Survey of medicinal herbaceous plants in Behali Wildlife Sanctuary, Assam, Northeast India: Traditional use patterns, phytodiversity, and conservation relevance among adjacent communities

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Ethnobotany Research and Applications 35:31 (2026) - http://dx.doi.org/10.32859/era.35.31.1-14
Manuscript received: 23/03/2026 - Revised manuscript received: 13/07/2026 - Published: 14/07/2026

Research

Abstract

Background: Behali Wildlife Sanctuary (BWS) harbors high biodiversity, including a rich diversity of herbaceous plants with considerable ethnomedicinal value. For generations, local communities in the surrounding areas have managed ailments such as fever, peptic ulcers, diabetes, headaches, wounds, digestive disorders, dysentery, malaria, and psoriasis through the use of these plants as traditional medicines. Scientific validation of these ethnomedicinal plants is essential to facilitate the identification of bioactive constituents, assessment of safety and efficacy, and exploration of their potential pharmaceutical applications.

Methods: An ethnobotanical survey was conducted in BWS between February 2025 and January 2026. A total of 207 informants, comprising traditional healers, farmers, and elderly community members from five adjacent villages, were consulted through semi-structured interviews and guided field walks. Data were collected following standard ethnobotanical methodologies and analyzed using quantitative indices.

Results: A total of 50 medicinally important herbaceous species belonging to 24 plant families were documented. Local inhabitants reported preparing herbal formulations from leaves, stems, rhizomes, roots, flowers, and whole plants for oral or topical application. *Torenia crustacea* (L.) Cham. & Schltdl. recorded the highest frequency of citation (FC = 116; RFC = 0.560), while *Murdannia japonica* (Thunb.) Faden recorded the lowest (FC = 2; RFC = 0.009). The Acanthaceae family showed the highest Family Importance Value (FIV = 0.576), while Asteraceae was the most species-rich family (7 species).

Conclusions: This ethnobotanical inventory documents significant diversity in medicinal herbaceous plants and reveals substantial traditional knowledge of plant-based therapeutics within BWS communities. The results underscore the urgent need for bioassay validation of the most frequently cited species, particularly with respect to bioactive compound isolation, safety profiling, and pharmaceutical integration. Conservation of both plant diversity and traditional knowledge in the sanctuary should be prioritized.

Keywords: Ethnobotany, Behali Wildlife Sanctuary, Assam, medicinal herbs, traditional medicine, Northeast India

Background

Assam occupies a strategic position in Northeast India, spanning latitudes 24° to 28° N and longitudes 89° to 96° E. Covering 78,438 km², the state supports exceptionally rich biodiversity, with forests covering over 35% of its area, including tropical rainforests, semi-evergreen woodlands, and protected wildlife sanctuaries. The state harbors more than 4,273 plant species, of which approximately 952 are recognized as having medicinal value (Barman & Goswami 2019). Assam's Protected Area Network extends over 3,925–4,938 km², encompassing 8 national parks, 17 wildlife sanctuaries, and 3 proposed sanctuaries. Behali Wildlife Sanctuary (BWS) is situated in the foothills of the Eastern Himalayas, in the Biswanath district of Assam, on the border with Arunachal Pradesh. A floristic inventory recorded 281 vascular plant taxa, comprising 272 species, one subspecies, and eight varieties in 206 genera and 79 families from the Behali Reserve Forest (Borah *et al.* 2020). BWS harbors a diverse array of medicinal trees and herbaceous plants that form the foundation of traditional healthcare for adjacent communities in managing ailments such as fever, peptic ulcers, diabetes mellitus, headaches, wounds, digestive disorders, dysentery, malaria, and psoriasis, among others (Umashanker & Shruti 2011).

Ethnobotanical documentation in the Biswanath district remains limited (Barooah & Mahanta 2006; Devi 1998; Sarma & Borah 2014), and no previous study has focused specifically on the herbaceous medicinal flora of BWS and its utilization patterns by adjacent communities. In the present study, we define medicinal herbs as those herbaceous plant species most frequently cited and quantitatively prioritized by local informants based on use-frequency data, as measured by the Relative Frequency of Citation (RFC) and Family Importance Value (FIV) indices. The adjacent communities include residents of villages bordering BWS, comprising ethnic groups such as Bodo, Mishing, Nepali, and other local communities whose livelihoods are intertwined with the sanctuary's resources.

With rapid modernization, changing socio-cultural values, and habitat degradation, indigenous knowledge of medicinal plants is increasingly at risk of erosion (Borah 2026). The documentation and scientific validation of this traditional knowledge is urgently needed to support biodiversity conservation and facilitate future ethnopharmacological research. Accordingly, the present study was conducted with the following objectives: (i) to document the ethnomedicinal herbaceous species used by communities adjacent to BWS; (ii) to quantify their relative importance using standard ethnobotanical indices; and (iii) to provide a foundation for future pharmacological and conservation research.

Materials and Methods

Study area

Behali Wildlife Sanctuary extends over an area of 140.16 km² across the outermost foothills of the Eastern Himalayas. It is part of the Kameng–Sonitpur Elephant Reserve, which encompasses protected areas in both Assam (including Behali Wildlife Sanctuary, Charduar Reserve Forest, Nowduar Reserve Forest, and Nameri Tiger Reserve) and Arunachal Pradesh (including Eagle Nest Wildlife Sanctuary, Pakke Tiger Reserve, Sessa Orchid Sanctuary, and Sonai-Rupai Wildlife Sanctuary) (Kushwaha & Hazarika 2004). The sanctuary is bounded by the Buroi River to the east, the Borgang River and Singlijan Reserve Forest to the west, Papum Reserve Forest to the north, and tea estates and human settlements to the south (Sarma *et al.* 2009; Singh & Chaturvedi 2017). Its geographical coordinates are 26° 52′ to 26° 57′ N latitude and 93° 15′ to 93° 24′ E longitude, with elevations ranging from 80 to 275 m above sea level. Adjacent human habitations include Rangagorha Tea Estate, Khorang Line, Serelia Pathar, Hatimara Pathar, Sialmari, and Bihmari.

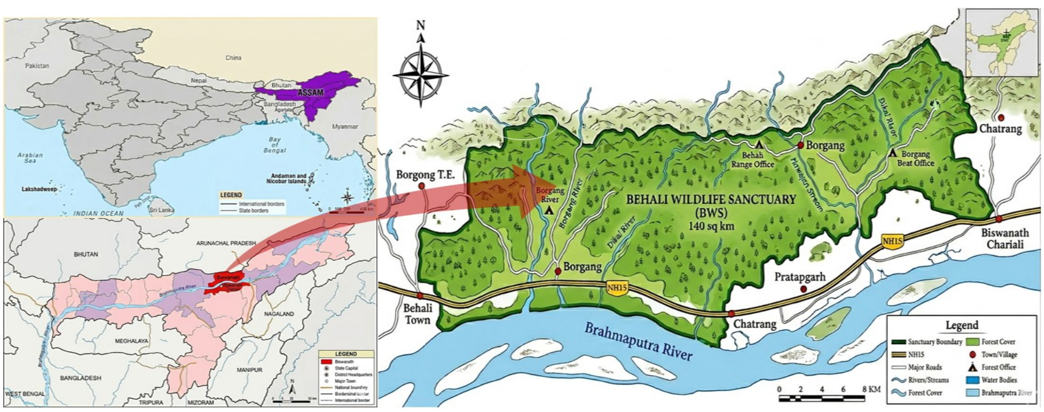

Figure 1. Map of Behali Wildlife Sanctuary showing the study area.

Study communities and informant selection

The study was conducted between February 2025 and January 2026. Field surveys covered the entire sanctuary area and five adjacent villages. The communities consulted include members of the Bodo, Mishing, Nepali, and general (non-tribal) local communities, whose livelihoods involve varying degrees of dependence on forest resources and traditional medicine. A total of 207 informants were selected using purposive sampling, targeting individuals recognized locally as knowledgeable about medicinal plants, including traditional healers (locally known as kaviraj), farmers, elderly residents, and women with demonstrated knowledge of plant-based home remedies. Informed consent was obtained from each participant prior to data collection. Interviews were conducted in Assamese and local dialects, with the assistance of a local interpreter where necessary.

Data collection

Ethnomedicinal botanical data were collected using semi-structured individual interviews, supplemented by guided field walks in which informants directly identified plant species in the field. Interview topics included plant identification, local names, parts used, methods of preparation, mode of administration, and ailments treated. Data collection followed the methodologies of Schultes (1962) and Jain (1963). A minimum of three field visits to each village were undertaken to ensure adequate data collection and cross-validation of reported uses.

Voucher specimens of all documented species were collected, photographed, and deposited at the Gauhati University Botany Herbarium (GUBH), Guwahati, Assam, following standard herbarium preparation protocols. Taxonomic identification was based on the works of Hooker (1872–1897) and Kanjilal's Flora of Assam (1934–1940), with comparisons against authenticated herbarium specimens. Scientific names and author citations were verified against the Plant List and World Flora Online databases.

Data analysis

Data collected during the ethnobotanical survey were analyzed using the following quantitative ethnobotanical indices. All calculations were performed using Microsoft Excel.

Frequency of Citation (FC): Frequency of Citation represents the number of informants who reported the use of each species for ethnomedicinal purposes.

Relative Frequency of Citation (RFC): As described by Tardío and Pardo-de-Santayana (2008), RFC measures the local prominence of each medicinal plant in the study area, calculated as:

$$RFC = FC/N \ (0 < RFC < 1)$$

where N is the total number of informants surveyed, and FC is the number of informants citing a given species.

Plant Part Value (PPV): PPV measures the relative importance of each plant part as reported by informants (Umair *et al.* 2024), calculated as:

$$PPV = RU \text{ plant part} / RU \text{ total}$$

where RU plant part is the total number of reported uses for a given plant part, and RU total is the total number of reported uses across all plant parts.

Family Importance Value (FIV): FIV emphasizes the relative ethnomedicinal importance of plant families (Phillips *et al.* 1993; Ralte *et al.* 2024), calculated as:

$$FIV = RFC \text{ family} / Ns$$

where RFC family is the relative frequency of citation at the family level, and Ns is the number of species in that family. A high FIV value thus reflects strong per-species citation intensity within a family, regardless of the total number of species recorded.

Ethics, permissions, and compliance

The study was conducted in accordance with the ethical guidelines for ethnobotanical research established by the International Society of Ethnobiology (ISE Code of Ethics, 2006). Prior to fieldwork, written permission was obtained from the Divisional Forest Officer, Biswanath Wildlife Division, Assam (Permit reference available on request). Prior Informed

Consent (PIC) was secured from all individual participants, as well as from village heads and community elders, following a clear explanation of the study objectives, expected benefits, and methods of dissemination. Participation was entirely voluntary. All data were managed confidentially, and the identities of individual informants are protected in this publication. In compliance with the Nagoya Protocol on Access and Benefit-Sharing (ABS) under the Convention on Biological Diversity, the study did not involve the commercial collection or export of biological material or genetic resources. The traditional knowledge documented herein is presented solely for scientific and conservation purposes, with due acknowledgment of the knowledge-holding communities. Benefit-sharing arrangements are restricted to the return of printed copies of the published research to village heads and relevant local authorities

Results

Sociodemographic profile of informants

The study involved 207 participants ranging in age from 20 to 78 years. Of the total informants, 109 (52.6%) were male and 98 (47.7%) were female. The age distribution showed that the 50–70-year group was the most represented (n = 85; 41.1%), followed by the 35–50-year group (n = 73; 35.2%), the 20–35-year group (n = 37; 17.8%), and those above 70 years (n = 12; 5.7%). Regarding educational attainment, 66 informants (31.8%) were illiterate, 58 (28.0%) had completed matriculation, 40 (19.3%) had completed intermediate level, and 43 (20.8%) were graduates. The complete sociodemographic profile is presented in Table 1.

Table 1. Sociodemographic profile of the interviewed informants (N = 207).

Attribute		**N**	**N%**
Gender	Male	109	52.6
	Female	98	47.7
Age (years)	20–35	37	17.8
	35–50	73	35.2
	50–70	85	41.1
	>70	12	5.7
Academic level	Illiterate	66	31.8
	Matriculation	58	28.0
	Intermediate	40	19.3
	Graduation	43	20.8

Documented medicinal herbaceous species and family distribution

A total of 50 medicinally important herbaceous species belonging to 24 plant families were documented (Table 2). The family Asteraceae was the most species-rich, contributing 7 species, followed by Lamiaceae, Polygonaceae, and Poaceae, each with 4 species. The families Zingiberaceae and Araceae contributed 3 and 2 species, respectively. The remaining 16 families each contributed a single species.

Family Importance Value (FIV)

The Family Importance Value (FIV), which measures the per-species citation intensity within each family, showed that Acanthaceae had the highest FIV (0.576), indicating that its two constituent species were among the most intensively cited on a per-species basis. This was followed by Phyllanthaceae (FIV = 0.454; 1 species), Piperaceae (FIV = 0.437; 1 species), Zingiberaceae (FIV = 0.398; 3 species), and Cleomaceae (FIV = 0.391; 1 species). The Dioscoreaceae family recorded the lowest FIV (0.024; 1 species). The complete FIV values are presented in Table 2.

Table 2. Ethnomedicinal herbaceous species documented in Behali Wildlife Sanctuary and their uses by local communities.

Family	Species	Vernacular name	Voucher No.	Part used	Preparation	Ethnomedicinal uses	FC	RFC	FIV
Lamiaceae	*Achyrospermum wallichianum* (Benth.) Benth. ex Hook.f	Majong bon	B009	Inflorescence and leaves	Aqueous extract consumed orally	Fever, stomachache, digestive disorders	8	0.038	0.084
	Clerodendrum infortunatum L.	Dhopat-tita	B006	Young leaves and roots	Aqueous extract consumed orally or applied topically based on ailment	Skin irritation, wounds, and fever	21	0.101	
	Leucas aspera (Willd.) Link	Durun	B034	Whole plant (young stage)	Aqueous extract and paste consumed orally	Bronchitis, immunostimulation, digestive disorders, skin ailments	32	0.154	
	Gomphostemma niveum Hook.f.	Bhumi-tita	B044	Whole plant	Aqueous extract consumed orally	Tuberculosis, fever, dizziness	9	0.043	
Asteraceae	*Grangea maderaspatana* (L.) Poir	Makhipotia	B007	Whole plant (young stage)	Aqueous extract consumed orally or applied topically	Pain relief, anti-inflammatory, bone pain	15	0.072	0.159
	Mikania micrantha Kunth	Mekani lota	B017	Whole plant (young stage)	Aqueous extract and paste applied topically	Skin irritation, wounds, minor burns, insect bites	21	0.101	
	Synedrella nodiflora (L.) Gaertn.	Sohoni bon	B002	Aerial parts and leaves	Aqueous extract consumed orally	Antidiabetic, digestive disorders	35	0.169	
	Eclipta prostrata (L.) L.	Bhringraj	B024	Leaves and aerial parts	Aqueous extract or fresh leaves consumed orally	Jaundice, hair loss, skin irritation	61	0.294	
	Acmella paniculata (Wall. ex DC.) R.K.Jansen	Bon narzi	B033	Flowers and leaves	Aqueous extract or fresh plant material consumed orally	Dental and oral disorders	55	0.265	
	Enydra fluctuans Lour.	Helonchi bon	B055	Whole plant (young stage)	Aqueous extract consumed orally; paste applied topically	Digestive disorders, skin irritation, wounds, inflammation	27	0.130	
	Tridax procumbens L.	Kurkuri bon	B099	Whole plant (young stage)	Aqueous extract and paste consumed orally or applied topically	Diabetes, hepatic ailments, bleeding wounds	17	0.082	

Family	Species	Vernacular name	Voucher No.	Part used	Preparation	Ethnomedicinal uses	FC	RFC	FIV
Zingiberaceae	*Alpinia nigra* (Gaertn.) Burt	Tora	B065	Rhizome, stem	Decoction consumed orally	Gastrointestinal disorders, respiratory conditions, inflammation	77	0.371	0.398
	Curcuma longa L.	Halodhi	B060	Rhizome	Aqueous extract and paste consumed orally or applied topically	Muscle pain, anti-inflammatory, digestive disorders, skin irritation	105	0.507	
	Globba multiflora Wall. ex Baker	Pakhi-halodhi	B101	Rhizome	Aqueous extract consumed orally	Peptic ulcers, fever, burns	66	0.318	
Acanthaceae	*Hygrophila polysperma* (Roxb.) T.Anderson	Xoru puni	B040	Leaves and seeds	Paste and aqueous extract applied topically or consumed orally	Muscle cramps, headache	13	0.062	0.576
	Andrographis paniculata (Burm.f.) Wall. ex Nees	Kolamegh	B015	Leaves and aerial parts	Aqueous extract consumed orally	Diarrhea, hepatic ailments, diabetes	23	0.111	
Polygonaceae	*Persicaria barbata* (L.) Hara	Bon-gehu	B036	Whole plant	Aqueous extract consumed orally	Helminthiasis, digestive disorders, menstrual pain	9	0.043	0.155
	Persicaria hydropiper (L.) Delarbre	Belongoni	B091	Whole plant	Aqueous extract applied topically	Pediculosis capitis	44	0.212	
	Rumex maritimus L.	Bon-suka xak	B077	Whole plant (young stage)	Aqueous extract consumed or used as culinary medicine	Constipation, diarrhea, abdominal pain, jaundice	35	0.169	
	Persicaria praetermissa (Hook.f.) H.Hara	Behu	B089	Leaves	Aqueous extract and paste applied topically	Rheumatism, fungal infections	41	0.198	
Poaceae	*Axonopus compressus* (Sw.) P.Beauv.	Carpet bon	B022	Whole plant	Aqueous extract consumed orally	Malaria, sore throat	25	0.120	0.215
	Eleusine indica (L.) Gaertn.	Babosa bon	B111	Whole plant	Decoction consumed orally	Diabetes, fever, renal disorders, urinary hesitancy	29	0.140	
	Oplismenus burmannii (Retz.) P.Beauv.	Oha-bon	B093	Whole plant	Decoction consumed orally	Eye infections, muscle pain	16	0.077	

Family	Species	Vernacular name	Voucher No.	Part used	Preparation	Ethnomedicinal uses	FC	RFC	FIV
	Cynodon dactylon (L.) Pers.	Dubori bon	B071	Whole plant	Decoction consumed orally; paste applied topically	Renal stones, diarrhea, peptic ulcers, skin infections	109	0.526	
Araceae	*Alocasia fornicata* (Kunth) Schott	Bez kosu	B119	Stem and rhizome	Consumed as culinary medicine	Skin diseases, reported use for tumors (traditional claim only)	57	0.275	0.330
	Colocasia esculenta (L.) *Schott*	Kola kosu	B127	Stem and rhizome	Consumed as culinary medicine; stem extract applied topically	Minor wounds, anemia	80	0.386	
Fabaceae	*Mimosa pudica* L.	Lajuki bon	B105	Roots and leaves	Aqueous extract consumed orally	Hemorrhoids, diarrhea, peptic ulcers, hepatic ailments	64	0.309	0.344
	Grona triflora (L.) H.Ohashi & K.Ohashi	Kodali bon	B116	Whole plant	Aqueous extract consumed orally	Dysentery, diabetes, fever	37	0.178	
	Clitoria ternatea L.	Aparajita	B004	Flower and root	Decoction consumed orally	Anxiety, insomnia, hepatic ailments, diabetes	113	0.545	
Rosaceae	*Potentilla indica* (Andrews) Th.Wolf	Kukur-muta	B012	Leaves, fruits, flowers	Aqueous extract consumed orally; fruits consumed raw	Tonsillitis, pharyngitis, immunostimulation, fever	32	0.154	0.154
Pontederiaceae	*Pontederia vaginalis* Burm.f.	Bhat meteka	B097	Root, leaves	Dried root powder and leaf extract consumed orally	Toothache, asthma, reported use for liver cirrhosis (traditional claim only)	9	0.043	0.052
	Pontederia crassipes Mart.	Pani meteka	B233	Roots	Decoction consumed orally	Diarrhea, fever, convulsions	13	0.062	
Lythraceae	*Rotala rotundifolia* (Roxb.) Koehne	Runa bon	B076	Leaves	Decoction consumed orally; paste applied topically	Rheumatoid arthritis, fever, inflammation, swelling	28	0.135	0.079
	Cuphea carthagenensis (Jacq.) J.F.Macbr.	Pani Jetuka	B082	Whole plant	Aqueous extract consumed orally; aerial parts consumed	Hypercholesterolemia, hepatic ailments, fever, cough, hemorrhoids	5	0.024	
Piperaceae	*Peperomia pellucida* (L.) Kunth	Pononua	B166	Whole plant	Decoction and culinary medicine	Hypertension, peptic ulcers, hyperuricemia, digestive disorders, fever, wounds	98	0.473	0.437

Family	**Species**	**Vernacular name**	**Voucher No.**	**Part used**	**Preparation**	**Ethnomedicinal uses**	**FC**	**RFC**	**FIV**
Saururaceae	*Houttuynia cordata* Thunb.	Mosundori	B505	Leaves and aerial parts	Decoction and culinary medicine	Pneumonia, bronchitis, immunostimulation, digestive disorders	77	0.371	0.371
Onagraceae	*Ludwigia perennis* L.	Pani long	B507	Whole plant (young stage)	Aqueous extract consumed orally; paste applied topically	Fever, diarrhea, skin infections	36	0.173	0.173
Rubiaceae	*Oldenlandia corymbosa* L.	Bon jaluk	B501	Whole plant	Aqueous extract consumed orally	Fever, jaundice, bronchitis, urinary tract infections, prostate ailments	42	0.202	0.115
	Exallage ulmifolia (Wall.) Bremek.	Kachi doriya	B408	Whole plant (young stage)	Aqueous extract consumed orally; paste applied topically	Jaundice, skin irritation, minor burns and cuts	6	0.028	
Phyllanthaceae	*Phyllanthus niruri* L.	Bhui amlokhi	B416	Whole plant	Aqueous extract consumed orally	Bronchitis, reported use in hepatitis B (traditional claim), peptic ulcers, fever	94	0.454	0.454
Cleomaceae	*Cleome rutidosperma* DC.	Xoru hurhuri xak	B471	Whole plant (young stage)	Decoction and culinary medicine	Convulsions, skin irritation, joint pain, viral fever	81	0.391	0.391
Linderniaceae	*Torenia crustacea* (L.) Cham. & Schltdl.	Ghai xak muroliya	B476	Whole plant (young stage)	Consumed as culinary medicine	Digestive disorders, immunostimulation, dysentery	116	0.560	0.359
	Bonnaya ruelloides (Colsm.) Spreng.	Kachi doriya	B472	Whole plant (young stage)	Aqueous extract consumed orally	Dysentery, cough, fever, urinary tract infections	33	0.159	
Begoniaceae	*Begonia silletensis* (A.DC.) C.B.Clarke	Tenga pat	B489	Leaves	Consumed as culinary medicine	Diarrhea and dysentery	59	0.285	0.285
Commelinaceae	*Commelina diffusa* Burm.f.	Nila kona-ximolu	B485	Whole plant	Paste applied topically	Insect bites, wounds, arthritis, rheumatism, swelling	18	0.086	0.047
	Murdannia japonica (Thunb.) Faden	Mati seleng	B483	Rhizome, stem	Decoction consumed orally	Oral disorders, peptic ulcers	2	0.009	
Urticaceae	*Laportea interrupta* (L.) Chew	Dam-chorat	B488	Leaves and whole plant (young stage)	Decoction consumed orally; aqueous extract consumed orally	Coughs, asthma, rheumatism, digestive disorders	14	0.067	0.067

Family	Species	Vernacular name	Voucher No.	Part used	Preparation	Ethnomedicinal uses	FC	RFC	FIV
Solanaceae	*Solanum nigrum* L.	Korochi xak	B444	Whole plant (young stage), aerial parts	Consumed as culinary medicine	Hyperuricemia, reported use for tumors/ulcers (traditional claim), rheumatism	79	0.381	0.381
Plantaginaceae	*Scoparia dulcis* L.	Bon dhoniya	B421	Whole plant (young stage)	Decoction consumed orally	Diabetes, jaundice	31	0.149	0.149
Dioscoreaceae	*Tacca integrifolia* Ker Gawl.	Baduli bon	B001	Rhizome	Decoction consumed orally; paste applied topically	Gastric ulcers, hypertension, diarrhea, skin infections, wounds	5	0.024	0.024

FC = Frequency of Citation; **RFC** = Relative Frequency of Citation; **FIV** = Family Importance Value. FIV is listed only for the first species within each family.

Relative Frequency of Citation (RFC)

The RFC values for all 50 species are presented in Table 2. *Torenia crustacea* (L.) Cham. & Schltdl. recorded the highest RFC value (0.560; FC = 116), making it the most frequently cited species in this survey. Other highly cited species included *Cynodon dactylon* (L.) Pers. (RFC = 0.526; FC = 109), *Clitoria ternatea* L. (RFC = 0.545; FC = 113), *Curcuma longa* L. (RFC = 0.507; FC = 105), and *Peperomia pellucida* (L.) Kunth (RFC = 0.473; FC = 98). At the lower end, *Murdannia japonica* (Thunb.) Faden recorded the lowest RFC (0.009; FC = 2), followed by *Commelina diffusa* Burm.f. (RFC = 0.086). It should be noted that *Cuphea carthagenensis* (Jacq.) J.F.Macbr. and *Tacca integrifolia* Ker Gawl. each had FC = 5 and RFC = 0.024, placing them among the least cited species in this survey, above only *Murdannia japonica*.

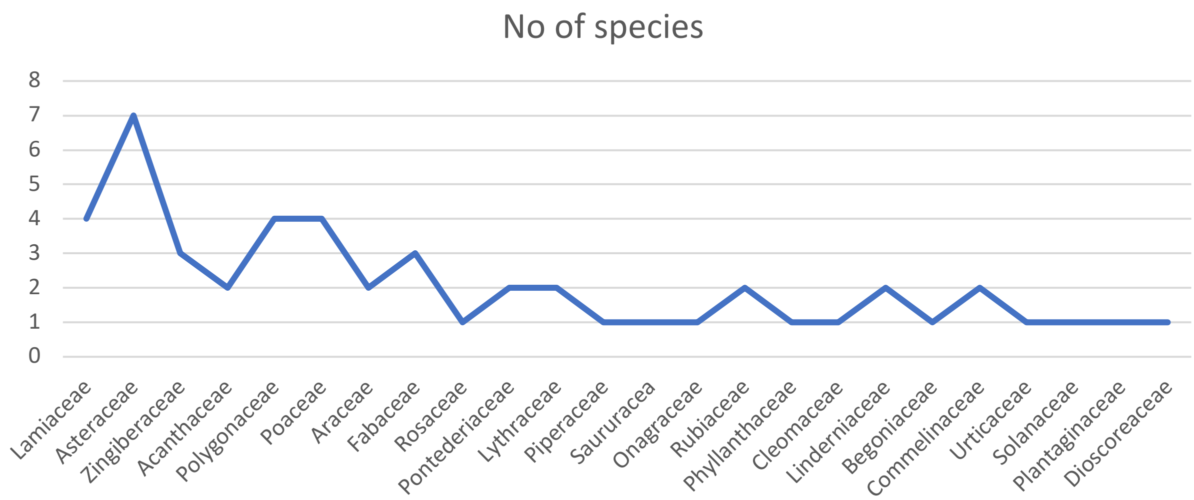

Figure 2. Number of medicinal herbaceous species recorded per family in Behali Wildlife Sanctuary.

Plant part utilization and Plant Part Value (PPV)

Various plant parts were used in ethnomedicinal formulations documented during the field surveys, including leaves, inflorescences, roots, stems, rhizomes, flowers, whole plants, and aerial parts. Whole plants recorded the highest PPV (0.52) and were the most frequently used plant part. This was followed by leaves (PPV = 0.26), stems and rhizomes (PPV = 0.12), aerial parts and roots (PPV = 0.08 each), and flowers and inflorescences (PPV = 0.06 each).

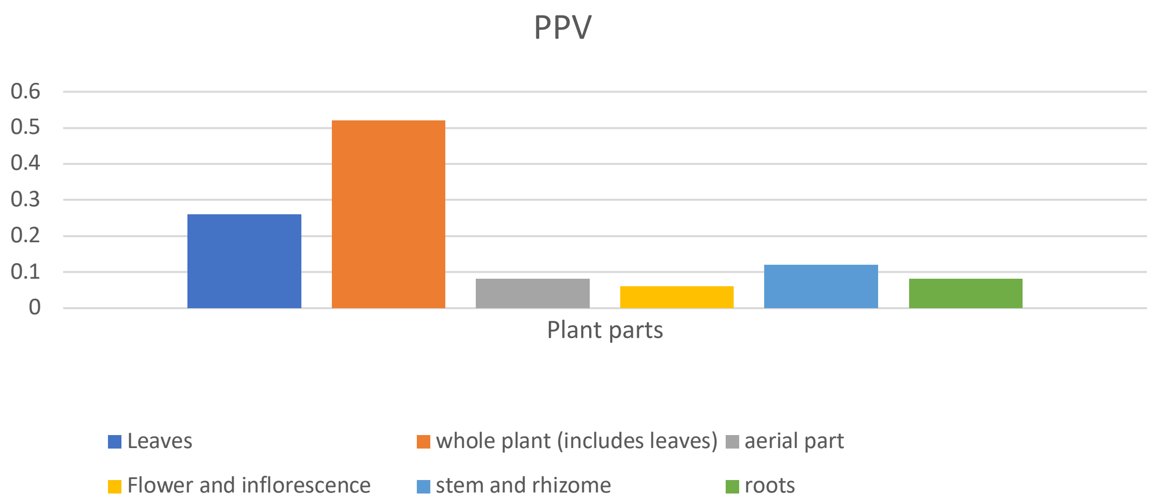

Figure 3. Plant parts used in ethnomedicinal formulations, showing Plant Part Values (PPV).

Discussion

Diversity and distribution of documented species

The present study documents 50 medicinally important herbaceous species from 24 families within and around BWS. This is consistent with the high phytodiversity reported from protected areas in Northeast India, particularly in the Kameng–Sonitpur Elephant Reserve corridor (Kushwaha & Hazarika 2004). The dominance of Asteraceae (7 species) in terms of species richness is notable and aligns with ethnobotanical surveys from comparable regions of Assam, Mizoram, and other parts of Northeast India (Ralte *et al.* 2024; Teklehaymanot 2017).

Family Importance Value: species richness vs. per-species citation intensity

The FIV results merit careful interpretation. Although Asteraceae contributed the highest number of species (7), its FIV was lower than that of Acanthaceae (FIV = 0.576; 2 species). This apparent discrepancy reflects the nature of the FIV metric: families with fewer species but highly cited constituent species receive a higher FIV than species-rich families with moderate average citation rates. In the case of Acanthaceae, both documented species—*Hygrophila polysperma* and *Andrographis paniculata*—were cited with reasonable frequency (RFC = 0.062 and 0.111, respectively), generating a high family-level RFC per species. Conversely, Asteraceae species showed a wide range of citation frequencies, from RFC 0.072 (*Grangea maderaspatana*) to RFC 0.294 (*Eclipta prostrata*), diluting the per-species average. These two metrics—species richness and FIV—thus capture complementary dimensions of ethnomedicinal diversity.

Frequently cited species and their reported uses

Torenia crustacea emerged as the most frequently cited species (RFC = 0.560), consistent with previous ethnobotanical studies from Mauritius that reported its traditional use in the treatment of dysentery and gastrointestinal disorders (Suroowan *et al.* 2019). *Cynodon dactylon* was also among the highest-cited species (RFC = 0.526). Traditional healers in the study area reported its juice as useful in managing dysentery and diarrhea, a finding that corresponds with ethnomedicinal reports from other parts of India (Tripathi *et al.* 2025). Similarly, *Clitoria ternatea* (RFC = 0.545) was widely cited for reported use in anxiety, insomnia, and metabolic ailments such as diabetes and hepatic conditions.

Phyllanthus niruri L. (RFC = 0.454) was reported for the management of bronchitis, peptic ulcers, and fever. Experimental studies have demonstrated the anti-inflammatory and gastroprotective activity of this species in animal models (Mostofa *et al.* 2017), lending partial scientific support to its traditional use. *Peperomia pellucida* (L.) Kunth (RFC = 0.473) was reported for hypertension, peptic ulcers, hyperuricemia, and fever. Researchers have demonstrated pharmacological effects of this species, including gastroprotection, antimalarial activity, and antihyperuricemic effects in experimental models; the compound dillapiole, extracted from this plant, has shown gastroprotective properties in rat models of gastric ulcers (de Albuquerque *et al.* 2007). *Cleome rutidosperma* DC. (RFC = 0.391) was reported for convulsions and viral fever, and a review has documented anticonvulsant bioactivity for this species (Nguyen 2023). It is important to emphasize that reported traditional use does not automatically constitute proof of clinical efficacy; for conditions such as hepatitis B, tumors, liver cirrhosis, and cancer, all traditional use claims reported in this study should be understood as ethnomedicinal documentation pending rigorous pharmacological and clinical validation.

Plant part utilization and conservation considerations

Whole plants had the highest PPV (0.52), indicating that local practitioners most frequently harvested and used the entire plant. This finding is consistent with ethnomedicinal surveys from comparable regions, including studies from North Africa (Benarba *et al.* 2015), Morocco (El Khomsi *et al.* 2022), and Bangladesh (Faruque *et al.* 2018), where leaves and whole plants were the predominant plant parts used in traditional remedies. While harvesting leaves and aerial parts generally allows the plant to survive and regenerate, the preference for whole plant harvesting observed in this study raises conservation concerns. Repeated harvesting of whole plants can lead to local population depletion, particularly for less common species. We recommend that future conservation and management plans for BWS explicitly address sustainable harvesting practices, including the promotion of leaf-only or aerial-part harvesting for high-demand species where pharmacological efficacy is concentrated in these parts.

Informant demographics and knowledge distribution

The survey included 207 informants with diverse age, gender, and educational backgrounds. The most represented age group was 50–70 years (41.1%), followed by 35–50 years (35.2%), suggesting that medicinal plant knowledge is predominantly held by middle-aged to older community members. Consistent with observations from other ethnobotanical surveys, experienced traditional healers and elders are generally regarded as the most authoritative sources of ethnomedicinal knowledge in traditional systems of medicine (Ritter *et al.* 2012). It is noted, however, that demographic differences in survey representation (i.e., having more male or more literate respondents) do not, by themselves, indicate differential knowledge levels between groups; such conclusions would require targeted comparative analysis beyond the scope of the present study.

Conservation of traditional knowledge

Ethnobotanical surveys in this region consistently emphasize that communities adjacent to BWS harbor substantial traditional knowledge of medicinal plant applications. With accelerating modernization, changing land use, and erosion of cultural practices, this knowledge base is increasingly threatened (Borah 2026). Scientific documentation, community engagement, and targeted conservation strategies are urgently needed to preserve this knowledge for future ethnopharmacological research and biodiversity management.

Conclusions

This ethnobotanical inventory documents 50 medicinally important herbaceous species from 24 families used by communities adjacent to Behali Wildlife Sanctuary, representing a significant contribution to the documentation of plant-based traditional medicine in Northeast India. Quantitative analysis identified *Torenia crustacea*, *Cynodon dactylon*, and *Clitoria ternatea* as the species with the highest community citation frequency, while Acanthaceae showed the highest Family Importance Value. Whole plants constituted the most commonly used plant part, a finding with direct implications for sustainable resource management in the sanctuary. All reported ethnomedicinal uses, particularly those involving serious conditions such as cancer, hepatitis B, and liver cirrhosis, are documented as traditional claims and require rigorous pharmacological validation before any therapeutic conclusions can be drawn. Future research should prioritize: (i) bioactive compound isolation and characterization from the most frequently cited species; (ii) safety and efficacy profiling through in vitro and in vivo studies; (iii) development of community-based conservation protocols to ensure sustainable harvesting; and (iv) strengthening of community benefit-sharing arrangements in accordance with the Nagoya Protocol.

Declarations

List of abbreviations: BWS – Behali Wildlife Sanctuary; FC – Frequency of Citation; RFC – Relative Frequency of Citation; PPV – Plant Part Value; FIV – Family Importance Value; ABS – Access and Benefit-Sharing; GUBH – Gauhati University Botany Herbarium.

Ethics approval and consent to participate: Fieldwork was conducted in accordance with the ISE Code of Ethics (2006). Written permission was obtained from the Divisional Forest Officer, Biswanath Wildlife Division, Assam. Prior Informed Consent (PIC) was secured from all individual participants and community leaders prior to data collection. Participation was entirely voluntary, and all data were managed with strict confidentiality and in full respect of local traditions and cultural practices. The study complies with the principles of the Nagoya Protocol on Access and Benefit-Sharing under the Convention on Biological Diversity.

Consent for publication: Not applicable.

Availability of data and materials: The datasets supporting the conclusions of this article are available from the corresponding author upon reasonable request. Voucher specimens are deposited at the Gauhati University Botany Herbarium (GUBH), Guwahati, Assam.

Competing interests: The author declares no competing interests.

Funding: No external funding was received for this study.

Author contributions: Lakhyajit Borah designed the study, conducted fieldwork, collected and analyzed data, reviewed the relevant literature, and wrote and revised the manuscript.

Acknowledgements

The author extends sincere gratitude to all participants, including both men and women informants, village heads, and traditional healers (kaviraj), for their invaluable cooperation in the ethnobotanical survey and for generously sharing their ancestral knowledge of herbal remedies. The author also thanks the Divisional Forest Officer, Biswanath Wildlife Division, for granting permission to conduct fieldwork within the sanctuary area.

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