



An Ethnobotanical Study of Non-Timber Forest Products in Dorokha, Bhutan

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Author's contribution

The sole author designed, analysed, interpreted and prepared the manuscript.

Article Information

DOI: 10.9734/APRJ/2023/v11i1204

Open Peer Review History:

This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: <https://www.sdiarticle5.com/review-history/96486>

Original Research Article

Received: 19/12/2022

Accepted: 22/02/2023

Published: 18/03/2023

ABSTRACT

The knowledge of indigenous people regarding the surrounding environment, local biodiversity, and their management have helped them thrive over thousands and millions of years. The indigenous people are local successors of various cultures. Their way of linking the environment with people who have cherished cultural, traditional, environmental, economic, social, and political views is diverse among modern lifestyles. Local traditional knowledge is dependent on the communication of man with nature. Local traditional knowledge focuses on the interrelationships and communications of living entities with one another and their surrounding environment. The survey listed around 146 plant species (52 trees, 19 shrubs, 48 herbs, 5 bamboo, and 23 climbers) under 67 families and 112 genera. Out of 146 species, 6 are used for dye extractions, 6 are used for fibre extractions or as a rope, 31 are used as fodder for livestock, 5 are used as bamboo, 7 are used as fuelwood and 3 species for the broom. NTFP is also used to make agricultural equipment, consumed as snacks, vegetables, and raw fruits, made into pickles, or dried up to be used during the cold season. Out of 246 species, 71 species (22 trees, 6 shrubs, 36 herbs, and 7 climbers) belonging to 46 families and 64 genera were used as medicinal plants.

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Keywords: Traditional knowledge; wild edible plants; Dorokha; Samtse; Bhutan.

1. INTRODUCTION

Bhutan is a small landlocked kingdom between China and India. However, it is more committed to environmental conservation than most [1]. The country covers a geographical area of 38,394 km² with a population of 735,553 [2]. Environmental conservation is one of the pillars of Gross National Happiness (GNH), the national developmental philosophy of Bhutan [3]. Its constitution requires Bhutan to keep 60 % of its land under forest cover for all times to come [4,5]. Bhutan has been successful in this endeavor. 71 % of the land is covered with forest, whereas 51.4 % is under protection [6]. Bhutanese conservation efforts may be seen all around the country. Native species such as the endangered Royal Bengal Tiger, elusive Snow Leopard, exquisite Black-necked Crane, Asian Elephant, and Bhutan Takin graze freely in a million acres of protected areas [7]. Most of the benefits (around 53 %) provided by Bhutan's ecosystem are acquired by the people living outside Bhutan [8].

Bhutan enjoys a natural landscape ranging from 150 to 7,570 masl [4]. It has 8 eco-regions, 53 critical plant areas, 23 important bird areas, and 3 Ramsar sites [9]. Near Tibet (China), the northern belt has alpine meadows; the central belt has serene river valleys; and the southern belt, towards India, has fertile alluvial plains. It is divided into three eco-floristic zones: alpine (> 4,000 masl), temperate (2,000-4,000 masl), and subtropical (150-2,000 masl) zones [10]. The alpine zone is characterized by scrubs, alpine meadows, snow-capped mountains, and glacier lakes. This zone features a cold winter and a dry summer, with only 40 mm of precipitation per year. In this alpine zone, species of *Nardostachys*, *Delphinium*, *Rhodiola*, *Meconopsis*, *Onosma*, *Rhododendron*, *Juniper*, *Aconitum*, *Gentiana*, and *Dactylorhiza* thrive. The temperate zone has cold winters (4-14°C) and hot/warm summers (14-26°C) [11]. Fir forests, blue pine forests, and mixed broadleaf forests are the types of forests found in this zone. Tree species such as *Populus ciliata*, *Castanopsis*, *Taxus*, *Quercus*, and *Abies* are found in this zone. The subtropical zone has high humidity throughout the year, with temperatures ranging from 15°C to 30°C. Broadleaf forests and Chir pine forests are found in this zone [11]. Plants like *Alnus*, *Bombax*,

Aquilaria, *Shorea*, and *Tectona* thrive in these forests.

Bhutan's forest covers 71 percent of the country's area. One strict nature reserve, 4 wildlife sanctuaries, 5 national parks, and a network of biological corridors preserve approximately 51.44 % of the country's land area [12]. Bhutan is home to around 11,248 species; 5,114 species from Kingdom Animalia, 5,369 from Kingdom Plantae, 55 from Kingdom Chromista, 690 from Kingdom Fungi, 2 species from Kingdom Protista, and 18 species from Kingdom Eubacteria [7]. Bhutan has documented around 5,369 species of plants, with over 105 species being endemic to Bhutan [13]. There are currently 27 families of pteridophytes in Bhutan, with 411 species [7].

Traditional Ecological Knowledge is place-specific, and the knowledge of one community will differ based on the availability of resources, the religion they practice, and the environmental context. The literature on TEK [14-17] recognizes the presence of knowledge explicit to native people groups.

People collect essential provisioning services from the forest through Non-Timber Forest Products (NTFP) [18] NTFPs provide economic possibilities for millions of people throughout the globe [19,20]. It is the source of medicinal plants, food, fibre, dye, broom, fuelwood, construction materials, and fodder for livestock [21, 22]. Biological resources acquired from forests, primarily NTFPs, may give as much as 20–25 percent of income to rural populations in underdeveloped nations [22]. The economic potential of NTFPs, on the other hand, is extremely contextual and is determined by a combination of socio-cultural, ecological, geopolitical, and economic factors. Nonetheless, NTFP market access and sustainable harvesting are two critical elements that must be addressed for the NTFP business to flourish sustainably [23]. The demand for NTFP is growing in local, regional, and international markets.

Unsustainable harvesting is a serious issue that impacts ecological processes at many levels, from the individual to the population to the community and ecosystem [24,25]. Marshall et al. [26] discovered that product marketing and selling were the most critical variables limiting NTFP commercialization success. The authors

also discovered a clear link between market nearness and NTFP dependence; rural locations with limited market access exhibited significant NTFP dependency.

Interestingly, many of the plants with medicinal values are also edible. Out of 229 medicinal plants used in traditional Bhutanese medicine, 71 are edible [27]. The study conducted by Wangchuk et al. [28] in three villages of Zhemgang *Dzongkhag* identified 28 plant species that the residents consume. Thapa [29] found 26 edible wild species offered in fresh, dried or partially processed forms in vegetable markets and by roadside vegetable vendors. These plants are used to make herbal teas and be eaten as common vegetables. Antioxidant-rich plants like *Bidens pilosa* and *Phyllanthus emblica* are thought to provide a variety of health advantages [30]. People in Bhutan's eastern region eat *Gaultheria trichophylla* fruits, high in minerals and antioxidants [31]. *Buddleja bhutanica* leaves are the best for generating yeast for creating locally-made wine.

Lhotshampas in the south and *Khengpas* in the central south consume bamboo shoots. Bamboo shoots are a healthy food since they are low in fat and cholesterol and abundant in potassium, carbohydrate, and dietary fiber. The fermented shoots have anti-cancer qualities [32]. The consumption of mushrooms is also widespread in Bhutan. Most Bhutanese cook mushrooms mixed with cheese. Miagro et al. [33] reported around 176 macrofungi species in Bhutan. More than 30 edible mushroom species have been found in Ura and Shingkar in Bumthang, including the popular *Lyophyllum aggregatum*.

Bhutan is home to many aromatic plant species, and these species have the potential to produce varieties of oil like palmarosa oil, wintergreen oil, agar oil, lemongrass oil, clamus oil, keora oil, pine needle oil, ginger oil, champ oil, and cedar oil [34,5]. Pelbar Natural Soaps, Bhutan Natural, and Bio-Bhutan are a few private Bhutanese companies that produce and offer organic fragrance items such as herbal essence, soaps, and perfumes. Bio-Bhutan makes a lemongrass air spray using essential oil from *C. flexuosus*. The essential oils of *Brassica juncea*, *Curcuma longa*, *Z. officinale*, *Artemisia annua*, and *C. flexuosus* are used to manufacture soap. Plant oils are primarily produced in the districts of Zhemgang, Sarpang, Lhuentse, and Trashigang [35]. It is considered that planting sandalwood trees or cypress trees around the residence will

keep the disease under control. These trees contain an essential oil that has a nice fragrance and antimicrobial properties [3].

2. MATERIALS AND METHODS

2.1 Study Area

The selected study area is located in the eastern part of the Samtse Dzongkhag, which lies in southwest of Bhutan. The study area is home to *Amochhu* (Toorsa river), Bhutan's 5th major river basin. The study area has experienced some major changes in its environment in recent years as the villagers have received electricity and road connectivity from the nearest town of Samtse and Phuentsholing. The government provides rural households with 100 units of free electricity to encourage the villagers to use green energy. However, still, some villagers prefer food cooked using firewood.

To record local people's traditional knowledge and practices about the use and management of natural resources, the study was carried out in the villages of Ngagang and Boribotey under the administration of the Dophuchen and Denchukha *gewog*. Indigenous and local peoples have traditionally maintained control over resources like pastureland, crops, forests, and non-woody forest products. The broadleaf forest dominates the study region, with *Chhuzhing* (irrigated and/or bench-terraced agricultural land), *Kamzhing* (cultivated rain-fed areas), and bushes primarily found near the river Toorsa coming in third and fourth (Amochu). Orchards, a river basin, and a rocky outcrop are the least dominant features. Depending on the geography, climate, and culture, different crops are grown. It is home to the Chinese Pangolin *Manis pentadactyla* L. 1758 and the Great Hornbill *Buceros bicornis* L. 1758, which are categorized as Vulnerable and Critically Endangered on the IUCN Red List of Threatened Species, respectively [36]. Agricultural activities are the main activity in the studied area.

2.2 Data Collection and Analysis

The total respondent of the study is 54 (N=54). 53.7 % (n=29) of total respondents were male while the remaining 46.3 % (n=25) were female. The average household size was 6. Out of 54 respondents, 38.9 % (n=21) belonged to 30 to 50 years old. 35.1 % (n=19) belong to the age group of < 30 years old and 26 % (n=14) belong to the

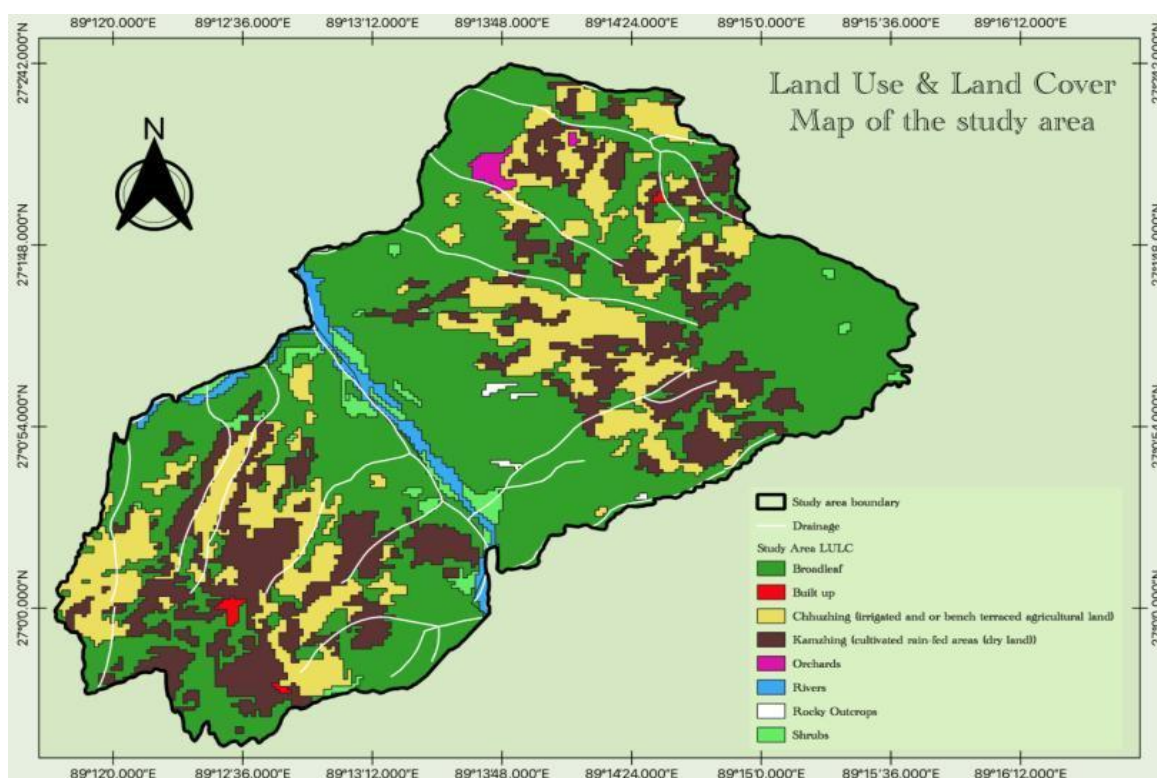


Fig. 1. Land use and land cover map of the study area (the LULC shape file was downloaded from the Bhutan Land Commission’s website, and it was analyzed using QGIS 3.22 Biatowieża software)

age group of > 50 years old. The age of the respondents is vital in this study to see the status of local traditional knowledge systems among the different age groups.

The constitutional right of receiving free education is well articulated in the concept of Gross National Happiness (GNH), the developmental philosophy of Bhutan. To achieve this objective, Non-Formal Education was established in 1992 to help those with basic literacy skills as they could not enjoy formal schooling due to personal and unavoidable circumstances. 9.25 % (n=5) respondents were illiterate, 33.33 % (n=18) had an opportunity to attend Non-Formal Education, 31.48 % (n=17) respondents attended primary education, 22.22 % (n=12) respondents had attended secondary level education, and 3.72 % (n=2) respondent attended a degree-level education. The respondent’s education level is important as it will determine their attitude towards biodiversity conservation and its integration with their traditional ecological knowledge. 22.22 % (n=12) of the respondents followed and practiced Buddhism, while 77.78 % (n=42) of respondents followed Hinduism. Religion plays a vital role in

biodiversity conservation and local traditional knowledge. Before Bhutan joined any of the world conventions and conservation agencies, she could conserve most of its biodiversity well. This is all possible because of the belief in Bonism (still natural elements are worshipped), religion, and a huge chunk of local ecological knowledge.

Google Earth Pro was used to create a CSV file of the study area. QGIS 3.22 Biatowieża was used to create maps of the study area. The data for maps were downloaded from the USGS website (<https://earthexplorer.usgs.gov/>) and Bhutan Geo-Portal (<https://www.geo.gov.bt>). Microsoft Excel was used to create graphs, tables, figures, and pie charts.

3. RESULTS AND DISCUSSION

Non-timber forest products have become a source of income, nutrition, and survival. To treat fever, people usually consume *Diplazium esculentum*, *Swertia chirata*, *Ocimum tenuiflorum*, and *Bergenia ciliata*. Whereas *Asparagus officinalis*, *Diplazium maxima*, *Cantharellus cibarius*, *Sechium edule*, *Manihot*

esculenta, and *Moringa oleifera* are consumed as vegetables by the people of Ngagang and Boribotey. Some species are used as economic and medicinal plants: *Choerospondias axillaris* is used to make pickles, consumed as raw fruit, or to treat secondary burns and anti-oxidants; *Tamarindus indica* is consumed raw, made into pickles, and is used to treat ulcer, inflammations, cough and cold disorders, and stomachache; *Moringa oleifera* is consumed as a vegetable, women use stem paste for long hair, and it also controls blood pressure; *Piper longum* is used as a spice, and it is also consumed when you have cough and cold; *Girardinia diversifolia* is used as a vegetable, and it is also used to treat headache, joint pain, chest pain,

gastric disorders, swollen body, and internal injury.

A 51 years old man says:

“For us, trees, birds, mountains, rivers, and everything in nature are sacred. From the moment you wake up to the moment you place your head on the pillow, we are blessed with the services provided by nature. So it is our responsibility to care for and sustainably use resources. When we need some herbs, leaves of a plant, or tree bark, we only extract them in small quantities. We never bring all the material at once and store it for future use, as the resource belongs to everyone.”

Table 1. Seasonal harvesting of edible and non-edible forest products

Forest products	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wild tubers												
Fuelwood												
Fruits												
Mushroom												
Resin												
Bamboo												
Fern/tree fern												
Fodder												
Cane												
Dye												

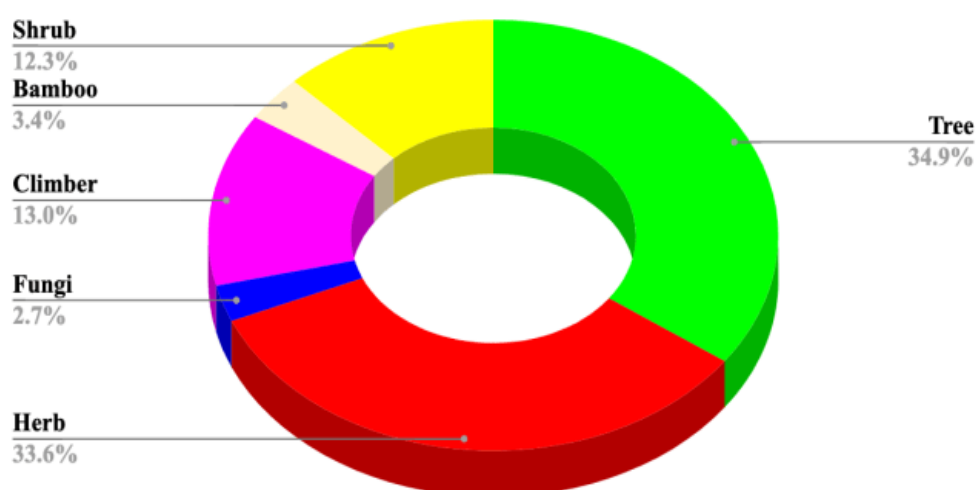


Fig. 2. Percentage of species under each habit class

The people of Ngagang and Boribotey have lived in harmony with nature for several generations. They have been enjoying the services sustainably provided by nature. However, most of the respondents express that some people overharvest the raw material, posing a threat to the local availability of the resources. To continue the availability of local resources, people have been collecting edible and non-edible forest products during their growing seasons. Wild tubers are collected between January and March as it is the right time to collect. The plant is not uprooted completely as it can give tubers next season when collecting. Fuelwood is collected throughout the year, but the villages collect more fuelwood in December, January, and February due to the cold months (Table 1).

The people of Ngagang and Boribotey in the Samtse district have a wealth of plant knowledge. Over 146 plant species were recognized and used by them. Trees were the most commonly used plants by the people in the study area (34.9 %), followed by herbs (33.6 %), climbers (13 %), shrubs (12.3 %), bamboo (3.4 %), and fungi (2.7 %) (Fig. 2). The people of Dorokha relied heavily on fruits and other portions produced from wild plants as a source of nutrition. Women collect the majority of NTFPs for household consumption.

The study area has a rich diversity and knowledge regarding plant resources. Under the tree class, 38 species are Wild Edible Plants (WEP), 23 species have medicinal value, and 18 species are used as fodder for livestock. The herb category has 37 species with medicinal value, 27 WEP species, and 7 species used as fodder for livestock. There are only four species under the fungi class. Under the climber category, 19 species have medicinal value, 17 species are WEP, and one species is used as fodder. The bamboo class has 5 and 2 species under WEP and fodder, respectively. Eighteen species have medicinal value, 12 species are WEP, and three are used as fodder under the shrub category (Fig. 3). Plants like *Mangifera indica*, *Rhus chinensis*, *Bauhinia variegata*, *Dioscorea bulbifera*, *Julgans regia*, *Cinnamomum tamala*, *Ficus religiosa*, *F. benghalensis*, *Moringa oleifera* are utilized as medicinal plants, WEP, and fodder for livestock.

To validate and check the conservation status of the species recorded from the interview data, the website of IUCN Red List of Threatened Species (<https://www.iucnredlist.org/>), Flora of

Peninsula India (<http://flora-peninsula-indica.ces.iisc.ac.in/index.php>), Global Biodiversity Information Facility (<https://www.gbif.org/>), and World Plants (<https://www.worldplants.de/world-plants-complete-list/complete-plant-list>) were referred to. IUCN Red List of Threatened Species categorises the species under nine categories: Extinct (EX), which means the species is wiped out; Extinct in the Wild (EW), when the species is wiped out from its natural habitat and are only found in ex-situ conservation; Critically Endangered (CR), when species have an extremely high risk of going extinct; Endangered (EN), when a species has very high risk of going extinct; Vulnerable (VU), when a species has high risk of going extinct; Near Threatened (NT), when a species is not categorized under threatened categories (CR, EN, VU) but are likely to be qualified in the near future; Least Concern (LC), when a species population is abundant, and there is no risk of extinction; Data Deficient (DD) when there is no enough data to place a taxon into the higher category; and Not Evaluated (NE) when the species is least studied by the researchers [37].

The species recorded from the interview data mostly fall under the category of Not Evaluated (46.5 %), followed by Least Concern (37.3 %), Data Deficient (12.7 %), Critically Endangered (1.4 %), Endangered (0.7 %), Vulnerable (0.7 %), and Near Threatened (0.7 %) (Fig. 4). The people of the study area have no knowledge of which species are common and which species' populations are decreasing.

A 70-year-old grandmother says:

“During my childhood, we collected so many edibles from the forest, and we used to know when and how much to collect. If we collect all the fruits and edibles this year, nothing will be left for next year. If we break branches and take the required resources, the branch would die, and there won't be resources for next year. Therefore, I always advise my children and grandchildren to take the required quantity only. You should know your limit. We collect fuelwood during the cold season as we need it for heating the room. Before electricity reached our village, we collected fuelwood every day as we ate the food cooked on fire, but now with 100 units of free electricity provided by the government, we don't use fuelwood during the warm season. However, sometimes I feel like eating food cooked on fire, which is when I ask my daughter-

in-law to collect some fuelwood and cook the food. However, the point is that we all should contribute in our ways to manage our sacred nature better.”

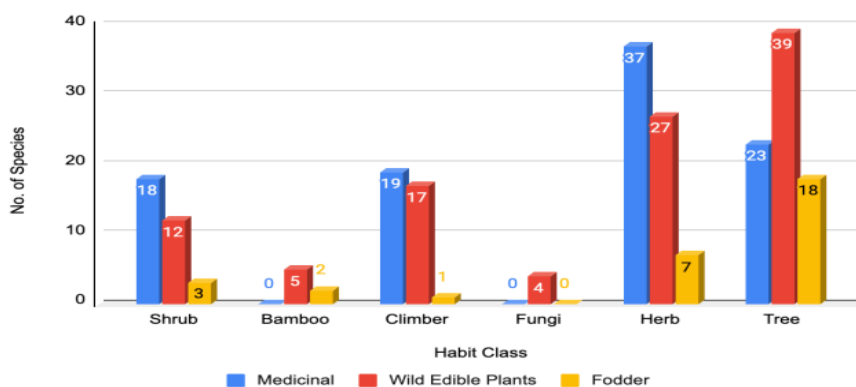


Fig. 3. Number of species under each habit class according to their uses

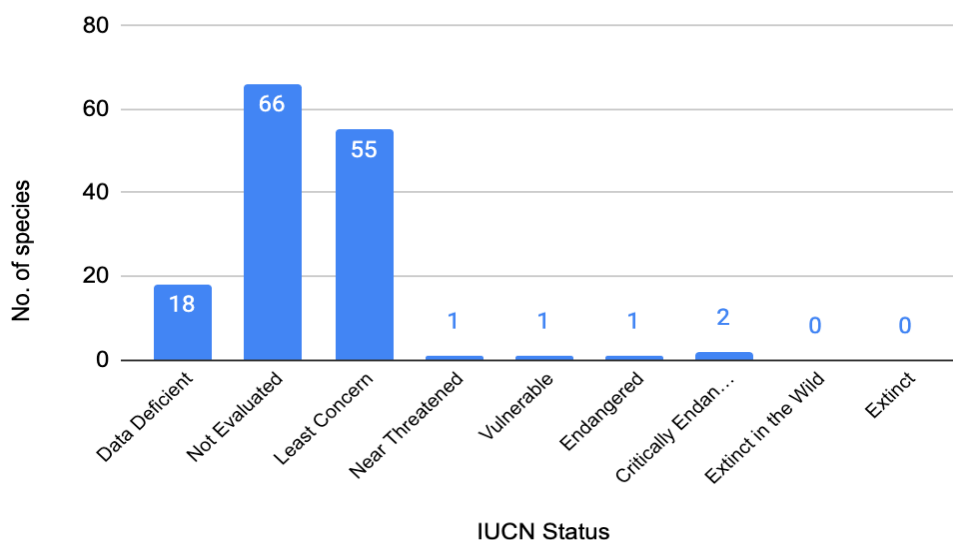


Fig. 4. The IUCN Conservation status of the species

Table 2. Top families with the most dominant species for WEP, medicinal, and fodder

Sl. No.	Wild edible plants		Medicinal		Fodder	
	Family	No. of species	Family	No. of species	Family	No. of species
1	Moraceae	7	Moraceae	7	Moraceae	7
2	Anacardiaceae	5	Asteraceae	6	Polygonaceae	2
3	Poaceae	5	Zingiberaceae	3		
4	Rutaceae	5	Urticaceae	2		
5	Cucurbitaceae	4	Saxifragaceae	2		
6	Urticaceae	4	Rubiaceae	2		
7	Piperaceae	4	Piperaceae	2		
8	Athyriaceae	3	Caesalpiaceae	2		
9	Zingiberaceae	3				

The forest is the source of wild tubers, fuelwood, fruits, mushroom, resin, bamboo, fern, fodder, can, fibre, and dye. Most people collect these edible items during the fruiting season, and if they cross that season, they don't collect or uproot it. Because of the easy access to packaged food and the nearness of the market, most people prefer packaged food over locally available resources. Because of this, only a few villagers collect edibles from the wild. Species from the family Moraceae, Anacardiaceae, Asteraceae, Poaceae, Rutaceae, etc., are most consumed, among others (Table 2).

A 37 year-years-old woman working in the school shares her opinion:

“The times are changing, and the living standards of people are also changing. There was a time when I used to hear from my parents and grandparents stories about how they had to pray to the Gods before picking or bringing anything from the forest as it was believed that everything in this universe belonged to the Gods. Because of this reason, our environment was clean, and the resource pool was managed sustainably. But slowly, I can see how our environment is getting polluted with the wrappers of packed junk food items. Everyone knows about it, and yet no one talks about it. However, I

feel like there is a drastic decrease in the use of wild food as a source of food, nutrition, and energy among the literate ones.”

Different parts of plant species are utilized for various purposes. Some of the commonly used parts of a plant are fruits, flowers, young shoots, fronds, seeds, nuts, rhizomes, bark, tuber, stems, and leaves (Fig. 5). Species like *Aloe vera*, *Ocimum tenuiflorum*, *Allium wallichii*, *Polygonum molle*, *Ulva* spp., and *Cantharellus cibarius* are fully utilized as the whole plant is used for medicinal and consumption purposes.

3.1 Traditional Knowledge of the use of Biological Resources

The people of Ngagang and Boribotey have long interacted with nature, utilizing plant and animal resources for various purposes, most of which have been done sustainably. Plants and their products are mostly used for fodder, fibre, timber, fuelwood, dye, edible oil, vegetables, and medicine. Animals or their parts have primarily been employed as medicines, furs, skins, and wool supplies. The most important traditional activities in the research region that include using various biological resources are briefly summarized below.

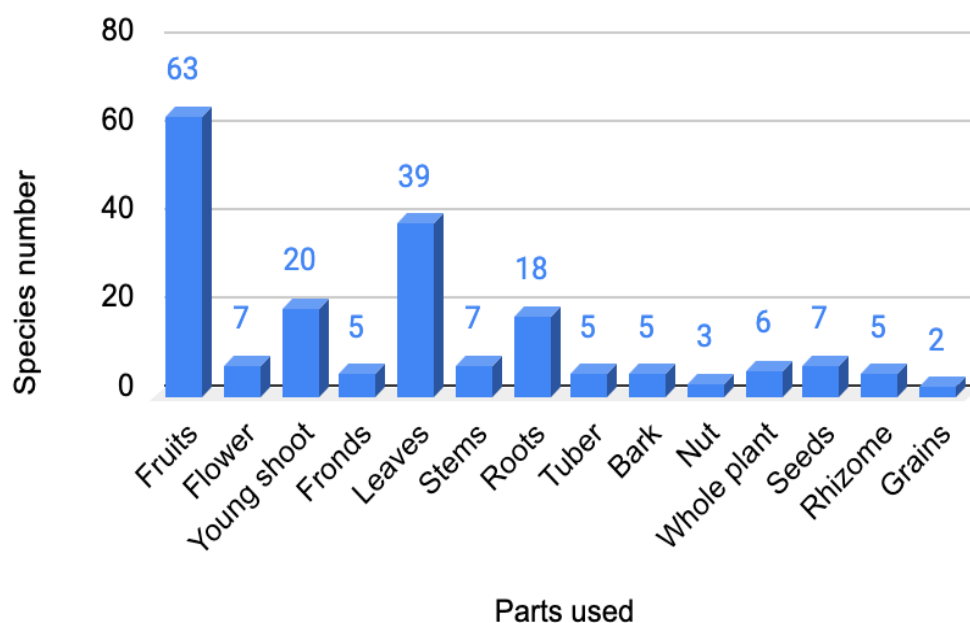


Fig. 5. Distribution of species according to their parts used

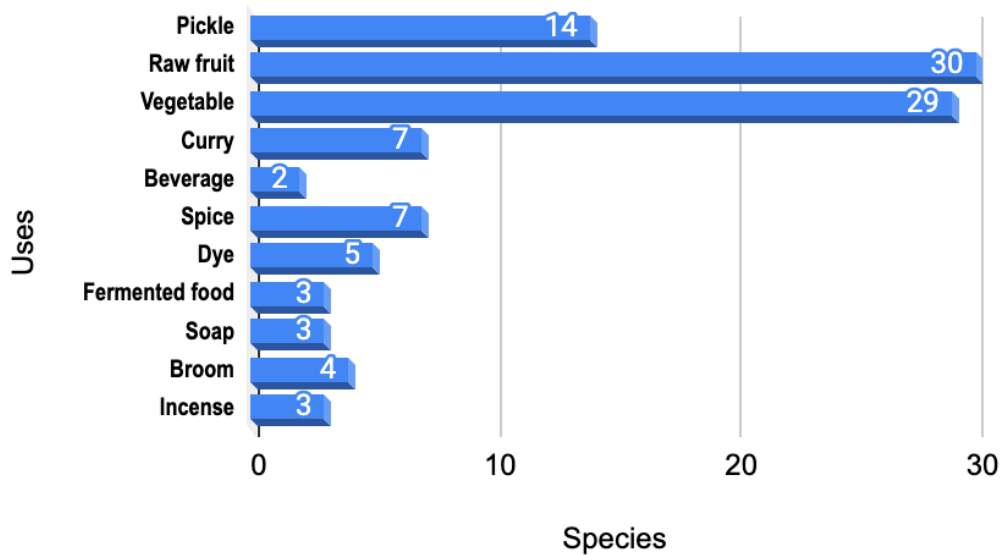


Fig. 6. Distribution of Wild Edible plants for different uses



Fig. 7. a. The preparation of Sinki from radish. b. *Manihot esculenta* (Simal tarul). c. *Diplazium esculentum* (Ningroo/nakay)

Non-timber forest products are utilized everywhere as it is the main source of nutrition and a lifesaver during the dry seasons. The people of Ngagang and Boribotey use around 140 plant species for various purposes (Fig. 6, Table 11, appendix). Around 30 species of wild plants are directly consumed, and 29 of them are used as vegetables.

3.2 Wild Vegetable

People of Ngagang and Boribotey consume more than 25 wild species as vegetables (Table 11, Appendix). Plants of *Diplazium* species (Ningroo), *Phytolacca acinosa* (Jaringo), *Dioscorea* species (Tarul), *Sechium edule* (Iskus), *Benincasa hispida* (Kubindo), *Nasturtium officinale* (Shimrayo), etc. are commonly

consumed vegetables in the study area. Either young stems or/and leaves of *Bauhinia variegata*, *Lobelia nummularia*, *Moringa oleifera*, *Piper betleoides*, *Yushania maling*, *Elatostema lineolatum*, etc. are consumed, whereas flowers of *Rhus chinensis*, *Bauhinia variegata*, *Leucosceptum canum*, *Moringa oleifera*, etc. are consumed. The *Dioscorea* species are mostly consumed as snacks after boiling them in water or consumed as vegetables. *Piper betleoides* combined with areca nut and some lime are traditionally consumed as *Doma*. Residents either dry or ferment green vegetables to deal with the lack of fresh veggies throughout the winter season. Fruits of *Spondias pinnata*, *Choerospondias axillaris*, *Mangifera indica*, *Tamarindus indica*, *Phyllanthus emblica*, *Glycine max*, *Punica granatum*, *Syzygium kurzii*,

Passiflora edulis Sims f. *flavicarpa*, *Ziziphus mauritiana*, *Persea americana*, *Prunus persica*, *Citrus medica*, and *Citrus aurantium* are either cut into small slices and dried up to be used or eaten during the off-season, made into pickles, or sold in the market for some hard currency.

Tama (made from young bamboo shoots) are used as fermented and preserved flavoring vegetables. *Gundruk* is fermented and stored from fresh leaves of *Brassica juncea* (cultivated), *Phytolacca* species, and other wild plants. The above-mentioned plant's fresh leaves are allowed to wilt in the sunlight before being beaten into smaller pieces and drained of excess water. These beaten leaves are stuffed into an airtight container and left to dry for a week in the sun. After that, the fermented leaves are removed and sun-dried for a few days. The fermented and dehydrated leaves are placed in a dry location for long-term storage.

3.3 Dye Extraction

Natural dye is used extensively in traditional Bhutanese textiles. The people of the study area use simple, different extraction methods to obtain natural vegetable color from plants and minerals. According to the household study, only 7 % of household-derived vegetable dye (Table 3). *Rhus chinensis*, *Juglans regia*, *Rubus ellipticus*, *Rubia cordifolia*, *Rubia manjith*, and *Curcuma longa* are common dye-producing plant species in the study area. The crushed root of these plants are cooked in water to extract the dye, and the colored water resulting is then used to color wool and fiber.

3.4 Fiber/Rope

The people of Ngagang and Boribotey use fibre and rope daily for farming and household tasks. *Debregeasia wallichiana* Wedd., *Dendrocalamus*

hamiltonii Gamble, and other plants make ropes and fiber. It produces a strong cane, used as a rope alternative (Table 4). The people in the study area have identified six plant species that they employ to obtain fibre (from bark) or make rope. The people of Boribotey and Ngagang use 6 species of plants for fibre extraction and making rope.

Table 3. Plants used to produce dye

Scientific name	Local name
<i>Rhus chinensis</i> Mill.	Bhakimlo
<i>Juglans regia</i> L.	Okhar
<i>Rubus ellipticus</i> Smith	Ainselu
<i>Rubia cordifolia</i> L.	Majito
<i>Rubia manjith</i> Roxb. ex Flemming	Majito
<i>Curcuma longa</i> L.	Haldi

3.5 Fodder

The Ngagang and Boribotey community's primary activity is livestock farming, and fodder plays a critical part in sustaining this activity. Cattle are raised in almost every home in Dorokha. Despite the locals grazing their cattle on their fields, more than 70% of households utilize fodder to augment grazing (Table 5). Farmers require fodder, especially in the winter when the land herbage is limited. The villagers of the study area feed their livestock with more than thirty different plant species. Fodder trees are lopped when the ground flora is exhausted during the winter. When the plants are coppicing between April and August, it is best to avoid lopping fodder trees. This is to help fodder trees to regenerate so that they would produce adequate food throughout the winter months when it is most needed. The branches are preserved and used as fuelwood when the cattle have finished eating the forage.

Table 4. Plants used for fibre/rope

Sl. no.	Scientific Name	Local Name	Uses
1	<i>Dendrocalamus hamiltonii</i> Gamble	Choya bans (Lh)	Rope
2	<i>Debregeasia wallichiana</i> Wedd.	Bahuni lahara (Lh)	Rope
3	-	Denap (Dz)	Rope, tie bundles of bamboo
4	-	Chaksela (Dz)	Fiber for cloth, rope
5	-	Nausengla (Dz)	Fiber, rope
6	-	Pagala (Dz)	Rope, fiber
Lh - Lhotshamkha, Dz - Dzongkha			

Table 5. The plant used as fodder by the people of study area

Sl. No.	Botanical name	Common name	Local name	Family	Habit
1	<i>Yushania maling</i> (Gamble) R.B.Majumdar & Karthik.	Arundinaria Maling	Malingo	Poaceae	Herb
2	<i>Ficus auriculata</i> Lour.	Roxburgh Fig	Nebera	Moraceae	Tree
3	<i>Ficus semicordata</i> Buch.-Ham. ex Smith	Drooping Fig	Khaniu	Moraceae	Tree
4	<i>Ficus neriifolia</i> Smith		Dudhilo	Moraceae	Tree
5	<i>Ficus subincisa</i> Bush.-Ham. ex Smith		Garulay	Moraceae	Tree
6	<i>Morus laevigata</i> Wall.	Common Mulberry	Kimbu	Moraceae	Tree
7	<i>Ficus carica</i> Linneaus	Common Fig	Nebharo	Moraceae	Tree
8	<i>Musa balbisiana</i> Colla	Plantain	Ban kera	Musaceae	Herb
9	<i>Boehmeria hamiltoniana</i> Wedd.		Chiplay	Urticaceae	Shrub
10	<i>Colocasia esculenta</i> (L.) Schott	Taro	Mane	Araceae	Herb
11	<i>Mallotus philippensis</i> (Lam.) Muell.	Kamala Tree	Sinduray	Euphorbiaceae	Tree
12	<i>Persicaria chinensis</i> L. H. Gross	Chinese Knotweed	Ratnewlo	Polygonaceae	Herb
13	<i>Persicaria runcinata</i> (Buch.-Ham. ex D.Don) H.Gross		Ratnewlo	Polygonaceae	Herb
14	<i>Saurauia napaulensis</i> DC		Gogun	Sauraujaceae	Tree
15	<i>Dioscorea bulbifera</i> Linneaus	Potato Yam	Ban tarul	Dioscoreaceae	Climber
16	<i>Albizia lebbek</i> (L.) Benth.	Lebbek Tree	Siris	Fabaceae	Tree
17	<i>Castanopsis hystrix</i> A.DC.	Indian Chestnut Tree	Katus	Fagaceae	Tree
18	<i>Bidens pilosa</i> Linneaus	Beggar ticks	Kalo Kuro	Asteraceae	Herb
19	<i>Fraxinus floribunda</i> Wall.		Lakuri	Oleaceae	Tree
20	<i>Cinnamomum tamala</i> (Buch.-Ham.) T. Nees & C.H. Eberm.	Indian Bay Leaf	Tez Patta	Lauraceae	Tree
21	<i>Ficus hispida</i> L.f.		Khasreto	Moraceae	Tree
22	<i>Schleichera oleosa</i> (Lour.) Oken		Kusum	Sapindaceae	Tree
23	<i>Dendrocalamus hamiltonii</i> Gamble	Hamilton's Bamboo	Choya bans/taama	Poaceae	Bamboo
24	<i>Dendrocalamus hookeri</i> Munro		Kalo bans	Poaceae	Bamboo
25	<i>Cinnamomum glaucescens</i> (Nees.) Hand.-Mazz.		Malagiri	Lauraceae	Tree
26	<i>Bauhinia variegata</i> (L.) Benth.	Mountain Ebony	Koiralo	Caesalpiniaceae	Tree
27	<i>Brassaiaopsis hainla</i> Buch.-Ham. Seem.		Chuletro	Araliaceae	Shrub
28	<i>Buddleja asiatica</i> Lour.		Phurse	Loganiaceae	Shrub
29	<i>Melia azedarach</i> L.		Bakaino	Meliaceae	Tree
30	<i>Rhus chinensis</i> Mill.	Nutgall tree	Bhakimlo	Anacardiaceae	Tree
31	<i>Girardinia diversifolia</i> (Link) Friis	Himalayan Nettle	Bhangray sisnu	Urticaceae	Herb

Table 6. Traditionally important food dishes with their preference matrix

Local Dish	Description	Appearance	Appetizing quality	Fuel efficiency	Nutrition	Preparation time	Flavour/ smell	Taste
<i>Chau</i>	Wild mushroom vegetable	4	2	2	4	2	3	5
<i>Gundruk</i>	Fermented leaves of <i>Brassica juncea</i>	2	2	3	2	4	4	3
<i>Sinki</i>	Fermented radish	3	5	3	5	5	5	5
<i>Iskus sinki</i>	Fermented Chayote	2	2	3	5	5	2	2
<i>Iskus chana</i>	Pickle made up of Chayote	2	3	0	2	4	2	2
<i>Mula chana</i>	Dry radish vegetable/pickle	2	2	0	5	2	2	5
<i>Phaphar</i>	Bread made from buckwheat	3	3	2	3	2	2	1
<i>Murai</i>	Rice soaked in water and fried	3	1	2	3	1	1	1
<i>Tama</i>	Vegetable/pickle made from bamboo shoots	4	2	3	4	4	3	2
<i>Amilo</i>	Syrup made from <i>Rhus chinensis</i> and <i>Citrus jambhiri</i>	3	2		2	3	4	4
<i>Dulay achar</i>	Powder of <i>Rhus chinensis</i> fruits mixed with chili	3	3	2	3	3	4	4
<i>Ningroo</i>	Wild fern	3	4	2	5	4	5	5

5-very good; 4-good; 3-average; 2-satisfactory; 1-bad; 0-worst

Table 7. Bamboo and cane species and their uses

Sl. no.	Scientific Name	Local Name	Uses
1	<i>Dendrocalamus sikkimensis</i> Gamble ex Oliv.	Bhalu bans	Vegetable, made into ladles, cups, and milk churners
2	<i>Dendrocalamus hamiltonii</i> Gamble	Choya bans	Fermented food, rope, winnower, fencing, and roofing
3	<i>Dendrocalamus hookeri</i> Munro	Kalo bans	Vegetable.
4	<i>Yushania maling</i> (Gamble) R.B.Majumdar & Karthik.	Malingo	Used to make mats, baskets; vegetables
5	<i>Bambusa clavata</i> Stapleton	Pagsi	Edible, made into baskets, tying material, fencing, roofing.

3.6 Traditionally Important Dishes

The people of Ngagang and Boribotey have been living in harmony with nature for over several hundred years. During the winter months, when the temperature is low and hardly anything grows, people use traditional food dishes like *Gundruk* (fermented leaves of *Brassica juncea*), *Sinki* (Fermented radish), *Iskus sinki* (fermented Chayote), *Iskus chana* (Pickle made up of Chayote), and *Mula chana* (pickle made from radish). These food items help them survive the winter months and add appetite and energy to the body (Table 6).

To prepare *Gundruk*, the leaves of *Brassica juncea* are washed properly, and it is kept to dry in the sunlight. After the water evaporates, the leaves are either put into bottles, jerry cans, or holes dug in the ground (wrapped in plastic and buried for several days). The leaves are kept like that for several days in an air-tight condition. After 15 to 30 days, it is taken out, spread out in the sun, and leaves are kept for drying. After it is dried up, it is consumed as food. It is an appetizer as the soup made from it tastes sour, and most of the villagers prefer *Gundruk* over other dishes. This also becomes a gift while visiting the house of relatives or a friend. While preparing *Sinki*, the procedure is similar to that of *Gundruk*, except it is made into smaller pieces and kept to dry in the sun. Another most preferred food item is a pickle made from *Tama* (bamboo shoots) and *achar* (Powder of fruits mixed with chili). The powdered pickle is made from the fruits of *Rhus chinensis*, lemon, *Citrus jambhiri*, and *Citrus aurantium*. Not only is the powdered pickle popular, but the pickle made from *Tama* (bamboo shoots) and *Sinki* also takes the highlight among the pickles popular in the study area. The fruits of *Rhus chinensis* and *Citrus jambhiri* are also used to make a thick syrup. The

syrup tastes sour, and it is consumed mixing with other watery fruits or is mixed into pickles to give flavor. However, the interview data showed that the art of making syrup is decreasing as syrup available on the market costs less than the one made at home.

3.7 Bamboo

Bhutan's forests are mostly undisturbed, thus, bamboo grows naturally there. This diversity is due to Bhutan's wide range of altitudes and climates. Bhutanese bamboo is mostly Himalayan and Chinese-Japanese in origin, with influences from Southeast Asia and South India. Bhutan has 30 native species of bamboo [38]. People use bamboo for various home applications and sell it for cash.

The residents of Ngagang and Boribotey use bamboo to make a variety of household products, including baskets of various sizes, rope, food/grain containers, wine/water containers, floor mats, milk churners, ladles, fences, posts and beams for dwellings, bamboo mats for building walls, roofing, prayer flag poles, and winnower. The most commonly used bamboo species by the people of Ngagang and Boribotey are *Dendrocalamus sikkimensis*, *Dendrocalamus hamiltonii*, *Yushania maling*, *Bambusa clavata*, and *Dendrocalamus hookeri* (Table 7). For consumption, the most popular bamboo is *Dendrocalamus hamiltonii*, as it has a sweet shoot. The bamboo are mostly utilized for domestic purposes, but they are also used to weave and trade or exchange handcraft for locally unavailable products. Fruit containers, milk churners, bags, rope, and baskets of various sizes are most regularly produced. Due to its appeal for handicraft and sweet shoots, *Dendrocalamus hamiltonii* is extensively cultivated and has a lot of commercial potential.



Fig. 8 a. Bamboo is used for fencing. b. Basket made from bamboo. c. Bamboo

Males primarily collect bamboo. A group of two to three persons travels to a nearby bamboo forest. Bamboo is cut at the base with *patang* (knife), sized to the required length, heaped into a bundle that each person can carry, and hauled to their homes. December, January, and February are the most popular for bamboo harvesting. During the shooting season, which runs from May to August, the villagers follow a closed season for bamboo harvesting. The study area residents cultivate the majority of bamboo species to minimize soil erosion and provide bamboo as needed by the residents. Because of its use in wine, milk, and butter container, *Dendrocalamus sikkimensis* is protected. During the fresh shooting stage, all bamboo species are protected. The people of the study area practice cyclic bamboo harvesting, which allows the harvested stock to regenerate. Only mature stems are harvested, and all clum stems are allowed to reach their full size before being chopped. Those who collect and use cane have a good understanding of the growth characteristics of the various varieties.

3.8 Agricultural Equipment

Various plant species (mainly trees) are utilized to make various farm equipment. Based on previous experience and wisdom passed down from their forefathers, they have gathered an understanding of the compatibility and durability of each variety of tree. *Schima wallichii* wood is noted for its strength, so it is used to make ploughs. Chilli grinding tools, rice pounders, knife handles, axe handles, and other farming tools are also created by the people in the study region. *Castanopsis hystris*, *Schima wallichii*, and *Shorea robusta* are the most widely utilized plant species for farming tools (Table 8). Wood was utilized by 92% of Dorokha households to build various agricultural equipment for their agriculture and other everyday needs.

3.9 Fuelwood

Firewood has been one of the most often used forest products by the people of the study area. It

is used for heating, cooking, and home lighting regularly. In the past, each household consumed around one back-load of fuelwood, but because of the 100 % electrification of the country and 100 units of free electricity for rural households, the consumption of fuelwood has decreased drastically. While men members are responsible for collecting fuelwood, female members are responsible for cooking. Almost all the woody plants can be used as fuelwood, but the people of Ngagang and Boribotey commonly use *Alnus nepalensis*, *Castanopsis hystris*, *Schima wallichii*, *Albizia lebbbeck*, *Mangifera indica*, and Bamboo for cooking and heating purposes (Table 9). In addition to fuelwood, the people gather *Meptshi* (torchwood), discovered as one of the primary sources of domestic lighting in these settlements. Many households do not have a problem collecting firewood because they live near forests. One of the primary informants claims that he can get a backload of firewood from his adjacent forest in under half an hour. Some residents have reported that collecting firewood from the forest is now forbidden (by the Forest Department). They chop off the tops, lops, and branches of trees cut for timber [39]. Fuelwood can also be harvested from dead trees. The residents of the study area used to collect firewood as and when they needed it, but now that it is becoming scarce, they gather and store it for future use. If one tree is felled for consumption, the people plant 2 to replace the tree felled.

3.10 Broom

Plants obtained from the forest are used to make brooms. *Calamus erectus*, *Thysanolaena maxima*, and *Artemisia* spp. are the most widely utilized broom plant species. Some of these plants are also used for thatching and being used as brooms (Table 10). Broom manufactured from these plants costs ranges from Ngultrum 10 to 50 depending on the thickness. Only the months of January and February are used to harvest *Thysanolaena maxima*. It falls off and does not last long, whether harvested early or later.

Table 8. Tree used for making agricultural equipment

Item	Local name	Species used
Mattock	Kutte	<i>Castanopsis hystris</i>
Spade	Kodalo	<i>Castanopsis hystris</i> , <i>Schima wallichii</i>
Sickle	Hasiya	<i>Schima wallichii</i>
Beam of plough	Harish	<i>Schima wallichii</i>
Plough	Halo	<i>Shorea robusta</i>
Axe	Bancharo	<i>Castanopsis hystris</i> , <i>Schima wallichii</i>

Table 9. Plants used for fuelwood

Scientific name	Local name
<i>Alnus nepalensis</i> D.Don.	Uttis
<i>Castanopsis hystrix</i> A.DC.	Katus
<i>Schima wallichii</i> (DC.) Korth.	Chilaune
<i>Albizia lebbeck</i> (L.) Benth.	Siris
<i>Mangifera indica</i> L.	Ban Amp
<i>Bambusa</i> spp.	Bans
<i>Dendrocalamus</i> spp.	Bans

Table 10. Plants used for broom

Scientific name	Local name
<i>Thysanolaena maxima</i> (Roxb.) Kuntze	Amliso
<i>Calamus erectus</i> Roxb.	Phegkray
<i>Artemisia indica</i> Willd.	Titepati

3.11 Other Traditional Practices

Plant resources are also used in a variety of other traditional practices. Nectar collection, honey production, and sweet (*gud*) preparation from *Diploknema butyracea* (*Chiuri*); use of *Boehmeria hamiltoniana*, *Cinnamomum glaucescens*, *Sapindus detergens* fruits as a soap substitute; hay collection and storage for the winter season; and sour syrup preparation from the fruits of *Punica* species, *Rhus* species, *Citrus* species, and others.

4. CONCLUSIONS

The study area of Ngagang and Boribotey is rich in wild edible plants and medicinal herbs. It is home to 146 species of wild edible plants and 71 species of medicinal plants as per the present survey. The Hindu-dominated study area has not only lived in harmony with nature for many generations but now preserved its local traditional knowledge base. The people of the study are dependent on non-timber forest products such as fodder species, fuelwood, medicinal plants, bamboo, wild vegetables, and other wild edible plant species. Some of the plant species are sold to generate some hard currency for the household, which aids in the improvement of livelihood security. The present was carried out to learn about the local traditional knowledge and document the wild edible plants utilized for various purposes from Ngagang and Boribotey. Interviews were conducted to understand how people integrated environmental elements into day-to-day life.

The study listed around 146 plant species (52 trees, 18 shrubs, 48 herbs, 5 bamboo, and 23 climbers) under 67 families and 112 genera. Out of 146 species, 6 species are used for dye extractions, 6 species are either used for fibre extractions or as a rope, 31 species are used as fodder for livestock, 5 species are used as bamboo, 7 species are used as fuelwood, and 3 species as a broom. NTFP is also used to make agricultural equipment, consumed as snacks, vegetables, and raw fruits, made into pickles, or dried up to be used during the cold season. Out of 246 species, 71 species (22 trees, 6 shrubs, 36 herbs, and 7 climbers) belonging to 46 families and 64 genera were used as medicinal plants.

Fifty-four individuals were interviewed for the study. They collected fodder for livestock, wild edible plants, and medicinal either for self-consumption or to generate some hard currency by selling the products in the market. If there is no proper regulatory mechanism, the wild species may deplete from over-cultivation. If there is an appropriate regulatory mechanism, the wild species can be conserved and used sustainably if there is a proper regulatory mechanism. Domestication of these wild edible plants and medicinal plants can be an option as it may reduce the pressure on the wild species. Though the Bhutan government has restricted the collection of species falling in the category of Threatened under the IUCN Red List, some pockets still illegally extract the resources.

The study will help to future researchers who wish to study the nutritional components and pharmacological activities of the plants found in the study area. It will also help in the proper planning and management of the wild edible and non-edible species. This will add to the knowledge pool of the community as there have been limited studies or literature on the subject.

CONSENT AND ETHICAL APPROVAL

All procedures were conducted according to the ethical standard of Nalanda University. Besides, consent was obtained from the respondent before the study. Full cooperation and voluntary were obtained by assuring them of the confidentiality of their involvement.

DISCLAIMER

This paper is an extended version of a preprint document of the same author.

The preprint document is available in this link: <https://www.researchsquare.com/article/rs-2467369/v1>.

COMPETING INTERESTS

Author has declared that no competing interests exist.

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APPENDIX

Table 11. Wild edible plants in the study area

Sl. No.	Botanical Name	Common Name	Family	Parts Used	Purpose		Habit	IUCN Status
					Consumption value	Medicinal value		
1	<i>Spondias pinnata</i> (L.f.) Kurz	Hog Plum, Amara (Lh)	Anacardiaceae	Fruits	Pickle, raw fruit		Tree	NE
2	<i>Choerospondias axillaris</i> (Roxb.) B.L. Burtt & A.W. Hill	Nepalese Hog Plum, Lapsi (Lh)	Anacardiaceae	Fruits	Pickle, raw fruit	Secondary burn, anti-oxidant	Tree	LC
3	<i>Mangifera indica</i> L.	Wild Mango, Ban aanp (Lh)	Anacardiaceae	Fruits	Pickle, raw fruit; Leaves are used while conducting puja	Pneumonia, stomach disorders	Tree	LC
4	<i>Rhus chinensis</i> Mill.	Nutgall tree, Bhakimlo (Lh)	Anacardiaceae	Fruits, flowers	Raw, Pickle, dye, fodder	Colic pain	Tree	LC
5	<i>Milium macrocarpa</i> Hook.f. & Thomson	Kalikat (Lh)	Annonaceae	Fruits	Raw fruit		Shrub	DD
6	<i>Colocasia esculenta</i> (L.) Schott	Taro, Mane (Lh)	Araceae		Fodder	Anti-bacterial	Herb	NE
7	<i>Acorus calamus</i> L.	Muskrat root, Bojho (Lh)	Araceae	Rhizome		Skin diseases, sore throat, toothache, tonsil, headache, skin disease, asthma	Herb	LC
8	<i>Brassaiopsis hainla</i> Buch.-Ham. Seem.	Chuletro (Lh)	Araliaceae	Shrub	Fodder		Shrub	LC
9	<i>Calamus acanthospathus</i> Griff.	Gauribet (Lh)	Arecaceae	Young shoot, fruits	Betel nuts, vegetable		Shrub	LC
10	<i>Calamus erectus</i> Roxb.	Viagra Palm, Phegray (Lh)	Arecaceae	Fruits, leaves, midribs	Betel nuts, roofing, broom		Shrub	LC

Sl. No.	Botanical Name	Common Name	Family	Parts Used	Purpose		Habit	IUCN Status
					Consumption value	Medicinal value		
11	<i>Asparagus officinalis</i> L.	Garden Asparagus, Kurilo (Lh)	Asparagoideae	Young shoot	Vegetable		Herb	LC
12	<i>Aloe vera</i> (L.) Burm.f.	Aloe vera, Ghiukumari (Lh)	Asphodelaceae	Whole plant		Skin treatment, burns, uterine disorder, jaundice, fever	Herb	NE
13	<i>Bidens pilosa</i> L.	Blackjack, Khe-peen la (Dz)	Asteraceae	Leaves	Tea leaf, fodder		Herb	NE
14	<i>Ageratum conyzoides</i> L.	Billygoat weed, Illmay (Lh)	Asteraceae	Leaves		Cut injury	Herb	LC
15	<i>Artemisia indica</i> Willd.	Titepati (Lh)	Asteraceae	Leaves	Broom	Injury, bleeding	Shrub	LC
16	<i>Eupatorium adenophorum</i> Spreng	Crofton weed, Banmara (Lh)	Asteraceae	Leaves		External injury, antiseptic	Shrub	LC
17	<i>Fagopyrum dibotrys</i> (D.Don) H.Hara	Ban Fapar (Lh)	Asteraceae	Grains, young shoots		Abdominal pain, swelling	Herb	LC
18	<i>Cyathocline purpurea</i> (Buch.-Ham. ex D.Don) Kuntze	Gal phulle (Lh)	Asteraceae	Roots, leaves, stem		Stomach pain	Herb	LC
19	<i>Diplazium esculentum</i> (Retz.) Sw.	Fiddlehead fern, Ningroo (Lh), Nakay (Dz)	Athyriaceae	Fronds	Vegetable		Herb	NE
20	<i>Diplazium maximum</i> (D.Don) C. Christensen	Nakay (Dz)	Athyriaceae	Fronds	Vegetable		Herb	DD
21	<i>Diplazium laxifrons</i> Rosenstock	Nakay (Dz)	Athyriaceae	Fronds	Vegetable		Herb	DD
22	<i>Alnus nepalensis</i> D.Don.	Nepalese Alder, Uttis (Dz)	Betulaceae	Leaves, bark	Manure	Dysentery, diarrhea, burns, wounds, cuts	Tree	NE

Sl. No.	Botanical Name	Common Name	Family	Parts Used	Purpose		Habit	IUCN Status
					Consumption value	Medicinal value		
23	<i>Oroxylum indicum</i> (L.) Benth. ex Kurz	Indian Trumpet Flower, Totla (Lh)	Bignoniaceae	Flowers, leaves	Important while conducting <i>puja</i>	Jaundice, gastric, tumors	Tree	NE
24	<i>Nasturtium officinale</i> W.T.Aiton	Watercress, Shimrayo (Lh)	Brassicaceae	Leaves, stems, fruits	Raw, vegetable		Herb	DD
25	<i>Cardamine hirsuta</i> L.	Hairy Bittercress, Shimrayo (Lh)	Brassicaceae	Young shoot		Low blood pressure	Herb	NE
26	<i>Canarium strictum</i> Roxb.	Black Dhup, Gokul dhup (Lh)	Burseraceae		Gum is used for Incense. People believe that burning incense of this gum would drive out the evil spirit.		Tree	NE
27	<i>Tamarindus indica</i> L.	Tamarind, Titri (Lh)	Caesalpiniaceae	Fruits	Raw, pickle	Ulcer, inflammations, cough and cold disorders, stomachache	Tree	NE
28	<i>Bauhinia variegata</i> (L.) Benth.	Mountain Ebony, Koiralo (Lh)	Caesalpiniaceae	Leaves, flowers, young shoot	Curry, pickle, fodder	Skin disease, stomach pain, ulcer, diarrhea, dysentery	Tree	LC
29	<i>Bauhinia vahlii</i> Wight & Arn.	Malu Creeper, Bharla (Lh)	Caesalpiniaceae	Seeds, leaves		Dysentery	Climber	NE
30	<i>Lobelia nummularia</i> Lam.	Common Pratia, Tilikosya (Lh)	Campanulaceae	Leaves, young shoots	Vegetable	Irregular mensuration, stomachache, scabies, swellings, boils, infected eyes	Herb	NE
31	<i>Drymaria diandra</i> Blume	Abijalo (Lh)	Caryophyllaceae	Young shoot		Throat pain, Pneumonia	Herb	NE
32	<i>Cannabis sativa</i> L.	Marijuana, Ganja (Lh)	Cannabaceae	Seeds		Indigestion, improves eyesight, insomnia, severe pain	Herb	NE

Sl. No.	Botanical Name	Common Name	Family	Parts Used	Purpose		Habit	IUCN Status
					Consumption value	Medicinal value		
33	<i>Cantharellus cibarius</i> Fries	Sisi shamu (Dz)	Cantharellaceae	Whole plant	Vegetable		Fungi	DD
34	<i>Terminalia chebula</i> Retzius	Gall Nut, Harra (Lh)	Combretaceae	Fruits	Salad, fried		Tree	NE
35	<i>Corylus ferox</i> Wall.	Himalayan Hazlenut, Thekiphal (Lh)	Corylaceae	Fruits	Raw		Tree	LC
36	<i>Sechium edule</i> (Jacq.) Sw.	Chayote, Iskus (Lh)	Cucurbitaceae	Fruits, young shoot, roots	Vegetable		Climber	NE
37	<i>Luffa aegyptiaca</i> Mill	Luffa Sponge, Ghiroula (Lh)	Cucurbitaceae	Fruits	Vegetable, Sponge		Climber	NE
38	<i>Momordica cochinchinensis</i> (Lour.) Spreng	Ban karala (Lh)	Cucurbitaceae	Fruits	Curry		Climber	NE
39	<i>Benincasa hispida</i> (Thunb.) Cong	Wax Gourd, Kubindo (Lh)	Cucurbitaceae	Fruits	Vegetable, pickle		Climber	NE
40	<i>Momordica charantia</i> L.	Bitter gourd, Tite karala (Lh)	Cucurbitaceae	Fruits, leaves		Blood purifier, control diabetes, treat bleeding, gastric troubles	Climber	NE
41	<i>Dioscorea bulbifera</i> L.	Potato Yam, Githa (Lh)	Dioscoreaceae	Tuber	Curry, boil, fodder	Used as an appetizer, stomachic, aphrodisiac	Climber	NE
42	<i>Dioscorea alata</i> L.	Purple Yam, Ghar tarul (Lh)	Dioscoreaceae	Tuber	Curry, boil		Climber	NE
43	<i>Dioscorea esculenta</i> Lour.	Lesser Yam, Ban tarul (Lh)	Dioscoreaceae	Tuber	Curry, boil		Climber	NE
44	<i>Dioscorea hamiltonii</i> Hook.f.	Ban tarul (Lh)	Dioscoreaceae	Tuber	Curry, boil		Climber	NE

Sl. No.	Botanical Name	Common Name	Family	Parts Used	Purpose		Habit	IUCN Status
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45	<i>Shorea robusta</i> Roth	Sal Tree, Sala (Lh)	Dipterocarpaceae	Young shoot, bark	Fermented food		Tree	LC
46	<i>Elaeocarpus lanceifolius</i> Roxb.	Bhadrasay (Lh)	Elaeocarpaceae	Fruits	Food		Tree	LC
47	<i>Elaeocarpus sikkimensis</i> Mast.	Bhadrasay (Lh)	Elaeocarpaceae	Fruits	Food		Tree	DD
48	<i>Elaeocarpus sphericus</i> (Gaert.) Schum.	Rudrakshay (Lh)	Elaeocarpaceae	Fruits	Customary rosary		Tree	LC
49	<i>Manihot esculenta</i> Crantz	Cassava, Simal tarul (Lh)	Euphorbiaceae	Roots	Beverage, Vegetable		Shrub	NE
50	<i>Phyllanthus emblica</i> L.	Indian Gooseberry, Amla (Lh)	Euphorbiaceae	Fruits, leaves	Raw, pickle, incense	Cough and cold, jaundice, asthma, urinary discharge, liver complaint, eye trouble, diarrhea	Tree	LC
51	<i>Mallotus philippensis</i> (Lam.) Muell.	Kamala Tree, Sinduray (Lh)	Euphorbiaceae		Fodder		Tree	NE
52	<i>Euphorbia hirta</i> L.	Hairy Spurge, Dodhe Jhar (Lh)	Euphorbiaceae	Roots		Piles, skin burn, antiseptic	Herb	NE
53	<i>Glycine max</i> (L.) Merr.	Bhatmas (Lh)	Fabaceae	Fruits	Raw, vegetable		Herb	LC
54	<i>Albizia lebbeck</i> (L.) Benth.	Lebbek Tree, Siris (Lh)	Fabaceae		Fodder		Tree	LC
55	<i>Senna tora</i> (L.) Roxb.		Fabaceae			Leprosy, ringworm, snakebites	Herb	NE
56	<i>Castanopsis hystrix</i> A.DC.	Indian Chestnut Tree, Katus (Lh)	Fagaceae	Fruits, young shoot	Roasted and eaten, vegetable, fodder, agriculture tool		Tree	LC

Sl. No.	Botanical Name	Common Name	Family	Parts Used	Purpose		Habit	IUCN Status
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57	<i>Garcinia cowa</i> Roxb.	Cowa Fruit, Kaphal (Lh)	Guttiferae	Fruits	Raw fruit	Relieve fevers, dysentery	Tree	NE
58	<i>Juglans regia</i> L.	Common Walnut, Okhar (Lh)	Juglandaceae	Nut	Raw, dye; At bhâi tikâ during the Hindu festival of tihâr, women place walnuts in the doorways of houses. When cracked, these are believed to kill local demons.	Pneumonia, wounds, throat pain, chest pain	Tree	NE
59	<i>Mentha spicata</i> L.	Spearmint, Pudina (Lh)	Lamiaceae	Leaves	Raw, cooked	Digestive problems, Obesity, fever, asthma, cough and cold	Herb	LC
60	<i>Ocimum tenuiflorum</i> L.	Holy Basil, Tulsi (Lh)	Lamiaceae	Whole plant	Worshipped as wife of Lord Vishnu	Malaria, diarrhea, skin disease, painful eye disease, insect bite, chronic fever, snake bite, asthma, mouth ulcer	Herb	LC
61	<i>Leucosceptrum canum</i> Sm.	Hairy White-wand, Ghurpis (Lh)	Laminaceae	Flowers	Vegetable		Shrub	LC
62	<i>Persea fructifera</i> Kosterm.	Pham-fhal (Lh)	Lauraceae	Fruits	Raw fruit		Tree	DD
63	<i>Cinnamomum tamala</i> (Buch.-Ham.) T. Nees & C.H. Eberm.	Indian Bay Leaf, Tez patta (Lh)	Lauraceae	Leaves, bark	Spice, fodder	Cough and cold, Allergy, Diarrhea, Stomachache, stomach gas	Tree	NE
64	<i>Cinnamomum glaucescens</i> (Nees.)	Malagiri (Lh)	Lauraceae	Fruits	Oil, soap, fodder; used seldom its		Tree	LC

Sl. No.	Botanical Name	Common Name	Family	Parts Used	Purpose		Habit	IUCN Status
					Consumption value	Medicinal value		
		Hand.-Mazz.				heartwood chips as incense		
65	<i>Allium wallichii</i> Kunth	Dung-dunge (Lh)	Liliaceae	Whole plant		Pickle, vegetable	Herb	LC
66	<i>Buddleja asiatica</i> Lour.	Phurse (Lh)	Loganiaceae			Fodder	Shrub	LC
67	<i>Punica granatum</i> L.	Pomegranate, Darim (Lh)	Lythraceae	Fruits		Fever, heart disease, sore throat, dysentery, diarrhea	Tree	LC
68	<i>Osbeckia crinita</i> Benth ex. Triana	Hairy Osbeckia	Melastomataceae	Roots, leaves		Appetizer, helps in digestion, toothache	Shrub	DD
69	<i>Melia azedarach</i> L.	Bakaino (Lh)	Meliaceae			Fodder	Tree	LC
70	<i>Entada pursaetha</i> Benth	Pangro (Lh)	Mimosaceae	Seeds		Skin disease, treat mumps, powder act as anti-dandruff agents	Climber	DD
71	<i>Ficus religiosa</i> Forssk.	Sacred Fig, Pipal (Lh)	Moraceae	Fruits		Food, beverage, Used in puja	Tree	NE
72	<i>Ficus benghalensis</i> L.	Banyan Fig, Bar (Lh)	Moraceae	Leaves		Wrapping, Used in puja	Tree	NE
73	<i>Ficus auriculata</i> Lour.	Roxburgh Fig, Nebera (Lh)	Moraceae	Fronds, fruits		Food, fodder	Tree	LC
						Constipation, warts		

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74	<i>Ficus hispida</i> L.f.	Khasreto (Lh)	Moraceae	Fruits	Vegetable, pickle, fodder		Tree	LC
75	<i>Ficus semicordata</i> Buch.-Ham. ex Smith	Drooping Fig, Khaniu (Lh)	Moraceae	Fruits	Food, fodder	Boils, cuts, scabies	Tree	LC
76	<i>Ficus neriifolia</i> Smith	Dudhilo (Lh)	Moraceae		Fodder		Tree	DD
77	<i>Ficus subincisa</i> Bush.-Ham. ex Smith	Garulay (Lh)	Moraceae		Fodder		Tree	NE
78	<i>Ficus carica</i> L.	Nebharo (Lh)	Moraceae		Fodder		Tree	LC
79	<i>Ficus benjamina</i> L.	Weeping fig, Kabra (Lh)	Moraceae	Rhizome		Applied on boils	Tree	LC
80	<i>Morus laevigata</i> Wall.	Common Mulberry, Sano Kimbu (Lh)	Moraceae	Fruits	Raw, fodder		Shrub	DD
81	<i>Artocarpus heterophyllus</i> Lam.	Jackfruit, Rukh katar (Lh)	Moraceae	Rhizome		Boils, fractured bones	Tree	NE
82	<i>Morus australis</i> Poir.	Common Mulberry, Sano Kimbu (Lh)	Moraceae	Bark, leaves, seeds		Soar throat, foot cracks	Shrub	NE
83	<i>Moringa oleifera</i> Lam.	Drumstick Tree, Sajana (Lh)	Moringaceae	Fruits, flowers, leaves	Vegetable, stem paste used by women for long hairs	Control blood pressure, tuberculosis	Tree	LC
84	<i>Musa balbisiana</i> Colla	Plantain, Ban kera (Lh)	Musaceae	Fruits	Vegetable, pickle, fodder		Herb	LC
85	<i>Syzygium kurzii</i> (Duthie) N.P.Balacr.	Ambakey (Lh)	Myrtaceae	Fruits	Raw		Herb	LC
86	<i>Fraxinus floribunda</i> Wall.	East India Ash, Lakuri (Lh)	Oleaceae		Fodder		Tree	LC
87	<i>Oxalis corniculata</i> L.	Crepping Wood Sorrel, Chariamailo (Lh)	Oxalidaceae	Leaves		Influenza, fever, snake bites, diarrhoea	Herb	NE

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88	<i>Pandanus nepalensis</i> H.St.John	Himalayan Screw Pine, Tarika (Lh)	Pandanaceae	Fruits	Raw fruit		Tree	LC
89	<i>Abrus precatorius</i> L.	Rosary Pea, Lalgheri (Lh)	Papilionaceae	Seeds		Removes dust from eyes	Herb	NE
90	<i>Passiflora edulis</i> Sims f. <i>flavicarpa</i> O. Deg	Lilikoi/Passionfruit, Aap Ihari (Lh)	Passifloraceae	Fruits	Raw		Climber	NE
91	<i>Phytolacca acinosa</i> Roxb.	Indian Pokeweed, Jaringo (Lh)	Phytolaccaceae	Leaves	Curry, vegetable	Boils, sores, urinary disorders	Herb	NE
92	<i>Piper betleoides</i> C. DC.	Betel Leaf, Paan (Lh)	Piperaceae	Leaves	Eaten with areca nuts		Climber	NE
93	<i>Piper mullesua</i> Buch.-Ham. ex D.Don	Hill Pepper, Pipla (Lh)	Piperaceae	Fruits	Raw	Cough and cold	Climber	NE
94	<i>Piper hamiltonii</i> C.DC.		Piperaceae		Spice		Climber	NE
95	<i>Piper longum</i> L.	Long pepper, Pipla (Lh)	Piperaceae	Fruits	Spice	Cough and cold	Herb	NE
96	<i>Picrorhiza kurroa</i> Royle ex Benth.	Kutki (Lh)	Plantaginaceae	Roots		Cuts, wounds, bruises, injuries, sore throat, cough and cold	Herb	EN
97	<i>Gigantochloa nigrociliata</i> (Buse) Kurz	Tabah (Lh)	Poaceae	Young shoot	Vegetable		Herb	NE
98	<i>Dendrocalamus sikkimensis</i> Gamble ex Oliv.	Giant Bamboo, Bhalu bans (Lh)	Poaceae	Young shoot	Vegetable, made into a ladle, cup, milk churner		Bamboo	NE
99	<i>Dendrocalamus hamiltonii</i> Gamble	Hamilton's Bamboo, Choya bans (Lh)	Poaceae	Young shoot	Fermented food, rope, winnower, fencing, roofing, fodder		Bamboo	NE

Sl. No.	Botanical Name	Common Name	Family	Parts Used	Purpose		Habit	IUCN Status
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100	<i>Dendrocalamus hookeri</i> Munro	Kalo bans (Lh)	Poaceae	Young shoot	Vegetable, fodder		Bamboo	NE
101	<i>Thysanolaena maxima</i> (Roxb.) Kuntze	Broom grass, Amliso (Lh)	Poaceae	Fruits	Broom		Shrub	NE
102	<i>Yushania maling</i> (Gamble) R.B.Majumdar & Karthik.	Arundinaria Maling, Malingo (Lh)	Poaceae	Young shoot, leaves	Use to make mats, baskets, vegetable, fodder		Bamboo	NE
103	<i>Cynodon dactylon</i> (L.) Pers.	Bermuda Grass, Dubo (Lh)	Poaceae	Roots, leaves	Used during bhâi tikâ	Scabies, cut, wound, piles, body pain, liver cirrhosis, diarrhea, dysentery	Herb	NE
104	<i>Bambusa clavata</i> Stapleton	Pagsi (Dz)	Poaceae	Shoot	Edible, made into a basket, tying material, fencing, roofing		Bamboo	VU
105	<i>Nephrolepis tuberosa</i> Bory ex Willd.	Pani Amla (Lh)	Polypodiaceae	Tubers	Raw	Kidney troubles	Herb	NE
106	<i>Rumex nepalensis</i> Spreng.	Nepal Dock, Halhalay (Lh)	Polygonaceae	Young shoot	Food	Purifies blood, poisoning, kills worm, relieves swelling, fever	Herb	NE
107	<i>Polygonum molle</i> D.Don	Thothne (Lh)	Polygonaceae	Whole plant	Raw, pickle		Herb	DD
108	<i>Persicaria chinensis</i> L. H. Gross	Chinese Knotweed, Ratnewlo (Lh)	Polygonaceae		Fodder		Herb	NE
109	<i>Persicaria runcinata</i> (Buch.-Ham. ex D.Don) H.Gross	Ratnewlo (Lh)	Polygonaceae		Fodder		Herb	NE
110	<i>Ziziphus mauritiana</i> Lam.	Indian Plum, Bayar (Lh)	Rhamnaceae	Fruits	Raw, Pickle	Dysentery	Shrub	LC

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111	<i>Persea americana</i> Miller	Avocado, Naspatti (Lh)	Rosaceae	Fruits	Raw fruit		Tree	LC
112	<i>Rubus ellipticus</i> Smith	Golden Himalayan Raspberry, Ainselu (Lh)	Rosaceae	Fruits	Raw fruit, dye	Typhoid, measles, gastric, sinusitis	Shrub	LC
113	<i>Prunus persica</i> (L.) Batsch.	Peach, Kham (Lh)	Rosaceae	Fruits, kernel, flowers		Constipation, dries pus, heals sores, treat hair loss	Tree	DD
114	<i>Rubia cordifolia</i> L.	Common Maddar, Majito (Lh)	Rubiaceae		Dye	Blood disorders, reduce swelling	Climber	NE
115	<i>Rubia manjith</i> Roxb. ex Flemming	Majito (Lh)	Rubiaceae	Roots	Dye	Skin disease, boils, chest problem, menstrual disorders, snake bite, scorpion bite, skin disease	Climber	NE
116	<i>Citrus aurantium</i> L.	Bitter Orange, Kali jyamir (Lh)	Rutaceae	Fruits	Raw fruit		Tree	NE
117	<i>Citrus jambhirir</i> Lush.	Rough lemon, Jyamir (Lh)	Rutaceae	Fruits	Raw, pickle		Tree	LC
118	<i>Aegle marmelos</i> Corrêa	Bael Tree, Belasi (Lh)	Rutaceae	Fruits	Raw fruit		Tree	NT
119	<i>Zanthoxylum armatum</i> de Candolle	Rattan Pepper, Timur (Lh)	Rutaceae	Seeds	Spice	Stomachache, gastric problem	Climber	LC
120	<i>Citrus medica</i> L.	Citron, Bimiro (Lh)	Rutaceae	Fruits	Raw fruit		Tree	LC
121	<i>Citrus reticulata</i> Blanco	Mandarin orange, Suntala (Lh)	Rutaceae	Fruits	Pulp		Tree	LC
122	<i>Pyralia edulis</i> (Wallich) A. Candolle	Umphi (Lh)	Santalaceae	Fruits	Oil		Shrub	LC
123	<i>Schleichera oleosa</i> (Lour.) Oken	Kusum (Lh)	Sapindaceae	Fruits	Raw, fodder		Tree	LC
124	<i>Sapindus detergens</i> Wall	Ritha (Lh)	Sapindaceae	Fruits	Traditional soap		Shrub	LC

Sl. No.	Botanical Name	Common Name	Family	Parts Used	Purpose		Habit	IUCN Status
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125	<i>Diploknema butyracea</i> (Roxb.) H.J. Lam	Indian Butter Tree, Chiuri (Lh)	Sapotaceae	Fruits	Raw fruit		Tree	NE
126	<i>Saurauia napaulensis</i> DC	Gogun (Lh)	Sauraujaceae	Fruits	Raw fruit, fodder		Tree	LC
127	<i>Houttuynia cordata</i> Thunb.	Chameleon Plant	Saururaceae	Leaves, roots	Vegetable, pickle		Herb	NE
128	<i>Astilbe rivularis</i> Buch.-Ham.	River Astilbe, Buro okhati (Lh)	Saxifragaceae	Roots, leaves		Wound, fever, dysentery, back pain, throat pain, waist pain, bleeding at pre and post-pregnancy, toothache, blood purifier	Herb	NE
129	<i>Bergenia ciliata</i> (Haw.) Starnb.	Pakhanbhed (Lh)	Saxifragaceae	Roots		Stomache, heart disease, wounds, boils, body ache, cough and cold, eye infection, fever, diarrhea	Herb	LC
130	<i>Selaginella delicatula</i> (Desv. ex Poir.) Alston		Selaginellaceae	Leaves		Wound	Herb	NE
131	<i>Schima wallichii</i> (DC.) Korth.	Needlewood tree, Chilaune (Lh)	Theaceae	Bark	Agriculture tool	Anthetmintic, fever, stomachache, bone fracture	Tree	LC
132	<i>Aquilaria malaccensis</i> Lam.	Eaglewood, Agori (Lh)	Thymelaeaceae	Heartwood		Refrigerant for a heart disorder, sedative, useful for nervous system disorder and nervine	Tree	CR

Sl. No.	Botanical Name	Common Name	Family	Parts Used	Purpose		Habit	IUCN Status
					Consumption value	Medicinal value		
133	<i>Ulva</i> spp.	Algae, Laue (Lh)	Ulvaceae	Whole plant	Vegetable		Herb	LC
134	<i>Girardinia diversifolia</i> (Link) Friis	Himalayan Nettle, Bhangray sisnu (Lh)	Urticaceae	Young shoot	Vegetable, fodder	Headache, joint pain, chest pain, gastric disorders, swollen body, internal injury	Herb	NE
135	<i>Laportea terminalis</i> Wight	Patley sisnu (Lh)	Urticaceae	Young shoot			Herb	NE
136	<i>Debregeasia wallichiana</i> Wedd.	Bahuni lahara (Lh)	Urticaceae	Fruits	Rope		Tree	DD
137	<i>Boehmeria hamiltoniana</i> Wedd.	Chiplay (Lh)	Urticaceae	Roots	To make traditional soap, fodder		Shrub	DD
138	<i>Elatostema lineolatum</i> Wight	Damroo (Lh/Dz)	Urticaceae	Stems, leaves	Vegetable	Fracture	Herb	NE
139	<i>Nardostachys grandiflora</i> Wall. ex DC.	Indian Nard, Jatamansi (Lh)	Valerianaceae	Roots		Fever, headache, cough and cold	Herb	CR
140	<i>Cissus adnata</i> Roxb.	Charchare (Lh)	Vitaceae	Fruits			Climber	NE
141	<i>Amomum subulatum</i> Roxb.	Black Cardamom, Bada alaichi (Lh)	Zingiberaceae	Seeds	Spice	Indigestion, teeth and gum infection, scorpion sting, insect bites	Herb	DD
142	<i>Curcuma longa</i> L.	Turmeric, Haldi (Lh)	Zingiberaceae	Rhizome	Spice, dye	Relieve digestive problems, sore throat, fractured bone, cough, irritable bowel disease, respiratory problems	Herb	DD
143	<i>Zingiber officinale</i> Rosc.	Ginger, Aduwa (Lh)	Zingiberaceae	Rhizome	Spice	Heart disease, throat pain, asthma, headache, cough and cold, joint pain	Herb	DD

Sl. No.	Botanical Name	Common Name	Family	Parts Used	Purpose		Habit	IUCN Status
					Consumption value	Medicinal value		
144		Denap (Dz)			Rope, tie bundles of bamboo		Climber	
145		Chaksela (Dz)			Fiber for cloth, rope		Climber	
146		Nausengla (Dz)			Fiber, rope		Climber	
147		Pagala (Dz)			Rope, fibre.		Climber	

Dz - Dzongkha, Lh - Lhotshamkha, Sh - Sharpchopkha, NE - Not Evaluated, DD - Data Deficient, LC - Least Concern, NT - Near Threatened, VU - Vulnerable, EN - Endangered, CR - Critically Endangered

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