Journal of Science Research International (JSRI)
ISSN: 2456-6365 (Online)

OPEN ACCESS

WILD EDIBLE FLORA OF NORTHEAST INDIA: TAXONOMIC DIVERSITY, ETHNOBOTANICAL HERITAGE, NUTRITIONAL PROFILE, ECOLOGICAL STATUS, AND FUTURE OUTLOOK: A COMPREHENSIVE REVIEW

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Received: 12 May 2026	Revised: 12 June 2026	Accepted: 14 July 2026	Published: 30 July 2026

DOI: https://doi.org/10.5281/zenodo.21838923

Abstract:

Northeast India is widely acknowledged as a premier global biodiversity reservoir, featuring complex ecological zones transitioning from tropical rainforests to high-altitude alpine zones (1). The territory hosts an exceptional variety of wild edible plants (WEPs), which have historically supplied indigenous populations with essential nourishment, traditional remedies, and sustainable revenue streams (2,3). These biological assets are vital for maintaining regional food security, safeguarding ancestral lore, upholding ecological equilibrium, and supporting local economies (4). Nevertheless, widespread habitat deterioration, global climate shifts, unmanaged harvesting, and land-use conversions pose severe threats to numerous wild taxa (5). This review systematically consolidates contemporary findings regarding the botanical variety, taxonomical structure, geographical distribution, ethnobotanical utility, nutritional composition, pharmaceutical potential, ecological functions, and conservation standing of edible wild flora across Northeast India. Furthermore, it emphasizes their contributions to traditional medical systems and rural livelihoods while identifying major research deficiencies and future priorities. Strengthening empirical documentation, encouraging responsible harvest protocols, harmonizing indigenous wisdom with advanced scientific studies, and formulating robust conservation frameworks remain imperative for the long-term preservation and utilization of these natural assets.

Keywords: *Wild Edible Plants, Northeast India, Ethnobotany, Biodiversity, Nutrition, Medicinal Plants, Conservation, Indigenous Knowledge.*

Introduction

Wild edible plants (WEPs) represent a fundamental component of natural ecosystems and have sustained human populations since prehistoric eras (1). Prior to the establishment of domesticated agriculture, human survival relied heavily on naturally occurring edible vegetation (2). Even today, millions of individuals globally continue to

depend on these flora as primary or supplementary sources of nourishment, dietary micronutrients, traditional medicine, and economic support (3–6).

Encompassing the eight states of Assam, Arunachal Pradesh, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, and Tripura, Northeast India forms a core segment of the Indo-Burma Biodiversity Hotspot (4,7). Although the territory accounts for under 8% of India's total land area, it sustains an extraordinarily high proportion of the nation's plant wealth (4). The intricate topography, pronounced altitudinal variations, heavy monsoonal precipitation, and varied climatic parameters generate diverse microhabitats that host thousands of vascular plant species, many exhibiting high levels of endemism and economic value (3,4).

The native populations inhabiting Northeast India possess deep-rooted traditional knowledge concerning the identification, foraging, culinary preparation, preservation, and medicinal utilization of wild flora (2,10). Tribal communities—including the Bodo, Mishing, Karbi, Khasi, Garo, Jaintia, Naga, Mizo, Adi, Apatani, Nyishi, Lepcha, Bhutia, Dimasa, Rabha, Tiwa, and numerous others—have cultivated elaborate ethnobotanical practices handed down through successive generations (15,16). Vegetative structures such as foliage, tender stalks, stems, blossoms, fruits, seeds, rhizomes, underground tubers, and young inflorescences are regularly consumed either fresh or following specialized processing as vegetables, condiments, spices, herbal infusions, or emergency sustenance (6,8,9).

Beyond fulfilling dietary requirements, wild edible plants contribute substantially to nutritional well-being due to high concentrations of essential vitamins, minerals, dietary fiber, antioxidants, and bioactive secondary metabolites (6,8). Numerous species demonstrate notable antioxidant, antimicrobial, anti-inflammatory, antidiabetic, hepatoprotective, and chemoprotective characteristics, rendering them valuable resources for pharmacological investigations and functional food development (11,26).

From an ecological standpoint, these botanical species execute essential functions in sustaining ecosystem stability by providing forage for pollinators, facilitating wildlife seed dispersal, mitigating soil degradation, promoting nutrient cycling, and accelerating forest regeneration (1,5). Additionally, they bolster rural household economies through local market commerce, domestic consumption, and the generation of value-added commodities (10,14).

Despite their critical ecological and socioeconomic value, wild edible plants remain inadequately documented across numerous districts within Northeast India (15,22). Rapid urbanization, large-scale deforestation, shifting cultivation cycles, habitat fragmentation, biological invasions, climate anomalies, and the gradual loss of traditional ecological knowledge present grave dangers to their persistence (1,5). Moreover, taxonomic ambiguities, incomplete nutritional profiling, and insufficient protection initiatives constrain their optimal utilization (4).

This review endeavors to deliver an exhaustive synthesis of the taxonomic diversity, ethnobotanical relevance, nutritional properties, ecological significance, conservation status, and future research directions concerning wild edible flora in Northeast India. It additionally stresses the necessity of merging traditional wisdom with modern scientific methodologies to advance sustainable resource utilization, safeguard biological diversity, and reinforce regional food security.

Wild edible plant diversity of Northeast India

Northeast India stands out as a preeminent center of botanical diversity across Asia, serving as a critical

component of the Indo-Burma Biodiversity Hotspot (4,33). The territory supports thousands of angiosperm taxa, a major share of which are harvested as wild edible plants by indigenous and rural dwellers (4). These species occur naturally across tropical lowland evergreen formations, subtropical belts, temperate woodlands, natural grasslands, aquatic wetlands, riparian zones, bamboo thickets, and swidden agricultural mosaics (3,15).

The edible wild flora comprises herbaceous plants, shrubs, woody climbers, arboreal species, ferns, bamboos, palms, and aquatic macrophytes (4,15). Practically every plant structure—ranging from young leaves, tender shoots, floral parts, fruits, and seeds to roots, tubers, rhizomes, stems, inner bark, and inflorescences—is utilized either directly or following culinary processing (10,15). Indigenous lore governing their collection, preparation, preservation, and medicinal applications has been meticulously preserved across generations (2,10).

This remarkable botanical richness stems from the unique geographical setting of Northeast India, which acts as a major ecological transition zone linking the Indian, Indo-Malayan, and Himalayan floristic realms (4). The convergence of high precipitation, varied climatic regimes, rich soil substrates, and steep altitudinal gradients has fostered exceptional species richness and localized endemism (3,4).

Floristic surveys performed across individual states have cataloged hundreds of edible wild species distributed across more than 90 botanical families (4,33). Prominent families contributing extensively to the edible flora include Asteraceae, Fabaceae, Moraceae, Araceae, Zingiberaceae, Rutaceae, Poaceae, Amaranthaceae, Cucurbitaceae, Urticaceae, Dioscoreaceae, Polygonaceae, Euphorbiaceae, Solanaceae, Rosaceae, and Lauraceae (33,37).

Although many taxa exhibit seasonal availability, collectively they supply continuous food resources throughout the annual cycle, thereby functioning as vital nutritional safety nets during periods of crop failure and seasonal food scarcity (1,6). Furthermore, several species have attained commercial significance in regional marketplaces, augmenting rural household earnings (10,14).

State-wise diversity distribution

- **Assam:** Features exceptional reservoirs of edible wild flora sustained by fertile alluvial floodplains, extensive wetlands, riverine tracts, and plantation ecosystems (29,32). Frequently consumed taxa include *Diplazium esculentum*, *Lasia spinosa*, *Houttuynia cordata*, *Clerodendrum colebrookianum*, and *Garcinia pedunculata* (19,27).
- **Arunachal Pradesh:** Exhibits maximum botanical diversity due to vast unbroken forest tracts and extreme altitudinal variation (15). Indigenous populations such as the Adi, Nyishi, Apatani, Galo, Monpa, and Mishmi heavily utilize diverse wild fruits, edible mushrooms, bamboo species, and medicinal herbs (15,35).
- **Nagaland:** Celebrated for traditional culinary preparations centered around tender bamboo shoots, *Parkia timoriana*, various *Zanthoxylum* taxa, and assorted leafy greens gathered from forest floors (6,28).
- **Manipur:** Maintains a rich spectrum of aquatic and terrestrial food plants linked directly to Loktak Lake and surrounding forest ecosystems (19,25).
- **Meghalaya:** Noted for a wide array of wild forest fruits, edible ferns, macrofungi, and aromatic herbs utilized by the Khasi, Garo, and Jaintia communities (16,17).
- **Mizoram:** Endowed with abundant bamboo resources and numerous edible woodland species constituting an integral element of daily diets (4,33).

- **Tripura:** Displays high diversity in edible climbing plants, herbaceous greens, and fruit-yielding arboreal species traditionally harvested by tribal groups (22,24).
- **Sikkim:** Sustains temperate wild fruit varieties, medicinal herbs, edible ferns, and high-altitude alpine vegetables possessing high nutritional value, driven by its Himalayan climate (3).

The extraordinary diversity of wild edible plants across Northeast India highlights centuries of co-adaptation between indigenous populations and forest environments (2,10). Their sustained utilization underscores the vital function of traditional ecological knowledge in biodiversity preservation and sustainable resource stewardship (10).

Ethnobotanical significance

The native communities of Northeast India preserve a vast reservoir of traditional ecological lore regarding the identification, collection, processing, and application of wild edible plants (WEPs) (2,33). Over 220 distinct ethnic groups—including the Adi, Apatani, Nyishi, Galo, Monpa, Mishing, Karbi, Dimasa, Bodo, Khasi, Garo, Jaintia, Naga, Mizo, Lepcha, Bhutia, Tripuri, and Reang—depend routinely on these flora for sustenance, healing arts, and cultural customs (15,22,25).

Wild edible plants contribute significantly to everyday nutrition, particularly within rural and forest-adjacent settlements (1,6). Tender shoots, leaves, floral structures, fruits, seeds, underground tubers, rhizomes, and mushrooms are gathered seasonally from woodlands, wetlands, river edges, and open grasslands (10,15). Well-known species like *Diplazium esculentum*, *Houttuynia cordata*, *Lasia spinosa*, *Garcinia pedunculata*, *Zanthoxylum armatum*, and *Parkia timoriana* enjoy widespread consumption and active commercial exchange in local markets (19,27).

Traditional knowledge encompasses not only culinary techniques but also sustainable foraging protocols, seasonal gathering calendars, and specialized procedures for detoxifying potentially toxic plant materials (2,10). Such wisdom has been orally communicated across generations, though it currently faces severe pressures from societal modernization and lifestyle shifts (2,14).

Furthermore, wild edible plants assume prominent roles in spiritual rituals, community festivals, and regional culinary traditions, thereby reinforcing cultural identity and preserving indigenous heritage (10,11).

Nutritional value

Wild edible plants serve as rich repositories of critical macronutrients, essential micronutrients, and bioactive phytochemicals (6,8). Numerous species exhibit significantly higher concentrations of vitamins, minerals, dietary fiber, antioxidants, and protective plant chemicals than standard cultivated vegetables (8,9).

Leafy green vegetables such as *Diplazium esculentum* and *Houttuynia cordata* contain high levels of vitamins A and C, calcium, iron, and potassium (8,27). Wild fruit species including *Baccaurea ramiflora*, *Myrica esculenta*, *Rubus ellipticus*, and various *Garcinia* taxa supply abundant vitamin C, flavonoids, anthocyanins, and phenolic constituents that drive strong antioxidant capacities (19,26).

Wild tuberous species belonging to the genus *Dioscorea* function as crucial carbohydrate reserves during periods of food scarcity, while tender bamboo shoots provide dietary fiber, essential amino acids, potassium, and antioxidant compounds (3,6). Several edible seeds and nuts further contribute high-quality proteins, beneficial dietary lipids, and micronutrients (6,8).

Routine integration of diverse wild edible plants elevates dietary variety and bolsters nutritional security,

especially in isolated rural tracts where access to cultivated market produce remains restricted (6,9).

Medicinal importance

A large proportion of wild edible plants exhibit therapeutic attributes alongside their nutritional value (11,21). Traditional healthcare practices across Northeast India heavily integrate edible flora to manage fevers, gastrointestinal disturbances, dermatological conditions, diabetes mellitus, hypertension, respiratory infections, inflammatory states, and physical injuries (16,21,30).

For instance, *Houttuynia cordata* displays strong antimicrobial, antiviral, antioxidant, and anti-inflammatory properties (27). *Clerodendrum colebrookianum* is traditionally ingested for blood pressure regulation (21). Fruits of *Phyllanthus emblica* deliver robust antioxidant and immunomodulatory activity, while *Garcinia pedunculata* is routinely utilized for digestive complaints (19,21).

Certain *Dioscorea* species synthesize diosgenin, a principal precursor utilized in steroidal drug synthesis (21). Members of the *Zanthoxylum* genus contain specialized essential oils and alkaloids possessing antimicrobial and analgesic qualities (28).

Merging ethnobotanical records with contemporary phytochemical and pharmacological screening can greatly accelerate the discovery of novel therapeutic agents and functional food formulations (18,26).

Inventory of ethnomedicinal and wild edible flora

The following detailed compilation outlines prominent wild edible and medicinal plant species recorded throughout the Northeast region:

Table 1: Ethnomedicinal and wild edible flora of Northeast India

Sr. No.	Scientific Name & Family	Local / Common Name	Plant Parts Used	Nutritional & Medicinal Attributes	Region / State
1	*Oroxylum indicum* (L.) Vent. (Bignoniaceae)	Bhatgilla / Toddy Tree	Bark, Root, and Tender Pods	Rich in antioxidants and antiinflammatory compounds; used for stomach ailments, fever, and digestive health.	Arunachal Pradesh / Assam
2	*Trevesia palmata* (Roxb. ex Lindl.) Vis. (Araliaceae)	Togo (Nyishi) / Tagor (Adi)	Leaves, flower buds, and young shoots	High dietary fiber and micronutrients; valued as a traditional vegetable and digestive stimulant.	Assam, Arunachal Pradesh, Mizoram
3	*Spilanthes acmella* (Asteraceae)	Marsang (Adi) / Suhoni (Assamese)	Flowers, Roots	Utilized traditionally for the management of toothaches.	Arunachal Pradesh
4	*Centella asiatica* (Apiaceae)	Bor manimoni (Assamese)	Leaves and stem	Beneficial for neurological health and cognitive memory enhancement.	Assam / Arunachal Pradesh
5	*Hydrocotyle sibthorpioides* (Araliaceae)	Shoru manimoni	Leaves and stem	Acts as an effective remedy for gastrointestinal disorders.	Assam / Arunachal Pradesh

6	*Zanthoxylum armatum* DC. (Rutaceae)	Toothache Tree / Jaiur	Fruits, seeds, and leaves	Possesses carminative, antibacterial, and digestive properties; applied for toothaches and gastric issues.	Meghalaya, Assam, Nagaland
7	*Dillenia indica* (Dilleniaceae)	Elephant apple / Outenga (Assamese)	Juicy fleshy sepals (fruits)	High concentrations of vitamin C, carbohydrates, and crude dietary fiber.	Assam / Arunachal Pradesh
8	*Paederia foetida* (Rutaceae)	Bhedai lota (Assamese)	Leaves and stem	Alleviates rheumatic pain, flatulence, and dysenteric conditions.	Assam / Arunachal Pradesh
9	*Oenanthe javanica* (Apiaceae)	Komprek (Manipuri), Hanchamhan (Naga), Hugu Hamang (Arunachal)	Tender leaves and young shoots	Valuable dietary source of iron, beta-carotene, and vital mineral elements.	Manipur, Nagaland, Arunachal Pradesh
10	*Catharanthus roseus* (Apocynaceae)	Noyontara (Assamese)	Leaves	Employed traditionally in the regulation of blood glucose levels.	Assam
11	*Abrus precatorius* L. (Fabaceae)	Latimoni lota	Root	Root paste applied in the management of diarrhea, dysentery, and tonsillitis.	Assam
12	*Acacia farnesiana* (L.) Willd. (Mimosaceae)	Tarua kadam (Assamese)	Bark	Decoctions utilized for treating diarrheal and dysenteric disorders.	Assam
13	*Ageratum conyzoides* (Asteraceae)	Gundhua bon (Assamese)	Leaves	Demonstrates notable wound-healing and antiseptic capabilities.	Assam
14	*Adhatoda vasica* Nees. (Acanthaceae)	Boga bahok	Leaves	Leaf extracts or juices utilized to relieve cough and bronchial asthma.	Assam
15	*Scoparia dulcis* (Scrophulariaceae)	Bon sheni	Leaves	Contains active phytochemicals relied upon to help regulate blood sugar levels.	Assam / Arunachal Pradesh
16	*Azadirachta indica* A. Juss (Meliaceae)	Maha neem (Assamese)	Leaves, bark	Juice controls intestinal helminths and scabies; leaves used during smallpox outbreaks.	Assam, Arunachal, Manipur

17	*Bryophyllum calycinum* Salisb. (Crassulaceae)	Dupur tenga (Assamese)	Leaves	Concoctions administered to relieve urinary complications and gastric illness.	Assam
18	*Caesalpinia bonducella* (L.) Fleming. (Caesalpinaceae)	Letaguti (Assamese)	Fruit	Seed coat extracts utilized in the treatment of pneumonia and chronic cough.	Assam
19	*Houttuynia cordata* Thunb. (Saururaceae)	Mosundari (Assamese)	Leaves	Extensively consumed for the management of dysenteric infections.	Assam
20	*Jatropha curcas* L. (Euphorbiaceae)	Bongali era	Leaves, seed	Employed in treating tumors, traumatic wounds, skin disorders, and ulcers.	Assam
21	*Leucas aspera* (Willd.) Link. (Lamiaceae)	Dorun (Assamese)	Leaves	Foliar extracts administered for the treatment of pneumonia.	Assam
22	*Murraya koenigii* (L.) Spreng. (Rutaceae)	Norokhingho (Assamese)	Leaves	Effective in alleviating abdominal griping and intestinal disturbances.	Assam, Arunachal, Nagaland, Manipur
23	*Litsea monopetala* (Roxb.) Pers. (Lauraceae)	Muga (Assamese)	Root, Bark	Bark and root extracts utilized in pneumonia treatment.	Assam
24	*Curcuma longa* L. (Zingiberaceae)	Halodhi (Assamese)	Rhizome	Pastes applied to cuts and wounds; ingestion relieves hyperacidity and chest discomfort.	Assam / Arunachal Pradesh
25	*Ocimum sanctum* L. (Lamiaceae)	Tulsi	Leaves	Foliar infusions assist in relieving pulmonary congestion and common colds.	Assam, Arunachal, Manipur, Tripura
26	*Terminalia arjuna* (Roxb. ex DC.) Wright & Arn. (Combretaceae)	Orjun	Bark	Bark decoctions administered to individuals suffering from cardiovascular complaints.	Assam
27	*Vitex negundo* L. (Lamiaceae)	Pasotia	Leaves	Foliar applications used to relieve rheumatic joint pain.	Assam

28	*Zingiber officinale* Roscoe. (Zingiberaceae)	Aada (Assamese)	Rhizome	Consumption aids in resolving digestive disorders and nausea.	Assam / Arunachal Pradesh
29	*Ipomoea aquatica* Forssk. (Convolvulaceae)	Kolmu xaak (Assamese)	Leaves	Leaf extracts consumed to alleviate asthma; intake stimulates appetite.	Assam
30	*Terminalia chebula* Retz. (Combretaceae)	Khilikha	Fruit	Ingested orally to enhance digestive function and resolve gastric distress.	Assam
31	*Terminalia bellirica* (Gaertn.) Roxb. (Combretaceae)	Bhomora (Assamese)	Fruit	Taken orally to promote digestive health and alleviate stomach ailments.	Assam
32	*Zanthoxylum nitidum* (Roxb.) DC. (Rutaceae)	Tezmui (Assamese)	Leaves, roots	Foliar and root matter rubbed onto gums to relieve toothaches.	Assam
33	*Phyllanthus emblica* L. (Phyllanthaceae)	Amlokhi (Assamese)	Fruit	Ingested for digestion and dermatological health; fruit pastes applied topically to hair.	Assam / Arunachal Pradesh
34	*Streblus asper* Lour. (Moraceae)	-	Leaves	Topical application on traumatic cuts and infected zones.	Assam
35	*Euphorbia hirta* L. (Euphorbiaceae)	Gakhiroti bon	Leaves and stem	Relieves asthma, bronchial inflammation, and cough symptoms.	Assam
36	*Solanum nigrum* L. (Solanaceae)	Kochi (Assamese)	Leaves	Alleviates gastric ulcers, reduces febrile states, and exhibits antiinflammatory activity.	Assam / Arunachal Pradesh
37	*Portulaca oleracea* L. (Portulacaceae)	Malbhog xaak (Assamese)	Aerial stems and leaves	High in omega-3 fatty acids, provides antioxidant benefits, and soothes skin irritation.	Assam
38	*Allium hookeri* Thwaites (Amaryllidaceae)	Talap (Adi)	Leaves, roots, and bulbs	Exhibits anti-inflammatory action, assists in cholesterol modulation, and aids digestion.	Arunachal Pradesh
39	*Solanum torvum* Sw. (Solanaceae)	Sote Baake / Petta Baake (Adi)	Small bitter berries and fruits	Employed in traditional practices to lower blood sugar levels and relieve chronic coughs.	Arunachal Pradesh

40	*Bambusa tulda* Roxb. (Poaceae)	Iku (Adi)	Young tender underground shoots	High dietary fiber, low fat, and rich in vitamins; fermented forms support metabolic health.	Arunachal Pradesh
41	*Piper pedicellatum* C.DC. (Piperaceae)	Rar / Rare / Raru (Galo/Adi)	Tender stems and leaves	High protein and mineral content; traditionally cooked with meats to aid digestion and body aches.	Arunachal Pradesh
42	*Dioscorea alata* L. (Dioscoreaceae)	Kaath aalu	Tubers and leaves	Starchy underground tubers utilized for both culinary and therapeutic purposes.	Assam
43	*Garcinia pedunculata* Roxb. ex Buch.-Ham. (Clusiaceae)	Bor thekera	Fruit	Acidic fruits sun-dried into ribbons (Thekera Tenga) for sour curries and dysentery remedies.	Assam
44	*Justicia adhatoda* L. (Acanthaceae)	Boga bahok	Leaves	Ancient remedy for respiratory tract ailments; fresh extracts treat bronchial coughs and asthma.	Assam
45	*Phlogacanthus thyrsiformis* (Roxb. ex Hardw.) Mabb. (Acanthaceae)	Teeta phool	Flower	Flowers and leaves act as natural antibiotics and immunomodulators for seasonal protection.	Assam
46	*Amaranthus spinosus* L. (Amaranthaceae)	Hul-khutoriya	Tender leaves and shoots	Functions as a natural diuretic, aids digestion, and reduces inflammatory responses.	Assam
47	*Amaranthus viridis* L. (Amaranthaceae)	Khutoria	Tender leaf and shoots	Exceptionally rich source of vitamins C and A, alongside folic acid.	Assam
48	*Bonnaya brachiata* Link & Otto (Linderniaceae)	Xaru kasipotitya (Assamese)	Leaves, roots	Boiled foliar preparations consumed on an empty stomach to alleviate painful urination.	Assam
49	*Amorphophallus paeoniifolius* (Dennst.) Nicolson (Araceae)	Ul koshu	Tender corm, shoot, and leaves	Corms utilized traditionally to alleviate pain and inflammation associated with hemorrhoids.	Assam
50	*Oxalis corniculata* L. (Oxalidaceae)	Khoru tengesi (Assamese)	Leaves	Foliar preparations utilized for treating headaches and indigestion.	Assam

Ecological importance

Wild edible plants execute indispensable ecological functions within woodland and natural habitats (1,5). They contribute directly to ecosystem dynamics by supplying nutritional resources for avian species, mammals, insects, reptiles, and other wildlife (5).

Fruit-bearing taxa including *Ficus*, *Garcinia*, *Rubus*, and *Baccaurea* sustain frugivorous fauna that subsequently drive seed dispersal and natural forest regeneration (5,19). Flowering plants support diverse pollinator assemblages, including bees, butterflies, and nectar-feeding birds (1).

Bamboo stands stabilize fragile soils, reduce erosion rates, and reinforce watershed protection, whereas ferns and herbaceous understory species augment soil fertility through nutrient cycling mechanisms (4,5). Wetland vegetation contributes significantly to water purification and habitat maintenance for aquatic organisms (5).

Consequently, the conservation of wild edible plants promotes human well-being while safeguarding overall biodiversity and ecosystem resilience (1,4).

Economic importance

Wild edible plants represent a vital pillar of rural livelihoods throughout Northeast India (10,14). Fresh vegetables, wild fruits, bamboo shoots, spices, and medicinal plants are routinely traded in rural village markets (*haats*) and urban retail centers (10,28).

Households secure supplementary financial income through the commercial harvest of *Garcinia pedunculata*, *Parkia timoriana*, bamboo shoots, *Houttuynia cordata*, wild berries, edible ferns, and other non-timber forest products (14,27).

Expanding consumer demand for organic dietary items, nutraceutical formulations, herbal medicines, and functional foods creates substantial prospects for value addition and commercial development (6,21). Community-operated enterprises focusing on the processing, packaging, and marketing of wild edible plants can enhance rural employment opportunities while fostering sustainable resource management (10,14).

Threats and conservation challenges

Despite their immense ecological and socioeconomic value, wild edible plants confront severe anthropogenic and environmental pressures (1,5). Habitat destruction driven by deforestation, infrastructure projects, urban expansion, mining operations, and agricultural intensification has substantially diminished natural populations (1,4).

Unregulated harvesting, climatic instability, recurrent forest fires, aggressive biological invasions, and general overexploitation further endanger multiple species (1,5). Additionally, the gradual erosion of traditional ecological knowledge among younger demographics has diminished customary utilization practices (2,10).

Furthermore, limited scientific documentation, unresolved taxonomic ambiguities, and inadequate conservation frameworks impede effective stewardship of these valuable botanical assets (4,21).

Conservation strategies and sustainable utilization

The long-term preservation of wild edible plants necessitates integrated frameworks combining biodiversity protection with sustainable livelihood enhancement (4,5).

Key priority actions involve reinforcing *in situ* conservation via legally protected zones and community-administered forests, promoting *ex situ* conservation within botanical gardens and germplasm seed banks, encouraging responsible harvesting protocols, documenting indigenous lore, and undertaking the domestication

of promising wild taxa (4,13).

Government agencies, scientific research institutions, non-governmental organizations, and local communities must collaborate closely to formulate conservation policies that ensure equitable benefit-sharing while preserving ecological integrity (4,5).

Future perspectives

Although substantial ethnobotanical information has been gathered, significant research gaps persist (15,21). Comprehensive taxonomic inventories encompassing all eight northeastern states remain incomplete (4). Nutritional profiling has been executed for only a fraction of recorded species, and numerous wild edible plants remain chemically unexplored (6,8).

Upcoming investigations should prioritize molecular systematics, nutritional analyses, phytochemical screening, climate change vulnerability assessments, domestication feasibility, sustainable harvest protocols, conservation genetics, and socioeconomic valuations (4,21).

Synthesizing indigenous knowledge with advanced scientific techniques will facilitate biodiversity preservation, enhance regional food security, and support sustainable rural development (2,4).

Conclusion

Wild edible plants constitute an invaluable pillar of the biological and cultural legacy of Northeast India (3,4). These taxa contribute substantially to food security, nutritional health, traditional healthcare systems, rural livelihoods, biodiversity conservation, and ecosystem functioning (1,6). Indigenous populations have sustained sophisticated bodies of knowledge concerning their sustainable utilization across centuries (2,10).

Nonetheless, intensifying anthropogenic pressures, habitat degradation, and climatic disruptions threaten both wild plant resources and associated traditional wisdom (1,5). Strengthening scientific research, documenting ethnobotanical lore, enforcing sustainable foraging practices, and fostering community-based conservation initiatives are crucial for guaranteeing the enduring survival of these valuable biological assets (4,5).

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