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Ethnobotanical study of Wild and Non-cultivated Edible Plants (WNEPs) in food security and health supplements among the Tangkhul Indigenous Community of Manipur, India

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Keywords

Ethnobotany;
Food Security;
Tangkhul;
Indigenous Knowledge;
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Abstract

Wild and non-cultivated edible plants (WNEPs) have been an integral part of the livelihoods of indigenous communities for generations. This study recorded 45 species from 35 families, including trees, herbs, shrubs, fungi, and other plant types, with Rosaceae and Polygonaceae being the most abundant. The Tangkhul tribal community in Manipur has traditionally utilized these species for food security, nutrition, and medicinal purposes. Plants such as *Centella asiatica* and *Clerodendrum colebrookianum* serve both dietary and therapeutic roles, demonstrating the significant socio-economic value of WNEPs. Despite their importance, WNEPs face increasing threats due to overharvesting, lack of conservation measures, and limited awareness of their nutritional and economic potential. Many species are disappearing rapidly, necessitating urgent conservation efforts and sustainable harvesting practices. Standardizing cultivation, promoting value addition through low-cost food processing, and supporting research and development can enhance their sustainable use. With proper policies and strategic interventions, WNEPs can contribute significantly to food security, nutritional supplements, and income generation in remote regions. Their commercialization and sustainable management could provide viable economic opportunities for indigenous communities, aligning with Sustainable Development Goals related to health, well-being, and poverty reduction.

1. Introduction

Wild and non-cultivated edible plants (WNEPs) are plants collected from natural and semi-natural environments for human consumption that have received little attention despite their significant contributions to the sustenance and livelihoods of mountain communities (Aryal et al., 2020). WNEPs cover a wide range, including wild fruits, leaves, roots, nuts, shoots and whole plants that grow naturally in the forest, hedges, grassland, or alongside cultivated and fallow agricultural land (Aryal et al., 2018). Throughout the history of humankind, wild food plants have been a part of diets and traditional food systems, providing essential nutrients and bioactive

substances that also offer significant health benefits (Pawera et al., 2020). With a population of 27,21,756 individuals (Census India, 2011), Manipur is home to more than 30 ethnic groups, including indigenous tribes and non-tribal communities. In addition to cultural differences among all the communities of this small state, there exist differences in lifestyle and eating habits. Since the dawn of civilization, the ethnic people of the state have relied on natural forest products for their subsistence, as the forest offers a wealth of options for gathering naturally abundant products that can supplement their diets as well as options for treatment of various ailments and as health supplements (Pandey et al., 2016). The excess is often sold in the local market as a whole plant (unprocessed) for consumption within the district or ethnic population. The exploitation of natural resources reached an all-time high due to population growth, gradually driving up the demand. The wild and non-cultivated edible plants support these indigenous people in the current environment.

WNEPS have been a part of the traditional food system for the locals living in Kamjong District of Manipur. Wild vegetables contribute significantly to the local community's food security and nutritional needs. The hill population of Northeast India is highly dependent on agriculture and forest-based natural resources for their livelihood and health care. Due to the remoteness of their location, the villagers depend on available ethnobotanical resources that can be immediately collected in the surrounding area to treat various ailments as first aid. Moreover, the forest is closely linked with agriculture and animal husbandry, which provide food, firewood, fodder, timber for house construction and medicine for humans (Maikhuri, 1996). They are eaten raw in salads, pickles, boiled in curries and soups, fried, or steamed depending on choice and flavour. Many of these plants have cultural significance, and some are revered as sacred and used in religious and cultural ceremonies (Aryal et al., 2018). Unfortunately, despite their potential benefits, such a wealth of wild edible plants has been undervalued and excluded from most formal education, legislation, and research or development initiatives. This study aims to document the diversity and usage patterns of WNEPs among the Tangkhul community, assess their role in food and health security, and propose strategies for their sustainable utilization.

2. Material and Methods

2.1 Study area

The present study was conducted in Kamjong District, located in the northeastern Indian state of Manipur, which shares a long stretch of its eastern boundary with Myanmar (Fig 1). The district is mountainous, with altitudinal variation ranging from 850 to 3114 m amsl. Kamjong spans approximately 2,000 km² and is predominantly inhabited by the Tangkhul Naga tribe, which accounts for around 94% of the population, and the remaining comprising Kukis, Nepalese, and Meiteis (Government of Manipur, 2022). The district experiences a humid subtropical climate, receiving significant rainfall from May to October and cold winters from November to February. Agriculture, including shifting cultivation, constitutes the primary livelihood of the local population. Christianity is predominant, and the Tangkhul dialect is the most widely spoken language.

Five villages were selected for this study based on their strong dependence on forest products, traditional subsistence practices, and accessibility. These were: Kamjong, Rambhoi,

Shakok, Koso, and Leiting Villages. Basic demographic details such as household numbers, total population, geographical coordinates, and elevation are presented in Table 1.

2.2 **Ethnobotanical Data Collection**

Data were collected across five villages in Kamjong District (Table 1). A total of 50 households were selected using a random sampling. A semi-structured questionnaire was developed and was pre-tested in one non-sample village before administration. The questionnaire included both closed- and open-ended covering: (i) vernacular plant names, (ii) plant parts used, (iii) preparation and consumption methods, (iv) medicinal and therapeutic applications, (v) seasonal availability, and (vi) marketability and economic value. To capture in-depth cultural knowledge, purposive sampling was used to identify key informants, particularly community members widely recognized for their ethnobotanical expertise. Five FGDs were also conducted, one in each village and each group comprised 5–10 participants (totalling 16 males and 21 females). The participants were drawn from different age groups and livelihood backgrounds to capture diverse perspectives. Discussions were guided by an interview checklist covering plant uses, traditional harvesting practices, cultural significance, and knowledge transmission.

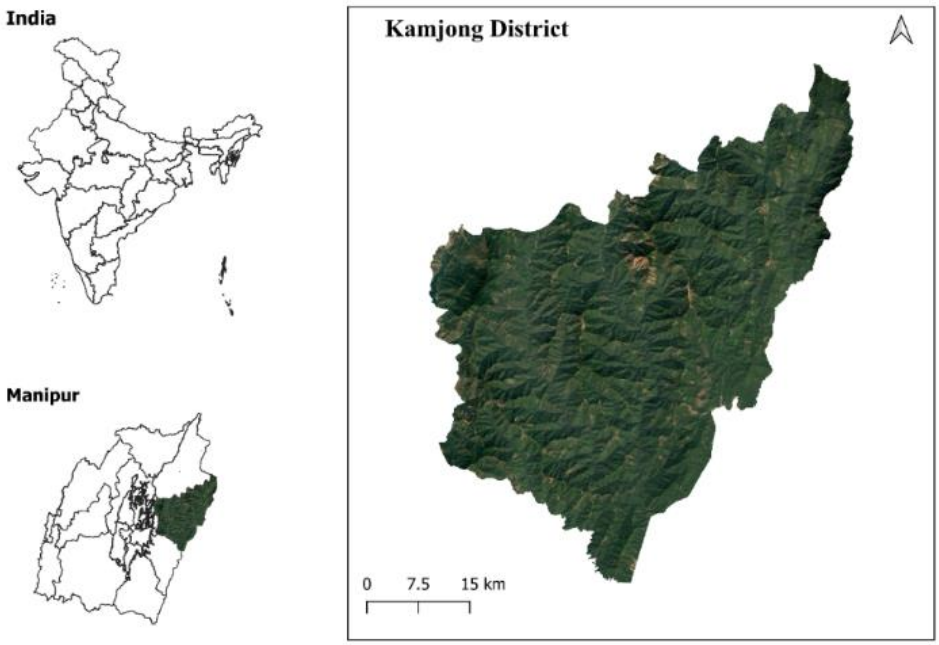

Figure 1. Map of the study area

2.3 Plant Identification and Verification

Plant species recorded during surveys and FGDs were collected during field visits with the assistance of local informants. Initial plant identification was based on local knowledge during field visits. Voucher specimens were collected and verified with the help of professional taxonomists familiar with the flora of Northeast India. The identification was cross-checked

against regional floras and published ethnobotanical studies to ensure taxonomic accuracy and consistency.

Table 1 Demographic profile of the different villages

Demographic Profile	Kamjong	Rambhoi	Shakok	Koso	Leiting
Latitude	25°51'41.50" N	24°42'49.30" N	24°52'32.47" N	24°58'11.46" N	24°55'48.79" N
Longitude	94°30'38.33" E	94°29'57.14" E	94°18'43.74" E	94°20'11.74" E	94°20'37.60" E
Elevation	1616 m	850 m	1337 m	1572 m	1613 m
Number of households	121	92	50	65	45
Population	729	601	226	216	248

3. Results and discussion

3.1 Species composition and diversity

The ethnobotanical survey recorded 45 species of Wild and Non-Cultivated Edible Plants (WNEPs), representing 35 plant families (Table 2 a,b). The most represented families were Rosaceae and Polygonaceae, each with three species, followed by Amaranthaceae, Anacardiaceae, Apiaceae, Lamiaceae, Phyllanthaceae, and Plantaginaceae, with two species each (Fig 2). The remaining families contributed one species each, reflecting high floristic diversity and an expansive ethnobotanical knowledge base among the Tangkhul community. In terms of growth habit, WNEPs were classified into eight categories: trees (16 species), herbs (12), shrubs (6), fungi (6), runners (2), and one species each of vine, grass, and palm tree (Fig 3). This range suggests that the local people utilize multiple vegetative forms to fulfil various dietary and medicinal needs, indicating adaptive use of available biodiversity in a resource-constrained environment.

3.2 Traditional usage and food security

The local people of the district have a long tradition of utilizing forest products and maintain a vast knowledge of the value of the flora and fauna. However, this ethnobotanical wealth in remote villages poses a serious threat due to indiscriminate collection, as there is no regulation framework for collecting freely available plants in the forest. Moreover, collecting WNEPs from natural habitats requires less workforce, no production cost, and investment, which may even lead to the extinction of the species (Sarangthem et al., 2019). The wild and non-edible plants that are collected are mostly not processed, and the most common way to process them is sun drying or natural fermentation. Species such as *Docynia indica* (Salam et al., 2019) and *Phyllanthus emblica* are usually cooked with sugar, sun-dried, and made into candy, and *P. emblica* is also used extensively for the preparation of pickles in Manipur (Hazarika and Singh, 2018; Sarangthem et al., 2019). Fermented bamboo shoots are an essential wild edible plant sold in local markets (Sarangthem et al., 2019). Some other common fermented foods marketed in Manipur include Hawaijar (soybean), Ngari (fish product), Soibum (bamboo shoot) and Zianshang (mustard leaf extract) (Jeyaram et al., 2009). These traditional fermented foods generally maintain safe microorganisms, with potential therapeutic enzyme sources and other health benefits (Singh et al., 2014).

The Paite tribe from Manipur cooks *Amaranthus viridis, Clerodendrum colebrookianum* and *Musa paradisiaca* as vegetables (Guite, 2016). Guite (2016) also states how the indigenous community uses *Houttuynia cordata* and *Zanthoxylum armatum* as spices or condiments to add

flavour to their cooking. Among some of the wild edible fruits *Rhus semialata* was considered as one of the crucial plants which was consumed as fruits or cooked with plain water to a concentrated paste that could be preserved for an extended period; it has medicinal value which is used when having stomachache or diarrhea, urinary problems and other health issues (Devi and Singh, 2018). Wild edible mushrooms play a vital nutritional supplement role, and species such as *Schizophllum commune* of Manipur origin have been reported to have significant nutritional value (Apshahana and Sharma, 2018). According to Longvah and Deosthale (1998), S. commune and *Lentinula* edodes from Northeast India have high protein and low fat, essential nutrients in a human diet. This lifestyle fosters a healthy community well-being for everyone, regardless of age, which adheres to Sustainable Development Goal 3 (SDG 3: Good health and well-being). Figure 4 shows some of the WNEPs found in the study area.

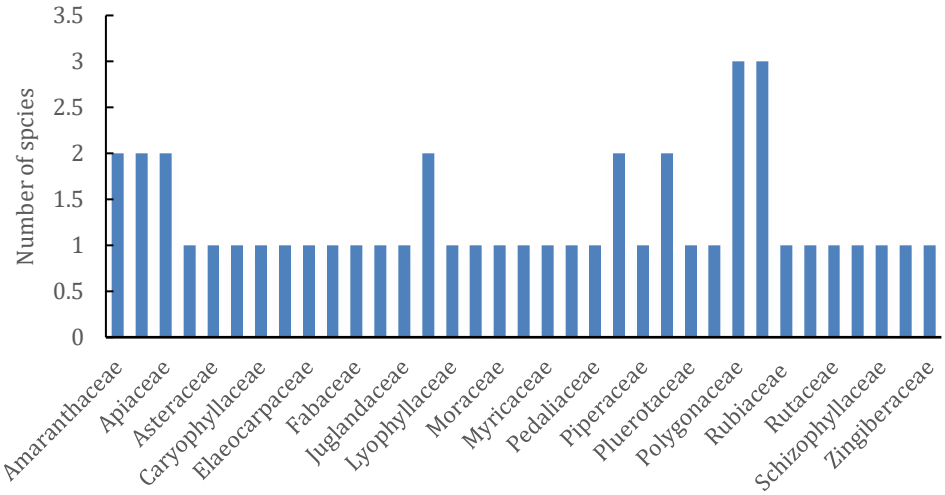

Figure 2. Family-wise distribution of WNEPs

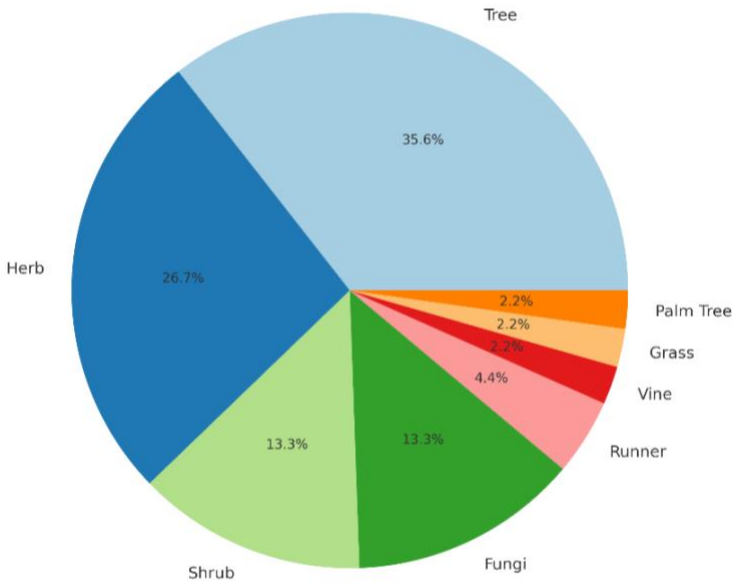

Figure 3. Growth habit distribution of WNEPs

Table 2a. List of Wild and Non-cultivated Edible Plants found during the study

Botanical names	Family	Local name	Growth Habit	Parts consumed	Mode of Use
Alocasia indica (Lour.) Spach	Araceae	yendem	Herb	Whole plant	Leaves and stems are boiled (champhut) and mashed with chilli to make it into chutney
Alpinia galanga (L.) Willd.	Zingiberaceae	kanghu	Herb	Rhizome and shoots	The spice is used as ingredient in cooking different kinds of curry.
Amaranthus viridis L.	Amaranthaceae	chengkruk	Herb	Leaves	Leaves are boiled (champhut) and consumed as a simple dish
Apium nodiflorum (L.) Lag.	Apiaceae	hanchamhan	Herb	Leaves and shoots	Leaves and shoots are boiled (champhut) and consumed
Auricularia delicata (Mont. ex Fr.) Henn.	Auriculariceae	uchina	Fungi	Whole plant	The harvested plant is cooked with ingredients of their own choices
Bambusa nutans Wall. ex Munro	Poaceae	kahathing	Grass	Stem and young shoot	The shoots are sliced into smaller pieces and cooked with potato to make chutney or added to different kinds of dishes.
Castanea sativa Mill.	Fagaceae	kahaothei	Tree	Nuts	Nuts when mature is edible
Centella asiatica (L.) Urb.	Apiaceae	peruk	Runner	Whole plant	The plants can be prepared as salad and chutney
Chenopodium album L.	Amaranthaceae	monsaobi	Herb	Leaves	The leaves are boiled (champhut) and eaten or added to other dishes such as potato and meat
Choerospondias axillaris (Roxb.) B.L. Burtt & A.W. Hill	Anacardiaceae	sangklakthei	Tree	Fruits	Fruits when ripe are edible
Clerodendrum colebrookianum Walp., 1845 var. *colebrookianum*	Lamiaceae	anphui	Shrub	Leaves	The leaves are boiled (champhut) and consumed, at the timed the leaves are mix with chilli and made it into chutney. The juice from the boil can be consume with meal.
Docynia indica (Wall.) Decne.	Rosaceae	theithukthei	Tree	Fruits	Fruits when ripe are edible. It is also made it into candies.
Drymaria cordata subsp. *diandra* (Sw.) J.A. Duke.	Caryophyllaceae	tandal pambi	Runner	Stems and leaves	The stems and leaves are simply boiled for consumption (champhut)
Elaeagnus umbellata C.P. Thunb. ex A. Murray	Elaeagnaceae	heiyai	Shrub	Fruits	Fruits when ripe are edible
Elaeocarpus serratus L.	Elaeocarpaceae	chorphon	Tree	Fruit	Fruits when ripe are edible
Elsholtzia ciliata (Thunb.) Hyl.	Lamiaceae	yompa	Shrub	Flower, leaves	The flower and leaves are added when cooking meat or any kind of dishes.
Fagopyrum cymosum (Trevir.) Meisn.	Polygonaceae	hanemhan	Herb	Leaves	The leaves are boiled (champhut)
Ficus semicordata Buch. ex J.E. Smith	Moraceae	heirit	Tree	Fruits	Fruits when ripe are edible
Houttuynia cordata Thunb.	Saururaceae	ngayung	Herb	Whole plant	The plants can be prepared as salad and chutney. They are also used as condiments.
Juglans regia L.	Juglandaceae	shirangthei	Tree	Nuts	Nuts when mature its edible
Lactarius volemus (Fr.) Fr. 1838	Russalaceae	pati	Fungi	Whole plant	The harvested plant is cooked with ingredients of their own choices
Laggera crispata (Vahl) Hepper & J.R.I.Wood	Asteraceae	ngamri	Herb	Leaves	The leaves are boiled (champhut)
Lentinula edodes (Berk.) Pegler	Polyporaceae	uyen	Fungi	Whole plant	The harvested plant is cooked with ingredients of their own choices

Table 2b. List of Wild and Non-cultivated Edible Plants found during the study

Botanical names	Family	Local name	Growth Habit	Parts consumed	Mode of Use
Musa paradisiaca L.	Musaceae	nanapur	Palm Tree	Stem	The stem is cooked with meat or prepared as chutney
Myrica esculenta Buch.-Ham. ex D. Don	Myricaceae	nonganghei	Tree	Fruit	The fruit when ripe is edible
Parkia roxburghii G.Don	Fabaceae	yongchak	Tree	Pods and seeds	The pods and seeds can be consumed as raw or boiled and prepared as chutney or salad
Passiflora edulis Sims	Passifloraceae	sitaphal	Vine	Fruits	The fruit when ripe is edible and the leaves are boiled
Persicaria wallichii W. Greuter & Burdet	Polygonaceae	hannahan	Herb	Leaves	The leaves are boiled (champhut)
Phyllanthus emblica L.	Phyllanthaceae	heikru	Tree	Fruits	The fruit when mature is edible
Phyllanthus urinaria L.	Phyllanthaceae	chakpa heikru	Herb	Leaves and stem	The leaves are boiled (champhut)
Piper nigrum L.	Piperaceae	changathei	Tree	Seed	Used as spice/condiments
Plantago erosa Wall.	Plantaginaceae	yempat	Herb	Leaves	The leaves are boiled (champhut)
Plantago major L.	Plantaginaceae	hanvathan	Herb	Leaves	The leaves are boiled (champhut)
Pleurotus ostreatus (Jacq.) P. Kumm. 1871	Pluerotaceae	chengum	Fungi	Whole plant	The harvested plant is cooked with ingredients of their own choices
Prunus nepalensis Hort. ex C. Koch	Rosaceae	theikanthei	Tree	Fruits	The fruit when mature is edible
Pyrus communis L.	Rosaceae	naspati	Tree	Fruits	The fruit when mature is edible
Rhododendron arboreum nilagiricum (Zenker) Tagg	Ericaceae	kokluiwon	Tree	Flower	The flowers are boiled and juice is extracted
Rhus semialata Murray	Anacardiaceae	khamkhuithei	Tree	Fruits	The fruit when mature is edible. The fruit can also be cooked with jaggery/sugar and made into a paste, which can be used for making juice.
Schizophyllum commune Fr. 1815	Schizophyllaceae	kanglayen	Fungi	Whole plant	The harvested plant is cooked with ingredients of their own choices
Sesamum indicum L.	Pedaliaceae	hanshi	Shrub	Seeds	The matured seeds are harvested, and is roasted and powdered to use as flavouring in cooking
Termitomyces eurhizus (Berk.) R. Heim, 1942	Lyophyllaceae	narin	Fungi	Whole plant	The harvested plant is cooked with ingredients of their own choices
Urena lobata L.	Malvaceae	sampakpi	Shrub	Leaves	The leaves are boiled (champhut)
Vangueria spinosa (Roxb. ex Link) Roxb.	Rubiaceae	heipi	Tree	Fruits	The fruit when mature is edible
Viburnum foetidum Wall.	Viburnaceae	raikuirathei	Shrub	Fruits	The fruit when mature is edible
Zanthoxylum armatum DC.	Rutaceae	mukthrubi	Tree	Leaves and fruits	Used as spice/condiments

3.3 Nutritional and therapeutic value

The seasonal WNEPs provide the major nutrients in the villages of the district. Studies reported that high mineral, vitamin, and antioxidant activity content was excellent and far ahead of commercial crops (Guleria et al., 2011; Pereira et al., 2011; Sharma et al., 2015). Nutritional profiling of commonly consumed WNEPs indicates that these plants are rich in essential micronutrients, antioxidants, fibre, and bioactive compounds (Table 3).

Table 3. Nutritional values of WNEPs recorded in the study area

Species name	Harvest Period	How it supplements in the diet
Alocasia indica	January - December	Rich in carbohydrate (Basu *et al*., 2014)
Alpinia galangal	November	Rich in anti-oxidant, minerals and vitamins (Chauhan, 2019)
Apium nodiflorum	July - August	Rich in anti-oxidant (Guijarro-Real *et al.,* 2019)
Amaranthus viridis	June - September	An excellent source of natural antioxidant (Kamal *et al.,* 2022)
Bambusa nutans	July - August	Rich in minerals and nutrient components such as carbohydrates, proteins and fiber (Basumatary *et al*., 2017)
Castanea sativa	November	High content of phytosterols and antioxidants (Rodrigues *et al*., 2020)
Centella asiatica	Throughout the year	Shows content of anti-inflammatory, anti-oxidative stress and anti-apoptotic (Sun *et al*., 2020)
Chenopodium album	June - September	A nutrient and phytochemical-rich vegetable (Poonia and Upadhayay, 2015)
Choerospondias axillaris	December - February	Rich in vitamin C and contains bioactive compounds (Dangal *et al,.*2023)
Clerodendrum colebrookianum	January - December	Phytoconstituents contents including antioxidant, anti-uric acid formation, anti-tumor (Payum, 2020)
Drymaria cordata	May - September	Contains phytoconstituents and biotic compounds (Singla *et al.,* 2023)
Docynia indica	November -December	Contains polyphenol especially alkaloids and flavonoids which significantly have an anti-hyperglycemic and anti-hyperlipidemic properties (Biswas *et al.,* 2021)
Elaeagnus umbellata	June - July	High content of polyphenols, monoterpenes and vitamin C (Bhat *et al*. 2023)
Elaeocarpus serratus	March - November	Good source of carotenoids, condensed tannins, flavonoids and vitamin C (de Lima *et al.,* 2018)
Elsholtzia ciliata	November - December	Has anti-cancer activity (Pudziuvelyte *et al.,* 2017)
Fagopyrum cymosum	March - April	An excellent gluten-free raw material and has high content of amino-acid nutrients (Chen *et al.,* 2018)
Ficus semicordata	August - September	High content of true protein, total fat, energy, Vitamin A, iron, zinc and phosphorus (Gupta and Acharya, 2019)
Houttuynia cordata	Throughout the year	High content of vitamin C, total flavonoids, soluble sugars & total protein (Qi *et al.,* 2022)
Juglans regia	October - November	Contains carbohydrates, starch, sugars, fiber, fat and minerals (Al-Snafi, 2018)
Musa paradisiaca	Throughout the year	Contains substantial to high levels of potassium, calcium, magnesium, sodium, phosphorus, nitrogen, moisture, and fiber (Oyeyinka and Afolayan, 2019)
Myrica esculenta	July - August	Contains carbohydrates, proteins, fats, and minerals like calcium, copper, iron, manganese, potassium, sodium, and zinc (Ahmad *et al.,* 2022)
Passiflora edulis	September - October	Has good content of vitamin A, vitamin C, Calcium and fiber (He *et al.,* 2020)
Parkia roxburghii	December -February	Good source of crude protein and energy, carbohydrates, vitamins and minerals (Singha *et al*., 2021)
Plantago erosa	December - February	High content of proline and sodium (Medak & Singha, 2017)
Plantago major	December - February	High content of vitamin C and calcium (Guil-Guerrero, 2001)
Phyllanthus emblica	December -February	Important source of amino acids, minerals and vitamin C (Orabi *et al*., 2023)
Phyllanthus urinaria	June - August	Source for biologically important phenolic compounds (Geethangili and Ding, 2018)
Physalis peruviana	December - February	Good source of provitamin A, vitamin C, vitamin B complex, phenolic compounds (Muñoz*et al*., 2021)
Piper nigrum	July - August	Contains phenolic components such as alkaloids, flavonoids, carotenoids, terpenoids (Banu and Aswinia, and2023)
Prunus nepalensis	October	Rich in vitamins C, β-carotene and minerals (Thakur, 2023)
Pyrus communis	August	High content of fiber, vitamins and minerals (Kolniak-Ostek, 2016)
Rhus semialata	November -January	The fruit has carbohydrate, fat, fiber, protein, minerals and vitamin C (Lourakpam *et al*., 2019)
Rhododendron arboreum	February - March	Rich in minerals and phytochemicals (Raturi *etal.,* 2023)
Sesamum indicum	November -Mid December	Contains antioxidant, anti-inflammatory, anti-tumor, blood lipid regulation, cardiovascular system protection, cholesterol reduction, kidney and liver protection effects (Wei *et al.,* 2022)
Zanthoxylum armatum	January - February	Reservoir of phytochemicals with health-promoting properties, such as anti-sickling, anticancer and anti-infectious disease activities (Okagu *et al,.* 2021)
Pleurotus ostreatus	July - August	Contains high protein, fat-free, carbohydrates, vitamins B1, B2, B12, C, D, E, and K, and mineral (Lesa *et al.,* 2022)
Auricularia delicata	April - November	Possesses antioxidant, antimicrobial, and hepatoprotective effect (Wangkheirakpam *et al.,* 2018)
Termitomyces eurhizus	May - July	High protein and fiber, low in calories, fat and cholesterol (Paloi *et al.,* 2023)
Schizophyllum commune	April - November	High in fiber, protein, minerals and low in fat (Prabsangob and Sittiketgorn, 2023)
Lactarius volemus	August - September	Rich in fat, minerals, polysaccharides, protein and vitamins (Shen *et al.,* 2023)
Lentinula edodes	April - July	Low lipid contents, high protein and source of minerals and minerals (Spim *et al.,* 2021)

Such species meet nutritional needs and contribute to preventive health care, particularly in rural areas with limited access to formal health infrastructure.

3.4 Cultural practices and market value

The inhabitants of Kamjong district rely on wild leafy vegetables, which are a significant food source and play a big role in the community's dietary customs. They are mostly eaten raw or boiled (champhut). Devi and Salam (2016) mentioned in their study how the Monsang Naga tribe of Manipur also consumes most of the plant species raw or boiled, and a few are taken as fried. Depending on its availability, the cost of these WNEPs varies from season to season. Studies show a decrease in the availability of fruit plants like *Phyllanthus emblica* and *Prunus nepalensis* in the market due to the population's increasing demand and over-exploitation. In addition, it is used to prepare traditional fruit juice, which is a core ingredient (Salam et al. 2019). A study by Konsam et al. (2016) shows that *Centella asiatica* and *Chenopodium album* are cooked and eaten. *C. asiatica* can be mashed with potato and chilli, similar to the current study. In the local markets, plants such as Indian pennywort (*C. asiatica*) and East Indian glory bower (*Clerodendrum colebrookianum*) are in good demand for their medicinal properties (Nath and Bordoloi, 1991; Singh and Singh, 2017). Indian pennywort boosts brain memory, and East Indian glory bower suits people with high blood pressure.

Figure 4. WNEPs found in the study area (a) Uyen (*Lentinula edodes*); b) Narin (*Termitomyces eurhizus*); c) Anphui (*Clerodendrum colebrookianum*); d) Shirangthei (*Juglans regia*); e) Nanapur (*Musa paradisiaca*); f) Yongchak (*Parkia roxburghii*); g) Hanemhan (*Fagopyrum cymosum*); h) Ngayung (*Houttuynia cordata*)

3.5 Environmental, nutritional, and economic benefits

WNEPs are significant in environmental sustainability, food security, and public health. It contributes to biodiversity conservation by maintaining genetic diversity and ecosystem balance; additionally, it helps restore degraded ecosystems by improving soil health and supporting pollinators and other wildlife (Singh et al., 2022). They grow naturally in their habitats without intensive agricultural practices, reducing the environmental footprint associated with conventional

farming (Motti, 2022). These plants are a vital source of nutritional diversity, especially in rural and indigenous communities (Mandal et al., 2023). They provide essential micronutrients and vitamins that might be lacking in conventional diets; their integration into local food systems can enhance resilience against climate change and other environmental challenges (Ray et al., 2020). In times of food scarcity, wild edible plants can serve as a reliable food source, ensuring food sovereignty and reducing dependency on global food supply chains, consuming them can lead to improved health outcomes due to their high content of antioxidants, vitamins, and minerals; they are often free from pesticides and other chemicals commonly found in cultivated crops, making them a healthier alternative (Motti, 2022). WNEPs also play a role in traditional medicine, offering natural remedies for various ailments. Incorporating WEPs into national food policies and promoting their sustainable use can have far-reaching benefits for the environment, food security, and public health (Ray et al., 2020). These wild edible plants are vital in supporting the local people and generating income. Still, due to a lack of research, conservation, and sustainable management, many of these priceless resources go unnoticed and undiscovered (Khapudang et al., 2024). Researching wild and non-cultivated edible plants involves certain limitations. Sample size and diversity may be restricted, limiting the generalizability of the findings. Accurate identification of plants is challenging, leading to potential misidentification. The reliance on local ethnobotanical knowledge can introduce biases, as different communities may have varying uses and names for plants. Conduct more in-depth ethnobotanical research in the area, as this could lead to the identification of many WNEPs that humans consume.

4. Conclusions

The present study highlights the critical role of Wild and Non-Cultivated Edible Plants (WNEPs) in traditional communities' socio-economic and nutritional lives. The increasing disappearance of many species, driven by a lack of awareness, poverty, and the absence of regulation, poses a serious threat to biodiversity and rural livelihoods. There are no proper guidelines or rules for collecting and marketing such economically valuable plants. This has led to capitalization and monopoly of a few individual villagers who are more knowledgeable about harvesting in bulk, depriving most other villagers of collecting and marketing wild and non-cultivated edible plants. To ensure sustainable use, there is a need for comprehensive strategies encompassing in-situ and ex-situ conservation, community-led value addition, and equitable access to market systems. Encouraging standardized cultivation, promoting low-cost food processing technologies, and integrating WNEPs into nutrition-sensitive agricultural planning can support local employment, enhance food security, and contribute toward the SDGs on poverty reduction, health, and biodiversity. Strengthening research and development (R&D) and formalizing traditional knowledge will transform WNEPs into sustainable economic assets for underdeveloped hill regions.

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