Diversity, Utilization and Dependency on NTFPs – A case study of a National Park in Indian sub-Himalayan Region

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Research

Keywords: Jaldapara National Park, Foot hills of Himalayas, Marketing, Wild Product

Posted Date: March 18th, 2021

DOI: https://doi.org/10.21203/rs.3.rs-306921/v1

Abstract

Background: Non timber forest products (NTFPs) greatly contribute to livelihood, development, and poverty alleviation of indigenous and rural communities across the tropics. We also assumed that the fringe communities inhabiting Jaldapara National Park (JNP) of Indian eastern sub-Himalayan region largely rely on the NTFPs for their livelihood due to its remote and isolated location with no physical infrastructure and facilities.

Methodology: Multistage sampling technique was used for the study. The sample size was 205 households selected randomly from a sample frame of 10 villages. Descriptive statistics was employed to analyze and summarize the data.

Results: A total of 146 NTFP species was documented. The communities in our study area also relied on their NTFP collection/harvest for food, medicine, firewood, animal fodder, and other socio-cultural items for household use and cash income. Income from NTFPs contributed on an average 45 % of the total annual household income of the sampled households.

Conclusion: NTFPs provided a natural insurance to households especially during the periods of scarcity. Focused interventions with technical and financial support are recommended to uplift the livelihood of the forest fringe indigenous communities in JNP.

Introduction

A large proportion of global population especially the indigenous/forest fringe and rural communities directly or indirectly depend upon forests for their livelihood (Shukla and Chakravarty, 2012; Endamana et al., 2016; Verma and Paul, 2016; Suleiman et al., 2017). Non timber forest products (NTFPs) along with tradition of plants based knowledge is distributed among the vast number of indigenous and rural communities (Myers and Mittermeier, 2000; Siva, 2007). NTFPs provide natural insurance against hunger and malnutrition during scarcity and even during famines (Endamana et al., 2016). NTFPs are thus vital for the social development of the indigenous/forest fringe and rural communities (Endamana et al. 2013).

The dependency of the indigenous forest and rural people on NTFP continues till today because of their poor economic conditions and non-empowerment towards socio-economic development (Alex et al., 2016). Unfortunately till now there are no serious efforts to analyze the revenue generated for neither livelihood through NTFPs nor any standard system of accounting its contribution towards household income exist (Endamana et al., 2016). Normally, NTFPs traded in markets are documented in studies or in accounting exercises but no such exercise have been made to record the domestic or non-commercial consumptions. Moreover, the traditional knowledge pertaining to NTFPs and its utilization is gradually eroding through acculturation and the loss of plant biodiversity along with indigenous people and their cultural background due to modernization and unsustainable development (Suresh et al., 2013, 2014; Bose et al., 2015). Awareness, research and education are needed to protect this diminishing knowledge

of NTFPs and conserve bioresources for benefits of our future generation (O'Neill et al., 2017). Fortunately enough the potential role of NTFPs in poverty alleviation and sustainable development is now recognized globally and academic efforts to analyse its economic role is increasing (Wunder et al., 2014).

The survival of indigenous and other communities in the Himalayas and its foothill is also based on collection, utilization and selling NTFPs (Shukla and Chakravarty, 2012; Biswakarma et al., 2015; Sarkar et al., 2015; Raj et al., 2018) and indigenous communities inhabiting Jaldapara National Park (JNP) is no exception (Bose et al., 2015). Unfortunately, the traditional knowledge on utilization of these natural resources is now mostly restricted to the older generation in this forest community also (Bose et al., 2015). The present study was conducted to generate information required for conservation and sustainable utilization of local NTFPs resources and which can also contribute to preserve cultural and genetic diversity. The present day strategy for societal development program is to incorporate traditional items like NTFPs into local livelihood improvement system (Jeyaprakash et al., 2011). The national governments of many developing countries are now promoting the NTFPs-based activities as a developmental strategy for uplifting and empowering the rural and indigenous communities. With this view the present study was conducted to documentation of NTPFs, use pattern and process of utilization among the fringe communities of JNP.

Methods And Materials

Study area

JNP is a part of Himalayan Biodiversity Hotspot (Myers and Mittermeier, 2000). It is situated on the foothills of the eastern Himalayas, India (Das et al., 2003). The park is mainly savannah containing giant grasses along with mixed deciduous, wet monsoon, tropical moist deciduous, tropical semi-evergreen and riverine forests (Champion and Seth, 1968). The region is sub-tropical receiving average annual rainfall of 250-300 cm from south-west monsoon of which 80 % is received from June to August. The summer and winter temperature are mild with 34°C as the highest in the month of May while the lowest temperature is 7.5°C in the month of January. The study area as measured by GPS was in between 25^0 58′ N and 27^0 45′ N latitude and 89^0 08' E and 89^0 55' E longitudes with elevation of 47 m above mean sea level.

The forest is inhabited by divergent Indo-Mongoloid communities of Mech, Ravas, Totos, Uraons, Tamang, Toppo, Lepcha, Rajbangsi and Mundas making it bioculturally diverse with varied socio-economic conditions. These indigenous people are permanently settled in and around the National Park. Each indigenous community has their own distinct culture and beliefs (www.alipuarduar.gov.in). The primary livelihood activity of these communities is subsistence farming and NTFPs collection. Their standing crop is frequently decimated by wild elephants. Further the habitations are remotely located and isolated with no physical infrastructure and facilities like limited accessibility by good roads, making the whole area underdeveloped. The inhabitants of the area thus depend on NTFPs to meet their income and

daily needs. The forest resources are locally managed by Forest Protection Committees under Joint Forest Management Scheme controlled by the State Forest Department (Pandey et al., 2011).

Sampling procedure

Multistage sampling procedures were applied in this study. JNP and the villages were selected purposively while the respondents were selected randomly. The selection of the study area was purposive because it is a National Park important for its Rhinoceros conservation and inhabited by the indigenous communities depending on it for NTFP resources. The villages were located in the designated forest area and are termed as Forest villages. The Indian Forest Act permits the inhabitants of these villages access and resource use rights over collection of NTFPs from the park as the country is a signatory of the United Nation Convention on Biological Diversity of 1992 (CBD 1992). Major ten villages located in and around the National Park which has more than 50 households were also selected purposively and from the each village, one tenth of the total households (205) were randomly selected (Lepcha et al., 2018).

Data collection

The data were collected from the sampled households by the lead author assisted by a trained enumerator with the help a pre-tested structured questionnaire through personal interviews and focus group discussions (FGD) guided by a checklist of questions (Frechtling et al., 1997; Dey et al., 2017$_{a, b}$). The questionnaire was pre-tested for elimination, addition and alteration with non-sample respondents of the study area. In pre-testing, care was taken not to include respondents who were selected as sample for final interview. On the basis of experiences in pre-testing, appropriate changes in the construction of item and their sequence were made. Prior to starting the interviews, a few days were devoted in each selected village to establish rapport with the respondents. The questionnaire was administered to the respondent in local language and the responses were recorded in English. On the basis of the objectives of study, questionnaire was designed with two sections. The first section was on socio-economic attributes of the respondents like literacy, occupation and total monthly household income, while the second section was on collection and utilization including processing of NTFPs, value of NTFPs consumed and sold by the households and contribution of NTFPs to total monthly household income.

Occupation indicates the economic activity of a household and thus is a source of income. We hypothesised that as our study villages are remotely located and isolated with no or very little basic infrastructure facilities, there will be limited or no livelihood options except dependency on its forest resources or subsistence farming as was also reported in earlier studies (Daneji and Suleiman, 2011).The limitations of our study area mentioned above also lead us to hypothesize that the inhabitants will be mostly illiterate and thus will have no other livelihood options except for relying on subsistence farming or on its forest resources. Studies have shown that education results in lesser dependency on forest or farming activity and more inclination towards alternative employment opportunities (Newton et al., 2016). Our last hypothesis was that the study area would have very low or marginal total household monthly income because of illiteracy and limited livelihood options rendering the inhabitants with no other

livelihood options other than to depend on subsistence farming and NTFP collection from the forest (Vedeld et al., 2004).

Generally, head of the household was taken as the respondent. The society of the study area is patriarchal, so the husband is the head of the family. In case when the husband is absent the wife, eldest son, or the daughter was interviewed on behalf of the head. A total of 10 FGDs were conducted, one in each selected village. There were about 15-20 participants in the discussions which included the village chief, senior citizens of the village, some prominent NTFP collectors, members of Forest protection committee and representative of State Forest Department. The information gathered from these discussions supplemented the household surveys which were finally used for interpretations of the results.

Data analysis

Data collected were statistically analysed using descriptive technique (frequency, percent and bar chart). We classified our respondents as literates and illiterates. According to Indian standards a person who has only basic ‘3Rs’ knowledge i.e. can read and write his/her name and can perform simple arithmetic is literate and otherwise not. Literacy of the respondents is expressed as per cent of total respondents. Monthly total household income is calculated as the sum total of income a household was earning from different sources (if any). Generally the total household income (THI) is summation of agricultural (AI), non-agricultural (NAI) and forest income (FI) or THI = AI + NAI + FI (Endamana et al., 2016). The households were classified as low, medium and high income group (Kochhar, 2015) based on their total monthly household income and then expressed as per cent of total respondents. USD to Indian rupee exchange rate during the study period was USD1 = INR60.

Results

Socio-economic attributes

The main occupation of the indigenous communities of the sampled villages in and around JNP is subsistence farming and collecting/harvesting of NTFPs supplemented with some temporary activities like daily paid manual labour or petty business. According to our classification made on the basis of total monthly household income there was only two income groups. Almost all the respondents i.e. 95.33 % were in low income group living on USD 2-10 daily and rest were in medium income group living on 10-20 USD daily. The contribution of NTFP towards total monthly household income varied widely in the range of 1-70 % with an average of 45 %. Around 60 % of the respondents in the study area were literate; atleast had spent two years in formal education and had the tendency to search for an alternate occupation other than farming or collecting NTFP.

NTFPs diversity/richness

Documented NTFPs were listed as plant, fungus and animal origin. A total of 146 NTFP species representing 126 genera and 76 families were documented which were used by the indigenous communities of JNP (fig. 1; table 1). Of these documented species, 95 species were collected from wild, 24 species were cultivated and 27 were either collected from wild or cultivated (table 1). Out of these documented NTFP species, 125 were plants, 14 animals and seven fungi. Among the plants, trees dominated the list with 70 species, herbs 32 species, shrubs 16 species and climbers the least with seven species. Fishes with 13 species dominated the list of animals with one species of honeybee. Family Fabaceae among plants dominated the list with six species and six genera followed by Euphorbiaceae and Malvaceae each with five genera and five species. In animals, family Cyprinidae dominated with five genera and five species. In fungus, Pleurotaceae and Lyophyllaceae dominated with two species each.

Part Used, Harvesting Pattern and Time

Plant parts of NTFPs used by the indigenous communities of JNP and their mode of harvesting and utilization pattern is presented in table 1 and fig. 2. It was recorded that leaves/foliage were the most used plant part harvested/collected from 70 species, followed by fruits of 36 species, branches of 30 species, barks of 23 species, roots & rhizome of 21 species, flowers of 17 species, seeds of 16 species and shoots, twigs & tender stem of 10 species. Latex and resin were extracted from three plant species. More than 60 % of the documented NTFP species were collected or harvested throughout the year and prominent among these is fuelwood. About 25 % species were collected or harvested during the rainy season which includes fodder, wild vegetable, medicinal plants, mushroom, honey and fish. Fourteen species were collected or harvested during winter season and rest of the species were collected or harvested during the summer season. Generally leaves were harvested during the profuse growth period of plant i.e. rainy season, which included fodder and leafy vegetable.

Utilization

The various uses of the NTFP species are medicine, food, fruit, vegetables, spice, fodder, fuelwood, decoration/ craft, fencing, religious purpose as well as for construction, agriculture implements, soap/shampoo, rope, furniture, plate and mosquito repellent (table-1; fig. 4). Maximum number of species was documented with single use (75 species) and *Mangifera indica* is used for six uses.

Medicine

Maximum number of 73 species were documented for medicinal purposes, of these 28 species had only medicinal use (table 1). Medicine was also the prime use for rest of the species along with another two or more uses. The important species used as medicine are *Acacia catechu*, *Azadirachta indica, Aegle marmelos*, *Artocarpus lakoocha*, *Bauhinia malabarica*, *Bauhinia purpurea*, *Bombax ceiba*, *Castanopsis indica*, *Oroxylum indicum*, *Syzygium cuminii*, *Terminalia chebula*, *Terminalia bellerica*, *Trewia nudiflora* and *Ziziphus mauritiana* which were usually administered against bleeding, urine infection, indigestion/stomach disorder, diarrhoea/dysentery, diabetes, ulcer, gastroenteritis, rheumatism, fever, control body temperature, skin disease, allergy, stomach pain, jaundice, cuts/wound, could, cough,

vomiting, nausea and blood pressure. *Azadirachta indica* was used round the year for treating various diseases like eye infection, allergy, skin infection and also used as tooth stick. *Oroxylum indicum* is also used round the year to control jaundice and blood pressure.

The indigenous communities of JNP were rich in ethnopharmacological knowledge to properly use NTFPs. A total of 49 diseases/ailments were cured with the help of locally available plant resources. Fever, cough and cold were documented as most common disease suffered by the community. For remedy the community used 12 different plant species. Other common disease was dysentery and 10 plant species were used for its treatment. Skin and stomach problem was treated with eight and seven species, respectively. Diabetes, vomiting and diarrhoea were treated with five species each, while four species each were used for treating indigestion, mouth ulcer, rheumatism and blood pressure. Similarly, three species each were used to treat asthma and allergy while two species each were used as remedy for urine infection, jaundice, kidney problem, heart problem, eye problem and burn.

Diseases/ailments like cut, wound, snake bite, fracture, swelling/pain, body pain, arthritis, pneumonia, loss of appetite, liver aliments, stomach worm, cholera, gastroenteritis, ring worm, boil, sexual disorder, hypertension, conjunctivitis, tooth pain, small pox, reducing weight, leprosy, bleeding control, cystitis, hiccup and nerve disorder were each treated with single species. Young twigs of *Azadirachta indica* and *Pongamia pinnata* are used for dental care. Honey secreted by Trigona spp. is mixed with black pepper powder and consumed for relief against cold and cough. Even mouth disease of domestic animal was documented to be treated and *Ficus racemosa* was used for it.

Proper selection of species, parts, as well as preparation and administration methods were given very important in traditional health care systems. Generally fresh part of the plant is used for the preparation of medicine except for the underground parts which were used in dried form. Ethnomedicinal formulations were administered both externally (skin, nasal, eye and dental) and internally as oral doses. Most of the preparations were mixture of different plant species and in few cases only one plant species was used. Different parts of a single species were also used to cure different diseases. Almost all plant parts were used to prepare different medicinal formulations: roots, rhizomes, tubers, bark, leaves, flowers, fruit, seeds, young shoots, whole plants, and gum and latex. Doses of these preparations were not standardized but administered on the basis of age, physical appearance and intensity of the illness. Children were usually administered with smaller doses than adult. The course of frequency of treatment is decided by the type of disease and its severity. The majority of formulations were prepared as juice followed by paste and decoction. Mode of preparation included juice, paste, decoction, powder, infusion, and chewing raw plant parts. The administration of the therapy is raw, dried form in small pieces or powdered, solution or mixed with water/milk/honey and paste/lotion. The preference for roots and rhizomes were preferred to prepare traditional remedies.

Food and nutrition

Many plant, animal and fungus based NTFPs were collected by the indigenous communities from JNP for food and nutrition (table 1). Plant based resources used for food and nutrition was represented by 42

species. Animal based resources used for food were represented by fish with 13 species and a honey bee species. Fruiting bodies of seven species of fungus were also used as food. Among the plant resources more than 50 % of species were used as vegetable and fruits. Honey and fungus collected was mostly used for food and medicine purposes. All the mushrooms were used for culinary purposes and sometimes as snacks and value added to pickle as well. Fish supplements protein in the diets of the collectors. Leaves/foliage, root, rhizome, tuber, fruit and flower/inflorescence of the plants were collected from the forest and either cooked or consumed fresh. The communities were collecting these plant resources round the year or when available. Fruits are also consumed ripe as dessert or as vegetable and also processed as pickle or chutney. Herbs are generally consumed as leafy vegetable. Some tubers, rhizomes, pods, fruits are also consumed as vegetable. Edible plants are generally important both for humans and domestic animals during the time of scarcity.

The indigenous communities of JNP were collecting different type of wild edible and cultivated fruits from the forest for both self consumption and sale for cash income. The community collects fruit of 17 species for food, vegetable, spice and also value add into product like pickles (table 1). Maximum amount of fruits collected were consumed directly either as raw or ripe. Fruits of *Artocarpus hetrophyllus* were either used as vegetable and pickle or consumed ripe. Fruits of *Mangifera indica* were also both consumed as ripe or raw after preparation of chutney. Fruits of *Syzygium cuminii*, *Baccaurea sapida, Aegle marmelos* and *Artocarpus lakoocha* were consumed as ripe only whereas, *Ziziphus mauritiana* and *Dillenia indica* were used for preparation of pickle or '*chutney*'

Wild vegetables were collected for self consumption and also sold in the local market to earn cash income. A total of 26 NTFP species were used as vegetable (table 1). Among these, 19 were plants and seven mushrooms. NTFPs for vegetable purpose were daily collected for household needs. Leafy part of the species were mostly preferred by the communities as vegetable and collected round the year from the forest. Some of the common species used as vegetable for both home consumption and sale were *Diplazium esculentum*, *Basella alba*, *Mussa endatreutleri* and *Colocasia esculenta*. Rhizome and tender shoots of the Colocasia and Basella were collected during the rainy season for self consumption and bulk of the amount was sold at local market. Flower of *Mussa endatreutleri* is used for culinary purpose and consumed with rice. This cuisine is locally known as '*Mocha*' and consumed for supplementing the iron deficiency. Tender upper leafy part of *Chenopodium album* is cooked as vegetable and consumed with '*chapatti*' during winter season. Young shoot of *Bambusa vulgaris* were either consumed as vegetable or processed as pickle.

Products from six species of plants were used as spices or aroma for preparation of locally made pickles either for self consumption or sale (table 1). These species are *Capsicum annum*, *Cinchona officinalis*, *Cinnamomum camphora*, *C. tamala*, *Flumaria indica and Murraya koenigii*. Leaves of *C. tamala* and bark of *C. camphora* are used for making black tea and also used with rice. Leaves of *M. koenigii* were used for aroma and as condiment. Fish and mushroom were collected both for self consumption and sale as well. Fishes like *Cirrhina mrigala*, *Labeo rohita*, *Mystus vittatus* and *Puntius ticto* were caught from the river, ponds and other perennial water sources round the year except *Catla catla* which is caught during

the rainy season only. The species is costly and used generally during ceremonial occasions. The fringe communities are highly dependent on these fishes for nutrition and energy along with cash income from sale in the local market. Seven type mushrooms were also collected from the forest during the rainy season to prepare different culinary items for consumption with rice.

Animal feed

Plant leaves/foliage, fern, herb and leaves of shrubs are collected from the forest as a supplement to the conventional fodder for domestic animals and for this purpose 36 plant species were used (table 1). Some of the preferred species as fodder were *Artocarpus*, *Ficus* and *Dillenia sp*. as these species are almost available round the year. Leaves of *Ziziphus mauritiana* and *Syzygium cuminii* were also used as fodder especially for goat. Leaves and foliage were mainly collected as fodder during summer and winter seasons when there is acute shortage of normal fodder. Fruits of *Dillenia indica* were also collected as feed for animals.

Other uses

The inhabitants of JNP largely depend for their domestic energy consumption on fuelwood collection from the forest and they mainly use dead and dried wood of 26 species collected from the forest (table 1). Apart from using it as domestic energy, firewood is sold in the local market and is a major contributor in the household income. Maximum consumption of firewood was documented during winter and rainy season as compared to summer season. The area experiences cold temperature during the winter season which necessitates firewood burning for heating. The firewood species preferred were *Albizia lebbeck*, *Anthocephalus cadamba*, *Pongamia pinnata*, *Schima wallichii*, *Lagerstroemia parviflora* and *Mangifera indica* as compared to other documented species. Dried leaves of *Tectona grandis* is also collected during summer and used as fuel.

The fringe communities also make different type of craft and decorative items from the plant resources for decorating house during festival, marriage and other traditional rituals. Eighteen plant species were listed which were in use for this purpose (table 1). The decorative or craft items were also sold in the local market for earning money. Some of the common species for this purpose are *Cassia fistula*, *Delonix regia*, *Oroxylum indicum* and *Sterculia villosa*. Leaves, foliage, flowers, fruits and twigs of six plant species were used for religious purposes (table 1). Leaves of *Aegle Marmelos* and *Mangifera indica* were sacred and used as offering to God during rituals. Fruits of *Datura metal*, *Saussurea lappa* flower and seeds of *Elaeocarpus sphaericus* were also used while performing a religious ritual. *Ficus religiosa* is considered sacred by the fringe community. Three plant species were used to fence the homestead for protection against stray animals (table 1). *Bambusa vulgaris* and *Bambusa bamboos* and *Lantana camara* were used for fencing around the animal shed and in crop fields. Bamboo thatching is also commonly used for fencing the house and animal shed.

NTFPs were also used for other purposes like agriculture implements, construction work (bridge, house, animal shed), furniture, flosses, gum, honey, katha, ladder, pole, mosquito repellent, plate, rope, soap and

shampoo (table 1). The branches of *Tetrameles nudiflora* and *Anthocephalus kadamba* were used for making small agriculture implements (handle of spade, plough). *Shorea robusta* is used for furniture and house construction while its dried leaves are burned as mosquito repellent. Its leaves are also used for plate making. Small root pieces of *C. camphora* are also burned along with firewood as mosquito repellent. B*ambusa bamboos* and *Dendrocalamus strictus* is used for making ladder and construction of small temporary bridge. Twigs of *Cissus repanda* is used for making rope, heart wood of *Acacia catechu* for katha, leaves of *Dillenia pentagyna* for plate, *Ficus elastica* for gum, *Bombax ceiba* for floss (floss of Bombax is locally known as '*Tula*') and *Sapindus rarak* for soap and shampoo.

Discussions

Socio-economic attributes

The settlement of the villages is in the designated forest area. The indigenous people have been living in these villages of JNP for past many generations with marginal land holding. They are doing so because of recognition of their traditional right to natural resources by the Forest Department. No inhabitants have additional land to till except for the land around homestead where subsistence farming is practiced i.e. homegarden agroforestry. The entire household had alternate income options, majority of them are engaged in daily paid manual labour and a few are self employed i.e. are local shopkeepers but is not ensured year round. NTFPs ensure year round income to the households and thus the reliance of the households is more on it than the other livelihood options. This indicates that NTFPs are satisfying multiple needs of food, shelter, medicines, fibres, energy and cultural artefacts and thus supporting the well being of indigenous people of JNP as was also reported in many studies (Pandey et al., 2011; Shackleton et al., 2015).

The availability of limited livelihood options to earn for a decent living and low development in the study area, the indigenous community living in and around the JNP were collecting NTFPs from the forest to meet their daily needs though their cash income varied widely from NTFPs. The cash income from NTFP sale is highly skewed because the NTFPs which remain unused after satisfying their needs are only subjected to sale in the local market and very less to the traders or vendors. It was reported that 43 NTFP species were sold by the fringe communities of JNP but in unprocessed form (Lepcha et al., 2018) and thus were undervalued fetching only the collection charges of NTFPs to the collectors (Sharma et al., 2015; Lepcha et al., 2018). Deprived of the fair prices of their product, the community is forced to spend more time on its collection leading to unsustainable harvesting (Prasad et al., 1999). Absence of fair price mechanism and regulated market links in JNP was reported to be the cause of deprival of fair prices of NTFPs to its fringe communities (Lepcha et al., 2018).

Moreover, remoteness and absence of good roads make it very rare to approach the study area by the traders/vendors from outside for trading NTFPs. Several other studies though had also reported wider range (10-60 %) in contribution of NTFPs to the total household income but ascertained that NTFPs do ensured a permanent source of income year round (Asfaw et al., 2013; Lepcha et al., 2018). Distribution,

collection and contribution in house hold economy of these NTFPs vary from region to region and forest to forest due to change in locality factors including socio-cultural domains (Bauri et al., 2015). Studies have also indicated that due to poorly developed market network, transportation absence of quality assurance, price fixing mechanism and processing, most of the NTFPs are consumed in household to satisfy daily needs (Ingram and Bongers, 2009). It is reported that the more isolated and remotely the area is located, the higher is the contribution of NTFPs to non-cash income (Endamana et al., 2016). The economic, livelihood and ecological benefits of NTFPs can only be realized when their collectors are benefitted fully (Endamana et al., 2013, 2016; Verma and Paul, 2016; Suleiman et al., 2017).

NTFPs Diversity

Documentation of 146 NTFP species indicates that the JNP is a rich reservoir of NTFP species of immense potential for human well being. This documentation of NTFP species from JNP may play a pivotal role in the utilization and conservation of this natural wealth. Further studies on phyto-chemical principles including extraction of different active constituents on a scientific scale will lead to recognition and preservation of the NTFP species unknown to the outer world. Among the enlisted 146 NTFP species, 116 species were not assessed or not evaluated, 26 were least concern and two species were under data deficit category according to the IUCN priority list of species, (IUCN, 2017). Enlisting the species comparing with IUCN priority list indicates the status of population of a particular species in an area. Such documentation will ensure future conservation of these species in the wild through their sustainable utilization and promoting its domestication. IUCN status of the JNP NTFP species warrants more vigorous and systematic research to gather accurate and complete information on population status of the species in the area for its sustainable management and conservation for their continuous exploitation.

The ethnobotanical plant species which were documented as cultivated (24 species) or both cultivated and wild (27 species) were actually been planted by the respondents in their home garden and it was found during the survey that almost all the respondents were maintaining a home garden contributing to conservation of the species they were using. Indigenous people of JNP domesticating/cultivating ethnobotanical plants in their home gardens clearly indicate the community consciousness on the conservation values of these ethnobotanical species. This means that the inhabitants of JNP have switched on to sustainable harnessing of their valuable natural resource through domestication of some valuable wild species and leaving these species intact in the wild. There is need to plant and domesticate the NTFP species of JNP through formulating local missions supporting indigenous strategies of food security. Similar report on home gardens maintaining rich biodiversity of ethnobotanical plants was also reported in earlier studies (Shukla and Chakravarty, 2012; Mekonen et al., 2015). There is relevance of man-made environments as a prominent source of ethnobotanical plants for both indigenous and non-indigenous agricultural societies for its conservation (Heckler, 2007). Home gardens serve as refuge for legacy species, being family tradition and family ties forces that promote knowledge transmission and conservation (Kujawska and Pardo-de-Santayana, 2015; Mekonen et al., 2015).

Plant part use/ harvesting time

Most of the species were harvested year round, while those used as fruits, vegetables and fodder were harvested during rainy season. Destructive harvesting was done in case of whole plants, roots, tubers and rhizomes. Harvesting bark and seeds were also destructive as these can affect the survival of the plants. Harvesting patterns of leaves or foliage, root, rhizomes and tubers indicates their possibility of vulnerability for becoming endangered and ultimately extinction (Shukla and Chakravarty, 2012). Earlier studies also documented similar time of harvest or collection of NTFPs (Saha et al., 2014; Verma and Paul, 2016). The use of various plant parts of these documented NTFP species in traditional uses were similarly reported by many workers (Shiracko et al., 2016; Raj et al., 2018). Genetic biodiversity of NTFP species gets threatened or vulnerable because of destructive harvesting techniques mainly done for commercial exploitation along with other causes like grazing, loss of habitat and unmonitored trade (Hamid and Raina, 2014). NTFPs are freely harvested by users either for their own use or for trade (Giday et al., 2009). The harvesting of these multiple use species can put them under threat (Dhillion and Shrestha, 2005) but can also lead to better chances for their conservation (Etkin, 2002) especially through home gardens.

Utilization

The acquaintance of forest flora and fauna and their importance are rich among the indigenous communities as they are traditionally integrated in the traditional life style of these people and this traditional knowledge system was accumulated and passed on from one generation to the other orally (Saha et al., 2014). NTFPs collected were of multipurpose nature and were mostly used to supplement daily food, nutritional and health requirements of the households and domestic animals as well (Bauri et al., 2015; Biswakarma et al., 2015, 2017$_{a, b}$; Bose et al., 2015; Sarkar et al., 2015; Verma and Paul, 2016; Ghosal and Liu, 2017 O'Neill et al., 2017; Raj et al., 2018; Vineeta et al., 2018). There is much documentation of use ethnobotanical plants other than medicines and food (Hamid and Raina, 2014; Łuczaj et al., 2015; Shiracko et al., 2016).

Generally, NTFPs collected were consumed fresh either for food or treating ailments traditionally (Ignacimuthu *et al*., 2006) except for underground parts when used for medicinal purposes were dried (Rokaya et al., 2014). Rarely they were value added and if done so were crudely done for domestic consumptions only (Malla et al., 2012; Shukla et al., 2013; Saha et al., 2014). Using roots and rhizomes to prepare traditional medicinal formulations has an advantage that these underground organs generally contain high concentrations of bioactive compounds (Moore, 1994). Many studies also have made such similar observations (Endamana et al., 2016; Ojea et al., 2016; Suleiman et al., 2017). Proper selection of species, parts, as well as preparation and administration methods were given very important in traditional health care systems (Sarkar et al., 2015; Raj et al., 2018; Vineeta et al., 2018).

Identification, documentation, collection/extraction and conservation of indigenous traditional knowledge about the plants are very essential to be used in near future for ever increasing population to ensure food

and nutritional security (Basumatary et al., 2014). No new food, particularly the wild food, will be accepted by the urban population without proper testimony from specialists. It will be no wonder if some plants used by the indigenous community as food may on analysis prove rich in nutrition. Others however may come out to poorer or even nutritionally almost useless. But that too, would not minimize the utility of recording whatever information can be gathered on the botanical folklore of these fast disappearing cultures (Endamana et al., 2016).

Information generated from this study will be helpful to understand the human-forest relationship in terms of livelihood options and scheduling sustainable harvest procedures for the indigenous communities and thereby increasing their participation in conservation and sustainable management of these natural resources (Yadav and Dugaya, 2013; Basumatary *et al.*, 2014). Such documentation will also aid in preservation of traditional conservation practices and framing management strategies whereas utilization pattern can be helpful in transferring the traditional knowledge to younger generations and appreciating its values for human welfare and thus conservation of these ethnobotanical plant species. However for development of indigenous people and to conserve their knowledge under intellectual property right, a vast effort is needed (Mondal and Samanta, 2014).

Revitalizing the principles of traditional, religious and practices where modern conservation programs could integrate traditional knowledge systems of indigenous communities into their conservation and management activities of natural resources is needed (Eneji et al., 2012). Ethnobotanical studies have reported resource management by the local people utilizing the principles of traditional knowledge in light of today's modern conservation principles (Suresh et al., 2013, 2014; Hong et al., 2015; O'Neill et al., 2017). The NTFP species managed for sustainable utilization before they are commercially traded. Institutional intervention was recommended to protect the rights and empower the JNP fringe community to access information on policy, market and value addition of their products with capacity building, financial and infrastructural support (Lepcha et al., 2018). Additionally, such missions will rejuvenate the socio-cultural heritage and traditional food market circuits of JNP which will conserve and replenish the NTFP resource to uplift socio-economic status and livelihood of indigenous communities at JNP (Bhutia et al., 2015; Hong et al., 2015; Ahmad and Pieroni, 2016).

Conclusion

The indigenous fringe communities of JNP with their traditional life style relied on NTFPs for their daily subsistence needs and also as permanent source of cash income. The sale of NTFP was contributing on an average of 45 % to the total annual household income. NTFPs also provided a safety net particularly during the periods of scarcity and filled the gap of food deficit especially when their subsistence standing crops were destroyed by wild elephants. We documented 146 NTFP species from our study area. In this list, 95 species were wild, 24 species cultivated and 27 species were both wild and cultivated. Some wild plant species were also grown in the home gardens thus aiding conservation of these species. However, there is very less or no information available for these documented species as 116 species were not assessed or not evaluated, 26 were least concern and two species were under data deficit category in the

IUCN priority list of species. More research is required to update information on population status of these NTFP species. Systematic accounting the volume of NTFPs collected/harvested along with cash and non-cash income should be initiated. Policies supporting *ex situ* conservation programs through capacity building the communities with improved cultivation techniques of commercially viable NTFP species and value addition of NTFP products will enhance their income and relieve pressure from the forest. Storage, grading, processing and value addition through linking with existing development schemes should be created or promoted. Institutional intervention is required to empower the communities with information on policy, finance, market and products to enable them trade NTFPs with better returns. Diversification of livelihood options along with education, skill and basic infrastructure development is also recommended.

Declarations

Ethics approval and consent to participate: NA

Consent for publication: All the authors are agreed for the submission of paper.

Availability of data and material: Data will be provide as on request.

Competing interests: No competing interest among the authors

Funding: No funding was received for the study.

Authors' contributions: Ms. Lakpa Doma Lepcha (M. Sc. Scholar) performed field work, Dr. Gopal Shukla (Assistant Professor) performed the experiments, recorded and analysed the data and corresponding author of manuscript; Ms. Vineeta (Assistant Professor) contributed in collection of secondary data, review literature and contributed in collection of field data and other information; Dr. Sumit Chakravarty (Professor) contributed in final editing of the manuscript.

Acknowledgements: Authors are sincerely acknowledge the local communities for sharing the uses of the NTFPs and authors are also thankful to Forest Department of Jaldapara National Park authorities for granting the permission for the study.

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Tables

Table 1. NTFP species diversity in JNP

Sl. No.	Sn/Vn/F/Lf	Is	Toc/Pu	Mou
Animal origin- fish				
1	*Channa striatus* (Bloch) *Sole*; Channidae	NA	Wy	Cooked and consumed
2	*Catla catla* (F. Hamilton) *Katlay*; Cyprinidae	NA	Wy	Cooked and consumed
3	*Cirrhinus mrigala* (Hamilton) *Mrigal*; Cyprinidae	LC	Wy	Cooked and consumed
4	*Clarias batrachus* (L.) *Magur*, Clariidae	LC	Wy	Cooked and consumed
5	*Garra gotyla* (Gray.) *Buduna*; Cyprinidae	LC	Wy	Cooked and consumed
6	*Gudusia chapra* (F. Hamilton) *Chipla*; Clupeidae	LC	Wy	Cooked and consumed
7	*Heterepneutes fossiles* (Bloch) *Sangri*; Heteropneustidae	LC	Wy	Cooked and consumed
8	*Penaeus monodon* *Chingri*; Clupeidae	NA	Wy	Cooked and consumed
9	*Labeo rohita* F. Hamilton *Rahu*; Cyprinidae	LC	Wy	Cooked and consumed
10	*Mystus vittatus* (Bloch) *Tangra*; Bagridae	LC	Wy	Cooked and consumed
11	*Psilorhynchus sucatio* (Ham.) *Chepti*; Psilorhynchidae	LC	Wy	Cooked and consumed

12	*Pethia ticto* (Hamilton) *Punti*; Cyprinidae	LC	Wy	Cooked and consumed
13	*Rita rita* (Ham.) *Rita*; Bagridae	LC	Wy	Cooked and consumed
Animal origin- insect				
14	*Trigona Sp.* *Putka*; Apidae	-	Sep-Jan/ Ho	Cooked and consumed as medicine.
Plant origin- climber				
15	*Coccinia grandis* (L.) Voigt *Telakucha*; Cucurbitaceae	NA	May-Aug/ L, Fr	**Cooked as vegetable**
16	*Cissus repanda* Vahl. *Panilahara*; Vitaceae	NA	Wy/Tw	Whole plant is to make rope and used as fodder.
17	*Dioscorea bulbifera* L. *Githa*; Dioscoreaceae	NA	Wy/B, L	Dried powder of tuber is applied to cure ulcer and cooked as vegetable.
18	*Dioscorea pentaphylla* L. *Bhegur*, Dioscoreaceae	NA	Jun-Jan/ Rh	Extract is applied on infected portion to cure boil and cooked as vegetable.
19	*Momordica dioica* Roxb. Ex willd. *Ban karela*; Cucurbitaceae	NA	May-Jul/ Fr, R	Fruits cooked as vegetable and also consumed to cure stomach disorder. Leaf extract administered orally (250 ml) twice a day for two days during fever.
20	*Piper thomsonii* Linn. *Pipla*; Piperaceae	NA	Nov-Mar/ Fr	Fruits are boiled in water with salt. This mixture is consumed to cure cough & cold.
21	*Plumbago zeylanica* L. *Chita*; Plumbaginaceae	NA	Wy/L, R, B	Leaf extract are mixed with rice for making rice bear. Rhizomes are crushed and boiled and consumed empty stomach during early morning to treat fever.
Plant origin- herb				
22	*Achyranthus arpera* L.	NA	Jan-Dec/R, Sd	Root powder mixed with black salt or root and seed crushed together and consumed with water to get relief from indigestion and dysentery.

	Apang; Amaranthaceae			
23	*Ageratum conyzoides* L. *Bhusuri*; Asteraceae	NA	Wy/L	Fresh leaf extract are applied on cut and wound and bandaged to stop bleeding and for healing.
24	*Artemisia vulgaris* L. *Titepate*; Asteraceae	NA	Wy/L, Fl, R	Leaves, flower and root are crushed together with fresh water and consumed to control dysentery.
25	*Asparagus racemosus* Willd. *Satamuli*; Asparagaceae	NA	Jan-Dec/Fl, R	Dried root powder is consumed to get relief from diabetes and dysentery. Leaves are eaten to get relief from fever.
26	*Bambusa bamboos* (L.)Voss *Bans*; Poaceae	NA	Wy/Wp	Used for fencing, making small bridge and ladder.
27	*Bambusa vulgaris* Schrad ex J.C Wendl. *Baans*; Poaceae	NA	Wy/Ys, L, St	Young and tender shoot are cooked as vegetable and processed as pickle. Leaves are used as fodder.Clumps as fencing.
28	*Basella alba* L. *Pui sag*; Basellaceae	NA	May-Jul/L	**Decoction of root relieves vomiting. Tender twigs as vegetable.**
29	*Bryophyllum pinnatum* (Lam.) Oken *Partharkurchi*; Crassulaceae	NA	Wy/L, Wp	Leaf paste applied on burnt skin and on swelling for relief. Whole plant used for decoration.
30	*Calamus rotang* L. *Bet*; Palmae	NA	Oct-Jan/L, Fr	Leaves are used for home decoration and fruits are edible.
31	*Cardamine hirsuta*L. *Simrayo sag*; Brassicaceae	NA	Oct-Feb/L	Leaves with small twigs are cooked and used as vegetable
32	*Cassia tora* L. *Chakunda*; Caesalpiniaceae	NA	Jul-Dec/L, Sd	Leaf extract is applied against rashes and allergies. Seeds are consumed to get relief against cough and cold.
33	*Centella asiatica* Linn. *Gortapre*; Apiaceae	LC	Jan-Dec/L	Leaves consumed as vegetables which also ease body pain and fever. Leaf extract in water solution is also administered orally during early morning in empty stomach to heal wounds.
34	*Chenopdium album*	NA	Sep-	Tender leaves are cooked as vegetable.

	L. *Bethu saag*; Chenopodiaceae		Jan/L	
35	*Cissus quadrangularis* L. *Harjora*; Vitaceae	NA	Jan-Dec/Wp	The plant is grinded and fried in mustard oil along with onion and then applied and messaged to get relief from fracture.
36	*Colocasia esculenta* (L.) Schott *Ban-Kuchu*; Araceae	LC	May-Aug/ Rh	Cooked as vegetable.
37	*Cynodon dactylon* (L.) *Dubbaghass*; Poaceae	NA	Jan-Dec/Sh	Shoot extract is applied externally to cure skin disease and taken orally to cure vomiting and leprosy. Entire plant is fed to cattle for increasing lactation.
38	*Cyprus rotundus* L. *Mutha*; Poaceae	LC	Jun-Nov/Rh	Powdered and administered orally againstdysentery, fever, and ulcer.
39	*Datura metel* L. *Dhutra*; Solanaceae	NA	Wy/L, Fl, Sd	Flowers and fruits are offered during religious ceremony. Mixture of leaf and seed is used to treat asthma, cold and cough.
40	*Dendrocalamus strictus* (Roxb.) Nees *Male bans*; Poaceae	NA	Wy/Wp	Leaves are used as fodder for goat. Clumps used as pole.
41	*Desmodium gangeticum* (L.) DC *Salpani*; Fabaceae	NA	Sep-Dec/ Wp	Plant extract is consumed to get relief from rheumatism. Root is fed to post-labour woman.
42	*Dichroa febrifuga* Lour *Vasak*Hydrangeaceae	NA	Wy/L, R	Root extract consumed to control cough & cold. Fresh leaf and root exudatesconsumed to control vomiting and blood pressure.
43	*Diplazium esculentum* (Retz.) Sw. *Dhenki saag*; Athyriaceae	LC	Apr-Oct/ Ys, L	Tender leaves are used as vegetable and whole plant as fodder.
44	*Drymaria villosa* Cham & Schlecht *Abijalo*; Caryophyllaceae	NA	Dec-Feb/L	Whole plant is consumed to cure jaundice and cold.
45	*Euphorbia thymifolia* Linn.	NA	Wy/Br	Leaf and tender stem decoction tender stem is consumed to treat cystitis and kidney problems.

	Dhudiya; Euphorbiaceae			
46	*Ficus cunia* Buch.-Ham. Ex Roxb. *Khaniyun*; Moraceae	NA	May-Nov/ Wp	Used as green fodder.
47	*Fumaria indica* Pugsley *Ban dhania*; Fumariaceae	NA	Mar-Jul/L	Leaves are used as spice.
48	*Hedyotiss candens* Roxb. *Koaru*;Rubiaceae	NA	May-Aug/L	Tender leaves with twigs are cooked as vegetable.
49	*Lycopodium clavatum* L. *Nagbeal*; Lycopodiaceae	NA	Wy/R, L	Young root and leaves are consumed to treat sexual disorder and also used for decoration.
50	*Phyllanthus fraternus* G.L Webster *Bhuiamala*; Phyllanthaceae	NA	Wy/Wp	Plant extract externally applied to cure skin infections. Plant exudates externally applied on sores and ulcers or mixed with oil to cure conjunctivitis
51	*Saussurea lappa* C. B. Clarke *Kur*, Compositae	NA	Wy/R, Fl	Dried roots are powdered with black pepper and administered orally to cure asthma, cold and cough. Flowers are used during religious ceremony.
52	*Solanum nigrum* L. *Kakmachi*; Solanaceae	NA	Wy/Fl, Fr, Sh	Animal feed, leaves with flower are cooked as vegetable and ripe fruits as dessert.
53	*Vernonia cinerea* (L) Less. *Chotokuksima*; Asteraceae	NA	Wy/Wp	Fever, hiccups,nerve disorders, kidney disease and stomach discomfort.
Plant origin- shrub				
54	*Abroma augusta* (L.) L. f. *Ulat Kambal*; Sterculiaceae	NA	Jan-Dec/R, L	Root powder is used to control urine infection. Leaf extract is useful for diabetes.
55	*Ageratina adenophora* (Spreng.) R. King & H. Rob.	NA	Wy/L	Leaves soaked in water for bathing to cure skin infection.

	Banmara; Asteraceae			
56	*Capsicum annum* L. *Jeray chilli*; Solanaceae	NA	Apr-Jul/Fr	Used as spice.
57	*Cinchona officinalis* L. *Cinchona*; Rubiaceae	NA	Wy/B, R	Root and bark decoction is orally administered against malaria and dysentery. Bark is also used as spice.
58	*Dendrocnide sinuata* (Blume) Chew *Moringe*; Urticaceae	NA	Apr-Oct/Ys	Young shoot cooked as vegetable.
59	*Lantana camara* L. *Ban-tulshi*;Verbenaceae	NA	Wy/Sh	Leaf extract is applied on ring worm and administered orally to get relief from cold and cough. Used as fencing and fuel wood.
60	*Melastoma malabathricum* L. *Dantrangi*; Melastomataceae	NA	Aug-Feb/Fl, L	Consumed to cure cholera, diarrhea, fever and dysentery.
61	*Meyna spinosa* Roxb. Ex Link *Kalomaney*; Rubiaceae	NA	May-Jun/L, Tu, Fr	Fruit are used as vegetable. Tuber and leaves are consumed to cure boil, dysentery and indigestion.
62	*Mussa endatreutleri* Stapf. *Tamba*; Rubiaceae	NA	Wy/Ys	Cooked as vegetable.
63	*Rauvolfia serpentina*(L.)Kurz. *Sarpagandha*; Apocynaceae	NA	Oct-May/R, L	Half tea spoon root and leaf powder is consumed thrice a day to get relief from hypertension and control blood pressure. Root extract is taken orally to cure jaundice.
64	*Sida cordifolia* Wight & Arnott *Berela*; Malvaceae	NA	Wy/Wp	Consumed as energy vitalizer.
65	*Sida fallax* L. *Sida*; Malvaceae	NA	Wy/Br	Used as fuelwood.
66	*Tetracera sarmentosa* (L.) Vahl *Rikang*; Dilleniaceae	NA	Wy/R	Consumed to controldiarrhoea. Paste is applied to get relief from burn. Extract is applied to cure mouth ulcers.

67	*Urtica dioica* L. *Sisnoo*; Urticaceae	LC	Wy/L, Fl, Ys	Cooked as vegetable.
68	*Vitex heterophylla* Roxb. *Panchpattay*; Lamiaceae	NA	Wy/L	Used as fodder.
69	*Vitex negundo* L. *Nisinda*; Verbenaceae	NA	Wy/Wp	Consumed during morning to cure rheumatism and fever.
Plant origin- tree				
70	*Acacia catechu* (L. f) Wild. *Khayer* ; Mimosaceae	NA	Wy/Br, Hw, B	Branches and twigs for fuelwood. Heartwood is processed as *Khatta* and consumed with betel leaf to cure indigestion. Bark powder is consumed to cure rheumatism.
71	*Aegle marmelos* (L.) Corr. *Bel*; Rutaceae	NA	Dec-May/ Fr, L	Pulp is used to make health drink as body coolant during summer and to cure dysentery. Leaves are used during religious ceremony.
72	*Aglaia hiernii* Visal. Ramach *Lali*; Meliaceae	NA	Mar-May/ Br, Ds, L	Branches are used as fuelwood. Dry seeds are decorative. Fresh leaves used as fodder during summer.
73	*Albizia lebbeck* (L.) Benth. *Siris*; Mimosaceae	NA	Jan-Dec/Br, Sd, B, L	Seed powder is administered orally to get relief from pile and body pain. Bark is boiled and extract is consumed orally to control cold.Leaves are used a fodder and twigs as fuel wood.
74	*Alstonia scholaris* (L.) R. Br. *Chhatian*; Apocynaceae	NA	Jan-Dec/B	Bark paste is applied to cure skin disease. One tea spoon of bark extract is administered orally during early morning once a day to in empty stomach to cure jaundice and get rid of stomach worms.
75	*Amoora rohituk* (Roxb.) Wight &Arn. *Lasuney*; Meliaceae	NA	Wy/Br	Twigs are used as fuel wood.
76	*Anthocephalus cadamba* (Roxb.) Wight & Arn. *Kadam*; Rubiaceae	NA	Wy/Br	Twigs are used as fuel wood and make agriculture implements. Fresh leaves are used as fodder.
77	*Artocarpus chama* Buch-Ham. Ex. Wall *Latore*; Moraceae	NA	Jan-Dec/L	Fresh leaves are used as goat fodder during lean period.
78	*Artocarpus*	NA	Jan-	Fruit consumed as dessert and processed to

	heterophyllus Lam. *Kanthal*; Moraceae		Dec/Fr, L Lt	pickle. Leaf is goat fodder and latex is used as gum.
79	*Artocarpus lakoocha* Buch-Ham *Bore*; Moraceae	NA	Jul-Dec/Fr, L, B	Fruits consumed as dessert. Leaf and bark are used against skin disease.
80	*Azadirachta indica* A. Juss. *Neem*; Meliaceae	LC	Apr-Dec/L, Sd, B	Fried leaves are consumed to cure mouth ulcers mouth. Leaves are boiled in water for bathing to cure small pox. Leaf extract is consumed orally to cure pneumonia and also used as appetiser. Twigs are used as tooth brush.
81	*Baccaurea sapida* (Roxb.) Mull. Arg. *Latka*; Euphorbiaceae	NA	Jul-Sep/Fr	Fruit are eaten as dessert.
82	*Bauhinia malabarica* Roxb. *Tanki*; Fabaceae	NA	Wy/L, F, Sh	Leaves are boiled and cooled solution is consumed daily to get relief from stomach pain. Fresh leaves are used as fodder. Flowers are cooked as vegetable. Branches are used as fuel wood.
83	*Bauhinia purpurea* L. *Devakanchan*; Caesalpiniaceae	NA	Wy/L, Fl, B, R	Leaf is boiled and solution is consumed to control jaundice. Bark paste is applied to heal wounds. Flower is used as vegetable and for decoration. Root paste is consumed to control ulcer.
84	*Bauhinia variegata* (L.) Benth. *Raktokanchan*; Caesalpiniaceae	LC	Jan-Dec/Fl, B, R	Decoction of bark and root is applied to cure mouth ulcer and skin disease. Flowers are used as vegetable.
85	*Beischimedia roxburgii* Nees. *Tarsing*; Lauraceae	NA	Wy/L	Leaves are used as fodder during lean season.
86	*Bombax ceiba* L. *Simul*; Bombacaceae	NA	Wy/Br, Fr, R, Sd,	Roots extract is consumed to treat diarrhea. Twigs are used as fuel wood. Seed and fruit floss used to make pillow and blanket.
87	*Bridelia retusa* (L.) A. Juss. *Gayo*; Euphorbiaceae	NA	May-Nov/L	Fresh leaves and small twigs are used as fodder.
88	*Butea monosperma* (Lam.) O. Kuntze *Palash*; Papilionaceae	NA	Wy/B, Sd, L, Fl	Flower and leaf infusion is orally administered against diarrhea. Seedpowder is consumed to kill stomach worms.
89	*Careya arborea* Roxb.	NA	May-Dec/ Fr,	Bark extract is consumed in empty stomach to cure dysentery. Flowers are used for decoration

	Kumbhi; Lecythidaceae		L, B, Fl	and branches are used as fuel wood.
90	*Cassia fistula* L. *Bandarlathi*; Caesalpiniaceae	NA	Wy/Fr, Fl, R, B	Dried Fruit and fresh flower are used to decorate the household. Root and bark are used to control asthma, fever and cold & cough. Root is also used to control skin disease.
91	*Castanopsis indica* (Roxb.ex Lindl.) A. DC *Kattus*; Fagaceae	NA	Wy/Sd, L, Br	Fruits & seed are cooked as vegetables and also to control blood pressure. Leaf paste in solution form is consumed to cure gastric problems. Twigs are used as fuel wood.
92	*Chukrasia tabularis* Juss. *Chikrashi*; Meliaceae	LC	Jun-Jan/Br	Branches are used as fuelwood, agriculture implements and for construction purposes.
93	*Cinnamomum camphora* (L.) J. Presl *Dalchini*; Lauraceae	NA	Wy/B, R, Tw	Dried bark is used for aroma in tea or hot water. Dried bark or leaves is consumed stomach disorder, diabetes and to check reduce body weight. Root is burnt with fuelwood to repel mosquito.
94	*Cinnamomum tamala* (Ham.) Nees & Eberm. *Tejpata*; Lauraceae	NA	Jan-Dec/L, B	Leaf and bark is consumed with food to control hypertension and diarrhea.
95	*Dalbergia Sissoo* Roxb. Ex DC *Sissoo*; Fabaceae	NA	Wy/L, Br	Leaves are fodder and branches as fuelwood and handles of agricultural implements.
96	*Delonix regia* (Hook.) Raf *Gulmohar*, Caesalpiniaceae	NA	Dec-Feb/P	Dried pods are used to decorate home.
97	*Dillenia indica* L. *Chalta*; Dilleniaceae	NA	Jan-Feb/Fr, L	Leaves and fruits are elephant feed. Raw fruits are processed to pickle.
98	*Dillenia pentagyna* Roxb. *Tantari*; Dilleniaceae	NA	Sep-Nov/L	Leaves are used as fodder, decoration and making plates.
99	*Elaeocarpus sikkimensis* Roxb. *Bandarey*; Elaeocarpaceae	NA	Wy/Br	Braches are used as fuelwood.
100	*Elaeocarpus sphaericus* (Gaertn.) K. Schum.	NA	May-Jul/Fr, Sd	Fruit and seed are consumed to control blood pressure and diabetes.

	Rudraksh; Elaeocarpaceae			
101	*Emblica officinalis* Gaerth *Amlakhi*; Euphorbiaceae	NA	Aug-Feb/Fr	Ripefruit are consumed as dessert and with sugar to get relief from cold and stomach pain. Fruits are also processed to pickle and candy.
102	*Erythrina stricta* Roxb. *Faledo*; Fabaceae	NA	Wy/L, B	Bark paste is consumed to cure liver problems, fever and rheumatism.
103	*Ficus elastica*Roxb. *Laberay*; Moraceae	NA	Jun-Oct/L, Lt	Fresh leaves are used as goat fodder. Fruit latex is used in making gum.
104	*Ficus racemosa*L.f *Dumri*; Moraceae	NA	Fr, L	Leaves are used to cure mouth disease of domestic animals and as fodder. Ripe fruit are used as dessert.
105	*Ficus religiosa* L. *Peepal*; Moraceae	NA	May-Nov/ L, Wp	Sacred and religious plant.
106	*Garunga pinnata* Roxb. *Dabdebay*; Burseraceae	NA	Sep-Dec/L, Fr	Used as fodder
107	*Gmelina arborea* Roxb. *Ghamari*; Verbenaceae	NA	May-Oct/L, R, Fr	Used as fodder during summer.
108	*Lagerstroemia parviflora* L. *Jarul*; Lythraceae	LC	Wy/Br, Sh, F, Fr	Small branches are used as fuel wood and to make handles of agriculture equipment. Flowers are used for decoration.
109	*Litsea monopetala* (Roxb.) Pers. *Kutmero*; Lauraceae	NA	Wy/B, R, Tw	Leaves cure arthritis. Bark and roots powder are applied externally against bruises and pains. Tender twigs with leaves are used as fodder.
110	*Mallotus philippensis* (Lam.) Muell. Arg *Sindure*; Euphorbiaceae; T	NA	Jun-Sep/L	Used as fodder.
111	*Mangifera indica* L. *Aam*; Anacardiaceae	DD	Wy/Fr, Br, L	Ripe fruit as dessert and raw are processed to pickle anddrink. Leaf is sacred. Branches are used for agri. implements and as fuel wood.
112	*Magnolia pterocarpa*	DD	Wy/L,	Fodder and fuelwood.

	Roxb. *Patpatay*; Magnoliaceae		Br	
113	*Michelia champaca* L. *Champ*; Magnoliaceae	LC	May-Dec/L, Sd, Fl	Leaf and seed isconsumed to control fiver and eye disease; fuel wood;flowers for decoration.
114	*Murraya koenigii* (L.) Sprengel *Karipata*; Rutaceae	NA	Wy/L	Leaf extract is consumed to control black fever, diarrhea. Leaves as spice and aroma or consumed in empty stomach to cure gastroenteritis.
115	*Oroxylum indicum* (L.) Benth. *Totola*; Bignoniaceae	NA	Nov-Feb/Fl, Sd, Fr, B	Bark is boiled with sugar and the solution is consumed thrice a day to control Jaundice. Flowers cooked as vegetable to maintain blood pressure and also used as house decoration.
116	*Phanera variegata* (L.) Benth *Koinar*; Fabaceae	NA	Wy/Fr, Br	Bark and fruits are consumed to treat diarrhea and indigestion.
117	*Pongamia pinnata* L. *Karanj*; Fabaceae	LC	May-Jun/ Br, F	As tooth brush to cure dental pain and small ones as fuelwood.
118	*Premna bengalensis* C.B.Clarke *Gidary*; Lamiaceae	NA	Wy/L	Used as fodder.
119	*Pterospermum acerifolium* (L.) Wild *Parari*; Sterculiaceae	NA	Oct-Nov/L, Br	Used as fodder and fuelwood.
120	*Pterygota alata* (Roxb.) R.Br *Narkeli*; Sterculiaceae	NA	Jan-Mar/Fr, L	Fruit with leaves are used for decoration.
121	*Sapindus rarak* DC. *Ritha*; Sapindaceae	NA	Oct-Dec/Fr	Used as soap and shampoo.
122	*Schima wallichii* (DC.) Korth. *Chilaune*; Theaceae	LC	Wy/Br, B	Branches as firewood and bark for dyeing and treating urine infection.
123	*Schleichera oleosa* (Lour.) Oken *Kusum*; Sapindaceae	NA	Apr-May/ Br, Fr	Ripe fruits are dessert and branches as fuelwood.

124	*Shorea robusta* Gaertn. f. *Sal*; Diterocarpaceae	LC	Apr-Oct/Br, L, Rs, S	Bark powder applied on burns, leaves plate making,flower, bark and leaves used during festivities and branches as fuelwood.
125	*Spondias mangifera* Willd. *Amara*; Anacardiaceae	NA	Apr-Jun/Fr	Fruits are as vegetable and processed to chutneys and pickles.
126	*Sterculia villosa* Smith *Odal*; Sterculiaceae	NA	Feb-Mar/Fr, Fl	Used for decoration.
127	*Syzygium cumini* (L.) Skeels *Jam*; Myrtaceae	NA	Jul-Dec/Fr, Sd, L, B	Branches as fuel wood, fruits as dessert and leaves as goat fodder. Seed powder mixed with table salt is consumed with water to control indigestion and dysentery.
128	*Tectona grandis* L.f. *Shegun*; Lamiaceae	NA	Wy/Br, L	Construction, furniture; agriculture equipment. Branch and leaves as fuelwood.
129	*Trema orientalis* (L.) Biume *Kuail*; Ulmaceae	LC	Wy/L	Used as fodder.
130	*Terminalia chebula* Retz. *Harra*; Combretaceae	NA	Jan-Mar/Br, L, Fr, Sd	Fruits, seed extract and flowers are consumed with water against cold and cough. Flowers vegetable, branches fuelwood and leaves fodder.
131	*Terminalia alata* Roth. *Panisaj*; Combretaceae; T	NA	May-Jul/Fr	Fruit are used for house decoration during marriage.
132	*Terminalia arjuna* (Roxb.) Wight & Arn *Arjun*; Combretaceae	NA	Wy/B, Br, L	Bark extract in water solution is consumed to cure heart problem and powder to control diabetes. Leaves and branches are used as fuelwood.
133	*Terminalia bellerica* Roxb. *Barra*; Combretaceae; T	NA	Wy/Br, L, Fr, Sd	Fruits and seed are used consumed to cure cough and stomach ailments. Leaves as fodder andbraches as fuelwood.
134	*Terminalia paniculata* Roth *Kainjal*; Combretaceae	NA	Wy/L, B	Bark and leaf decoction control diabetes. Leaves are fodder.
135	*Tetrameles nudiflora*	LC	Wy/Br	Used as fuelwood and handles for agriculture

	R.Br *Maina*; Tetramelaceae			implements.
136	*Tinospora cordifolia* (Willd) *Gulancha*; Menispermaceae	NA	Wy/B, Sh, L	Roots in water solution after overnight soaking are consumed empty stomach in early morning to cure diabetes and stomach pain.
137	*Toona ciliata* Roem. *Toon*; Meliaceae	LC	Wy/L, Fr	Hut construction, furniture, fuel wood & agriculture equipment.
138	*Trewia nudiflora* L. *Pitali*; Euphorbiaceae	NA	Wy/Br, L	Shoot and leaf decoction controls excessive bile and leaf paste applied on wounds. Leaves are fodder and branches are collected for fuelwood.
139	*Ziziphus mauritiana Lam.* *Kul*; Rhamnaceae	NA	Jan-Mar/Fr, L,	Leaf is goat fodder. Fruit and seed with salt control vomiting.
Fungus				
140	*Pleurotus ostreatus* (Jacq.) P. Kumm. *Chamray Chew*; Pleurotaceae	NA	Jun-Sep/Mu	Consumed as vegetable and processed to pickle.
141	*Pleurotus* sp. *Kaney*; Pleurotaceae	-	Jun-Sep/Mu	Consumed as vegetable
142	*Armillaria mellea* (Vahl) P. Kumm. *Cheplay chew*; Phylsalacriaceae	NA	Jul-Nov/Mu	Boiled mushroom is consumed directly.
143	*Cantharellus cibarius* Fr. *Girolle*; Cantharellaceae	NA	Jul-Oct/Mu	Consumed as vegetable and processed to pickle and snacks.
144	*Lentinuss quarrosulus* Mont. *Kath chattu*; Polyporaceae	NA	Jun-Nov/ Mu	Consumed as vegetable.
145	*Termitomyces clypeatus* R. Heim *Kalunge Chew*; Lyophyllaceae	NA	Jun-Sep/ Mu	Consumed as vegetable.

146	*Termitomyces mammiformis* R. Heim *Jauri Chew*, Lyophyllaceae	NA	Jun-Sep/ Mu	Consumed as vegetable and processed to pickle.

Sn- scientific name; Vn- vernacular name; F- family; Lf- life form (C- climber; Fi- fish; Fu- fungus; H- herb; I- insect; S- shrub; T- tree); Is- IUCN status (DD-Data deficient; NA-Not yet assessed; LC-Least concern); Toc- time of collection (Whole year- Wy); Pu- part used (B- bark; Br- branch; Ds- dry seed; Fl-flower; Fr-fruit; Ho- honey; Hw-Hardwood; L-leaf; Lt-latex; Mu- mushroom; P- pod; R- root; Rh- rhizome; Rs- resin; Sd- seed; Sh- shoot; St-stem; Tu-Tuber; Tw-twigs; Wp- whole plant; Ys- young shoot); Mou- mode of utilization

Figures

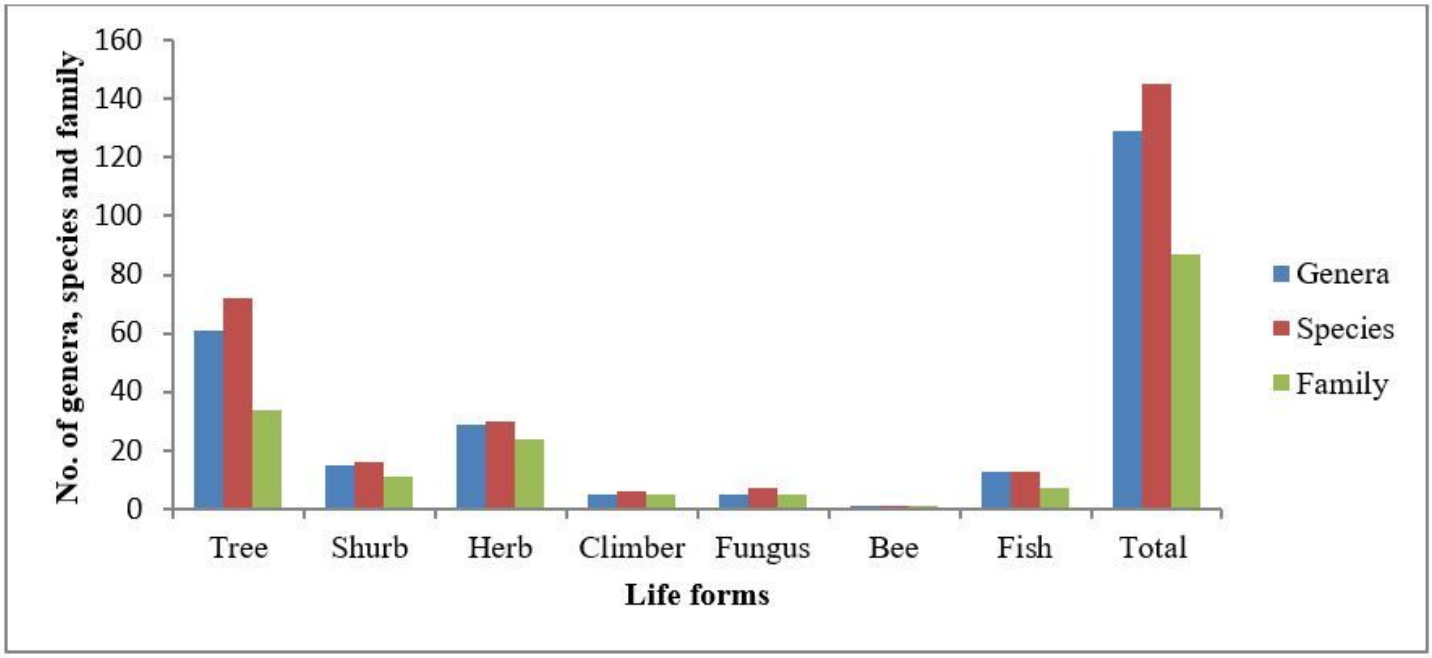

Figure 1

NTFP diversity/richness used by fringe communities of JNP

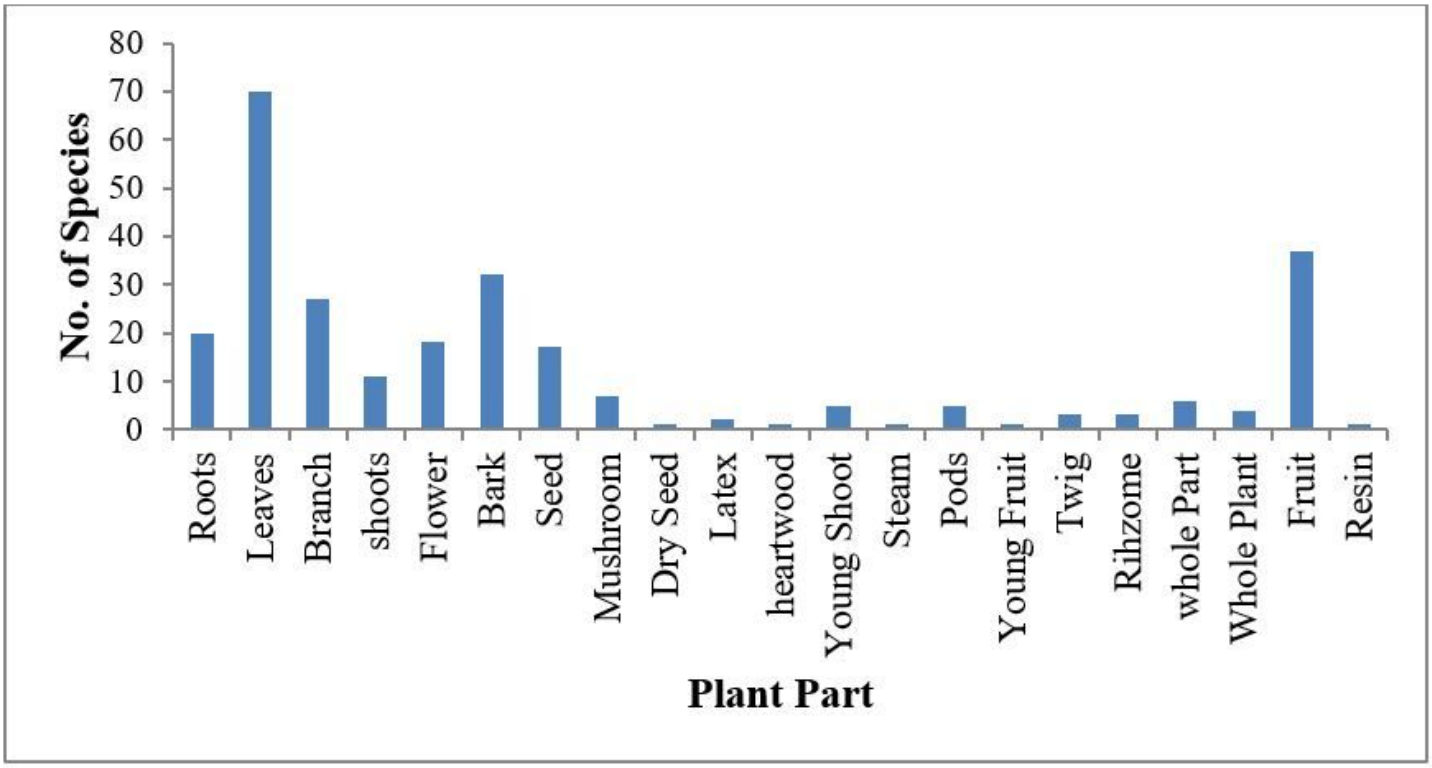

Figure 2

Plant parts used

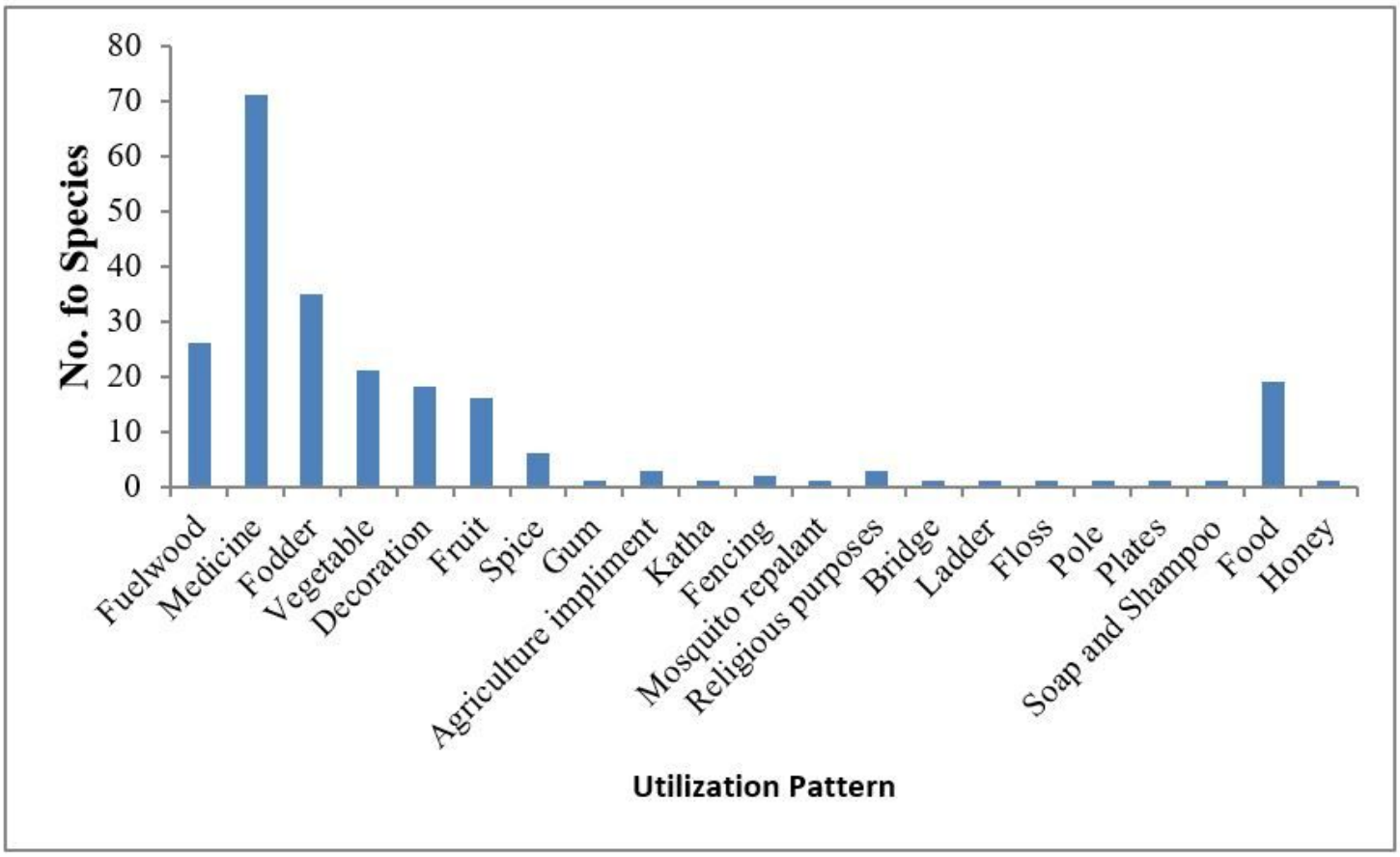

Figure 3

Mode of NTFP use