



Wild edible plants associated with the people of Thoubal Khunou village and its migrated villagers.

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Abstract

Thoubal Khunou is one of the isolated villages residing in the Thoubal district of Manipur since they are being outcasted by society and settled in a particular area for a long time. Due to the long isolation period, they have shown variations in their socio-economic, cultural and religious, and education from the rest of Manipur. So, It would be highly beneficial to study and analyze their different behaviors as a case study to know their relationships with nature in different aspects such as livelihoods, food consumption, medicine, and health. Here, in particular, the importance of wild edible plants is discussed using statistical relations also. Classification of species according the Preference Ranking, their mode of consumptions and seasonal values are also discussed here.

Keywords: Thoubal Khunou, Wild edible plants, Ethnobotanical study, *Yaithibi*, Statistical methods

Introduction

Billions of people in many countries don't have adequate food to supply their daily needs and many people are also facing a deficiency of micronutrients (FAO,2004). Therefore, wild edible plants are one of the best options for food supplements. Commonly, in rural communities, wild resources are important to fulfill the food required during a food crisis. The diversity in wild edible plants gives variety to many people's diets and contributes to domestic food security. Various articles (Kathambi *et al.*, 1999; Guijt *et al.*, 1995; Balemite *et al.*, 2006) were published and give details about the edible wild plants in different

countries' specific areas. A study conducted in Zimbabwe (Wilson, 1990) revealed that some poor households rely on wild fruits as an alternative to cultivated food for a quarter of all dry season's meals. In Swaziland, wild plants are still of great importance and contribute a greater share to the annual diet than domesticated crops (Ogle *et al.*, 1985). Various reports also noted that many wild edibles are nutritionally rich (Campbell, 1986) and can supplement nutritional requirements, especially vitamins and micronutrients. Nutritional analysis of some wild food plants demonstrates that in many cases the nutritional quality of wild plants is comparable and, in some cases, even superior to domesticated varieties.

Manipur is one of the states amongst North-East India having 23°59'-25°47'N Latitudes and 92°59'-94°46' E Longitudes. It has an area of 23,327 km² and a population of around 3.1 million according to the data published by <https://www.populationu.com>. In Manipur, 64% of the geographical area is occupied by natural vegetation and it consists of various edible wild plants. Manipur state is surrounded by hills and is divided into 16 districts. People residing in remote areas purely rely on their surroundings for their needs like food, medicine, woods, etc. Due to the impact given by the environment towards the socio-economic condition of the people living in that area, it is necessary to overlook the ethnobotanical studies so that theoretically able to evaluate the ethnobotanical factors of the various plant according to their used preference by the community. Due to its geographical location, there are varieties of wild edibles plants available in Manipur but the investigation regarding the wild edible plants and their various applications in Manipur is still at the stage of the nursery.

In this view, the present articles focus on the investigations of various wild edible plants available the Thoubal Khunou, Lousi *Yaithibi*, and Kamu *Yaithibi* areas and further document the numbers of plant species used by the locals for their traditional usage. Various statistical methods like relative frequency citation (RFC) and preference ranking (PR) will be used to quantify the data collected. It will also help to find out the novel usage of many plants which are not available in other areas so that their chemical nature can be effectively studied for further development.

Methodology

Study area

Thoubal Khunou (24.675560 latitudes N, 93.998688 longitude E) is one of the isolated villages under the Thoubal district of the Manipur. According to the villagers, people living in this village were once outcasted during the early time in the history of Manipur and they were settled in this remote area for many years. The village is surrounded by many hills where they can graze their cattle and also collected many herbs, plants for consumption and medicinal purpose. Due to the rapid urbanization and modernization, they are now able to connect with villages but still, they have remained as lower caste in the society. This village has been available with a variety of wild edible seasonal and non-seasonal

plants. The main settlement village has an area of around 301.64 hectares. Some of the villagers started migration towards the area of Kamu *Yaithibi* and *Lousi Yaithibi*. A cross-sectional ethnobotanical study of wild edible plant species was conducted from January 2017 to March 2019. About 90 people of Thoubal Khunou were randomly selected as informative.

Climate and topography

The climatic condition of Thoubal Khunou is characterized as moderate. It has a sub-tropical climate with a slightly longer summer along with the rainy season and followed by a distinct winter season for nearly 3 months. Due to being surrounded by hilly regions, the daytime is slightly shorter than the nearby areas. During April-June, summer starts, and the temperature is started to elevate in the range of 24-34°C. January is the coldest month of this area with a minimum temperature of 7°C and a maximum temperature of around 20°C.

Ethnographic background

Since they are an outcast ethnic group residing in Manipur, their culture is somewhat different from the surrounding villages due to the long isolation period. They share the same language with neighboring villages but having different speaking tones due to the isolated confinement during history. But, also, some of them were even converted into Christianity with time. This ethnic group is named *Yaithibi* (Hemlet, 2001) by the Meitei society. Some of the villagers are resettled in the areas of Kamu *Yaithibi* and Lousi *Yaithibi* with few populations.

Socio-economic status

Most of the inhabitants of the area are in extreme poverty and their livelihoods depend mainly on agriculture, rearing of livestock, production of hatched items, fuelwood production as well as collecting medicinal plants from the hills.

Data collection and analysis

A cross-sectional ethnobotanical study of wild edible plant species was conducted seasonally from January 2017 to March 2018 since many of the wild edible plants are available during a particular season only. About 90 informants of Thoubal Khunou were randomly selected for ethnobotanical data. Among the

informants, there are 50 men (56%) and 40 women (44%) as shown in Table 1. After receiving the required proper permission from the village chief, an ethnobotanical survey was conducted with the help of local elders who have a good understanding of traditional knowledge of wild edible plants. During the whole stage of the survey, the ethical guidelines described by the ISE (International Society of Ethnobiology) were strictly followed. A series of interviews with the local elders were carried out to extract the wealthy knowledge regarding the different available wild plants and their edible parts which was passed down to generations through generations. In addition, an interview was done for multiple usages for the collected plants also. By using the relative frequency citation index (RFCi) to estimate the

relative significance of a particular species. Mathematically, RFCi is calculated from the Frequency of Citation (FCi), which is given by the total number of informants who named the particular use of a species) divided by the total numbers of informants during the study. The preference ranking (PRi) (Alex *et al.*, 2005; Abbas *et al.*, 2016) of the various species according to their tastes are also calculated using the available methods with the variation of values from 1-3, with the highest taste preference gets 3 and 1 for the lowest taste preference. After the thorough analysis of the plant species with the already available data, each specimen was numbered separately and stored in the plant collection centre of the CMJ University, Jorabat, Meghayala, India.

Table 1. Age group, number of male and female informants in different age groups

Age group	No. of informants	No. of Males	No. of Females	Percentage
30-40	15	8	7	16.67
41-50	22	12	10	24.44
51-60	29	15	14	32.22
61- Above	24	15	9	26.66

Results and Discussion

Most of the wild edible plants available in Manipur are seasonal i.e. some plants are grown in summer and some plants are grown in winter. So, if we used wild edible plants wisely there are no problems for food lacking crisis. Some of the plants are used for medicinal (folk medicine and pharmacological value)

purposes since ancient times and above the used for edible purposes. Table 2 shows the list of wild edible plants collecting from the Thoubal Khunou and its migrated villagers settled at Kamu *Yaithibi* and Lousi *Yaithibi* and their mode of usage. The details of these plants will be discussed later.

Table 2. List of species along with their vernacular names, family, and mode of consumption

Sl no	Scientific name	Vernacular name	Family	Mode of use	RFCi	PRi
1	<i>Alisma plantago-aquatica L</i>	<i>Kaothum</i>	<i>Alisma-ceae</i>	<i>Cooked or fresh rhizome is eaten</i>	0.25	2
2	<i>Allium hookeri Thw</i>	<i>Maroi napakpi</i>	<i>Liliaceae</i>	<i>The whole plant used as vegetables and spices especially leaves are commonly used as a garnish and flavouring.</i>	0.19	1
3	<i>Alocasia macrorrhiza (Lour) Schott</i>	<i>Hongngu</i>	<i>Araceae</i>	<i>The petiole are crushed along with dry small fishes and the paste is dried and eaten after cooked and the dried slices of the rhizome is used as chips</i>	0.35	3

4	<i>Alpinia allughas</i> Rose	<i>Pullei</i>	Zingiberaceae	Boiled rhizome with water and soup is widely used. Eromba (a special dish) made by Rhizome and pseudostem in traditional style is also used.	0.16	1
5	<i>Amaranthus viridis</i> Linn	<i>Chengkruk</i>	Amaranthaceae	The shoot tender plant is used for curry	0.34	3
6	<i>Asternanthera sessilis</i> sp	<i>Phakchet</i>	Amaranthaceae	The leaves with tender stems are used specially in chagempomba curry	0.14	1
7	<i>Bambusa nutans</i> & <i>Bamboo satuida</i> Wall	<i>Saneibi</i>	Poaceae	Young shoots from the fresh plant are cooked or fermented shoots are used.	0.08	1
8	<i>Benincasa hispida</i> (Thoxb)Cogn	<i>Torbot</i>	Cucurbitaceae	Fruits are used as fresh or cooked	0.20	2
9	<i>Psophocarpus tetragonolobus</i>	<i>Tengnoumanbi</i>	Leguminosae	Leaves are eaten as fresh or cooked, seeds are also used as vegetables.	0.29	2
10	<i>Centella asiatica</i> (L) Urb.	<i>Peruk</i>	Apiaceae	The whole plant is cooked and used as curry.	0.22	2
11	<i>Chenopodium album</i> L	<i>Monshaobi</i>	Chenopodiaceae	The leaves are used as vegetables.	0.23	2
12	<i>Cissus adnata</i> Roxb	<i>Kongouyen</i>	Vitaceae	The leaves are used as vegetables	0.33	3
13	<i>Colocasia gigantea</i> Hook	<i>Yendem</i>	Araceae	The whole plant is generally used for vegetables and rhizome in Singju.	0.36	3
14	<i>Crotalaria juncea</i> L	<i>U Hawaii Matol</i>	Papilionaceae	The stems with young tender leaves are used as salad.	0.24	2
15	<i>Cycas pectinata</i> Grift	<i>Yendang</i>	Cycadaceae	The young tender leaves and male cones are used as vegetables.	0.20	2
16	<i>Euryale ferox</i> Salish	<i>Thangjing</i>	Nymphaeaceae	The young thorny leaves and petioles are used as fresh or cooked. Seeds with pulp are used as raw or cooked.	0.37	3
17	<i>Houttuynia cordata</i> Thunb	<i>Toningkhok</i>	Saururaceae	The fresh whole plant is used as spices for curry and salad.	0.32	3

18	<i>Hibiscus cannbinus L</i>	Sougri	Malvaceae	The boiled leaves are used as curry.	0.17	1
19	<i>Ipomoea aquatic Forsk</i>	Kolamni	Convovul-aceae	The whole plant is used in salads and cooked in curry.	0.22	2
20	<i>Lagenaria vulgare Standl.</i>	Khongdrum	Cucurbvita ceae	The fruits are edible as vegetables.	0.24	2
21	<i>Lysinachiaovovat a Z.D.H.</i>	Kengoi	Primula-ceae	The whole plant is eaten by cooking	0.39	3
22	<i>Memordica charantia L</i>	KarotAkhabi	Cucur-bitaceae	The cooked or fry fruits are eaten as curry.	0.19	1
23	<i>Musa paradisiaca L</i>	Laphu	Musaceae	The stem, inflorescence, and fruits are eaten as curry.	0.24	2
24	<i>Nelumbo nungcifera Gaentn</i>	Thambal	Nympha-ceae	The young stems, leaves, and rhizomes are used as vegetables. Fruits are also edible.	0.22	2
25	<i>Neptunia oleraceae Lour</i>	Ishing Ikaithibi	Mimosa-ceae	The young stems and leaves are eaten raw in salad and cooked.	0.20	2
26	<i>Nymphaea sp</i>	Tharo	Nympha-ceae	Tubers and boiled are eaten. The fruits petiole and flowers are used as vegetables.	0.26	2
27	<i>Ocimum barilieum L</i>	Mayangba	Lamiaceae	The leaves and whole inflorescence are used as spices for salad and curry.	0.35	3
28	<i>Oenanthe javanica (BI) DX</i>	Komprek	Araceae	The plant is used in salad and cooked as a curry.	0.13	1
29	<i>Parkia javanica Merr</i>	Yongchak	Mimo-saceae	The flower is used in salad. The fruits are also used as a vegetable as raw or cooked.	0.19	1
30	<i>Clerodendron serratum (L) Moon</i>	Moirang khanam	Lamiaceae	Used in eromba and singju.	0.15	1
31	<i>Polygonum barbatum L</i>	Yelang	Polygona-ceae	The young shoot and tender leaves are used as vegetables.	0.25	2
32	<i>Sagittaria sagittifolia L</i>	Koukha	Alisma-ceae	The petioles are cooked and eaten. The tubers are also eaten as cooked or raw.	0.36	3
33	<i>Sesbania cannabinuss Merr</i>	Chuchurangmei	Papilionaceae	The young leaves and fruits are used as vegetables.	0.18	1

34	<i>Stellaria media L</i>	Yerum keirum	Caryophylliaceae	The young leaves and shoots are used as vegetables.	0.14	1
35	<i>Trapasnatas L</i>	Heikak	Trapaceae	The leaves, stems, roots, and fruits are eaten as a vegetable by the people.	0.15	1
36	<i>Vicia sativus L</i>	Pikhongjai	Papilionaceae	The young tender stems with leaves are used in salad by the people in rural areas.	0.28	2
37	<i>Gynura Cusimbua (Don) Moore</i>	Terapaibi	Astera-ceae	The plant or fruiting is used as vegetables.	0.1	1
38	<i>Viola Pilosa Blume</i>	Huikhong/Mansang	Violaceae	Used raw in Singju, cooked eaten as eromba and kangsu.	0.18	1
39	<i>Anaphalis contorta Hook</i>	Phunil	Astera-ceae	Cooked eaten as vegetables.	0.25	2
40	<i>Vangueria spinosa (Roxb. Ex Link) Roxb</i>	Heibi mana	Rubiaceae	Eaten in Singju.	0.16	1
41	<i>Wendrandiaaniculate (Roxb) DC</i>	Oothum Maton	Rubiaceae	Eaten as chutney, kangsu and eromba.	0.22	2
42	<i>Eryngium foetidum L.</i>	Awa phadigom	Apiaceae	Used for flavor and strong taste.	0.30	2
43	<i>Chimonobambusa callosa (Munro) Nakia</i>	Laiwa	Poaceae	Eaten in kangsu and kanghou (Fry with pea, potato etc)	0.25	2
44	<i>Plantago erosa wall</i>	Yempat	Plantaginaceae	The leaves is use as vegetable as curry	0.18	1
45	<i>Exbucklandiapopulnea (R.Br. ex. Griff) R.W. Br</i>	Heiba mana	Hamamelidaceae	Making chutney, eromba and eaten raw in singju.	0.14	1
46	<i>Zehneria scabra Sond.</i>	Lamthabi mana	Cucurbitaceae	Simply boiled and used as vegetables	0.13	1

General description of plants and methods for consumption and other uses

As shown in Table 1., *Alisma Plantago-Aquatica L* (*Alismaceae* family) is a wild edible plant available in different countries in Europe, Asia, Japan, Africa, Vietnam, Australia, India, etc. It is an aquatic plant (Moravcová 2001) but it can grow mud and freshwater. In Manipur (Thoubal Khunou) this plant is widely available in muddy areas in the local name *Kaothum*. It can be used after cook or it can also be used as a fresh rhizome without cooking. From the medicinal point of view, its root can be used for the cure of hydrophobia (Kim *et al.*, 2007), and its fresh leaves are used in homeopathy.

Allium hookeri thwaitesii is a wild edible plant that is widely available in Manipur, it is under the *Amaryllidaceae* family and locally it is called *Maroinapakpi*, it can grow whole of the year. It has been reported that *Allium hookeri thwaitesii* (Roh *et al.*, 1937) is available in countries like China, Myanmar, Sri Lanka, Bhutan, etc. But it is widely available in Manipur and it is almost used in daily food. The whole plant is used as vegetables and spices especially leaves is commonly used as a garnish and flavoring. It is also reported that *Allium hookeri's* leaf and root are found to have properties (Cho *et al.*, 2014) like anti-oxidant, anti-microbial, anti-inflammatory, anti-diabetic effects, etc.

Alocasia cullata (Lour) G. Don, is widely available in Thoubal Khunou locally known as *hongnu* with *Araceae* family. It is commonly found in LousiYaithibi and KamuYaithibi also. It is crushed along with dry small fishes and the paste is dried and eaten after cooked and the dried slices of the rhizome are used as chips. For edible purposes, it can't be eaten directly because it irritates skin due to the presence of calcium oxalate crystals (Boyce, 2008), so it needs to cook a long time to removed calcium oxalate crystals. Its sap of the stem can be used to treat earache. For external use, it is used to treat cuts and swollen lymph glands. It is also reported that *Alocasia cullata* (Lour) G. Don, is used to treat headaches (Romeiro *et al.*, 2006) in New Guinea. *Alpinia nigra* (Gaertn) Burt, is used in summer edible in local name *pullei* Boiled rhizome with water and soup is widely used. *Eromba* (a special dish) made by Rhizome and pseudostem in traditional style is also used. Its leaves have a good scent so they can be used use as wrappers materials in roasting food items. It is used as a folk medicine for the treatment of aphrodisiac, tonic, diuretic, expectorant, appetizer, and analgesic (Das *et al.*, 2014; Ahmed *et al.*, 2012).

Amaranthus viridis Linn is not a seasonal wild edible plant. i.e. it grows throughout the years but it healthily grows during summer, its leaves are used as curry after cooking in the local called it as *chengkruk*. Furthermore, the plant possesses anti-proliferative and antifungal lectin properties (Ganapathy *et al.*, 2012) as well as ribosome-inactivating protein, scarotene, and antiviral activities.

Asternanthera sp plants are started growing in summer but they can live throughout the years. From our study, it is found that this plant needs water for its living and is more likely to grow in muddy and good sunlight. It is *Amaranthaceae* family and is locally called *phakchet*. The leaves with tender stems are used especially in *chagempomba* (popular local dish) curry. It is used as folk medicine in fever.

Bambusa nutans & *Bamboosatuda* Wall is an evergreen plant that can live through the year, not a seasonal plant. It is *Poaceae* family and local people called as *shaneibi*. There are various ways of use, their strong stem can be used for making a hut and its fresh young shoots can be used as food after being cooked. Its fermented shoots can also be used as food after cook; this fermented shoot can be kept for a long time. Its fermented shoot is used as folk medicine in bone fracture.

Benincas ahispida (Thoxb) is a winter season plant with the local name called *Torbot* and it is a *Cucurbitaceae* family. This plant is widely available in the winter season, its big oval-shaped (1-5 kg) fruit is used for curry and soups. This plant is used widely as a folk medicine for various diseases. This fruit fresh or cook is mainly used in diabetes and jaundice due to its low sugar as well as oil present. It is reported that all parts of the plant can be used for medical purposes. The root of this plant is used for the treatment of gonorrhoea (Rahmatullah *et al.*, 2012) after infusion. The fruit of this plant is used in ayurvedic medicine for the treatment of diseases (Duke *et al.*, 1987) like coughs, lung diseases, asthma, etc. Recently, it has been shown that the fruit is found to contain anti-cancer properties. The seed is anthelmintic, anti-inflammatory, demulcent, diuretic, expectorant, febrifuge, laxative, and tonic (Bown, 1995).

Psophocarpus tetragonolobus, is a seasonal plant that is grown in winter, is in the *Leguminosae* family, and is locally called *Tengnoumanbi*. The whole plant is edible, bean pods, leaves, roots, and flowers and can be eaten raw or after cooked. The seeds can be used as vegetables after cooking. The whole part of the plants contains vitamin C, vitamin A, calcium, and iron (Taofeek *et al.*, 2019), among other nutrients. Its fruits and roots are used as medicines that increase strength, and as treatment of ulcers in New Guinea. Moreover, its leaves were used in the treatment of smallpox, and its tubers were used in the treatment of vertigo in Malaya (Verdcourt *et al.*, 1978). *Centella asiatica* (L) Urb is from the family of *Apiaceae* and locally name *peruk*. This is an evergreen plant that grows throughout the years but it healthily grows in the rainy season. This plant is widely used in every house of Thoubal Khunou since it can easily find abundant in hill and paddy fields. The entire plant can be used as a curry with or without cooked, it is slightly bitter but all the local people used it popularly. This plant is used in various folk medicines and clinical purposes. The crushed leaves are used for wound healing and skin lesions. It is also used as a remedy for venous insufficiency, high blood pressure, insomnia, and brain tonic (Brinkhaus *et al.*, 2000). It contains chemicals like triterpenes and glycosides, Asiatic acid, flavonoids (Wijeweera *et al.*, 2006; Chen *et al.*, 2006; Lianget *et al.*, 2008), etc

Chenopodium album L is an annual plant, it is a *Chenopodiaceae* family. It is widely available in Manipur (Thoubal Khunou) during the winter season and it dies at the very hot season, it is locally called

Monshaobi. The leaves of this plant are used as vegetables after being cooked. The medicinal use of these plants is still not well known but it is used as folk medicine. The plants produce various black seeds, these seeds are found to contained high phosphorus, protein, vitamin A, calcium, and potassium (Poonia *et al.*, 2015). It is used in pest control; by planting this plant near other plants, leaf miners have prominently attracted these plants which might otherwise have attacked the crop to be protected.

Cissusadnata Roxb is a creeper plant that can grow throughout the year, it is a family of *Chenopodiaceae* and is locally called *Kongouyen*. These plants' leaves are used as vegetables after being cooked and are sour in the test. It is used as folk medicine in remedy for swollen in Thoubal Khunou people. *Colocasia gigantean Hook* is a seasonal herb that can grow healthily in the rainy summertime, during the winter season this herb is almost dead. To survive this herb it needs particular precautions i.e. it needs to protect from winter ice. In Manipur, it is locally called *yendem* and it is *Araceae* family. It has been reported that this herb is found in some countries like South East Asia and Japan (Ivancic, 2008). The whole herb can be used as vegetables after being cooked. From ancient times local peoples used this herb during pregnancy due to the presence of high iron. In Thailand, this herb is the heated tuber of this herb is used for the treatment of fever and drowsiness (Zilania *et al.*, 2021) reported the anticancer activity of this herb in inhibiting cervical cancer Hela cell proliferation (Pornprasertpol *et al.*, 2015) and stimulating human white blood cell growth.

Crotalaria juncea L is an evergreen plant with the *Papilionaceae* family, locally called *U Hawaii Matol*. This leaf of the plant is used as salad. The plant is not seasonal but it healthy grows in winter compared to summer. Now a day, *Crotalaria juncea* has various applications; it is the main source of natural fiber. It is used in cordage, fishing nets, ropes, tissue paper, cigarette paper, bags (Tripathi *et al.*, 2015), etc. It also has a high fuel value. It is also used for improving nutrients (skinner *et al.*, 2012) in agriculture by combining with animal manure.

Cycas pectinate Grift is not a seasonal plant it can grow throughout the year, it is *Cycadaceae* family locally called *Yendang*. The male cone and its young leaves can be used as a vegetable after being cooked. It is available in hilly areas of Manipur (Thoubal Khunou) but it can grow in the home garden also.

It can grow healthily during rainy summer. It is used as a folk medicine as anti-diabetic (Kar *et al.*, 2003) materials.

Euryale ferox Salishis a kind of water lily species, which is found in the lake and pond of Thoubal Khunou. It is a family of *Nymphaeaceae*, locally known as *Thangjing*. The young thorny leaves and petioles are used as fresh or cooked. The seeds with pulp are used as raw or cooked. It is also reported that these water lily species are found in the southern and eastern parts of Asia, eastern Russia, Japan, Korea, (Sangtae *et al.*, 2015), etc. This watery plant gives white seed which is starchy and edible. Therefore, this plant is specially cultivated for its seeds. This plant does not need much care as paddy; it can grow in water easily than paddy without much fertilization like paddy. It has an important place in Indian food value and it has many medicinal applications (Jalaj *et al.*, 2019) indigestive, respiratory, circulatory, and renal diseases.

Houttuynia cordata Thunb, is herbaceous seasonal sort life (2-3 years) plant that is available in every house of Thoubal Khunou at home garden. It is a family of *Saururaceae* and is locally known as *Toningkhok*. The whole plant is edible, the fresh plants are used as spices for curry and salad. It is used as folk medicine, it is reported that this plant possesses anti-SARS activity (Lau *et al.*, 2008; Kumar *et al.*, 2014) and another disorder disease. This plant extract is found to contain chemicals like 2-undecanone and -myrcene which are used in essential oil.

Hibiscus cannbinus L is a perennial plant that is found in every home garden of Thoubal Khunou during the winter season. It is a family of *Malvaceae* and is locally called *souгри*. The leaves of these plants are used as curry and soup after being cooked. It has a variety of applications in food, fibers, oil, and medicine. This plant is cultivated for its fibers its long stem is responsible for fibers. The stems of this plant can be obtained from two types of fibers one is coarser fibers which are obtained from outer layers and another is fine fibers which are obtained from the inner core. (Ali *et al.*, 2018) These plants' seeds also produce edible vegetable oil. From the medical points of application, it has antibacterial, antiulcer, antioxidant, immunological properties (Ali *et al.*, 2018).

Ipomoea aquatic Forsk is a semi-aquatic plant that can grow anywhere whenever water is available. It is *Convolvulaceae* family and is locally called *kolamni*. The whole plant can be used as salad and as curry after

being cooked. It is used as traditional medicine (Malakar *et al.*, 2015) for the treatment of high blood pressure, piles, jaundice, anti-microbial, etc.

Lagenaria vulgare Standl is a seasonal sort of life i.e. 3-5 month creepy plants which are available in every house of Thoubal Khunou during the winter season. It is *Cucurbitaceae* family and is locally called *khongdrum*. The fruit of this plant is used as vegetables after being cooked. It is a creepy plant but not a parasite, it needs trees or any support for its growth. But it can grow at the surface also. It is used as traditional medicine in jaundice, diabetes, piles (Rakesh *et al.*, 2014), skin diseases, constipation, nervous disorders, hair loss, and heart-related diseases. The fruit is an excellent source of nutrients like proteins, vitamins, carbohydrates, amino acids (Prajapati *et al.*, 2010), etc.

Lysinachia ovovata Z.D.H. also named as *Kengoi* locally is a simple herb having a branch of nearly 0.5-1.5 ft long. Leaves with spoon-shaped, soft, and having small dots of slightly purple color. When this plant gets matured, it starts to produce tiny flowers at the end of each branch. Flowers are white with obovate petals. The whole plant is used to cooked and is slightly sour and highly in demand during the summer season. However, it can also able to survive during the winter season also under moist conditions. It is also used as a medicinal plant to cure tooth decay or bleeding gums and to cure respiratory tract disease (Singh *et al.*, 2015; Jain *et al.*, 2011). It is also used to cure piles, diabetes, and intestinal disorder.

Memordica Charantia L. is a seasonal creepy plant which healthily grown in winter. It is *Cucurbitaceae* family and is locally called *karotakhabi*. The fruit has slightly bitter in a test but it can be used as vegetables after cooked. This is also a crippling plant but not a parasite. This plant provides various medical applications starting from folk medicine to pharmacology ways. As a folk medicine, it is used to remedy stomach complaints, diabetes (Ooi *et al.*, 2009), skin disease, gout, wound, etc. From the pharmacological point of view, it is used in the prevention of cancer (Fang *et al.*, 2012), diabetes, HIV and AIDS, etc.

Musa paradisiaca L. is an evergreen plant i.e. it can growing throughout the whole year. It is a family of *Musaceae* family which is locally called *laphu* and its stem, inflorescence, and fruits are eaten as curry. This plan gives banana which most familiar fruit, as we

know that useful banana. *Musa paradisiaca L.* plant is used as folk medicine in diarrhea, hypertension, colitis, gout, diabetes, cardiac disease (Ahmed *et al.*, 2020), etc.

Nelumbo nungcifer Gaentn. is a not seasonal plant but the flower is seasonal. It is *Nymphaeaceae* family and is locally called *thambal*. Its young stems, leaves, and rhizomes are used as vegetables without being cooked and their fruit is also edible. The whole plant can be divided into three parts, flower lotus, rhizome lotus, and seed lotus. All the three-part have different usage, rhizomes flower can be taken as vegetables as a whole or cut in the piece as a salad. Flower lotus is mainly used for ornaments and seed lotus can be taken as edible as raw. For medical applications, leaves are used for hematemesis, epistaxis, and hematuria, the flowers are used for lowering blood sugar levels, diarrhea, cholera, fever (Paudelet *et al.*, 2015; Puloket *et al.*, 2009; Das, 1996), and hyperdipsia. Rhizomes are used for the treatment of diabetic and inflammatory diseases (Paudelet *et al.*, 2015; Puloket *et al.*, 2009; Das, 1996; Saraswati *et al.*, 2019).

Neptunia oleraceae Lour is not a seasonal plant; it is a water-loving plant i.e. it grows by floating on the surface of the water. It is a family of *Mimosaceae* and is locally called *Ishingkaithibi*. The young stems and leaves of these plants are eaten raw in salad and after being cooked. The stem and root can be made as juice and used for medicinal purposes (Ghosh *et al.*, 2015). The whole plant extracts display cytotoxic properties in neoplastic cell lines and possess hepatoprotective activity.

Nymphaea sp. is an aquatic plant of *Mimosaceae* family and is locally known as *tharo*. It is also known as a water lily. The several parts of these plants are edible. Tubers and boiled are eaten. The fruits, petiole and flowers are used as vegetables. The seeds of this plant are found to present high in protein and starch. It is also used as decoration, helps in reducing the growth of algae and cosmetics. In medical applications, it is used as a sedative, anxiety relief, and antioxidant (Archana *et al.*, 2016).

Ocimum basilicum L. is an aromatic seasonal and perennial plant (herb), it is *Lamiaceae* family and is locally known as *mayangba*. The whole plant is used as spicy in curry as fresh or dry. This plant has many hybrid species. This plant is found in every home garden of Thoubal Khunou and used as spices due to its good aroma. This plant has many applications in

essential oils and medical value. Due to the presence of chemicals like 1-allyl-4-methoxy benzene, 3,7-dimethyl-1,6-octadien-3-ol, methyl cinnamate, 1,8-cineole, and 4-allyl-2-methoxyphenol it is used as an essential oil. As a traditional medicine it is used in fever, insect bites, headaches, coughs, antiseptic, respiratory diseases (Chiang *et al.*, 2005), etc.

Oenanthe javanica (Blume) DC, is a seasonal perennial plant of the *Araceae* family. It can grow in cold muddy areas and is locally called *Komprek*. The whole plant is used as salad and as vegetable curry after being cooked. It is also reported that this plant is available in different countries like Japan, China, Korea, Indonesia, Thailand, etc., and used as edible wild vegetables as well as folk medicine. The plant is used in different medical applications like antioxidant (Chuan-li *et al.*, 2019), anti-cancer, anti-fatigue, analgesic, anti-inflammatory, etc.

Parkia javanica Merr tree is not seasonal it can grow throughout the years but its seed is a seasonal and most popular plant in Manipur. It is a family of *Mimosaceae* and is locally known as *yongchak*. The flower of the plants is used as salad and seed is used as curry after cooked known *asiromba* (a special dish of Manipur). Amongst the *iromba*, *Yongchakiromba* is the most popular curry in Manipur therefore during the *Yongchak* season it is very demanding in the market. The seed is a strong sulfur smell due to the presence of thioproline. From the medicinal point of view, this plant possesses antioxidants (Patra *et al.*, 2016), insecticide, antidiabetic, antibacterial properties.

Clerodendron serratum (L) Moon is not a seasonal plant but its flower is seasonal. The plant is a family of *Lamiaceae* and is locally called *Moirangkhanam*. Its flower is used as curry (*eromba*) and *singu* (salad). The plant bark, root, and leaves were found to contain compounds like carbohydrates, terpenoids, phenylpropanoids, steroids, etc. It is also found to possess pharmacological activities like antibacterial, anticancer, anti-asthmatic (Patel *et al.*, 2014), etc.

Polygonum barbatum L is a seasonal and sort life plant. It is a family of *Polygonaceae* and is locally called *Yelang*. It is found in wet areas, it is also found in a dry area but not healthy. The plant's young shoot and tender leaves are used as vegetables after being cooked. It has pharmacological activities as an anti-inflammatory, antiviral (Ajaz *et al.*, 2016), and antibacterial properties.

Sagittariasagittifolia L is a seasonal herbaceous plant that required wet or moist soil; with the family of *Alismaceae* and locally called *Kaokha*. The petioles are cooked and eaten. The tubers are also eaten as cooked or raw. It is also reported that the plants are found in countries like Russia, China, Japan, Ukraine, etc. The plant leaves are used for the treatment of skin disease as folk medicine (Grieve, 1984), the plants also act as antiscorbutic as well as a diuretic.

Sesbania sesban (L) Merr is a seasonal perennial flowering plant in the *Papilionaceae* family. This plant is locally called *Chuchurangmei*; it is available in Thoubal Khunou at paddy field and home garden. The plant's young leaves and fruit are used as vegetables and salad. The plant has various species. The plants served as a nitrogen-fixing agent when it is alley cropping. The plant's leaves and roots are used for abscesses, scorpion sting, sore throat, and jaundice during pregnancy (Chirwaet *et al.*, 2004), etc.

Stellaria media L, is a sort of life winter season plant (herb) of *Cariophylliaceae* family. Locally called as *Yerumkeirum* and it is available at the home garden in every house of Thoubal Khunou. The plant's young leaves and shoots are used as vegetables after being cooked. This plant can live only for 1-3 months during winter, when the summer comes the plant is dry and die automatically. The plants have many applications as folk medicine and pharmacological value. Various parts of this plant are used for the treatment of renal infection, asthma, diarrhea, jaundice, reparatory tract infection (Shan *et al.*, 2010) etc.

Trapasnatas L, is a seasonal aquatic plant of *Trapaceae* family. Locally called *Heikak*, the whole plant is edible the leaves, stem, roots, and fruits are eaten as a vegetable after being cooked. It can grow in warmed wet areas; this plant is available in Thoubal Khunou at ponds and lakes. The plant has medicinal value for the treatment of rabies, diarrhea (Parekh *et al.*, 2007), amoebic, dysentery, poisonous animal bites.

Vicia sativus L is a seasonal perennial plant (herb) of *Papilionaceae* family. Locally known as *Pikhongjai* and the young tender stems with leaves are used in the salad by the people in rural areas. It can live with sort life during cold weather and therefore it harvests during summer is coming.

This plant also can fix nitrogen and use it in alley cropping. A medicinal application of this plant is not well known but as a folk medicine, it is used for healing in wounds.

Gynuracusimbua (D. Don) Moore which has the local name of *Terapaibi*. It is a perennial herb with erected stems and having simple leaves, alternate, large sessile leaves, obovate laminae with serrate–dentate margins. It grows throughout the year on the wetland and evergreen mossy areas. This plant is used to cure bleeding of wounds (Vanijajiva et al., 2011), during headaches, decreasing inflammation, and also use to treat gastric ulcers (Tiwari et al., 2019) to relieve the pain.

Viola Pilosa Blume is a seasonal herbaceous plant with *Violaceae*. The plant is locally known as *Huikhong/Mansang*, it is used as raw in a salad, cooked eaten as *eromba* and *kangsu* (a special dish of Manipur). It is available in hilly areas and paddy fields. It is used medicinally in Unani oil, headache (Trabiet et al., 2009; Gerlach et al., 2010), etc.

Vangueria spinosa (Roxb. Ex Link) Roxb, is a non-seasonal plant with *Rubiaceae* family. The plant is a medium tree that can grow throughout the years and is locally called *Heibi mana*. The leaves of the plant are used for salad and ritual ceremonies. The ripen fruit of this plant is dried in sunlight and used as delicious fruit. The leaves and fruit are used as folk medicine in fever, constipation (Chopra et al., 1986), headache, etc.

Wendlandia aniculate (Roxb) DC, is an evergreen tree of *Rubiaceae* family. Locally called *OothumMaton* and its young leaves are used as vegetables like salad, *iromba*, *kangsu* (special dish of Manipur without liquid). The plant is available in Thoubal Khunou at the home garden and hill areas. The bark and leaves of the plants are used as folk medicine in diabetes, jaundice, typhoid fever (Roskovet et al., 2014), etc.

Eryngium foetidum L, is not a seasonal herb of *Apiaceae* family. This plant is locally called *Awaphadigom* and is used as a spice due to its strong aroma. The plant is available in Thoubal Khunou at home garden, paddy field, and hill areas. The plant (herb) is suitable in cold and water available places. But it can grow in dry places also, however it is not healthy. The plant has various medicinal applications as traditional medicine in burns, fevers, asthma, earache, hypertension, worms, snake bites, diarrhea (Paul et al., 2011), etc.

Chimonobambusa callosa (Munro) Nakia, is not a seasonal plant with *Poaceae* family. Locally called as *Laiwa* and used as vegetables like *kangsu*, *kanghou* (special dish of Manipur fry in oil with potato, pea, and chili). It is available on the hill and rarely in the home garden. It is used as folk medicine in ear infections and fever.

Plantago erosa wall, is a perennial herb of *Plantagineaceae* family. Locally called *yempat* and used as vegetables after cooking. It is available in Thoubal Khunou at the river bank and home garden. It is healthily grown in cold and wet areas. The plant is more use in medicinal applications than used as curry. This herb is found to possess the properties of anti-inflammatory, anti-toxic, anti-microbial, diuretic (Samuelsen et al., 2000), etc. In Thoubal Khunou this herb is used as folk medicine in stone in the kidney and uterus by boiling the leaves with sugar.

Exbucklandia populnea (R.Br. ex. Griff) R.W. Br, is a medium to large tree with *Hamamelidaceae* family. Locally known as *Heiba mana* and the young leaves are used as a vegetable like chutney, *eromba*, and salad. It is available in the home garden and hill area and only young leaves are responsible for edible purposes. The medicinal application of this plant is not well known but it uses as folk medicine in high blood pressure (Jingyuet et al., 2009) and diabetic patient.

Zehneria scabra Sond, is a perennial creeping plant with *Cucurbitaceae* family. Locally called *Lamthabi* and used as a vegetable after cooked. The plant is available in the home garden and hill area. It is used as anti-diarrhea and antisecretory (Tadesse et al., 2014).

Socio-economic status of informants

Since they were generally categorized as a lower caste in the society of Manipur, most of the elders were not having with formal education. Most of the informants are comprised mainly of farmers and vegetable vendors. Nearly 70% are illiterate in the age groups 50 and above, while in the age group 30-50, 60% got formal education of secondary education, 30% primary education, and still 10% are illiterate.

Statistical analysis (RFCi and PRi)

The various values of RFCi and PRi are tabulated in Table 1. From the table, we see that, *Alocasia macrorrhiza* (Lour) Schott (0.35), *Amaranthus viridis* Linn (0.34), *Cissus adnata* Roxb (0.33), *Colocasia*

gigantean Hook(0.36), Euryale ferox Salish(0.37), Houlttuynia cordata Thunb(0.32), Lysinachiaovovata Z.D.H.(0.39), Ocimum barilieum L(0.35), Sagittaria sagittifolia L(0.36), Eryngium foetidum L(0.36) have the highest values of both RFCi and PRi. The high value of RFCi of the *Alocasia macrorrhiza (Lour) Schott* is because it is used to make a thick paste called *Hentak* after grinding with dry fish which will be seasoning for nearly 7 days before use and it is used to enhance the taste of curry. *Amaranthus viridis Linn* is also used for both stew curry and *iromba* (special dish) which can be consumed daily. *Cissus adnata Roxb* is mainly more used during the summer season due to its sour test. It is also commonly used as a side dish daily to enhance digestion. *Colocasia gigantean Hook* is usually eaten as a whole plant after slicing into small pieces and directly cooked with different vegetables or meats. *Euryale ferox Salish* is the most consumable plant, its seeds are covered by soft layers which have a high taste value when mixed with chilly powder and

ngari (fermented fish). This is used in every household from summer till early winter. *Houlttuynia cordata Thunb* is also a widely used species since its aroma can enhance the taste of *Iromba* (special dish). *Lysinachiaov ovata Z.D.H.* is one of the most herbs which have a slightly sour taste and is very commonly used in the form of stew curry. *Ocimum barilieum L* is also commonly utilized to enhance the aroma of the curry or *iromba* and is also widely used to prepare the *Bora* (fried crispy vegetable using flour). *Sagittaria sagittifolia L* is also a species, having a very special taste in the form of *Bora*. *Eryngium foetidum L.* has a multi-functional aroma enhancer that is used while cooking vegetables or meats in oils due to its intense smell. Besides, these plants also have the highest Preference rating (PRi) value of 3 since they are believed to possess traditional medicinal power of healing bodies from different illnesses in the first aid or sometimes it can permanently cure it which is already been discussed above for every plant species.

Taxonomy diversity and distribution of species

Table 3. Number of species and their distributions

Sl.No.	Families	No. of species	Percentage
1	<i>Alismaceae</i>	2	4.35
2	<i>Liliaceae</i>	1	2.17
3	<i>Araceae</i>	3	6.52
4	<i>Zingiberaceae</i>	1	2.17
5	<i>Amaranthaceae</i>	2	4.35
6	<i>Poaceae</i>	2	4.35
7	<i>Cucurbitaceae</i>	5	10.87
8	<i>Apiaceae</i>	2	4.35
9	<i>Leguminosae</i>	1	2.17
10	<i>Chenopodiaceae</i>	1	2.17
11	<i>Vitaceae</i>	1	2.17
12	<i>papilionaceae</i>	3	6.52
13	<i>Cycadaceae</i>	1	2.17
14	<i>Nympheaceae</i>	3	6.52
15	<i>Saururaceae</i>	1	2.17
16	<i>Malvaceae</i>	1	2.17
17	<i>Convonvulaceae</i>	1	2.17
18	<i>Musaceae</i>	1	2.17
19	<i>Mimosaceae</i>	2	4.35
20	<i>Lamiaceae</i>	1	2.17
21	<i>Polygonaceae</i>	1	2.17
22	<i>Caryophylliaceae</i>	1	2.17
23	<i>Trapaceae</i>	1	2.17
24	<i>Violaceae</i>	1	2.17
25	<i>Asteraceae</i>	2	4.35
26	<i>Rubiaceae</i>	2	4.35
27	<i>Plantahinaceae</i>	1	2.17
28	<i>Hemameliadaceae</i>	1	2.17
29	<i>Primulaceae</i>	1	2.17

Table 3 shows the distribution of species of the known 46 wild edible plants found in the area of Thoubal Khunou village. From the table, we see that the highest species consumption is from *Cucurbitaceae* family (10.87%) followed by *Araceae* (6.52%), *papilionaceae* (6.52%) *Nympheaceae* (6.52%),

Alismaceae (4.35%), *Amaranthaceae* (4.35%), *Poaceae* (4.35%), *Apiaceae* (4.35%), *Fungi*(4.35%), *Mimosaceae* (4.35%) and *Rubiaceae* (4.35%). Each of the remaining 18 species has distributions of about 2.17%.A graphical representation of the above statements is also shown in Figure 1.

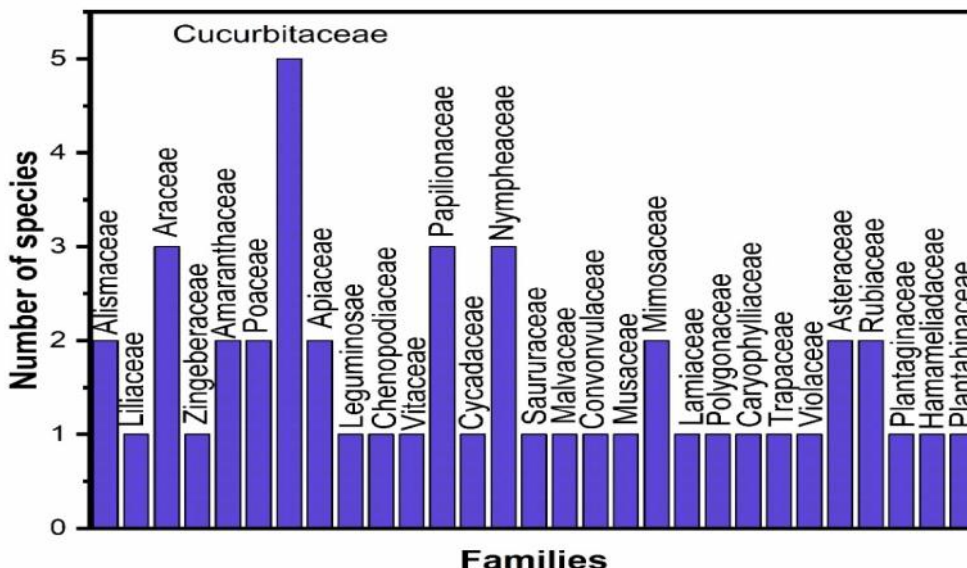


Figure.1 Graphical representation of species distribution with their families.

Growth forms and mode of consumption

As from Figure2(a), we know that among wild edible plants found in the area of Thoubal Khounou, the highest number of wild edible plants are falling into the categories of Herbs i.e. nearly 78% belongs to the herbs. The remaining categories are shared by both trees and Shrubs which comprise about 10% each.

Among the herbs, *Alocasia macrorrhiza* (Lour) Schott, *Amaranthus viridis* Linn, *Cissus adnata* Roxb, *Colocasia gigantean* Hook, *Euryale ferox* Salish, *Houttuynia cordata* Thunb, *Lysinachia ovovata* Z.D.H., *Ocimum barilieum* L, *Sagittaria sagittifolia* L, *Eryngium foetidum* L. have the highest usage as they are tasted very good to the local people and some of them are used daily to enhanced the aroma of curry.

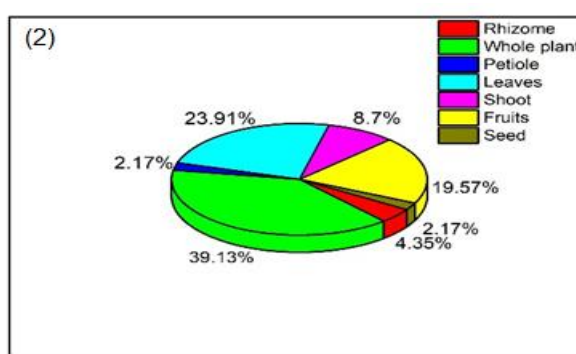
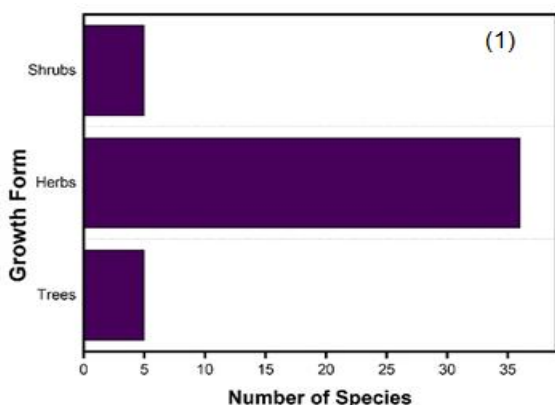


Figure 2 (1) Growth form vs the number of species. (2) Mode of consumption of various parts

To understand easily the various modes of consumption of different species, we here broadly classified into seven categories namely Rhizome, Whole Plant, Petiole, Leaves, Shoot, Fruit, and seeds. Of the various given mode of consumptions, consumption as whole plants (39.16%) gets the highest rank followed by leafy parts (23.91%), fruits (19.57%), shoot (8.7%), Rhizome (4.35%) and last sharing by both Petiole (2.17%) and seed (2.17%). Since most of the herbs are contributed to the highest RFCi value, the same is also accounted in the mode of consumption as shown in Figure 2(b) since most of the available herbs are consumed as whole plants.

Seasonal variations

Out of the 46 wild edible plants available to the Thoubal Khunou village, 14 species namely *Alisma plantago-aquatica* L, *Alpinia allughas* Rose,

Asterantherasessilis sp, *Benincasa hispida* (Thoxb) Cogn, *sophocarpous tetragonolobus*, *Colocasia gigantean* Hook, *Euryale ferox* Salish, *Hibiscus cannbinus* L, *Lagenaria vulgare* Standl, *Memordica charantia* L, *Nymphaea* sp, *Sagittaria sagittifolia* L, *Sesbania cannabinuss* Merr, *Trapasnatas* L are only available during summer season. While the remaining seven i.e. *Vicia sativus* L, *Stellaria media* L, *Polygonum barbatum* L, *Parkia javanica* Merr, *Oenanthe javanica* (BI) DX, *Ocimum barilieum* L, *Chenopodium album* L are available during the winter season only. The remaining 21 species are available throughout the year. So, it is the high time to perform research regarding the storage of these seasonal plants which will further enhance the socio-economic status of the Thoubal Khunou and its migrated villages. Some common species of wild edible plants and how they are being with the help of informant collected are shown in the Figure 3.

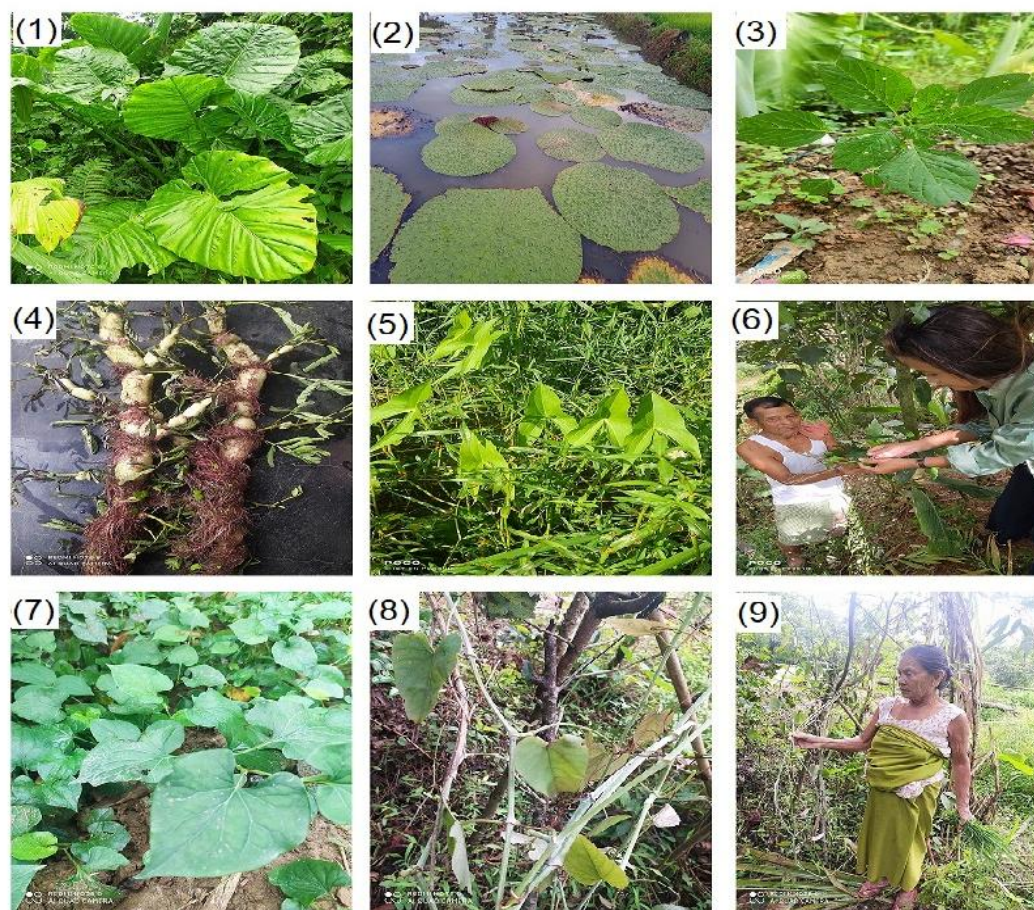


Figure 3. (1) *Alocasia macrorrhiza* (Lour) Schott (2) *Euryale ferox* Salish (3) *Amaranthus viridis* Linn (4) *Neptuniaoleraceae* Lour (5) *Ipomoea aquatic* Forsk (6) Collection specimen with Informant (7) *Houttuynia cordata* Thunb (8) *Cissusadnata* Roxb (9) presentation of wild plant by Informant.

Conservation of wild edible plants:

Due to the increasing technology and improving health sectors, the population of the Thoubal Khunou is also rapidly rising and ultimately leads to the extra exploitation of the nearby forest. Since most of the wild edible plants naturally grown around this area are also steadily decreasing. Some of the main factors are (a) deforestation i.e. destruction of the natural habitats of the wild edible plants (b) Overgrazing (c) poor economic conditions (d) climate change (e) market value (f) poor knowledge of the collection of plants (Khan *et al.*, 2019). Some of these plants are seriously depleting and about to extinct in the future. Those plants with high market values are still hard to find even in the high altitude also.

Most importantly, the idea of the regeneration of the forest is the only little hope that remains to conserve those plants. Special awareness program regarding afforestation and its benefits for sustainable consumption, involving locals and different organizations will be highly beneficial to conserve these resources.

Conclusion

From the above investigation, we found out that the Thoubal Khunou village has a variety of wild edible, medicinal plants and herbs. Some of the plants are growing in winter, and some of the plants are grown in summer. While some plants can only live for a short duration of 1-3 months only and some plants can live throughout the whole year. The mode of use of edible plants is also different, they can be used as curry, salad, chutney, soup, and as fresh raw (without cooked). From the above discussion it can be said that some of the plants have very nutritive value (rich in vitamins, minerals, protein), so such plant is important from a nutritive point of view as food nutritive supplement. From the above investigation, it is also found that all the wild edible plants discussed here are medicinal applications as folk medicine (traditional medicine) and pharmacological important. Some of the plants' extracts were present useful compounds especially important for making drugs. Therefore, it needs further deep investigation on this. We already mention that the wild edible plants available in the Thoubal Khunou area are seasonal and non-seasonal, therefore if we used such wild edibles plants wisely it can fulfill food requirements during the food crisis.

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Conflict of Interest

The authors claim that there is no room for conflict

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