochia cathcartii, Chromolaena odorata, Clerodendrum infortunatum, Croton caudatus, Mikania micrantha, Solanum myriacanthum, etc.) are mostly used by both the communities, suggesting that they have diverse and useful medicinal plants within the particular locality for treating different ailments (Solomon 2016). Most of the respondents used specific species for particular ailments as shown by the seven species having FL above 70%. The variation in ICF value and high value of FL suggests that though the local people have access to government health care system, for common ailments, they tend to use traditional medicine and traditional medicinal plants have not lost their values among the local people (Bibi et al. 2014).

For plants with high ICF and FL value such as Clerodendrum celebrookeanum, Chromolaena odorata, Aristolochia assamica, Croton caudatus, Solanum myriacanthum, Aristolochia cathcartii, etc., phytochemical investigations and nutritive analysis need to validate their uses as traditional medicines and to check their bioactive constituents. This type of
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Studies could potentially guide the development of new nutraceutical products and broaden the scope of bioprospecting in the future (Shaanker 2004, Ong & Kim 2014).

In fact, the number of NTFP’s reported here is far more when compared to the Garo hills of Meghalaya, 50 species (Sangma & Lahnundanga 2019), Namdapha National Park, Arunachal Pradesh, 63 species (Sarmah 2010), Cachar district, Assam, 67 species (Dattagupta et al. 2014), East Siang district, Arunachal Pradesh, 34 species (Kumar et al. 2015), Sonitpur district, Assam, 40 species (Sarma et al. 2016) and slightly less than Jaldapara Wildlife Sanctuary of West Bengal, 132 species, Pandit et al. 2004, Ziro valley, Arunachal Pradesh, 112 species, (Jha 2015), Buxa Tiger Reserve, West Bengal, 112 species, (Sarkar & Das 2015).

Figure 2. A- Landscape of Behali Reserve Forest; B- Amam Pharo; C- Chujun; D- Preparation of Gnetum gnemon, in Rongker; E,F,G- Key respondents; H. Aristolochia cathcartii; I. Aristolochia assamica; J. Strobilanthes paniculiformis; K. Citrus indica; L. Monoon simiarum “Mengsuri”.

Threats status of some plants and guidance to sustainable forest management

The people are seen to use the common species more, probably due to their high availability, and wide occurrence. Among the reported plants, only nine plants were accessed by IUCN (2020), among which (Alstonia scholaris, Diplazium esculentum, Bauhinia variegata, Gnetum gnemon (Figure 2D), Cinnamomum bejolghota, Baccarea ramillora, Persicaria hydropiper and Rhamnus napalensis) are listed as least concern, and Eleocarpus rugosus as vulnerable. Among the collected ones, some species were found to be rare in BRF such as Aristolochia assamica (Figure 2I), Hodgsonia macrocarpa, Artocarpus chama, Zanthoxylum rhetsa and Citrus indica (Figure 2K). The current population shows significant decline in BRF which may be perhaps due to unregulated collection and exploitation. Some conservative measures are being taken for these plants, starting with studying the population structure (Borah et al. 2018), conducting awareness programmes in those selected villages to aware the present and the future scenario of those plant species to the villagers by referring the local name of the plants and later towards germination and in situ approaches.
Conclusions
With an ever-increasing population, the demand for forest products is at a rise due to the collection of NTFPs and timber, leading to loss of biodiversity and threatening the native endemic and threatened flora. Anthropogenic activities such as construction of roads, cutting of forests for jhum (shifting) cultivation, natural calamities like landslides etc., were observed to be serious threats to native biodiversity. It is recommended to provide skill development trainings and financial support for the installation of renewable and alternative energy technologies to minimize the use of forest resources in BRF for better forest sustainability.

Declarations
List of abbreviations: NTFP-Non-timber forest products; BRF-Behali Reserve Forest.
Ethical approval and consent to participate: The necessary permissions to conduct this study was provided by the forest department of Assam as well as the village heads of the respective villages. Written consents were obtained from all the respondents during the interview process.
Consent for publication: Not applicable.
Conflict of interests: The authors declare that they have no conflict of interests.
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Authors’ contributions: DB and AU participated in data collection; ST and APD participated in drafting the manuscript. PM analyzed the data using quantitative approaches. All the authors approved the final version of the manuscript.

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Literature cited
Ahenkan A, Boon E. 2011. Non-timber forest products (NTFPs): clearing the confusion in semantics. Journal of Human Ecology 33:1-9.
Albuquerque UP, Hanazaki N. 2009. Commentary: Five problems in current ethnobotanical research and some suggestions for strengthening them. Human Ecology 37:653-661.
Albuquerque UP, Lucena RFP, Monteiro JM, Florentino ATN, Almeida CFCBR. 2006. Evaluating two quantitative ethnobotanical techniques. Ethnobotany Research and Applications 4:5160.
Alexiades MN, Sheldon JW. 1996. Selected guidelines for ethnobotanical research: a field manual, New York Botanical Garden, New York, United States.
Bala A. 2011. Traditional Knowledge and Intellectual Property Rights: An Indian Perspective. http://dx.doi.org/10.2139/ssrn.1954924
Balick MJ, Cox PA. 1996. Plants, People, and Culture, New York, Freeman, New York, United States.
Bibi T, Ahmad M, Tareen BR, Tareen MN, Jabeen R, Rehman US, Sultanaa S, Zafara M, Yaseena G. 2014. Ethnobotany of medicinal plants in district Mastung of Balochistan province Pakistan. Journal of Ethnopharmacology 157:79-89.
Borah D, Kafley P, Tangjiang S, Das AP, Population structure and conservation of endangered Citrus indica Yu. Tanaka (Rutaceae) in Behali Reserve Forest of Assam, India, Pleione, 12 (2018) 181-186.
Chamberlain JL, Hammett AL. 2002. Non-timber forest products: alternatives for landowners. Forest Landowner 61:16-18.
Champion SH, Seth SK. 1968. A revised survey of the forest types of India. Manager of Publications, Delhi, India.
Chandrasekharan C. 1995. Terminology, definition and classification of forest products other than wood. In Report of the International Expert Consultation on Non-Wood Forest Products. Yogyakarta, Indonesia 17-25 January. FAO NWFP Series No.3, pp. 345-380. Rome, Food and Agriculture Organization of the United Nations.
Cocksedge W. 2006. Incorporating non-timber forest products into sustainable resource management: an overview for resource managers. Royal Roads University, Victoria, Seychelles.
Dattagupta S, Gupta A, Ghose M. 2014. Diversity of non-timber forest products in Cachar District, Assam, India. Journal of Forestry Research 25:463–470.
Dattagupta S, Gupta A, Ghose M. 2010. Non-Timber Forest Products of the Inner Line Reserve Forest, Cachar, Assam, India: dependency and usage pattern of forest dwellers. Assam, University Journal of Science and Technology: Biological and Environmental Sciences 6:21–27.
De Beer JH, McDermott M. 1989. The Economic Value of Non-Timber Forest Products in South-East Asia. Amsterdam, the Netherlands Committee for IUCN.
Grivins M. 2016. A comparative study of the legal and grey wild product supply chains. Journal of Rural Studies 45:66-75.

Hooker JD. 1872–1897. The Flora of British India. I-VII. L. Reeve and Company, London, England.

Hossain U, Rahman OM. 2018. Ethnobotanical uses and informant consensus factor of medicinal plants in Barisal District, Bangladesh. Bangladesh Journal of Plant Taxonomy 25:241-255.

IUCN. 2020. The IUCN Red List of Threatened Species, Version 2019-3. Accessed on 21 October 2019.

Jain SK, Rao RR. 1977. A handbook of field and herbarium methods. Today & Tomorrow’s Printers & Publishers, New Delhi, 107 pp.

Jha KK. 2015. Non-timber Forest Products, Their Vulnerability and Conservation in a Designated UNESCO Heritage Site of Arunachal Pradesh, India. Notulae Scientia Biologicae 7:444-455.

Kanjilal VN, Kanjilal PC, Das A, De RN, Bor NL. 1934-1940. Flora of Assam, I- V. Government Press, Shillong, India.

Kumar N, Kumar S, Singh B, Mishra BP, Singh B, Singh V. 2015. Traditional practices of utilization and conservation of non-wood forest products by Adi tribes of Arunachal Pradesh. Journal of Applied and Natural Science 7:111-118.

Leßmeister A, Heubach K, Lykke AM, Thiombiano A, Wittig R, Hahn K. 2016. The contribution of non-timber forest products (NTFPs) to rural household revenues in two villages in southeast Burkin Faso. Agroforestry Systems 92:139-155.

Martin GJ. 1995. Ethnobotany:a methods manual, Earthscan, London, England.

Martinez R. 2004. Non-timber forest products in Colombia:review of constraints for effective commercialization. School of Natural and Rural Systems Management, University of Queensland, Brisbane, Australia.

Mipun P, Bhat NA, Borah D, Kumar Y. 2019. Non-timber forest products and their contribution to healthcare and livelihood security among the Karbi tribe in Northeast India. Ecological Processes 8:1-21.

Nongbri E, Borthakur SK, Bokolial D. 2017. Plants Associated with Rituals and Beliefs of Indigenous Khasi Religion of Meghalaya, North-East India. Advances in Plant Sciences 30:1-4.

Ong GH, Kim DY. 2014. Quantitative ethnobotanical study of the medicinal plants used by the Ati Negrito indigenous group in Guimaras island, Philippines. Journal of Ethnopharmacology 157:228-242.

Pandit BH, Shrestha KK, Bhattarai SS. 2014. Sustainable Local Livelihoods through Enhancing Agroforestry Systems in Nepal. Journal of Forest and Livelihood 12:47-63.

Pandit PK, Ghosh C, Das AP. 2004. Non-timber forest products of Jaldapara Wildlife Sanctuary:An assessment. Indian Forester 130:1169-1185.

Paul A, Khan ML, Arunachalam A & Arunachalam K. Biodiversity and conservation of rhododendrons in Arunachal Pradesh in the Indo-Burma biodiversity hotspot, Current Science, 89 (2005):623-634.

POWO. 2019. Plants of the World Online. Royal Botanic Gardens, Kew. Available from:https://www.plantsoftheworldonline.org/ (accessed 12 January 2020).

Pradhan BK, Badola HK. 2008. Ethnomedicinal plant use by Lepcha tribe of Dzoungu valley, bordering Khaschendzonga Biosphere Reserve, in North Sikkim, India. Journal of Ethnobiology and Ethnomedicine 4:1-18.

Pradhan P, Singh M. 2019. Role of Non-Timber forest products (NTFP’s) in sustaining forest based livelihoods:a case study of Ribdi village of Sikkim, India. Indian Journal of Traditional knowledge 18:595-609.

Reyes-García V, Huanca T, Vadez V, Leonard W, Wilkie D. 2006. Cultural, practical, and economic value of wild plants:a quantitative study in the Bolivian Amazon. Economic Botany 60:62-74.

Saikia A, Borah MP, Sarmah R, Kutum A. 2017. Non-Timber Forest Products (NTFPs) and their Role in Livelihood Economy of the Tribal People in Upper Brahmaputra Valley, Assam, India. Research & Reviews:Journal of Botanical Sciences 6:24-28.

Singma AJT, Lainundanga. 2019. Non-timber forest products (NTFPs) used by Garo tribe of Rongram block in West Garo Hills, Meghalaya. Indian Journal of Traditional Knowledge 18:151-161.

Sarkar A, Das AP. 2015. Subsistence use of floral elements in Jainti under Buxa Tiger Reserve in West Bengal, India. Pleione 9:301-310.

Sarma J, Devi A, Sarma GC. 2016. Exploration of Non-Timber Forest Produces (NTFPs) used by the Mishing community in Sonitpur district of Assam, India. Pleione 10:23-31.

Sarma PK, Borah R, Upadhaya S, Dutta S, Mahanta G. 2009. A handbook of Behali Reserved Forest. Nature’s Bonyopran, Assam, 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.

Shaanker RU, Ganeshia KN, Krishnan S, Ramya R, Meera C, Aravind NA, Kumar A, Rao D, Vanaraj G, Ramachandra J, Gauthier R, Ghazoul J, Poole N, Reddy BVC. 2004. Livelihood gain and ecological cost of non-timber forest product dependence: assessing the roles of dependence, ecological knowledge and market structure in three contrasting human and ecological settings in South India. Environmental Conservation 31:242-253.

Shakya AK. 2016. Medicinal plants: Future source of new drugs. International Journal of Herbal Medicine 4:59-64.

Solomon MM. 2016. Importance of Non-timber Forest Production in Sustainable Forest Management and Its Implication on Carbon Storage and Biodiversity Conservation in Case of Ethiopia. Journal of Biodiversity and Endangered Species 4:160.

Sunderlin WD, Ba HT. 2005. Poverty alleviation and forests in Vietnam. In Poverty Alleviation & Forests in Vietnam, CIFOR:Hanoi, Vietnam.

Terangpi R, Basumatay TK, Teron R. 2014. Ethnomedicinal plants of the Karbi ethnic group in Assam state (India) for management of gynaecological disorders. International Journal of Pharmacy & Life Sciences 5:3910-3916.

Terangpi R, Enttipi U, Teron R. 2013. Utilization of less known plants, Gnetum gnemon L. and Rhynchotechum ellipticum (Dietr.) A.DC. among the Karbis, Northeast India. Journal of Scientific and Innovative Research 2:943-949.

Teron R. 2019. Cross-Cultural Ethnobotanical Exploration of Diversity and Utilization of Medicinal Plants in Karbi Anglong District, Assam, Northeast India. NeBio 10:35-46.

Trotter RT, Logan MH. 1986. Informant census: a new approach for identifying potentially effective medicinal plants. In: Etkin LN (ed) Plants in indigenous medicine and diet, Redgrave, Bedford Hill, New York, United States.

Uddin ZM, Hassan MA. 2014. Determination of informant consensus factor of ethnomedicinal plants used in Kalenga forest, Bangladesh. Bangladesh Journal of Plant Taxonomy 21:83-91.

Upadhaya SA. 2016-17. Atobi, a souvenir published on the occasion of the centenary celebration of Behali Reserved forest. Nature’s Bonyopran, Assam, India.