An ethnobotanical study of traditionally used medicinal plants: Case study from Assam, India

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Research

Abstract

Background: Traditional knowledge of medicinal plants, their application, and conservation is very likely to be disappearing. From the perspective of conservation planning and management, it is crucial to assemble information about the use of medicinal herbs by various ethnic groups and at various spatial scales. Therefore, with this viewpoint in mind, this study was carried out, which included the ethnobotanical analysis of medicinal plants in Dimoria, Assam, which contributed to the locally based traditional healthcare system of the people living there.

Methods: The study was conducted with 140 traditional knowledgeable people (78 male and 62 female) being interviewed purposively. Household questionnaire surveys (HQS), key informant interviews (KII), and focus group discussions (FGD) were used for data collection. The use value (UV) score of species, informant consensus factor (ICF), and fidelity level (FL) were computed as standard ethnobotanical data analytical methods.

Results: The current study compiled information on the traditional use of 80 plant species from 45 different botanical groups to treat 56 distinct human diseases. The families that have the most species were Fabaceae followed by Rutaceae, Lamiaceae, Acanthaceae, Amaranthaceae, etc. Leaves (60%) were found the most commonly used plant parts for the treatment of various health ailments. The average UV score was found to be 0.64 (0.40 – 0.89). Based on UV scores, the most used species was *Zingiber officinale* (UV 0.89) and the least used species were *Cereus repandus* (UV 0.40). The FL of plant species ranged from 67.09 % to 94.44 % for the eleven categories chosen in the study area. The maximum FL of 94.44 % was found for *Azadirachta indica* for the dermatological disorder category. In our study, ICF factors for each category of usage ranged from 0.69 to 0.94, with cardiovascular disorder exhibiting the highest ICF value of 0.94.

Conclusions: The results of the study demonstrated that Dimoria is a repository for indigenous knowledge and a highly varied range of reliable plant species. Furthermore, additional research is required to determine the safety and efficacy of described ethnomedicinal plants in treating a variety of diseases, as the findings presented in this paper are preliminary in nature. As a result, the study highlights the potential of ethnomedical research as well as the significance of recording customary knowledge about the use of medicinal plants by the community for the benefit of all people.

Keywords: Ethnobotany; Indigenous; Medicinal plants; Traditional knowledge; Assam

Background

Plant wealth has remained a crucial element of human culture ever since the time when civilization began. Throughout history and across the globe, the understanding of plant wealth has significantly contributed to human wellness, with plants being utilized for the treatment of human illnesses over an extensive period (Haq *et al.* 2023).The profound understanding of medicinal plants' efficacy has evolved through countless battles against ailments, prompting humanity to unlock the healing treasures concealed within the barks, seeds, fruit bodies, and various other botanical wonders (Ahmad *et al.* 2021). A subfield of ethnobotany is ethnomedicine, which is a body of empirical regional practices derived from local and indigenous knowledge systems (Bussmann & Sharon 2006). Delving into the intricate ways individuals discern, categorize, and articulate health concerns lies at the heart of ethnomedicinal research, unravelling a fascinating tapestry of knowledge that bridges traditional wisdom with modern understanding. Depending on the culture, a health problem's classification and labelling may be based on the aetiology, the affected body part, the symptoms, or some combinations of these. The knowledge of how to identify and address the social, cultural, and economic factors that impact health issues is often transmitted orally from generation to generation (Gulzar *et al.* 2019).

Research on ethnomedicine is a vital source of knowledge for finding new substances that may lead to the development of new drugs. Actually, a number of essential medications have been made possible by the methodical documentation of traditional knowledge on the use of native plant species (Umair *et al*. 2017, Cox 2000). The World Health Organisation (WHO) estimates that between 70–95% of people in developing nations still mostly receive their primary medical care from medicinal plants. The value of the global market for medical plant products—which are derived from plant extracts that contain phytochemicals—was over US$60 billion in 2017 and is projected to surpass US$ 129 billion by 2023 (Rahman *et al.* 2022). However, only 15% of medicinal plants have been assessed internationally for their potential in terms of phytochemical and phytopharmacological properties (De Luca *et al.* 2012). Embarking on a journey across cultures, traditional medicines stand as pillars of well-being, celebrated in nations like China, India, and Japan. In the vibrant tapestry of India, where approximately 65% of the population, especially in rural realms, embraces the time-honoured embrace of traditional medicine, these ancient healing practices weave seamlessly into the fabric of primary healthcare (Haq *et al.* 2023).

It is now evident that the gradual erosion of indigenous knowledge about the use of medicinal plants, once deeply embedded in traditional cultures, is now unmistakably evident with the march of modernization. As cultural diversity wanes over time, the diminishing tapestry witnesses a decline in human understanding of medicinal plant species, their distribution, management, and the age-old techniques for extracting the beneficial properties concealed within these botanical treasures (Arora 2018). The wisdom surrounding medicinal plant use has predominantly found its way through the pages of traditional scholarly documentation, encompassing knowledge repositories like pharmacopoeias tailored for medical professionals and institutions. Simultaneously, a rich tapestry of traditional medical knowledge has been woven within households, communities, and ethnic groups, further enriching our understanding of the therapeutic properties these plants offer (Wanjohi *et al.* 2020). Rather than relying solely on legislation and regulations, there is a growing consensus that efficient methods for promoting the sustainable use and management of medicinal plants should pivot towards local initiatives that engage traditional medicinal knowledge (Pieroni *et al*. 2015, Blanco & Carrière 2016).

The north-eastern part of India is a biodiversity hotspot with ~ 145 tribal communities inhabiting this region. There are around 1350 plant species that have been identified as being employed in region traditional medicinal preparations (Tamang *et al*. 2023). In northeast India, traditional groups have cultivated valuable knowledge of locally abundant natural resources, leveraging herbal treatments with deep-rooted cultural significance and unique medical cultures to inform holistic tribal development, embodying a wealth of unrecorded traditional wisdom

(Offiah *et al*. 2011). In today's context, documenting and protecting traditional knowledge of medicinal plants is crucial for discovering new drugs and expanding traditional medicine's applications, preserving indigenous cultural heritage and ensuring its legacy thrives for future generations. (Mahwasane *et al.* 2013). This can be done in a number of ways, including (a) educating and appraising tribal youth about the advantages and encouraging them to choose it as a career path, (b) reducing the exploitation of natural resources, and most importantly (c) by integrating it into the medical system (Tripathi 2019). Ethnomedicinal research is pivotal, particularly in biodiverse regions like Assam, India, serving as vital records unveiling numerous traditional treatments for illnesses, despite the multitude of researchers conducting various studies on plants across different regions of Assam different times. (Hazarika & Barua 2023, Das *et al.* 2023, Gogoi & Sen 2023, Bhattacharjya *et al.* 2023, Boro *et al.* 2023). Recognizing the paramount significance of ethnomedicine, we embarked on a journey to meticulously document the traditionally employed medicinal plants within the captivating landscapes of the

Dimoria region in Assam. Our pursuit extends beyond documentation, delving into the fascinating analysis of ethnobotanical data, unveiling the rich tapestry of indigenous wisdom.

Delving into the healing traditions of the Dimoria people, our research unveils i) a treasury of medicinal plants employed in treating diverse ailments ii) quantify the consensus and fidelity level among the informants for medicinal plants and associated knowledge iii) the comprehensive documentation of these plants and their applications not only serves as a valuable record but also lays the groundwork for forthcoming phytochemical and pharmacological studies.

Materials and Methods

Study site

Our study area was the Dimoria block of the Kamrup (Metro) district in Assam in the north-eastern part of India (Fig. 1). Dimoria is located on the south-eastern side of the Kamrup district and on the south bank of the Brahmaputra River. It is about 12 km to the east of Guwahati city occupying an area of 822.64 km² and having a population of 10, 06,265 by 2020 (https://geoiq.io/places/Dimoria/guxLx2xApN). It lies between 91°55 E to 92°10 E longitude and 26° N to 26°14 N latitude. The southern border of Dimoria is marked by the stable rocky foundation of the Meghalaya plateau. In the north, flows the Kalang River, a tributary of the Brahmaputra River. It is flanked by the Morigaon district on the eastern side and part of the northern boundary. Along the western and north-western boundary of Dimoria, Guwahati is located. The climate in the area is characterized by extreme humidity, heavy summer rainfall, and winter drought. However, the area's microclimatic conditions are greatly impacted by the region's and the surrounding environment's dominance of forest areas, vast shallow water bodies, dispersed hillocks and hill ranges, etc. (Sharma 2018, Bania *et al*. 2022).

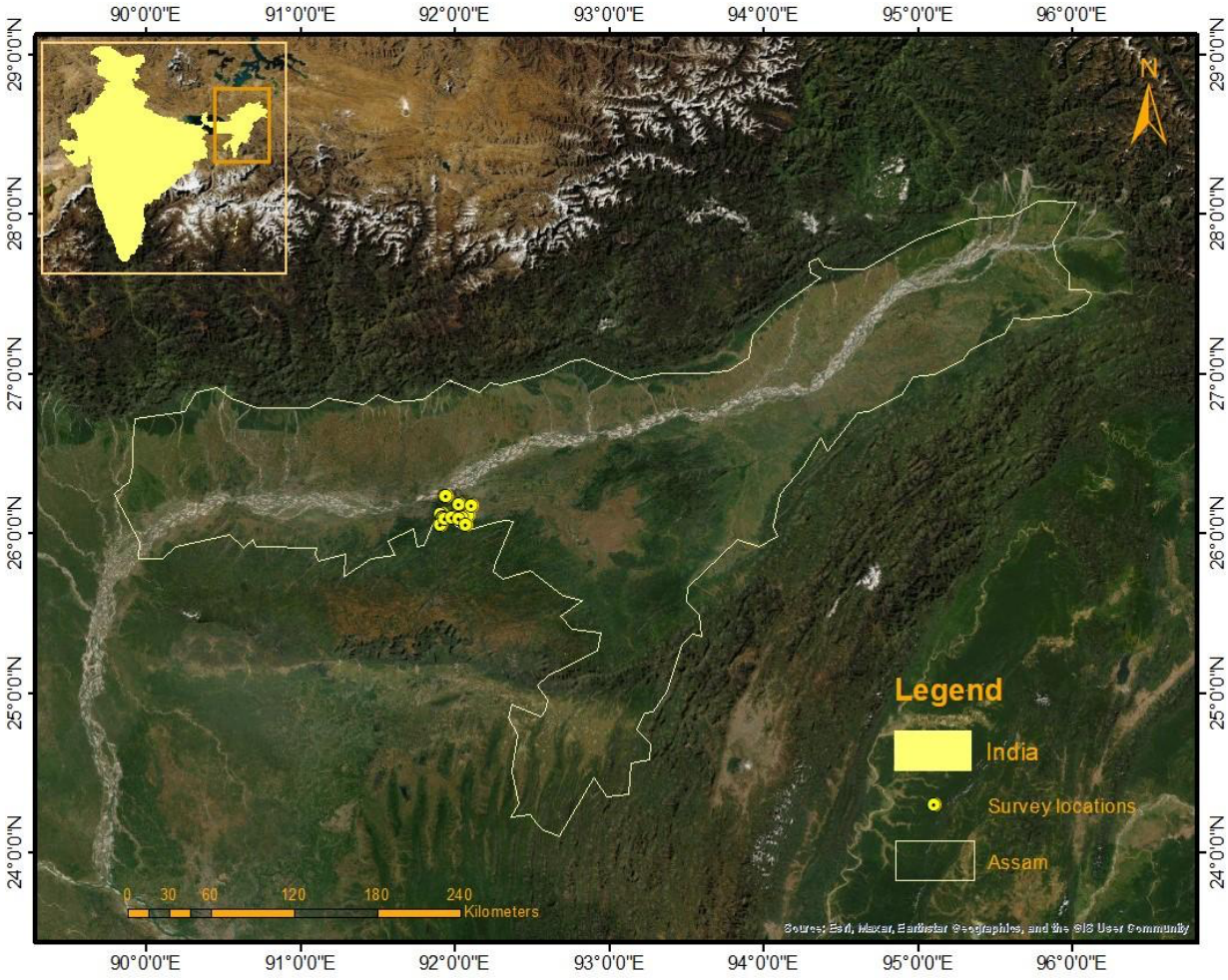

Figure 1. Map of study area with sampled village locations

Data Collection

The ethnomedicinal potential of the local flora was investigated through fieldwork in the study area conducted from the year 2019 to 2020. The survey was conducted in the villages within the 12 village councils under the studied area. Prior to the main survey, a preliminary assessment set the stage, unveiling insights into the realm of local healers and individuals well-versed in the domain of medicinal plants. The inaugural visit served as a friendly introduction, acquainting informants with the study's noble objectives. Building on continuity, each informant was warmly revisited at least thrice, ensuring a rich tapestry of data woven seamlessly from the threads of earlier interactions. The data collection process involved conducting Participatory Rural Appraisal (PRA) exercises with various community members, including Assamese, Karbi, Bodo, Rabha, Miri, Bengali, and Nepali residing in the study area (Bano *et al.* 2014). PRA employs a diverse array of participatory techniques, including individual and group discussions, field excursions alongside key informants, and the utilization of local languages (Ali *et al*. 2022, Chambers 1994). This methodology is geared towards eliciting insights into the traditional knowledge surrounding medicinal plants and their various applications. The overarching goal of PRA is to empower local residents, fostering the preservation of traditional wisdom and promoting the sustainable utilization of environmental resources (Bazai *et al.* 2013). The community's active participation in the data collection process not only ensures the acquisition of comprehensive and accurate ethnobotanical information but also upholds the principles of respecting and preserving local knowledge and practices (Amri & Kisangau 2012).

Household questionnaire survey (HQS)

The interviews were initiated only after explaining the goal of the study and obtaining the interviewees' prior consent. A semi structured questionnaire survey was used to poll households about ethnobotanical information (Jamal *et al*. 2012). To choose homes for survey interviews, the study used a purposive sample strategy (village → household → respondent, for instance). Our objectives were to ascertain which medical plants were used by nearby people, document their traditional knowledge and perspectives regarding the use of medicinal plants, and look for any trends in the management and harvesting of certain species of medicinal plants. For this, the survey was specifically oriented toward experienced people, usually of older age (Rahman *et al*. 2022). HQS was conducted in all 12 village councils in the study area. These 140 respondents (78 male and 62 female) were purposively selected and interviewed for the study. Moreover, a designated guide, chosen from each indigenous community for their deep familiarity with community traditions and norms, accompanied the team throughout all field surveys.

A semi-structured questionnaire was used to gather data on various aspects of medicinal plant usage among locals. This included information on the species of medicinal plants used, the specific plant parts utilized, the ailments treated, usage patterns, and commonly preferred forms of drug administration (AbouZid & Mohamed 2011). Every respondent's viewpoint was captured for the study during interviews that were performed in their homes using their native tongue, especially Assamese. Sometimes more than one informant participated at once. Informants were allowed to express their views freely and in an uninhibited manner without any strict questions being asked of them throughout the questionnaire survey.

Key informant interviews (KII)

Among 140 informants; 53 (comprising 49 males and 4 females) were key informants and while the remaining 87 served as general informants. The major informants he chose included herbalists or *ved*, herbal entrepreneurs, nursery operators, and members of the Forest Office, Anchalik Panchayat Committee, and Village council Committee. The selection of key informants for the ethnobotanical study was meticulous, considering the expertise and familiarity with medicinal plants to guarantee the comprehensive and accurate collection of data (Rahman *et al*. 2022).

Focus group discussion (FGD)

FGDs were held at local markets, at the social club, and in front of house-yards. In focus group discussions (FGDs) conducted in social clubs and markets, men tended to predominate, whereas, in the house-yard FGDs, female participants were more responsive (Alemu *et al.* 2024). An average of eight contributors took part in each FGD. Participants in the FGDs were limited to those who were aware of the origins of medicinal plants and how they are used in medicine. During the FGDs, the use of medicinal plants and their preservation were hot subjects. During the FGDs, information from the HQSs and KIIs was cross-checked, validated, and confirmed.

Data analysis

Each medicinal plant was initially identified during the field study by its colloquial name. Local names were then compared to the India Biodiversity Portal (India Biodiversity Portal), Assam Biodiversity Portal (Assam Biodiversity Portal) and other relevant taxonomic literature (Kanjilal *et al.* 1934, Kanjilal *et al.* 1936, Kanjilal *et al.* 1938, Kanjilal *et al.* 1939, Kanjilal *et al.*

1940, Bor 1940. The species' scientific names were recorded from these sources. In the end the family name and scientific name of every species were confirmed with the "The World Flora Online" website (available at http://www.worldfloraonline.org/)

Quantitative analysis

To quantitatively characterize the properties of the data, descriptive statistics were employed. We calculated (a) Use value (UV) score of species, (b) Informant consensus factor (ICF), and (c) Fidelity level (FL) using the specific equations provided below:

Use value (UV)

The use value (UV), a quantitative measure of the relative importance of a species observed locally, was used to analyse the relative importance:

$$UV = U/n$$

Where "U" is the total number of practice reports for a particular species that all informants have cited. 'n' denotes the total number of informants that were questioned. When a plant species had a high UV score, it was most commonly suggested, meaning it had a lot of usage reports; conversely, when it had a low score, informants reported less use reports (Rahman *et al.*2022).

Informant consensus factor (ICF)

Ailments were roughly divided into several illness categories prior to the ICF value being calculated (Rahman *et al.* 2022). In ethnobotanical research, consensus analysis provides a measure of dependability for each assertion supported by solid data, and their output ranges from 0 to 1 (Singh *et al.* 2012). Because a well-known species is genuine in curing illnesses, a significant number of informants utilised it, according to the maximum ICF value, which is a value near 1. Nonetheless, a low ICF index value near 0 indicated that informants treated reported illnesses with this species at random (Rahman *et al.* 2022). The ICF value was calculated using the following equation:

$$ICF = (Nur - Nt) / (Nur - 1)$$

Where Nur is the total number of use reports for a particular ailment category, and Nt is the total number of species used for that ailment category.

Fidelity level (FL)

The FL was calculated to identify a species that is most frequently used for the treatment of a particular ailment category.

$$FL (\%) = N_P/N \times 100$$

Where N is the number of informants who use plants as a medicine to treat any ailment, and N_P is the number of informants who claim to use a particular plant species to treat a disease (Chaachouay *et al*. 2019).

All the graphs were created using ggplot2 (Wickham 2016) and cowplot (Wilke 2020) packages in R 3.6.1 (R Core 2019).

Results

Demographic profile of surveyed respondents

Out of the 140 survey respondents, 78 were men (55.71%) and 62 were women (44.28%). The informants were divided into three age groups (a) 31–45 (b) 46–60 and (c) 61–75 years. The majority of the informants (58.57%) were 46–60 years old. However, most of the traditional healers/practitioners were between the ages of 61–75 years (Table 1).

According to reports, most of their knowledge about herbal plants comes from their family members who are experienced in treating human ailments. It was interesting to note that in contrast to the male respondents, the female informants (40%) listed "housewife" as their occupation and had a remarkable understanding of the handling and production of herbal remedies.

Table 1. Demographic data of informants

Parameters	Categories	Number of respondents	Percentage of respondents
Sex	Male	78	55.71%
	Female	62	44.28%
Age Class	31-45	17	12.14%
	46-60	82	58.57%
	61-75	41	29.29%
Occupation	Housewife	56	40%
	Farmer	47	33.58%
	Day Labour	14	10%
	Businessman	8	5.71%
	Others	15	10.71%

Diversity of medicinal plants

In all, 80 plant species from 45 different botanical families were identified in the study's region (Table 2). The families with the highest number of species were Fabaceae (7 species) followed by Rutaceae (5 species), Lamiaceae (4 species), Acanthaceae (3 species) Amaranthaceae (3 species), Apocynaceae (3 species), Asteraceae (3 species), Combretaceae (3 species), Phyllanthaceae (3 species), Solanaceae (3 species), and Zingiberaceae (3 species) (Fig. 2A). The remaining 27 families each represented a single species, whereas 5 families each represented two species.

Habit and plant parts used

Herbs made up the majority of the species (32), followed by trees (23), shrubs (19), climbers (5), and aquatic body (1) (Fig. 2B). Thirteen different plant parts including leaves, twigs, seeds, fruits, bark, roots, rhizomes, flowers, spines, shoots, creepers, stems, and whole plant—were used in the current study to prepare traditional remedies (Fig. 2C). Out of all the plant parts utilised, leaves accounted for 40% of the total, with fruits (14%), seeds (10.5%), roots (9.5%), bark (7.8%), rhizomes (5.5%), whole plant (4.1%), flowers (2.1%), spines, shoots, creepers, stems and twigs (1.3%) each.

Routes of administration and crude drug type

Based on crude drug type, decoction and juice were the most popular, accounting for 23.75% and 21.25% respectively. Powder and paste were also frequently used, making up 16.25% each. Interestingly, many plant parts were used directly without any modification, with raw forms comprising 11.25% of treatments. Other forms of herbal remedies, such as extracts and infusions, were less commonly used but still present in the healing repertoire, with 10.00% and 1.25%, respectively.

Traditional applications of medicinal plant species to treat illnesses

Our study revealed that a total of 56 different diseases have been traditionally treated using different plant species. However, there are 11 common categories for illnesses that every single disease falls under based on user reports (Table 3). 26 of the species that have been identified were utilised to treat respiratory conditions, 22 were used to treat skeletomuscular pain, 24 were used to treat the dermatological disorder, 12 were used to treat urogenital problems, 6 to treat oral and dental disorders, and 39 to treat gastrointestinal disorders. 18 were used to treat endocrine and liver disorders, 10 were used to treat nose, eye, ear and throat problems. 26 species were used to treat fever, 3 to treat the cardio-vascular disorder and 10 were used to treat various other disorders (Table 4).

Table 2. Table showing different plant species and their uses and use value (UV) of every plant species.

Scientific Name	Family	Habit	Local Name	IUCN Status	Part Used	Crude drug type	Route of administration	Medicinal Uses	Use value (UV)
Andrographis paniculata (Burm.f.) Nees	Acanthaceae	Herb	Sirota tita	NA	Leaves	Extract	Oral	Leaf extract is used against tuberculosis, diarrhea, dyspepsia and sinusitis	0.54
Ecbolium viride (Forssk.) Alston	Acanthaceae	Shrub	Nilakantha	NA	Root	Extract	Oral	Extract of root is used to cure jaundice	0.61
Justicia adhatoda L.	Acanthaceae	Shrub	Basak	LC	Root, leaf	Decoction	Oral	Used to cure bronchitis, asthma	0.65
Sambucus javanica Blume	Adoxaceae	Shrub	Xukloti	LC	Leaf, fruit	Infusion, decoction	Oral, cutaneous	Leaf infusion is used to cure tuberculosis; decoction of the fruit is used to treat skin diseases and swelling	0.48
Alternanthera brasiliana (L.) Kuntze	Amaranthaceae	Herb	Ronga pat	NA	Leaf, root	Decoction, infusion, paste	Oral, cutaneous	The leaves and roots are traditionally used to prepare decoctions or infusions for treating various inflammatory conditions such as rheumatism and arthritis; paste of leaves is used against wound healing	0.46
Amaranthus tricolor L.	Amaranthaceae	Herb	Ronga Moricha Xak	NA	Leaf	Decoction	Cutaneous, oral	Leaves decoction is used against external inflammation and bladder distress	0.56
Amaranthus viridis L.	Amaranthaceae	Herb	Khutura Xak	NA	Leaf, root	Decoction	Oral	Leaves decoction is used to treat fever, asthma; root decoction is used against urinary problem	0.49
Spondias pinnata (L.f.) Kurz	Anacardiaceae	Tree	Amora	NA	Leaf	Paste	Cutaneous	Used against skin problems	0.78
Centella asiatica (L.) Urb.	Apiaceae	Herb	Bor Manimuni	LC	Leaf	Juice, raw	Oral	Leaf juice and sometimes raw leaves used against stomach complains and usually used locally as liver tonic	0.64

Eryngium foetidum L.	Apiaceae	Herb	Mann Dhania	NA	Whole plant	Paste, decoction, juice	Cutaneous, oral	For burns, the leaves of the plants are crushed and applied topically to the affected area; for fevers, hypertension, constipation, asthma and stomachache the leaves of the plant are boiled and the decoction is consumed orally; for worms, the plant is crushed and the juice is extracted and consumed orally; decoction of leaves is used against infertility complications in women	0.79
Calotropis gigantea (L.) Dryand.	Apocynaceae	Shrub	Akon	NA	Leaf	Raw, powder, paste	Cutaneous	Leaves are used to stew the body parts suffering from pain; powdered leaves are used for the fast healing of wounds, hot poultices are made from the leaves and applied to the stomach to relieve pain	0.64
Catharanthus roseus (L.) G.Don	Apocynaceae	Shrub	Nayantora	NA	Leaf	Powder	Oral	Useful in the treatment of diabetes, menorrhagia, stomach-ache	0.69
Rauvolfia serpentina (L.) Benth. ex Kurz	Apocynaceae	Herb	Sarpagandha	NA	Root	Decoction	Oral	Decoction of root is used for treating liver disorder, rheumatism, expulsion of intestinal worms	0.62
Colocasia esculenta (L.) Schott	Araceae	Herb	Kola kosu	LC	Leaves	Extract	Cutaneous	Extract is used to treat against the bite of wasp, macerated leaves can be used as a poultice on infected sores	0.49
Hydrocotyle javanica Thunb.	Araliaceae	Herb	Horu Manimuni	LC	Leaf	Juice	Oral	Leaf juice is used in fever and cough and stomach problem	0.61
Asparagus racemosus Willd.	Asparagaceae	Herb	Satmul	NA	Roots, seed	Powder	Oral	Root powder is used to cure tuberculosis, stomach problem, constipation and seed powder is used to cure fever in women after delivery	0.46
Aloe barbadensis (L.) Burm.f.	Asphodelaceae	Herb	Aloe vera	NA	Leaf	Gel	Cutaneous	Known as a treatment for sores, particularly burns, including sunburns	0.51

Acmella paniculata (Wall. ex DC.) R.K.Jansen	Asteraceae	Herb	Parboti sak	LC	Flowers	Raw	Buccal	Flowers are used to relieve toothache and infections of throat and gum	0.54
Eclipta prostrata Lour.	Asteraceae	Herb	Bhringaraj	LC	Whole plant	Extract, juice	Cutaneous	Extract of whole plant is used to stimulate hair growth, boost the immune system; leaf juice is used against eye disorder	0.61
Mikania micrantha Kunth	Asteraceae	Climber	Amar lota	NA	Creeper, leaf	Raw, decoction	Oral, cutaneous	Leaves decoction is used to cure fever after delivery, jaundice and creeper is also wrap up to join bones when fracture occur	0.69
Basella alba L.	Basellaceae	Herb	Puroi xak	NA	Leaf	Juice	Oral	Used for the treatment of dysentery, diarrhea and good source of vitamin	0.59
Cereus repandus (L.) Mill.	Cactaceae	Herb	Siju	LC	Leaf	Extract	Oral	Extract is used to cure cough	0.40
Terminalia arjuna (Roxb. ex DC.) Wight & Arn.	Combretaceae	Tree	Arjun	NA	Bark	Powder	Oral	Bark powder is used to cure heart disease, high blood pressure and fever	0.56
Terminalia bellerica (Gaertn.) Roxb.	Combretaceae	Tree	Bhomora	NA	Fruit	Powder, paste	Oral, cutaneous	Fruit powder is used to cure jaundice, eye disorder; paste is used in swollen part to get relief from inflammation	0.54
Terminalia chebula Retz.	Combretaceae	Tree	Xilikha	LC	Fruit	Powder	Oral	Good for stomach problem also against to cure jaundice; fruits has been used in chronic diarrhea	0.69
Ipomoea aquatica Forssk.	Convolvulaceae	Herb	Kolmou khak	LC	Leaf	Raw, decoction	Oral	The leaves are often boiled and eaten as a vegetable or taken orally in decoction form to stimulate digestion and alleviate digestive problems such as constipation, bloating, and flatulence; used to treat respiratory problems such as cough, asthma, and bronchitis; reduce fever	0.63

Kalanchoe pinnata (Lam.) Pers.	Crassulaceae	Herb	Dupor tenga	NA	Leaf	Extract	Oral	Leaf extract is used for dissolving kidney stone	0.74
Cyperus rotundus L.	Cyperaceae	Herb	Keya bon	LC	Seed, rhizome	Powder, decoction	Oral	Seed powder is used to cure fever in women after delivery; rhizome decoction is used to cure stomach and bowel problem	0.82
Dillenia indica L.	Dilleniaceae	Shrub	Outenga	LC	Fruit	Paste, decoction	Cutaneous	Mucilage is used to wash hair as shampoo and good for hair growth and fruit decoction is used to cure stomach related problem	0.54
Elaeagnus latifolia L.	Elaeagnaceae	Shrub	Mirika Tenga	NA	Fruit	Juice	Oral	Considered to have medicinal properties useful in constipation and as a health tonic	0.61
Elaeocarpus serratus L.	Elaeocarpaceae	Tree	Jolphai	NA	Leaf and fruit	Decoction	Oral	The local people used the leaves in rheumatism; fruits are washed and crushed, and then boiled in water for about 20-30 minutes. The resulting liquid is strained prescribed in dysentery and diarrhea	0.59
Bauhinia variegata L.	Fabaceae	Tree	Kanchan	LC	Bark and leaf	Decoction	Oral	A decoction is prepared by boiling the bark and leaves in water and drinking the resulting liquid to treat malaria, treatment of diarrhea; decoction prepared from bark is used in asthma	0.56
Mimosa pudica L.	Fabaceae	Herb	Nilaji lota	LC	Root, leaf	Juice, paste	Oral, cutaneous	Juice of root is mixed with milk to cure piles, also used to cure diarrhea, jaundice, asthma; leaf paste is used in toe infection,	0.86
Pongamia pinnata (L.) Pierre	Fabaceae	Tree	Korosh	LC	Seed, leaf	Extract, powder, decoction	Cutaneous, oral	Seed extract is used to cure against wounds; leaf powder reduces fever and leaf decoction helps in treating bronchitis and whooping cough	0.69

Saraca asoca (Roxb.) Willd.	Fabaceae	Tree	Ashok	VU	Bark	Powder	Oral	Powder form is used to cure high fever, used as an astringent for menstrual bleeding	0.64
Senna occidentalis (L.) Link	Fabaceae	Herb	Bon medelua	LC	Leaf	Leaf juice, raw leaves	Oral, cutaneous	Leaf juice is used to cure diabetes, cough, malaria and paste of leaf is used against cut and healing of wound	0.69
Sesbania sesban (L.) Merr.	Fabaceae	Herb	Jayanti	LC	Leaf, seed	Decoction, powder	Cutaneous, oral	Leaves are boiled and the resulting liquid is applied topically as a poultice against inflammation; seed powder is used to cure diarrhea	0.45
Tamarindus indica L.	Fabaceae	Tree	Teteli	LC	Fruit	Paste	Cutaneous	Local people used the fruit as a poultice applied to foreheads for treating fevers	0.54
Clerodendrum glandulosum Lindl.	Lamiaceae	Shrub	Nephaphu	NA	Leaf and root	Paste, decoction	Cutaneous, oral	Leaves are typically crushed and applied topically to the affected area to help reduce rheumatic pain, skin diseases; root decoction is used to treat dysentery and abdominal pain	0.77
Leucas aspera Link	Lamiaceae	Herb	Durun	NA	Leaves	Paste, decoction	Oral, cutaneous	The leaves of the plant are often crushed and consumed as a paste or taken orally in decoction form to treat liver ailments; headache; leaves are often crushed and applied topically as a poultice to the affected area to treat snake bites and scorpion stings; leaves of the plant are often crushed and inhaled to treat sinusitis	0.61
Mentha arvensis L.	Lamiaceae	Herb	Pudina	LC	Leaf	Juice, raw	Oral	Considered medicinal for digestive system and help in stomach related problem	0.66
Ocimum tenuiflorum L.	Lamiaceae	Shrub	Kola tuloxi	NA	Leaf	Juice	Oral	Leaf juice is used against tuberculosis and also in bronchitis	0.73

Cinnamomum verum J.Presl	Lauraceae	Tree	Dalseni	NA	Bark	Decoction, paste	Oral, sublingual	Bark is used to cure tuberculosis; used to cure menstrual cramp and discomfort; bark powder is mixed with water and make paste to treat toothache	0.61
Litsea glutinosa (Lour.) C.B.Rob.	Lauraceae	Tree	Baghnala	LC	Bark	Paste	Cutaneous	Paste of bark is used for reducing pain, swelling	0.64
Lawsonia inermis L.	Lythraceae	Shrub	Jetuka	LC	Leaf	Paste	Cutaneous	Leaves are useful as prophylactic against skin diseases	0.69
Trapa natans L.	Lythraceae	Aquatic body	Bor Singori	LC	Fruit	Raw, powder	Oral, cutaneous	The fruits are eaten raw or cooked, while the seeds are dried, ground into a powder, and consumed orally to treat digestive disorders such as indigestion, constipation, and diarrhea; fruits are also mashed and applied topically as a poultice to cure skin ailments	0.48
Abroma augusta (L.) L.f.	Malvaceae	Shrub	Gorokhia koroi	NA	Leaf	Juice	Oral	Leaf juice is mixed with milk and used to cure jaundice and high fever	0.66
Azadirachta indica A.Juss.	Meliaceae	Tree	Neem	LC	Leaf/ twig/ seed	Paste	Cutaneous	Leaf is used against skin disease named Besu, used against fungal infection, leprosy and intestinal worms, used against wounds	0.80
Artocarpus heterophyllus Lam.	Moraceae	Tree	Kothal	NA	Root and fruit	Extract	Oral	Antioxidant and used for treatment of fever.; stomach ulcers and constipation	0.81
Musa balbisiana Colla	Musaceae	Herb	Bhim Kol	LC	Fruit, leaf	Raw	Oral, cutaneous	The fruit pulp is often consumed raw to treat gastrointestinal disorders, such as diarrhea and dysentery; fruit pulp and leaves of the plant are often applied topically as a poultice to treat wounds and various skin disorders	0.72
Myristica fragrans Houtt.	Myristicaceae	Tree	Jaifol	DD	Seed	Powder	Oral	Seed is used to cure tuberculosis, treat stomach ulcers, indigestion, liver disorders	0.64

Psidium guajava L.	Myrtaceae	Shrub	Madhuri aam	LC	Leaf	Decoction	Oral, buccal	Tea made from the leaves is used to treat dysentery, diarrhea. Leaves can be chewed raw to get rid of gum and teeth problems.	0.82
Syzygium cumini (L.) Skeels	Myrtaceae	Tree	Kola Jamu	LC	Bark, leaf, fruit and seed	Decoction, juice, powder	Oral	Bark and leaves decoction consumed orally to help relieve digestive symptoms; the fruit can be consumed raw or in the form of juice or jam, while the seeds can be dried and powdered and consumed orally as medicine for diabetes	0.52
Nyctanthes arbor-tristis L.	Oleaceae	Shrub	Sewali	NA	Leaf, flower	Powder, cooked, juice	Oral, cutaneous	Leaf powder is used against to cure malaria; fried flower is used to cure diabetes; leaf juice is applied externally on ringworm and other skin diseases	0.78
Averrhoa carambola L.	Oxalidaceae	Tree	Kordoi tenga	NA	Fruit	Juice	Oral	Ripe fruits are boiled and used as medicine for jaundice, fever and diarrhea	0.77
Baccaurea ramiflora Lour.	Phyllanthaceae	Tree	Leteku	LC	Fruit	Paste	Cutaneous	The fruit is used to treat skin diseases	0.56
Phyllanthus niruri L.	Phyllanthaceae	Herb	Bhui Amlokhi	NA	Leaf	Decoction	Oral	Decoction of leaves is used to treat various digestive disorders, such as constipation, diarrhea, and dysentery	0.49
Phyllanthus emblica L.	Phyllanthaceae	Tree	Amlokhi	LC	Fruit	Juice	Oral, cutaneous	Used to cure jaundice, help in digestion and also in hair treatment	0.69
Piper longum L.	Piperaceae	Climber	Pipoli	NA	Fruit	Decoction, powder	Oral	Decoction or powder of fruit is used to improve digestion, alleviate constipation; the fruit is often combined with other herbs to make herbal formulations for treating respiratory problems such as asthma, cough, and cold; the fruit is often taken orally in powder or decoction form to reduce fever	0.79

Piper nigrum L.	Piperaceae	Climber	Goolmorish	NA	Fruit	Decoction, powder, paste	Oral, cutaneous	Decoction or powder of fruit is used to stimulate digestion and alleviate digestive problems such as flatulence, bloating, and constipation; the fruit is often combined with other herbs to make herbal formulations for treating respiratory problems such as cough, asthma, and bronchitis; it is often applied topically in the form of a paste to alleviate joint pain and inflammation, useful for treating skin problems such as acne, dermatitis, and eczema	0.62
Persicaria hydropiper (L.) Delarbre	Polygonaceae	Herb	Bon Ghehu	LC	Leaf, stem	Raw, decoction	Cutaneous, oral	The leaves and stems of the plant are often applied topically as a poultice or taken orally in decoction form to relieve pain associated with various conditions, such as arthritis and muscle soreness	0.62
Neolamarckia cadamba (Roxb.) Bosser	Rubiaceae	Tree	Kadam	NA	Leaf, bark	Paste, decoction	Cutaneous, buccal	The paste of leaves are used to reduce localized pain and swelling; bark decoction is used for gargling to treat mouth ulcers and inflammation of the gums	0.71
Paederia foetida L.	Rubiaceae	Climber	Bhedai-lota	NA	Leaf	Juice	Oral	Leaf juice is used against cough, abdominal pain	0.65
Aegle marmelos (L.) Corrêa	Rutaceae	Tree	Bael	NT	Leaf and fruit	Juice	Oral	Used for indigestion and constipation	0.73
Citrus aurantiifolia (Christm.) Swingle	Rutaceae	Shrub	Gol Nemu	NA	Fruit and leaf	Juice	Cutaneous	Considered to have antioxidant and antibacterial properties and fruit juice is used in treatment of skin diseases	0.69

Citrus limon (L.) Osbeck	Rutaceae	Shrub	Nemu Tenga	LC	Leaf and fruit	Raw	Oral	It is considered to be highly antibacterial and fruit is consumed for improving digestion; leaf used raw or made tea from it is used to prevent vomiting	0.74
Murraya koenigii (L.) Spreng.	Rutaceae	Shrub	Narasingha	LC	Leaf	Juice, raw	Oral	Used in stomach problem and it is also believed that leaf juice regulates good functioning of the stomach	0.56
Zanthoxylum oxyphyllum Edgew.	Rutaceae	Shrub	Mejenga	NA	Leaf, fruit	Powder	Buccal	The fruits are said to be astringent, digestive and stimulant. Leaf powder is useful in treatment of tooth ache.	0.64
Litchi chinensis Sonn.	Sapindaceae	Tree	Lichu	NA	Fruit, leaf and seed	Decoction, powder	Oral	Fruit peel and pulp decoction is used in treatment of cough, stomach ulcers, seed powder is used to treat flatulence; a decoction of leaves is used to treat diabetes; eating the fruit in moderation as part of a balanced diet control obesity	0.64
Mimusops elengi L.	Sapotaceae	Tree	Bokul	LC	Bark, seed	Powder	Buccal, cutaneous	Used in treatment of problems of teeth; seeds bruised and locally applied within the anus of children in cases of constipation; bark powder application on forehead cures headache	0.59
Smilax glabra Roxb.	Smilacaceae	Climber	Chopchini	NA	Rhizome	Decoction	Oral	Used for the treatment of general dropsy	0.61
Solanum indicum L.	Solanaceae	Shrub	Brihati	NA	Seed, root, fruit	Powder, extract, paste	Oral, cutaneous	Seeds are ground into a fine powder and then mixed with water or milk and consumed against fever in women after delivery; root extract is used to cure asthma; fruit paste is used to cure skin diseases	0.76

Solanum surattense Burm. f.	Solanaceae	Herb	Kantakari	NA	Spine, leaf	Decoction, paste	Oral, cutaneous	Decoction of spines is used to cure fever in women after delivery; leaves of the plant are often ground into a paste and applied topically to the affected area to reduce inflammation and pain associated with piles, decoction of leaf is used to treat asthma	0.54
Withania somnifera (L.) Dunal	Solanaceae	Shrub	Ashwagandha	NA	Root, leaf	Powder, paste	Oral, cutaneous	Root powder is used to cure tuberculosis, leaf paste is used against inflammation	0.61
Aquilaria malaccensis Lam.	Thymelaeaceae	Tree	Agaru	CR	Whole plant	Decoction, paste	Oral, cutaneous	Use to lowers fever, relieves spasms, decoction prepared from wood is useful in diabetes; stem paste is useful in skin disorders	0.74
Cissus quadrangularis L.	Vitaceae	Climber	Har bhanga	NA	Creeper	Raw, juice	Cutaneous, oral	Creeper used to tied up the body parts which facing fracture on it, stem juice used in painful menstrual periods	0.61
Curcuma aromatica Salisb.	Zingiberaceae	Herb	Keturi	NA	Rhizome	Paste	Oral	Paste used against jaundice, paste of rhizome with milk is used for dysentery and gastric ailments	0.61
Curcuma longa L.	Zingiberaceae	Herb	Halodhi	DD	Rhizome	Paste	Cutaneous	Used to cure skin disease, used against inflammation, used against to relief from joint pain	0.85
Zingiber officinale Roscoe	Zingiberaceae	Herb	Ada	DD	Rhizome	Extract	Oral	Extract of rhizome is used in stomach disease, sore throats, indigestion, vomiting, reducing pain during menstruation	0.89
Tribulus terrestris L.	Zygophyllaceae	Herb	Gokhurchurna	LC	Seed, root	Powder, extract	Oral	Seed powder is used to cure fever in women after delivery, root extract is useful in cough, asthma	0.59

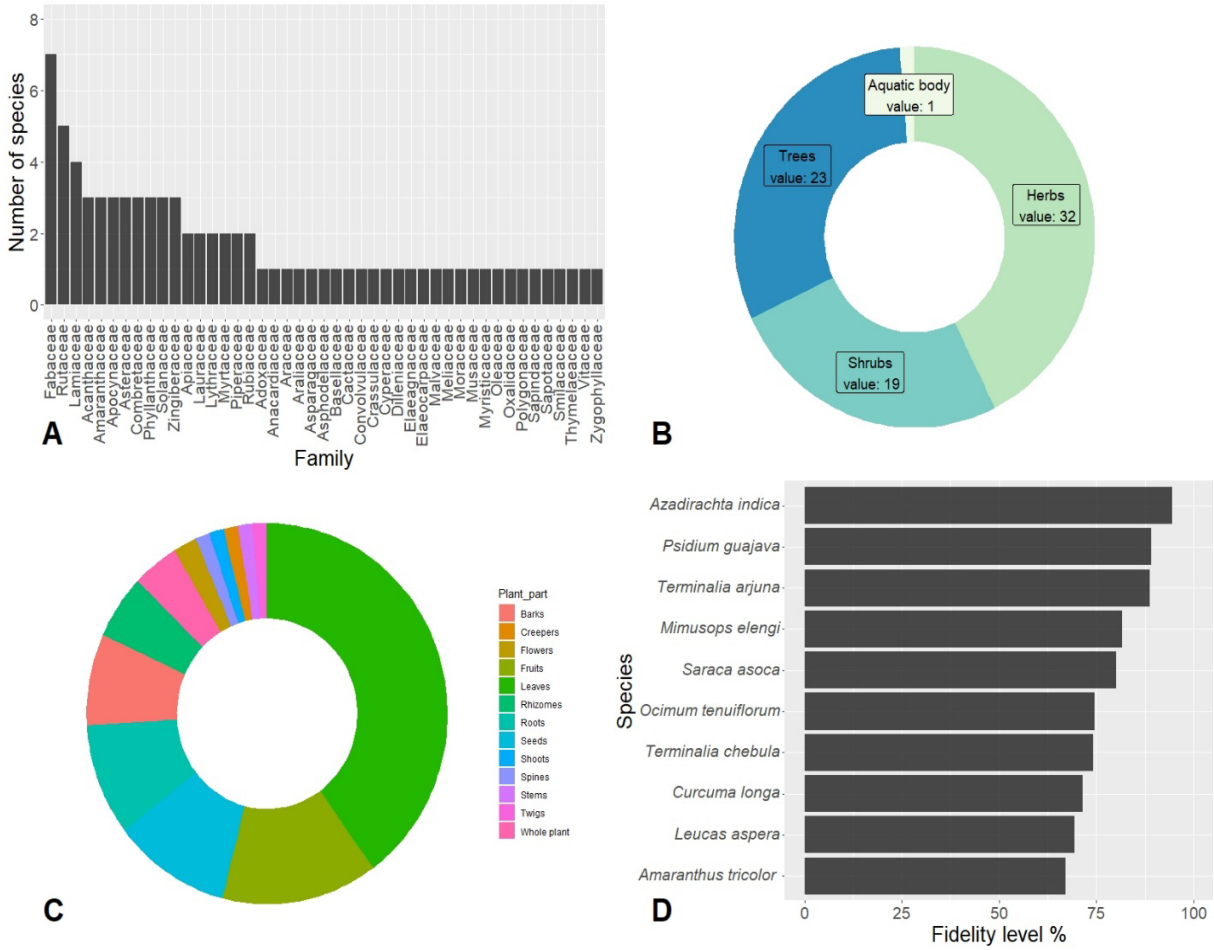

Figure 2. Figure showing A: graph of all families of plants recorded during the study; B: habit of plants recorded; C: plant parts used for medicine; D: Fidelity level of medicinal plants

Table 3. Ailment categories

Ailment Categories	Different ailments included under particular category
Respiratory disorder	Cough, Cold, Asthma, Bronchitis, Tuberculosis, Whooping Cough
Skeleto-muscular pain	Swelling, Fracture, Body pain, Spasms, Headache, Rheumatism
Dermatological disorder	Wounds, Skin problems, Ring worms, Hair growth, Leprosy, Fungal infection, Burns
Gastro-intestinal disorder	Constipation, Diarrhoea, Dysentery, Piles, Anthelminthic, Stomach problem, Indigestion, Stomach ulcer, Gastric ailments, Dyspepsia, Anal fissure
Endocrine and Liver disorder	Liver disorder, Diabetes, Jaundice
Urogenital disorders	Menstruation, Kidney Stone, Testicular swelling, Bladder distress, Infertility
Oral and dental disorders	Tooth problems, Mouth Problems
Nose, Eye, Ear, Throat problems	Sinusitis, Eye problems, Throat problems, Ear problems
Fever	Fever, Malaria, Fever after delivery
Cardio-vascular disorder	Blood pressure, Heart disease, General dropsy
Miscellaneous	Immune system booster, Snake bite, Scorpion sting, Bite of wasp, Obesity, Aphrodisiac

Table 4. Table showing data of ICF

Ailment Categories	Number of Plants used (Nt)	Number of use reports (Nur)	ICF value
Respiratory disorder	26	96	0.74
Skeleto-muscular pain	22	105	0.8
Dermatological disorder	24	137	0.83
Gastro-intestinal disorder	39	135	0.72
Endocrine and Liver disorder	18	56	0.69
Urogenital disorders	12	58	0.81
Oral and dental disorders	6	52	0.9
Nose, Eye, Ear, Throat problems	10	73	0.88
Fever	26	130	0.81
Cardio-vascular disorder	3	37	0.94
Miscellaneous	10	52	0.82

Quantitative Analysis of the recorded plant species

***Use value* (UV)**

The current study's average UV score turned out to be 0.64 and ranging between 0.40 and 0.89. Based on UV scores, the most used species was *Zingiber officinale* (UV 0.89); followed by *Mimosa pudica* (UV 0.86); *Curcuma longa* (UV 0.85); *Psidium guajava, Cyperus rotundus* (UV 0.82 each); *Artocarpus heterophyllus* (UV 0.81); *Azadirachta indica* (UV 0.80). The least used species were *Cereus repandus* (UV 0.40); *Sesbania sesban* (UV 0.45); *Asparagus racemosus* and *Alternanthera brasiliana* (UV 0.46 each); *Sambucus javanica* and *Trapa natans* (UV 0.48 each); *Phyllanthus niruri, Amaranthus viridis* and *Colocasia esculenta* (UV 0.49 each) (Table 2).

***Informant consensus factor* (ICF)**

Singh *et al.* (2012) reported 56 different disorders which were split into 11 categories with the aim of examining the influence of informant consensus (Table 3). According to the informant consensus of the Dimoria region's medicinal plant users, ICF factors for each category of usage ranged from 0.69 to 0.94 in our study. Cardio-vascular disorder had the highest ICF value (0.94), followed by oral and dental disorders (0.90), nose, eye, ear, throat problems (0.88), miscellaneous (0.82), dermatological disorder (0.83), urogenital and fever (0.81 each), skeletomuscular pain (0.80) (Table 3). The average ICF value was recorded to be 0.81 and the least agreement of respondents was on endocrine and liver disorder (0.69).

***Fidelity level index* (FL)**

The FL of plant species ranged from 67.09 % to 94.44 % for the eleven categories chosen in the study area. The maximum FL of 94.44 % was found for *Azadirachta indica* for the dermatological disorder category followed by *Psidium guajava* (FL of 89.09%) for the gastro-intestinal disorder category. On the other hand, the FL 67.09% expressed by *Amaranthus tricolor* revealed the informants' lower preference for the urogenital disorders category (Table 5 and Fig. 2D).

Table 5. Table showing data of FL

Botanical name	Disease Categories	Citation for particular disease /Use – report) NP	Number of informants that use the plants as a medicine to treat any disease (N)	Fidelity level (FL) %
Ocimum tenuiflorum	Respiratory disorder	76	102	74.5
Curcuma longa	Skeleto-muscular pain	85	119	71.42
Azadirachta indica	Dermatological disorder	102	108	94.44
Psidium guajava	Gastro-intestinal disorder	98	110	89.09

Terminalia chebula	Endocrine and Liver disorder	72	97	74.22
Amaranthus tricolor	Urogenital disorders	53	79	67.09
Mimusops elengi	Oral and dental disorders	67	82	81.7
Leucas aspera	Nose, Eye, Ear, Throat problems	59	85	69.41
Saraca asoca	Fever	72	90	80
Terminalia arjuna	Cardio-vascular disorder	63	71	88.73

Discussion

Demographic profile and diversity of medicinal plants

The findings of our current investigation unveil a fascinating reality: within our study area, older people stand as repositories of profound wisdom and expertise in ethnomedicinal plant species. Through a combination of survey data and meticulous field observations, we confirmed that these seasoned individuals possess a wealth of knowledge, ranging from which plants hold medicinal value to the precise ailments they can treat. Remarkably, it was evident that the custodians of this invaluable knowledge were predominantly aged between 46 and 60 years, constituting 58.57% of our informant pool. This discovery resonates with earlier studies, reinforcing the notion that traditional wisdom tends to be most deeply entrenched within older generations. However, a concerning trend emerged: among the younger populace, there appeared to be a waning interest in the inheritance and utilization of ethnomedicinal practices. This decline mirrors similar patterns observed across the wider Himalayan region, where the transmission of ethnic knowledge regarding therapeutic plants is gradually diminishing. As modern education becomes more important for young people, they often lose interest in traditional ethnomedicinal wisdom. This shift underscores the urgent need to foster greater appreciation and engagement among the youth, ensuring the preservation of this precious heritage for generations to come (Rahman *et al*. 2022, Bhatia *et al*. 2014, Haq *et al*. 2021).

According to descriptive statistics, female respondents knew more about medicinal plants than male respondents, which may be related to their job managing the home and treating illnesses to keep the family healthy. Perhaps because the majority of women in rural communities are involved in domestic chores and spend more time at home gathering wood, timber, herbs and local vegetables, from their nearby areas, women also possess a broad understanding of medicinal plants. (Dulal *et al*. 2022). The prominence of women in this domain likely stems from their pivotal role as household caretakers, skilfully crafting nourishing meals and plant-based concoctions to nurture their loved ones. Moreover, this expertise is not merely acquired but rather deeply ingrained, passed down through generations from mother to daughter, creating a timeless legacy of herbal wisdom (Jan *et al*. 2021 (I), Jan *et al*. 2021 (II), Mechaala *et al.* 2021).

Amidst the rich array of plant families revered for their medicinal properties in our area, it is the Fabaceae family that reigns supreme, casting its botanical spell over the landscape. This dominance is no mere coincidence but rather a testament to the family's unparalleled capacity to proliferate across diverse habitats, boasting an impressive array of species rich in bioactive compounds (Bekele *et al*. 2022, Tugume *et al*. 2016). From the rolling hills to the lush valleys, Fabaceae's ubiquitous presence underscores its global significance in traditional herbal remedies, a fact echoed across continents. Indeed, the family's widespread distribution ensures its accessibility in every season, offering a perennial wellspring of healing potential (Maroyi 2023). Across borders, Fabaceae stands tall as a stalwart ally in combating both human and animal afflictions, its diverse traits rendering it indispensable to humanity's well-being. Whether as medicine, sustenance, or ecological stewardship, the multifaceted role of Fabaceae renders it a cornerstone of our relationship with the natural world (Mongalo & Raletsena 2023).

Plant habit, usable plant parts and route of administration

Based on the results of the current study, the use of plant species indicates that the people living there have a high level of traditional and ethnobotanical knowledge about the particular plants and plant components they can utilize for everyday healthcare. Among the diverse array of plant types, herbs emerge as a cornerstone of medicinal practices for a majority, owing to their unparalleled accessibility and ease of utilization. Their efficacy stems from the simplicity of collecting, storing, transporting, and extracting their potent active ingredients, setting them apart as a preferred source of medicine. Furthermore, herbs boast elevated levels of vital secondary metabolites crucial to their survival strategies, enhancing their therapeutic potential (Dulal *et al*. 2022). Across continents, studies resonate in showcasing the prevalence of herbaceous

plants in addressing various ailments, a trend likely fueled by their widespread availability and abundance in nature's bounty (Hong *et al*. 2015, Singh *et al.* 2017, Singh *et al*. 2019, Bizuayehu, & Garedew 2018, Mekonnen *et al.* 2022). As integral components of forest ecosystems, herbs stand as nature's pharmacy, readily offering their healing bounty to those in need (Heinrich *et al*. 2009). Their enduring popularity in herbal therapies is underscored by the richness of pharmacologically active compounds they offer, eclipsing even their woody counterparts in efficacy and accessibility (Kamatenesi *et al.* 2011).

In the realm of crafting herbal remedies, leaves reign supreme as the most utilized plant part, eclipsing all others in proportion and versatility. This preference finds its roots in several factors: the perceived potency of fresh leaves, their ease of access and harvest, and the straightforwardness of preparation. Furthermore, leaves offer a rich reservoir of chemical compounds essential for treating a myriad of ailments, making them indispensable in traditional medicine (Bekele *et al.* 2022). While harvesting roots may entail the loss of the entire plant, the sustainable practice of leaf collection ensures the preservation of medicinal flora (Mekonnen *et al.* 2022). Central to photosynthesis and metabolic activities, leaves serve as nature's pharmacopeia, synthesizing a diverse array of active ingredients crucial for therapeutic efficacy. This sustainable approach not only safeguards medicinal plants but also enhances their protection, ensuring their availability for future generations (Haq *et al.* 2023). With their pivotal role in nutrition synthesis and heightened biochemical activity, leaves emerge as the cornerstone of herbal therapies, embraced by communities worldwide for their sustainable and potent healing properties. This enduring tradition finds resonance in studies across regions, affirming leaves' indispensable role in ethnomedicine for combating various diseases (Baidya *et al*. 2020).

In the recent study, it was found that the most common method of preparing these remedies in the study area was decoction. This technique facilitates the absorption of the herbal treatments and enhances the flavour of medicinal herbs (Mela *et al*. 2022). Many different ethnic groups use decoction, which is regarded as the main technique for making herbal medicine, on a global scale. It's interesting to note that medicinal plants are boiled before being mixed to make herbal medicine since boiling causes all of the plant's nutrients to dissolve into the water. This creates a potent concoction that is taken orally or even used for bathing after boiling (Navia *et al*. 2022). The process of boiling proves highly efficient in extracting botanical substances while simultaneously ensuring the longevity of herbal remedies, surpassing the preservation achieved by cold extraction methods (Tugume *et al*. 2016).

The study's conclusion that the oral route of administration is the best way to treat human illnesses was supported by numerous other investigations (Baidya *et al*. 2020, Boadu & Asase 2017). Overall, these findings showcase the power and efficacy of conventional therapy, as well as the significance of understanding and preserving these ancient healing practices. Possibly, the effectiveness of oral routes stems from the rapid interaction of prepared medicines with pathogens' physiology, bolstering their curative potency. Another contributing factor lies in the prevalence of internal diseases within the study area. This discovery aligns with previous findings suggesting oral administration as the predominant route (Tamru 2016, Giday *et al*. 2007). The choice to consume orally can be linked to the presence of solvents or additives, such as food and water, which are frequently thought of as means of delivering medications. These additives are essential for reducing discomfort, improving flavour, and reducing negative effects including vomiting and diarrhoea in addition to making it easier to extract bioactive compounds during preparation (Behailu 2010).

Quantitative evaluation

The relative uniqueness of a certain plant species is also demonstrated by the quantitative significance of medicinal plants for conventional healthcare. Most species with higher UV scores such as *Zingiber officinale* (UV 0.89); *Mimosa pudica* (UV 0.86); *Curcuma longa* (UV 0.85) etc. were employed for a variety of tasks, such as treating stomach disease, sore throats, indigestion, vomiting, reducing pain during menstruation**,** piles, diarrhea, jaundice, asthma, toe infection, leprosy, intestinal worms, used against wounds, astringent, anti-inflammatory, antiseptic, gum, and teeth problems, etc. The nine species that have the lowest UV ratings were only utilized for health purposes such as cough, fever in babies, inflammation, tuberculosis, stomach problem, constipation, fever in women after delivery, sexual debility, liver disorder, etc. These species had the greatest UV index since they were stated by the most informants, and UV directly relates to the number of informants indicating the use of a certain plant **(**Chaachouay *et al*. 2019). The UV of a taxon will vary according on the usage, accessibility, and knowledge of the informant of a certain plant in a given area (Sukumaran *et al*. 2021). Because their preferred usage may put their populations at risk of overharvesting, medicinal plant species with high UV levels need to be further assessed for phytochemical and pharmaceutical investigation in order to determine their active ingredients for any medication extraction (Vitalini *et al*. 2014). Priority should also be given to the protection of these species. Even though certain plant species have lower UV values than others, they are nonetheless very important in medicine for treating a wide range of illnesses.

Besides that, the ICF value calculation assisted us in identifying consistency in the ethnobotanical data of the users. A high ICF score suggests that informants chose their taxa in accord (Dulal *et al*. 2022); however, the informant disagreed with the use of species in the treatment of illnesses that belong to the same general category of health problems, as evidenced by the lower stated ICF score (Rahman *et al.* 2022).

Various ethnomedicinal studies in Assam show that diverse cultures continue to employ medicinal plants to cure a variety of human problems. The current study also supports residents' agreements regarding the usage of taxa and their use of medicinal plants in the study area. Even though our study included a variety of communities, a high ICF value may have resulted from the fact that all the plants were found in the same community and geographic area. The ailment with the highest ICF value (Cardio-vascular disorder, 0.94) has received higher consideration in our analysis. This might be because people are experiencing cardio-related issues more frequently these days as a result of stress and the most prevalent health problem that affects people. Tobacco, alcohol abuse, physical inactivity, and poor diet are the main behavioral risk factors for cardiovascular illnesses (https://www.who.int/health-topics/cardiovascular-diseases). Large informants also employed a limited number of species to cure this illness, which raised its ICF value, and the people of Dimoria have been developing their own treatments by researching the medicinal properties of numerous plant species.

It was found that *Azadirachta indica* was exclusively used for treating dermatological disorders (94.44 % FL). The higher fidelity level values may provide a hint for locating medicinal plants with greater therapeutic potential as well as those required for additional phytochemical and bioactive material research (Bekele *et al.* 2022).This research demonstrates that the informants in the Dimoria region tended to rely more heavily on a single plant species for treating a single specific illness than for treating a variety of illnesses. Usually, the high FL value of plant species is frequently referenced for metabolic issues. Additional research to assess their efficacy and veracity is warranted. Furthermore, since doing so raises the possibility of knowledge gradually disappearing, low FL percent plants shouldn't be abandoned in order to protect them for future generations (Chaachouay *et al*. 2019).

Conserving herbal remedies by safeguarding medicinal flora

The plant species variety of Dimoria has been dwindling everyday as a result of the local population's strong reliance on daily resource collection for their subsistence. The main causes of biodiversity loss include overexploitation, pollution, habitat degradation, and the introduction of non-native species, which are all occurring at a faster rate than natural replenishment rates (Gannon *et al*. 2017). Compelling parallels emerged in the assessment of ethnomedicinal vegetation threats from the Buska Mountain range in Hamar district, Southwestern Ethiopia, the Sedie Muja District in South Gondar, Ethiopia and Karbi angling District of Assam (Bekele *et al.* 2022, Mekonnen *et al.* 2022, Baidya *et al*. 2020).

According to the findings of the current study, the overharvesting of important medicinal plants, a lack of programmes to raise public awareness about them, a lack of documentation of medicinal plants, a lack of activities to generate income from them, and a lack of organized marketing channels for the sale of products made from them are all contributing factors to the lack of plant conservation in the Dimoria region. Upon analysing the species, we meticulously classified them based on their IUCN status and uncovered a sobering reality - certain species were deemed as critically endangered (CR), vulnerable (VU), and near threatened (NT) (Table 2). The preservation of medicinal plant species is crucial, particularly for those that fall under the critically endangered (CR), vulnerable (VU), and near threatened (NT) categories. To ensure the continuity of their therapeutic benefits, we must take deliberate action to safeguard these species. This can be achieved through a combination of planting medicinal plant species, reducing the overharvesting of valuable species, and promoting awareness about the therapeutic benefits of plants, particularly among younger generations (Rahman *et al*. 2022, Mekonnen *et al.* 2022) To further support the conservation efforts, we can also provide financial assistance, seedlings, and training to establish nurseries for medicinal plant conservation, while simultaneously documenting traditional knowledge. Empowering herbal practitioners and the local community within the study area with knowledge of sustainable harvesting methods for medicinal plants is essential to ensure their availability for generations to come. Educating the public about efficient propagation methods is also essential to advancing the cultivation of priceless and endangered medicinal flora. Through domestication efforts, a myriad of benefits await, including the creation of new income avenues for locals and a potential alleviation of strain on wild populations. Crafting effective conservation strategies prioritizing sustainable harvesting practices is paramount for safeguarding these invaluable resources (Amri & Kisangau 2012).Together, we can work towards preserving the rich and diverse natural heritage of medicinal plants for generations to come.

Conclusions

The current investigation revealed that therapeutic herbs are of exceptional significance due to their idiosyncratic potential as a huge source of therapeutic phytochemicals. Despite being quite close to Guwahati city, the local people of the study area continue to use medicinal plants as their primary form of healthcare. Candidate species for phyto and pharma investigation include *Zingiber officinale* (Ginger), identified as the most used species with a high UV score of 0.89, indicating its significant importance in traditional medicine. Its diverse usage suggests potential for further investigation into its phytochemical and pharmacological properties. Additionally, *Mimosa pudica*, *Curcuma longa*, *Psidium guajava*, *Cyperus rotundus*, *Artocarpus heterophyllus*, and *Azadirachta indica* also exhibited high UV scores, indicating widespread usage and potential for phytochemical studies. Species with lower UV scores, while not as commonly used, still play crucial roles in treating specific ailments. Investigating these less utilized species could uncover novel compounds or therapeutic properties.

Hence, the findings of this study serve as foundational data for medicinal plant researchers to forge connections between local traditional healers and scientific institutions. The usage of ethnomedicinal plants should be documented and promoted, especially among the younger generation, in order to preserve and advance this valuable knowledge. Through this collaboration, the pharmaceutical and agro-food industries will benefit from the integration of historic expertise with contemporary scientific approaches. Moreover, conserving these biological resources holds immense importance as their sustainable utilization can boost employment and income levels. The wealth of ethnopharmacological knowledge underscores the need for its acknowledgment and serves as a catalyst for future pharmacological research aimed at enhancing global healthcare systems through the discovery and development of natural drugs. Nevertheless, in order to validate these discoveries, thorough pharmacological studies are required to maximize the use of therapeutic plants worldwide. Additionally, this study lays the groundwork for the conservation of local flora, highlighting its dual significance as both food and medicine. It also sheds light on the various socioeconomic aspects intertwined with the lives of ordinary people.

In conclusion, the findings from this ethnobotanical study provide valuable insights into the traditional use of medicinal plants in Assam, India. By identifying candidate species for further investigation and emphasizing the importance of documenting and preserving indigenous knowledge, this study contributes to the fields of ethnobotany, community health, and conservation. Implementing conservation measures and integrating traditional knowledge into modern healthcare systems can help ensure the sustainable use of medicinal plants and safeguard this rich cultural heritage for future generations.

Declarations

***List of abbreviations*:** Use value (UV), Informant consensus factor (ICF), and Fidelity level (FL).

***Ethics approval and consent to participate*:** The Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Resulting from their Utilization of the Convention on Biological Diversity has guided the conduct of this study. Every participant gave their oral prior consent.

***Consent for publication*:** Not applicable.

***Availability of data and materials*:** All data generated or analysed during this study are included in this article.

***Competing interests*:** The authors declare that they have no competing interests.

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