

Species Richness and Use Values of Wild and Non-cultivated Vegetables in Nepal

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Abstracts

Forest always remains very important source for collecting diverse types of resources including vegetables. Vegetables collected from wild and around farming areas without seeding and caring are defined as wild and non-cultivated vegetables. Their distribution, values and harvesting months varied across the country. This study therefore was conducted to assess the status of wild vegetables along with their use values and availability in different districts. Information were collected through focus group discussion in 30 districts and key informant survey in 11 districts. This information was further updated and verified in many literatures and websites. The number of species was estimated for different altitude ranges and districts. The highest number of species was observed in Bagmati Province whereas the lowest in Madhesh Province. We have reported a total of 334 species from 99 families, out of which, the highest vegetable species were recorded from Fabaceae (21 species) and Polygonaceae (20 species) family. Based on plant parts used, 116 species were leafy vegetables. Maximum vegetable diversity (211 species) is available in June. The hotspot areas for diversity were identified based on the number of species and farmers' responses and this information would be very useful for conservation plan. Many wild vegetables are very useful to sustain the farming and consumer communities across the country. Some of them can easily be domesticated and marketed widely. Conservation experts, researchers, breeders and policy makers should plan to prioritize wild vegetable species for domestication, in-situ and ex-situ conservation and use in breeding program.

Keywords: Distribution, harvest month, use form, wild vegetables

Introduction

Nepal is located in South Asia between China in the north and India in the south, east and west. This is in central part of the Himalayas between 26°22' and 30°27' North latitudes and 80°04' and 88°12' East longitudes, with diverse topography and climate covering 118 ecosystems and 35 forest types. The country can be divided into five major physiographic zones, namely the High Himal, High Mountain, Middle Mountain (or Mid Hill), Siwalik (or Chure) and the Tarai plain (MoFSC, 2014). The elevation in Nepal ranges from 60 meters above sea level in the eastern alluvial plain to 8,848.86 meters at the Mount Everest. This variation creates huge diversity in flora and fauna. Nepal is the home of an extensive number of species of flora and fauna that are important from national and global perspective (Joshi, 2014). Both cultivated and wild edible plant species are many and within species many genetic diversities have been reported from Nepal (Joshi et al., 2020, Upadhyay and Joshi, 2003). It is very common practices of collecting wild edible plant species since ancient time from forest and around farm areas in Nepal.

Forest is the most important asset that provides the basic necessities and the second major source of Nepal's income after agriculture (Ghimiray et al 2010). Forest represents an important repository of food and other resources eg, herbs, spices, timber, fuel wood, fodder, green manure, pesticides and several other sources of livelihoods and wellbeing. Nepali forest has been used for numerous purposes and one of the tribes in Nepal called Raute still depends mostly on forest resources for their livelihoods.

All physiographic zones in Nepal, except High Himal (above 6000 m), have several types of wild edible plants. Most of the people residing in rural area & close to forest are more acquainted with wild edible plants. Senior citizens and indigenous ethnic peoples who live near to forest resources have a huge knowledge on large numbers of plant species. These plant species have been used for centuries for many different purposes. Many of the edible wild plants are staple food items that are used for vegetables and pickles, beverages, fruits, spices and condiments and medicinal purposes. Wild and non-cultivated edible plants other than timbers, are found naturally in the forest and surroundings the farm lands, have nutritive and medicinal values and have been used for fulfilling dietary requirements. The Food and Agriculture Organization (FAO) has defined it as “the plants that grow spontaneously in self-maintaining populations in natural or semi-natural ecosystems and can exist independently of direct human action” (FAO 1999). These plants have important contributions to the food security and livelihood by providing the staple and supplement foods and income generating opportunities to the local communities. These plants have additional importance to the rural, ethnic, poor and marginalized people even in the age of modernized world. As wild edible plants (WEPs) are in the wild state, the number, abundance, density and availability of many of these plants are still unknown to the public, except some of the researchers and the communities who have been continuously utilizing them for their livelihood and well-being (Dongol 2017). Very few of them are domesticated for vegetables, spices and condiments, medicines, religious purposes and other food items.

Among the wild edible plants, wild and non-cultivated vegetables are very important components that are tremendously used by Nepalese people since immemorial. Many types of forest creation, both timber and non-timber products, fungi, ferns and allied species, herbs and creepers are being collected and used as vegetables, spices and condiments. Dangol et al (2017) reported that 246 spp of wild plants are being used as vegetables. These vegetables can be grouped as root and tuber, fruit, leafy, young shoot, flower, flower bud, tender part and twig vegetables. Among them the most popular are wild fern, edible mushrooms, bamboo shoots and wild yams. Some of these vegetables are culturally importance eg wild yam is very commonly eaten in *Maghe Sakranti*, a festival celebrated as New Year by Magar and Tharu ethnic communities. Bamboo shoot (Tama) is very famous among women to celebrate Teej festival. There is also a culture of taking wild taro as vegetable by female devotees after worshipping Rishi Panchami. However, many different factors have now thretended the wild species and associated traditional knowledge. Understanding the status of wild edible plants are very important for planning conservation works, exploring economic values, breedings and value addition. Distribution, values and harvesting months of wild and non-cultivated vegetables species varied across the districts. This study therefore was conducted to assess the status of wild vegetables along with their use values and availability in different districts of Nepal.

Methodology

This study was conducted by collecting primary as well as secondary data along with authors' experiences. Primary information were collected through Focus Group Discussion (FGD) in 30 different districts namely Humla, Jumla, Doti, Dadeldhura, Bardiya, Baitadi, Dolpa, Gulmi, Banke, Dang, Surkhet, Rupendehi, Kapilvastu, Kaski, Lumjung, Tanahu, Gorkha, Dolakha, Kathmandu, Bhaktapur, Lalitpur, Rasuwa, Nuwakot, Dhanusha, Ilam, Sunsari, Morang, Dhankuta, Bhojpur and Tehrathum. Key Informants Survey (KIS) was also carried out in 11 different districts to further verify the information generated through FGD. Information was gathered from four physiographic regions namely High Mountain, Mid-hill, Siwalik/Chure and Tarai. Purposive sampling was done to acquire data with subjective judgment and consultation with experts. Additional information were collected from literatures and online databases. The survey data were further verified through literatures and online database. The major consulted literatures were Bastakoti and Sharma 2008, Ghimire et al 2008, Shrestha 1998, MoFSC 2016, MoFC1982, Limbu and Thapa 2011, Poudel and Joshi 2020. The website visited for information collection and verification were <http://tropical.theferns.info/>, <http://temperate.theferns.info/>, <http://flowersofindia.net/>, <http://www.plantsoftheworldonline.org/>, <https://gobotany.nativeplanttrust.org/>, <http://www.naturalmedicinalherbs.net/>, <https://pfaf.org/user/Default.aspx>, <https://www.prota4u.org/database/>, <https://indiabiodiversity.org/species/list>, http://www.efloras.org/flora_page.aspx?flora_id=110, http://www.efloras.org/flora_page.aspx?flora_id=2, <https://www.catalogueoflife.org>.

From each surveyed district, total number of species were listed. The family-wise richness was estimated. The number of species available for consumption was listed for each month. These species were further grouped based

on use form eg vegetables, pickles, salads and dried. Species frequency was estimated for different altitude ranges, districts, plant parts used and different habitats/types.

Results

Due to the different ecosystem and micro climatic variation, the number of species of wild and non cultivated vegetables (WnCVs) varied across the districts and provinces of Nepal. A total of 334 species of wild and non-cultivated vegetables (WnCVs) have been found in 30 districts out of 77 districts of Nepal. The highest number of species were recorded in Bagmati province (174 species in Figure 2) followed in Lumbini (167 species) and Kanali (135 species) province. The least number of species (35) were observed in Province 2. Three districts in Bagmati province, namely Kathmandu, Bhaktapur and Lalitpur have the highest number of WnCVs (96 species) followed by Kapilvastu, Rupandhei, Surkhet, Bardiya, Banke and Dang. 19 and 4 species were reported from Dolakha and Dolpa districts respectively.

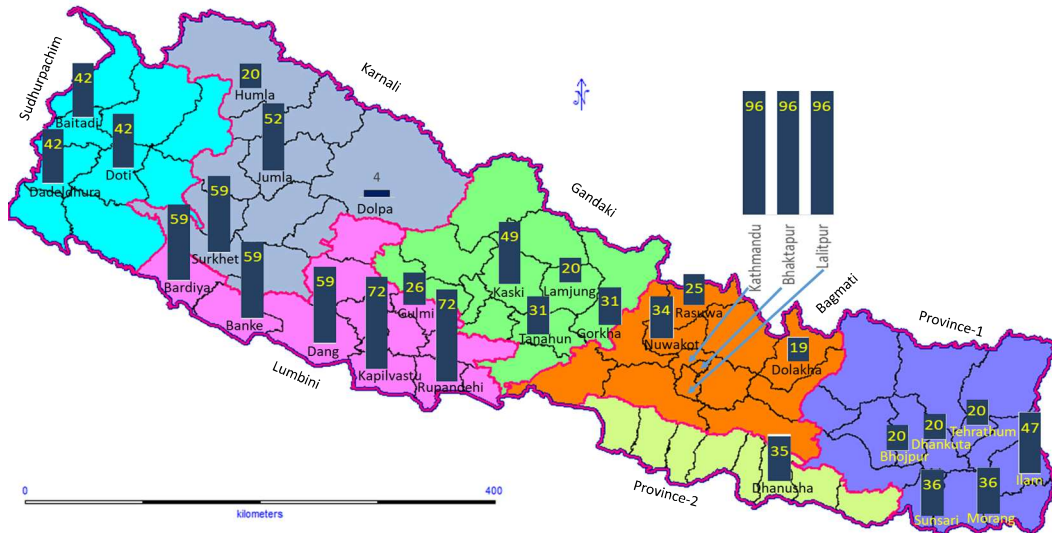


Figure 1. Distribution of wild and non-domesticated vegetables (figures in bars are number of species observed) in Nepal

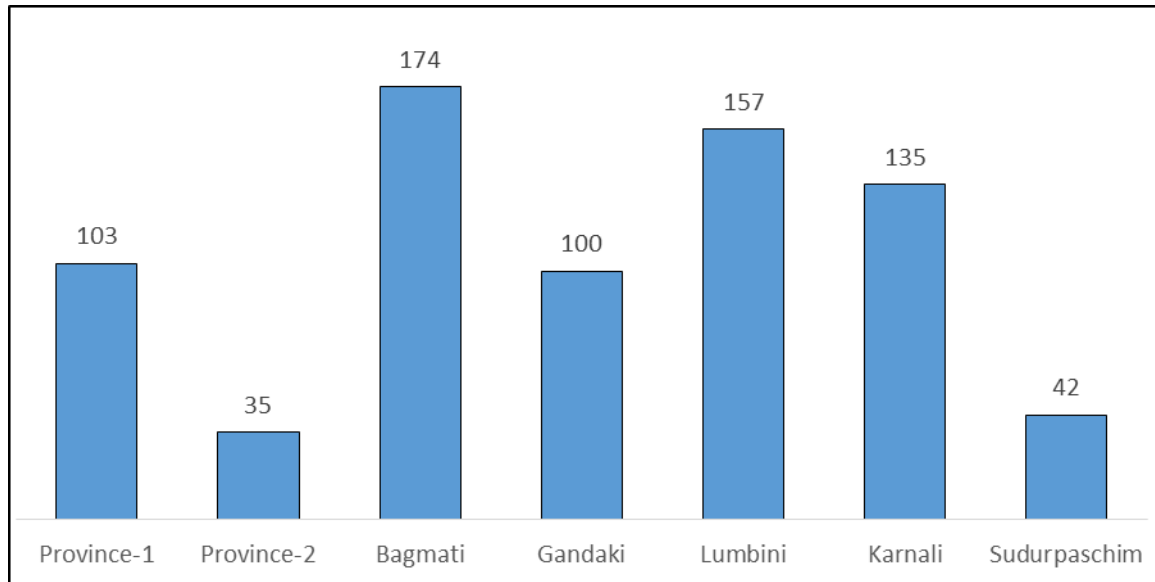


Figure 2. Province-wise frequency distribution of studied species of wild vegetables in Nepal

Based on the altitude, the highest number of species (216) were found within the range of 501-1000 m. The number of species have been decreased gradually as the altitude increased. The least number of species were recorded above 3500 m altitude. The species diversity was higher in mid range altitude.

These 334 species were distributed in 99 families (Table 1). These species belong to Angiosperms (264 species of 69 families), fungi (33 species of 18 families) and pteridophytes (33 species of 12 families). Of the total families, the most dominant one is Fabaceae with 21 species, followed by Polygonaceae (19 spp.), Araceae (14 spp.), Apiaceae (13 spp.), Dioscoreaceae (13 spp.), Urticaceae (10 spp.), Amaranthaceae (9 spp.), Brassicaceae, Compositae and Poaceae (with 8 species each) (Table 1). 18 and 47 families contain two and a single species respectively.

Table 1. Number of wild edible vegetables in different families

SN	Family	Number of species	SN	Family	Number of species
1	Acanthaceae	2	51	Lamiaceae	4
2	Adoxaceae	1	52	Lardizabakaceae	1
3	Agaricaceae	2	53	Liliaceae	6
4	Aizoaceae	1	54	Lyophyllaceae	2
5	Amanitaceae	2	55	Malvaceae	7
6	Amaranthaceae	9	56	Meripilaceae	1
7	Amaryllidaceae	6	57	Moraceae	7
8	Anacardiaceae	4	58	Morchellaceae	3
9	Anthericaceae	1	59	Moringaceae	1
10	Apiaceae	13	60	Musaceae	3
11	Apocynaceae	2	61	Nyctaginaceae	2
12	Araceae	14	62	Omphalotaceae	1
13	Araliaceae	1	63	Ophioglossaceae	6
14	Arecaceae	2	64	Osmundaceae	1
15	Asclepiadaceae	1	65	Oxalidaceae	2
16	Asparagaceae	6	66	Papaveraceae	1
17	Aspidiaceae	4	67	Parkeriaceae	1
18	Asteraceae	12	68	Phyllanthaceae	1
19	Athyriaceae	4	69	Physalacriaceae	2
20	Auriculariaceae	2	70	Phytolaccaceae	1
21	Balsaminaceae	1	71	Piperaceae	1
22	Basellaceae	1	72	Plantaginaceae	1
23	Begoniaceae	1	73	Pleurotaceae	4
24	Berberidaceae	1	74	Poaceae	8
25	Bignoniaceae	1	75	Polygonaceae	19
26	Blechnaceae	1	76	Polyporaceae	1
27	Boraginaceae	1	77	Portulacaceae	1
28	Brassicaceae	8	78	Primulaceae	1
29	Capparaceae	4	79	Pteridaceae	1
30	Cyatheaceae	2	80	Ranunculaceae	5
31	Chenopodiaceae	2	81	Rosaceae	1
32	Cleomaceae	1	82	Rubiaceae	4
33	Colchicaceae	1	83	Russulaceae	2
34	Combretaceae	1	84	Rutaceae	2
35	Commelinaceae	3	85	Sapotaceae	1
36	Convolvulaceae	3	86	Saururaceae	1
37	Cucurbitaceae	6	87	Schizaeaceae	2
38	Dilleniaceae	2	88	Sclerodermataceae	1
39	Dioscoreaceae	13	89	Smilacaceae	6

SN	Family	Number of species	SN	Family	Number of species
40	Dryopteridaceae	7	90	Solanaceae	7
41	Ericaceae	1	91	Strophariaceae	3
42	Euphorbiaceae	3	92	Tectariaceae	1
43	Exobasidiaceae	1	93	Tricholomataceae	2
44	Fabaceae	21	94	Typhaceae	2
45	Gomphaceae	1	95	Urticaceae	10
46	Grifolaceae	1	96	Valerianaceae	2
47	Hericiaceae	2	97	Vitaceae	1
48	Hydnaceae	2	98	Woodsiaceae	3
49	Hydrangiaceae	1	99	Zingiberaceae	1
50	Icacinaeae	1			

Of the total species, herbs are the highest in number (165 spp) followed by shrubs (38 spp) (Figure 3). Other life forms of wild edible plants are trees (37 spp), climbers (30 spp) and rest are fern and fungi. These species were further grouped based on the use forms, eg pickle, raw, spice, vegetable (as cooked), etc. Maximum number of species (274 spp) were used as vegetables (Figure 4). A total of 35 species have been used as pickle, 19 species as spices, 16 species as staple food and 11 species as raw.

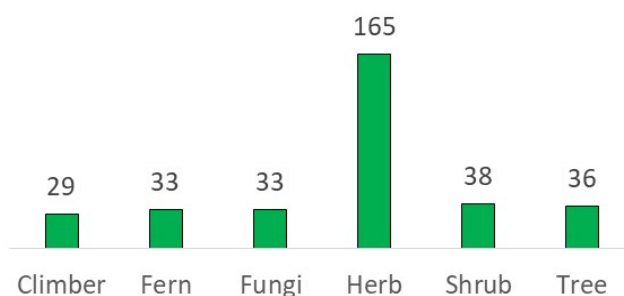


Figure 3. Growth habit/ type-wise frequency distribution of wild vegetable species

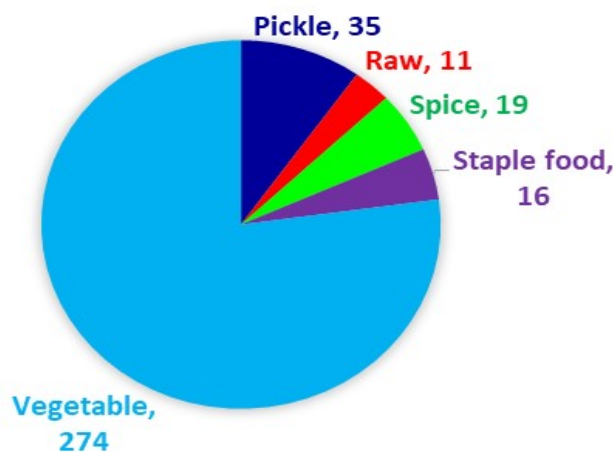


Figure 4. Number of species used in different forms

Majority of the households in the surveyed areas consume WnCVs in each month. These WnCVs have very important role on providing tasty and organic vegetables to many people. Some of these vegetables have medicinal values. Diversity in WnCVs also meets the diverse needs of farming communities. Farmers are very familiar with the importance, collection time and cooking methods of all these vegetables. Some vegetables are also kept dried for future use and sale. Due to natural products, their market value is also higher than other cultivated vegetables. Poor people generally collect and sale WnCVs.

Discussion

Diversity of WnCVs varied across the country. Diversity in such vegetables is decreasing over the year and amount per harvest in each species is also decreasing. Very few species now can be found around farming areas with the care of farmers. Species diversity is higher in mid hill compare to high hill and Tarai. Mid hill is climatically diverse and possess higher variation in micro climate. Due to lack of proper guidelines and policy framework, many species are being ignored in the conservation perspective. Forest areas including other public areas should be managed well for the continuity of such WnCVs and different conservation approaches (Joshi et al 2020) should be applied for them. Currently 44.74% of total land area is covered by forest in Nepal (NPC 2019). The existence of 118 different types of ecosystems is the major drivers to create and maintain diversity in WnCVs. These ecosystem harbors 3.2% of the world's flora that includes 5.1% of gymnosperms and 8.2% of bryophytes (MoFSC, 2014).

These WnCVs are free and without any inputs and investment from human, farmers and consumers who collect regularly for their home requirement as well as for income generation. Because of natural products, these vegetables considered very healthy and tasty. Due to diverse species and diverse parts used as vegetables, they are nutritionally good. Some species is specifically associated with certain function, conditional consumptions and specific occasion. WnCVs play great role in both food and nutritional security and means of income generating by collecting and selling the WnCVs. In these days most of the people living in city areas are demanding forest products as WnCVs were commonly used by them in their previous village home.

Main two drivers of threatening WnCVs are loss and degradation of natural habitats and over exploitation and illegal exploitation. Loss and degraded habitat, invasion by alien plant species, unplanned infrastructure construction, forest fire and unsustainable harvesting procedure/practices are some issues that trigger to genetic loss in the forest and as around farming areas. Most of the people are still unaware about sustainable way to collection, regeneration and management practices. Conservation awareness of the local people including consumer and policy makers must be increased and strengthened. Disturbance from invasive alien plant is another threat to maintain the diversity of WnCVs. There are 219 alien plant species recorded from Nepal and 26 are recognized as threats to the native biodiversity including WnCVs (Shrestha et al 2017, Tiwari et al 2005).

Widespread mining of gravel from streams and river beds has been emerged as a major threat as well. High dam construction during hydro power project has also caused deforestation and forest degradation in the mid hills and Siwalik region. Natural disasters, such as landslides, glacial lake outburst floods and drought pose considerable threat to mountain ecosystems. Climate change can have profound impacts in the future, particularly in the mountains. Forest fire has adverse ecological and economic impacts and is a major concern for losing WnCVs. In Nepal, forests in more than 30 districts face damage due to forest fires. An effective fire detection and monitoring system is an important component of forest fire management. (ICIMOD, 2019).

Large number of species of WnCVs are consumed across the country. Popularity and consumption pattern seems location specific. However, bamboo shoots (*Tama/Tusa*), ferns (*Niuro*), mushrooms (*Chyau*) and wild yam (*Ban Tarul*) are the most common and extensively used and liked by the people everywhere. How much amount of WnCVs collected, what percentage of the demand of vegetable replaced by them and contribution in national GDP are still lacking. Even rules and regulations are lacking for harvesting and managing such nature gifted importance vegetables. The trade of wild and non-cultivated vegetables is not well documented although the collection and marketing are very common and continued across the country. The forestry sector in Nepal contributes about 15% of the national GDP, of which about 5% is contributed by non timber forest product (NTFP). Majority of the WnCVs are NTFP.

Conservation and management of WnCVs are challenged by various factors. The major conservation issues are over-harvesting, forest degradation, landslide, firing, haphazard cutting, etc. Many people even could not recognize the species. In many species, further diversity below species taxon are very poorly understood. All level diversity are necessary to assess for effective management and utilization. Habitat destruction, livestock grazing, forest fires, etc. are responsible for the loss of many species. Depletion of many species has also been attributed to the lack of comprehensive policies and regulations for sustainable collection, use, trade and management. Rural, indigenous ethnic group and senior citizens have great information and knowledge on these species as they are using these

commodities generation to generations. Active participation of community in conservation activity is very important.

Conclusion

Wild and non-cultivated vegetables play a significant role for human beings. The availability of diverse vegetables all the months are the indication of greater role on providing nutritious and healthy natural products to human. The dependency on natural resource is much higher in mountain and agrarian countries like Nepal. Due to high dependency, many such species are at risk of extinction. Population size of such species is very commonly decreasing each year. This study comprehensively explored and illustrated the availability of the WnCVs across the country however, their nutritive value and contribution in national economy (GDP) is still lacking, which is very critical to justify the importance. It is only possible through collaborative efforts of all concerned stakeholders. These WnCVs have greater role on food and nutrition security along with maintaining the healthy and dynamic environment however, their management is almost neglected in all areas. Conservation and management of these species should be given due emphasis. Some of them can be easily domesticated which help to diversify the conventional food system. Status of these species need to monitor at regular time period so that effective management practices can be imposed on time. Policy framework on better managing such diversity both in wild and farming land is needed.

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