



Ethnomedicinal study on plant resources from sacred groves of Dakshin Dinajpur district, West Bengal, India

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Research

Abstract

Background: Sacred groves found in Dakshin Dinajpur district are natural *in-situ* conservatories that provide a home to numerous biological entities with rich ethnomedicinal plant diversity. Native communities have been conserving these groves through their own beliefs and folklore practices and they possess vast knowledge of herbal ethnic medicines. The current study aims to explore the ethnic traditional practices of medicinally important plants among different indigenous communities residing in sacred grove-centric villages throughout the district.

Methods: For the current study, 15 ethnomedicinally enriched sacred groves were selected. Ethnomedicinal data were collected from 179 informants and were quantitatively analyzed using various statistical indices viz., Use value, Informant consensus factor, Fidelity level, and Relative Frequency of citation. With the help of an *in-silico* network pharmacological study, the findings were revalidated.

Results: In the present study, a total of 105 ethnic plants belonging to 93 genera and 47 families were documented and the most dominant plant family was Fabaceae. The diseases reported by the informants were classified into 16 different disease clusters. *Cuscuta reflexa* Roxb., *Heliotropium indicum* L. and *Cynodon dactylon* (L.) Pers. were the most popular medicinal plants.

Conclusion: Gathering such first-hand information about ancient traditional practices will be helpful in further pharmacological studies and may show new paths to modern therapeutic approaches.

Keywords: Sacred Groves; Traditional Knowledge; Dakshin Dinajpur; Quantitative analysis; *in-silico*

Background

Since time immemorial, India has been a valuable source of traditional medicine systems and has been documented and explored by various people across the globe (Verma *et al.* 2007). Medicinal plants are hidden treasures of

nature. Until now, over 35000 to 70000 plant species with medicinal properties, recorded worldwide (Dapar *et al.* 2020). These plants can act as the savior of humankind through their natural healing properties.

Although Dakshin Dinajpur, geographically, is a small district in the state of West Bengal, it has a unique range full of biodiversity under varied environments and complex ecology. Local inhabitants of almost all the villages in the district have been conserving innumerable trees, animals, forests, and wetlands through their own beliefs and folklore practices. In ecology, those lives and ritual practices with nature described as 'sacred' and associated conserved patches are called Sacred Groves. The groves were seen as the abode of deities and were therefore considered sacred. The trees and other vegetation in these groves were not to be cut down or disturbed in any way. This traditional knowledge and practice of protecting sacred groves has helped preserve biodiversity in India for centuries. Sacred groves are critical to biodiversity conservation because they provide a refuge for many species of plants and animals that are under threat due to habitat loss and fragmentation. The groves act as a gene pool for the surrounding landscape, providing a source of seeds and propagules for natural regeneration. They also act as ecological islands, allowing species to move between fragmented habitats. Due to the distinctive biological and cultural features, sacred groves also have received recognition from Indian agencies including the Forest Department and the National Biodiversity Authority as significant places for the protection of biodiversity. To preserve biological diversity, including sacred groves and water bodies, section 41 of the Biological Diversity Act of 2002 created Biodiversity Management Committees (BMCs). BMCs establish the People's Biodiversity Registry (PBR) with the express purpose of concentrating on the documentation of regional biodiversity and folklore. These groves have higher richness and restore ecological niches with superior regeneration capacity of endangered medicinal plants than usual forest patches (Boraiah *et al.* 2003). The rural people of West Bengal, especially in the northern part of the state, still believe in their traditional medicines and healing therapies (Mitra & Mukherjee 2010; Biswakarma *et al.* 2015). And these patches act as a repository of a large number of indigenous Tribal & Folk medicines as well as Ayurvedic and Unani medicine (Bhakat & Sen 2008). These groves are home to numerous medicinal plants, which can provide lifesaving drugs. Some researchers conducted ethnomedicinal studies in West Bengal (Sen 2019; Chowdhury & Mukherjee 2010) and in the current study area (Talukdar & Talukdar 2012; Chowdhury *et al.* 2014); however, no detailed sacred grove-specific quantitative ethnomedicinal studies had been carried out to date. It is the first kind of study carried out in these sacred groves where medicinal plants were quantitatively analyzed. In addition to this, an *in-silico* network pharmacological study also conducted as ethnobotanical knowledge can provide a rich source of information for identifying novel drug candidates, while network pharmacology can help to validate traditional knowledge and provide a mechanistic understanding of the therapeutic effects of natural compounds thereby providing a scientific basis for their traditional use (Chinnasamy *et al.* 2019).

Therefore, the study aimed to gather the ethnic knowledge of those sacred grove-centric communities, to document the ethnomedicinal usage of plants and formulations, utilization of different plant parts established by the local communities as well as the indigenous herbal practitioners, and to evaluate the plants in a quantitative process to find the importance of those medicinal plants to stimulate future opportunities to discover new drugs.

Materials and Methods

Description of Study Area

Dakshin Dinajpur is a district in the northern part of West Bengal in the Republic of India and geographically lies between latitudes 24°20'N and 25°35'N and longitudes 88°20'E and 89°30'E. The district covers a vast area of 2162 square kilometers (<http://ddinajpur.nic.in>) and is bordered on the east by Bangladesh and on the other side by various districts of West Bengal. The district comprises two sub-divisions, viz., Balurghat and Gangarampur, of which Balurghat consists of four community development blocks (Hili, Balurghat, Kumarganj, and Tapan) and Gangarampur consists of three community development blocks (Gangarampur, Banshihari, and Harirampur). It lies in a warm and temperate region with an average annual temperature ranges from 18°C to 29°C, and yearly precipitation of about 1756 mm (Climate-Data.org).

Field Surveys and Data Collection

For the present study, extensive field surveys were conducted in all blocks of Dakshin Dinajpur district during October 2021 to September 2022 (Fig 2). Primarily, we visited sacred groves throughout the district, from which 15 well-preserved and medicinal plant-rich sacred groves were selected for the study (Fig 1). Three sacred groves each from Balurghat, Tapan, and Kumarganj blocks, two from Hili and Banshihari, and one from Gangarampur, Harirampur, and Tapan blocks were initially selected for the study (Table 1). These sacred groves were selected due to their vast and varied ecological diversity and medicinal plant resources. A total of 179 informants, including men,

women, and herbal practitioners from different age groups and literacy stages, were interviewed (Table 2). At first, the snowball sampling method was applied to identify individuals with a particular experience or expertise then a semi-structured questionnaire technique was used to gather ethnomedicinal data from the informants (Alexiades & Sheldon 1996; Chhetri & Chowdhury 2018). As the local people are predominantly Bengali speakers, the questionnaire was made in Bengali and later translated into English.

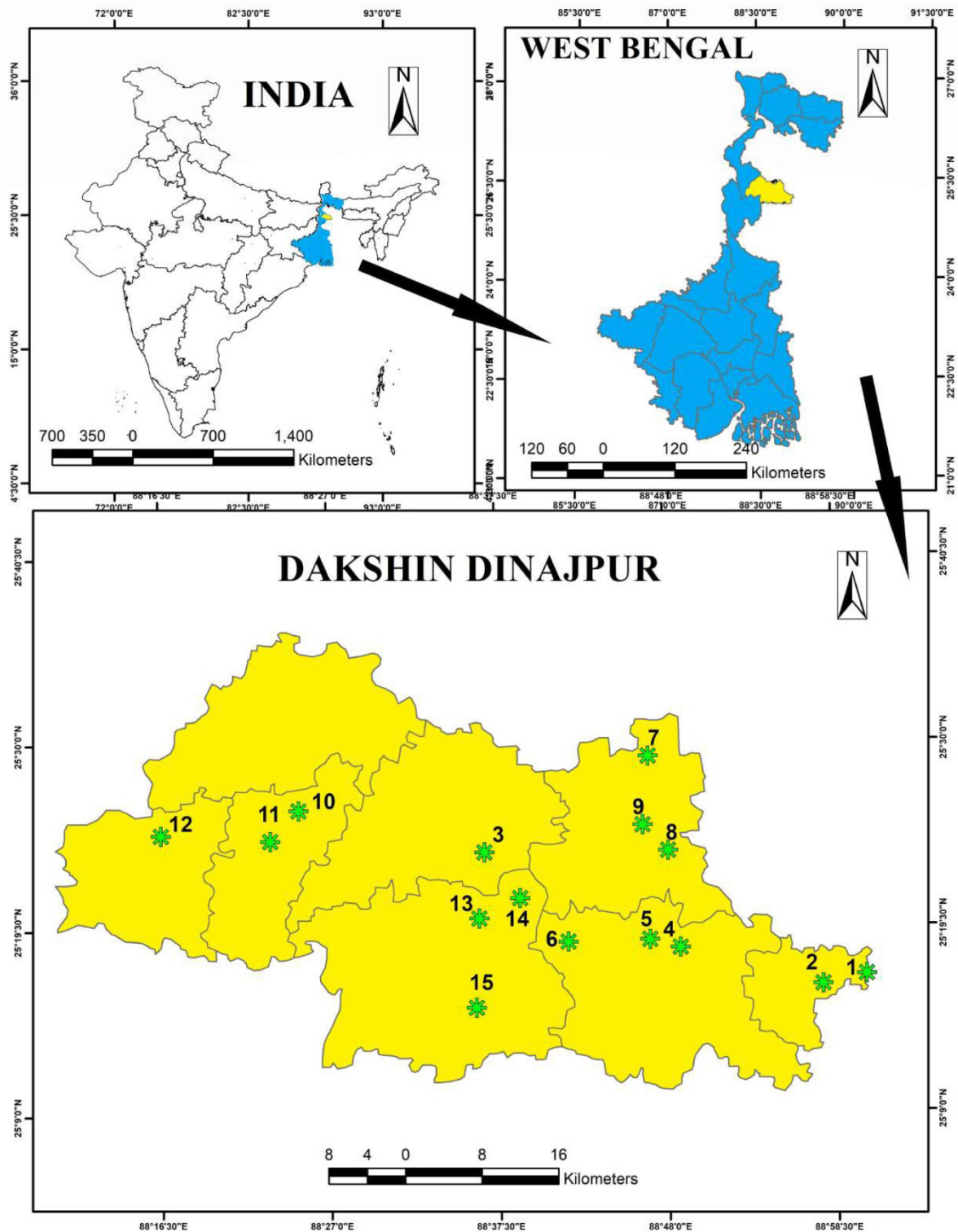


Figure 1. Map showing the survey area with the location of sacred groves (Here the numbering of sacred groves is according to Table 1).

Table 1. Detailed location of surveyed sacred groves of Dakshin Dinajpur district, West Bengal, India

Sacred Groves	GP	Block	Latitude	Longitude
Tetuli Surkali	Debra	Hili	25°17.424'N	88°55.465'E
Shitalasthal	Panjole	Hili	25°16.590'N	88°58.684'E
Bura Mashna Bon	Uday	Gangarampur	25°24.383'N	88°37.955'E
Shree Tarasagar Shiva Bon	Nazirpur	Balurghat	25°19.061'N	88°49.513'E
Batkhorina Akhraghat	Nazirpur	Balurghat	25°19.543'N	88°47.973'E
Takshoil Surkalighati	Bolla	Balurghat	25°18.915'N	88°42.222'E
Pir Than	Raynanda	Kumarganj	88°46.610'E	25°29.839'N
Radha Surkali	Radhakrishnapur	Kumarganj	25°24.508'	88°48.798'E
Sasthi Shiva Kali Bon	Gobindapur	Kumarganj	25°21.825'N	88°46.806'E
Burapir Than	Elahabad	Banshihari	25°27.029'N	88°27.960'E
Telpir Ghat	Buniadpur	Banshihari	25°23.107'N	88°23.185'E
Sannyashi Sthal	Bairatha	Harirampur	25°24.542'N	88°14.939'E
Darga-e-pirbaba	Jagadishbati	Tapan	25°20.378'N	88°37.787'E
Gambhira Bon	Harsura	Tapan	25°20.067'N	88°37.767'E
Daralhat Samshan Bon	Dipukhonda	Tapan	25°18.083'N	88°37.260'E

Identification of medicinal plant species

Primarily, the medicinal plants cited by the informants and commonly used by the local communities were collected and tagged based on vernacular names provided by the informants. The collected plant samples were processed following the standard herbarium protocol (Paul *et al.* 2020). For taxonomic authentication and correct identification purposes, "The Plant List" (<http://theplantlist.org>), "The International Plant Name Index" (<http://www.ipni.org>), and "POWO: Plants of the World Online" (<https://powo.science.kew.org>) were followed. The voucher specimens were submitted to the North Bengal University Herbarium (NBU), University of North Bengal, West Bengal, India.

Quantitative Ethnobotany

The quantitative ethnomedicinal analysis is carried out by the following indices:

Informant Consensus Factor

ICF is calculated to test the homogeneity of the knowledge or information provided by the informants on the use of medicinal plants for particular ailment categories. ICF or Informant Consensus Factor was obtained by the following formula (Heinrich *et al.* 1998) -

$$ICF = (N_{ur} - N_t) / (N_{ur} - 1)$$

Where, N_{ur} indicates the total number of use reports for a specific disease cluster and N_t indicates the total number of plant species used for that specific disease cluster. The value of ICF ranges from 0 to 1.

Use Report and Use Value

To determine the relative importance of plant species Use Value is calculated. The UV was calculated using the following formula (Phillips *et al.* 1994) -

$$UV = \sum U_i / N$$

Where, UV refers to the Use Value, U_i refers to the total number of use reports provided by the ITK informants for a particular species and N is the total number of informants participated in the survey. High use value means that the plant is more important.

Frequency of Citation and Relative Frequency of Citation

Relative Frequency of Citation (RFC) indicates the significance of a particular plant species in a study area. The RFC index was calculated by dividing the number of informants referred the use of the particular species (FC) by the total number of informants in the survey (N). The RFC was obtained by the following formula (Tardío & Pardo-De-Santayana 2008) -

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

Fidelity Level

By calculating Fidelity Level (FL) index we can determine the most suitable medicinal plant species preferred by the informants to cure a particular disease. It was calculated by the following formula (Friedman *et al.* 1986) -

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

Where, N_p refers to the number of ITK informants mentioned the use of a particular plant for a specific disease and N refers to the total number of informants citing the species for any disease.

Network Pharmacological (*in-silico*) analysis**Mining of phytochemicals**

Medicinal plants are composed of a wide variety of phytochemicals. The phytochemicals of three most popular plants were detected from IMPPAT (Indian Medicinal Plants, Phytochemistry And Therapeutics) database (Mohanraj *et al.* 2018). Chemical compositions, Canonical smiles and InChI keys which were obtained from IMPPAT, were validated from PubChem. PubChem is an open database with a broad range of chemical information (Kim *et al.* 2021). It is maintained by NCBI (National Center for Biotechnology Information).

Mining of synthetic drugs

The DrugBank Online database (<https://go.drugbank.com/>) is a richly annotated resource that combines detailed drug data with comprehensive drug target and drug action information (Wishart *et al.* 2008). In this study, the latest release of DrugBank database (version 5.1.9) was employed to search synthetic drugs of different diseases.

Target prediction and validation of targets

BindingDB is a web-accessible public database platform of protein target entities (Liu *et al.* 2007). All the targets (phytochemical targets) were screened from BindingDB with equivalent molecules having compound similarity greater than 0.85. To validate these protein targets, all targets were re-retrieved with their gene names from UniProt (Wang *et al.* 2021), an open access platform of protein sequences with functional information. Synthetic drug targets were directly collected from UniProt. From the organism section only human (*Homo sapiens*) protein targets were taken.

Construction of Networks

Cytoscape is widely used, JavaScript-based open-source software for visualizing highly complex interaction networks. All the networks were made using Cytoscape 3.7.2 (Shannon *et al.* 2003). In this graphic network, molecular species (compounds and proteins) or diseases were represented as nodes and intermolecular interactions (plant-phytochemical-target or plant-phytochemical-common target-synthetic drug-disease interactions), which were indicated as links, i.e., edges between nodes.

Programs and software used for statistical analysis

For data analysis various data application software and online programs were used. Principal Component Analysis (PCA) was performed by Origin Pro 2021 (OriginLab Corporation, USA). Principle Component Analysis (PCA) (Gabriel 1971) was performed based on quantitative variables of ethnomedicinal indices and to create the biplots PC1 and PC2 were used. PCA was executed by Origin Pro 2021 (OriginLab Corporation, USA). Heatmap was carried out based on the quantitative results found, using the web enabled program Clustvis (Metsalu & Vilo 2015; Haydar *et al.* 2022).

Results**Demographic Attributes of Informants**

A total of 179 informants were interviewed in the surveys conducted for the current study. Among them, 12 were traditional health practitioners, and 162 were local Rajbanshi and ethnic people (Fig 2). The Rajbanshis were very interested in their heritage and tradition in this study area, so they are still practicing their traditional healing with great faith (Kundu & Bag 2012). The local informants we interviewed were of different age groups and educational levels. The informants were mainly of five different age groups. Based on the information obtained about the informants they were characterized into different demographic classes (Table 2). The informants interviewed were from various occupational fields. As we surveyed the sacred groves which were mostly in rural areas, a large number of informants were farmers and from a farming background. Besides they are of various occupations likely herdsmen, people working in crafts, college students, housewives, teachers, small shopkeepers, etc. The informants

were very helpful and possess vast knowledge of medicinal plants and their therapeutic applications. Several traditional health practitioners were also interviewed. Based on the working experience in the field, the traditional health practitioners we interviewed (6.7% of total informants), were classified into five different classes: viz., below 2 years (25%), 2-5 years (33.33%), 5-10 years (8.33%), 10-20 years (16.66%), above 20 years (16.66%).



Figure 2. Pictorial view of different stages at study sites **a.** Rituals performed at sacred groves under sacred tree. **b.** Horse clay idol offered to deity **c.** Deity place in different sacred groves **d.** and **e.** Interaction with informants and local people **f.** Indigenous tribe with flute **g.** and **h.** Therapeutic herbal healers showing medicinal plants **i.** Traditional medicine preparation from medicinal plants

Table 2. Statistical attributes of the informants

Variable	Categories	No. of individuals
Informant Category	Traditional Health Practitioner	12
	Indigenous People	167
Gender	Male	125
	Female	54
Age Group	20-30	9
	31-40	22
	41-50	36
	51-60	63
	>60	49
Educational Qualification	Illiterate	47
	Elementary or Primary (4 th standard)	69
	Upper Primary (8 th standard)	37
	Secondary (10 th standard)	12
	Higher Secondary (10+2 Standard)	9

	Graduation (10+2+3 standard)	5
Experience of the THPs*	<2 years	3
	2-5 years	4
	5-10 years	2
	10-20 years	2
	>20 years	1

*THP= Traditional Health Practitioner

Ethno-medicinal plant species and their taxonomic diversity

In the present study, a total of 105 medicinally important plants belonging to 93 genera and 47 families were documented (Table 3). Fabaceae was the most dominant plant family with 9 genera and 10 species, whereas the second most utilized family was Asteraceae with 8 species, followed by Moraceae with 7 species, Rubiaceae and Solanaceae with 6 species each, Malvaceae with 5 species; Apocynaceae, Poaceae, and Lamiaceae with 4 species each, and Menispermaceae, Myrtaceae, and Rutaceae with 3 species each. Other plant families were documented by either 1 or 2 species. Similar results were found in previous ethnomedicinal studies in the Dakshin Dinajpur area (Chowdhury *et al.* 2014). Of the documented plant species, the majority were herbs (44%), followed by trees (31%), climbers (14.2%), shrubs (11.4%), aquatic herbs, epiphytic herbs, and parasitic twiners (0.95% each) (Table 4). Similar results were obtained in the work of (Li *et al.* 2021). In the case of life span, most of the plant species were perennial (69.5%), followed by annual (27.6%), and biennial (2.85%). Among the collected species, 26 species were found to be in the 'Least Concerned' category under the IUCN threatened category, 1 species in the 'Data Deficient' category, and the rest of the plants have not been assessed, hence they were in the 'Not Evaluated' category (IUCN 2022).

Usage of plant parts, preparation and mode of application

In the present study, the most used plant part documented was 'leaf' with 44.05% usage (Fig 3). The second most utilized plant part was Root (20.3%); The third most utilized part was fruit (11.8%) followed by stem (6.16%), whole plant (5.7%) following bark, seeds, rhizome, and flower. Various kinds of herbal preparation methods by local communities were documented during the present study. Most commonly ten different preparation methods were reported (Fig 3). Among these, the most frequently used preparation mode was extract (32.58%) and decoction (30.35%) followed by paste (18.3%), whole leaf (5.8%), powder (5.4%), oil decoction (3.1%), consumption of raw twig (1.7%), cooked (1.3%), latex (0.89%) and ash (0.44%). Besides these preparation methods, a number of application modes were also reported. The most common mode was oral consumption (56.87%) followed by topical application (31.87%), as a toothbrush (3.12%), ophthalmic (2.5%), chewing (1.87%), gargle (1.87%) and aural application (0.625%) respectively.

Informant Consensus Factor

In the present study, the diseases reported by the informants were differentiated into 16 different categories (Table 5). Disease clustering was done by going through the survey responses and creating a list of all the diseases mentioned. After identifying the diseases, we categorize them into different groups, such as respiratory diseases, digestive diseases, neurological diseases, etc., based on their symptoms, causes, or any other relevant criteria. The value of the ICF data ranges from 0 (Antidote, Respiratory Problems) to 0.33. The highest ICF value of 0.33 was documented in the case of sexual and gynecological disorders. Fever, cough, and cold disease category ranked second with an ICF value of 0.32, and gastrointestinal disorders are in the third rank with an ICF value of 0.30 followed by dermatological problems, infectious diseases, tonic, oral problems, endocrine-related disorders, parasitic diseases, neurological problems, ear-eye-nose and throat problems, urological disorders, blood circulatory system disorders along with muscular and skeletal disorders respectively (Fig 4). In the present study, the average ICF value of all disease clusters was 0.17.

Use Value and Relative Frequency of citation

The use value of a species is quite important as it shows the relative importance of a particular plant species in the ethnomedicinal ground by local indigenous communities (Raj *et al.* 2018). In the present survey, the Use Value ranged between 0.02 and 0.50 (Table 4). The highest UV was calculated in some plants which were reported with multiple uses in the study area by the informants. Some most commonly utilized plants such as *Aegle marmelos* (L.) Correa (0.50), *Mucuna pruriens* (L.) DC (0.39), *Artocarpus lacucha* Buch.-Ham. (0.31), *Rumex maritimus* L. (0.31), etc. were documented with higher use values. This indicates the high and common use of these plants in the recorded study area. The use of these plant species was triggered by their easy availability and abundance in those areas.

Table 3. Family wise distribution of plants

Plant Family	No. of Genera	Percentage(%) of Genera	No. of Plant Species	Percentage(%) of Plant Species
Acanthaceae	1	1.07	1	0.95
Amaranthaceae	2	2.15	2	1.90
Anacardiaceae	1	2.15	1	0.95
Apiaceae	1	1.07	1	0.95
Apocyanaceae	4	4.30	4	3.80
Araceae	1	1.07	1	0.95
Arecaceae	2	2.15	2	1.90
Asteraceae	7	7.52	8	7.62
Bignoniaceae	1	1.07	1	0.95
Boraginaceae	1	1.07	1	0.95
Cannabaceae	1	1.07	1	0.95
Commelinaceae	1	1.07	1	0.95
Convolvulaceae	2	2.15	2	1.90
Crassulaceae	1	1.07	1	0.95
Cucurbitaceae	1	1.07	1	0.95
Dioscoreaceae	1	1.07	1	0.95
Ebenaceae	1	1.07	1	0.95
Euphorbiaceae	2	2.15	2	1.90
Fabaceae	9	9.68	10	9.52
Lamiaceae	4	4.30	4	3.80
Malvaceae	5	5.37	5	4.76
Meliaceae	2	2.15	2	1.90
Menispermaceae	3	3.22	3	2.85
Moraceae	3	3.22	7	6.66
Moringaceae	1	1.07	1	0.95
Musaceae	1	1.07	1	0.95
Myrtaceae	2	2.15	3	2.85
Nyctaginaceae	1	1.07	1	0.95
Oleaceae	1	1.07	1	0.95
Orchidaceae	1	1.07	1	0.95
Oxalidaceae	1	1.07	1	0.95
Passifloraceae	1	1.07	1	0.95
Phyllanthaceae	1	1.07	1	0.95
Piperaceae	1	1.07	2	1.90
Plumbaginaceae	1	1.07	1	0.95
Poaceae	4	4.30	4	3.80
Polygonaceae	1	1.07	2	1.90
Pontederiaceae	1	1.07	1	0.95
Rhamnaceae	1	1.07	1	0.95
Rubiaceae	6	6.45	6	5.71
Rutaceae	3	3.22	3	2.85
Schizaeaceae	1	1.07	1	0.95
Scrophulariaceae	1	1.07	1	0.95
Simarounaceae	1	1.07	1	0.95
Smilacaceae	1	1.07	1	0.95
Solanaceae	3	3.22	6	5.71
Verbenaceae	1	1.07	1	0.95

Table 4. Ethnomedicinal uses of plant species from the study area

Family	Species	Vernacular Name	Voucher Specimen Accession No.	¹ Habit	² Life Span	³ IUCN category	⁴ Plant Parts used	Mode of Application	Medicinal uses	⁵ UV	⁶ RFC	⁷ FL (%)
Acanthaceae	<i>Andrographis paniculata</i> (Burm.f.) Nees	Kalmegh	NBU 00011618	S	P	NE	Le-extract	Oral	Anthelmintic , Dysentery	0.11	0.10	100
Amaranthaceae	<i>Achyranthes aspera</i> L.	Apang	NBU 00011602	H	A	NE	Rt-extract, decoction, Le-paste	Oral, Topical	Jaundice , Dog Bite, Leucorrhea	0.14	0.12	77.2
Amaranthaceae	<i>Amaranthus spinosus</i> L.	Kantakhuria	NBU 00011591	H	A	NE	Rt-decoction	Oral	Dysentery , Diarrhea	0.09	0.12	59
Anacardiaceae	<i>Mangifera indica</i> L.	Aam	NBU 00011575	T	P	DD	Le-extract ,whole leaf, decoction	Oral, Chewing, Gargle	Dysentery, Toothache, Sore Throat	0.17	0.10	50
Apiaceae	<i>Centella asiatica</i> (L.) Urb.	Thankuni/ Manimuni	NBU 00011747	H	A	LC	Le-paste, decoction	Oral	Gastritis , ulcer, dysentery	0.17	0.10	72.2
Apocyanaceae	<i>Alstonia scholaris</i> (L.) R.Br.	Chatim	NBU 00011601	T	P	LC	St-decoction, Ba-decoction, Rt-powder	Oral	Severe Fever , Nervous Problems	0.14	0.07	78.5
Apocyanaceae	<i>Calotropis gigantea</i> (L.) Dryand	Akanda	NBU 00011606	S	P	NE	Le-extract, Le-latex	Oral , Topical	Swollen Joint , Wound Healing, Severe Fever	0.18	0.08	62.5
Apocyanaceae	<i>Cascabela thevetia</i> (L.) Lippold	Ghontaful	NBU 00011608	T	P	NE	Le- Paste, decoction, Ba-decoction	Oral , Topical	Piles , Conjunctivitis, Bowel problems,	0.13	0.12	45.4
Apocyanaceae	<i>Ichnocarpus frutescens</i> (L.) W.T.Aiton	Shyama Lata	NBU 00011737	C	P	NE	Le-extract	Oral	Diarrhea , Dysentery	0.11	0.11	57.9
Araceae	<i>Colocasia esculenta</i> (L.) Schott	Kalakochu	NBU 00011623	H	P	NE	Wp-cooked, Rt-decoction, St-extract	Oral, Aural	Blood Purification , Itchy Ear, Anaemia	0.17	0.10	72.2
Arecaceae	<i>Borassus flabellifer</i> L.	Tal	NBU 00011624	T	P	NE	Fr-extract	Oral	Diarrhea , Dysentery	0.11	0.10	66.6
Arecaceae	<i>Phoenix sylvestris</i> (L.) Roxb.	Khejur	NBU 00011622	T	P	NE	Fr-whole fruit	Oral	Constipation, Anaemia	0.08	0.15	68.9
Asteraceae	<i>Acmella uliginosa</i> (Sw.) Cass.	Titri	NBU 00011567	H	A	NE	Wp-decoction	Oral	Cold , Fever	0.08	0.14	52

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Asteraceae	<i>Ageratum conyzoides</i> L.	Nilfuli	NBU 00011630	H	A	NE	Le-paste	Topical	Ringworm ,	0.07	0.15	57.6
Asteraceae	<i>Ageratum houstonianum</i> Mill.	Jarafuli	NBU 00011759	H	A	NE	Rt-paste, Le-paste	Topical	Wound Healing , Skin rashes	0.15	0.07	53.8
Asteraceae	<i>Blumea lacera</i> (Burm.f.) DC.	Holud ful	NBU 00011728	H	B	NE	Le-extract	Oral	Blood Purification , Neurological disorder	0.13	0.09	56.3
Asteraceae	<i>Chromolaena odorata</i> (L.)R.M. King & H.Rob.	Gondhi	NBU 00011599	H	A	NE	Le- decoction, extract	Oral	Malaria , Fever, Body ache	0.12	0.15	42.3
Asteraceae	<i>Mikania scandens</i> (L.) Willd.	Jongli lata	NBU 00011580	C	A	NE	Le- paste	Topical	Wound Healing , Antiseptic	0.10	0.11	60
Asteraceae	<i>Sphagneticola trilobata</i> (L.) Pruski	Bhringaraj	NBU 00011598	H	A	LC	Le-extract	Topical	Antidandruff lotion, Hair Tonic	0.14	0.08	71.4
Asteraceae	<i>Tridax procumbens</i> L.		NBU 00011743	H	A	NE	Wp-decoction	Oral	Cough , Cold	0.17	0.06	58.3
Bignoniaceae	<i>Oroxylum indicum</i> (L.) Kurz	Sonapata	NBU 00011733	T	P	LC	Rt-decoction, extract, Fr-powder	Oral	Diarrhea, Kidney Pain , Cardiovascular Disease	0.12	0.15	50
Boraginaceae	<i>Heliotropium indicum</i> L.	Hatishura	NBU 00011577	H	A	NE	Le-extract	Ophthalmic, Oral	Cataract , Gastritis	0.11	0.10	100
Cannabaceae	<i>Trema orientalis</i> (L.) Blume	Jigmi	NBU 00011748	S	P	NE	Le- decoction	Oral	Fever , Body Pain	0.2	0.05	55.5
Commelinaceae	<i>Commelina diffusa</i> Burm.f.	Kanchira	NBU 00011750	H	A	LC	Le-paste	Topical	Skin rashes , Dermatitis	0.06	0.06	58.3
Convolvulaceae	<i>Cuscuta reflexa</i> Roxb	Swarnalata /Alokata	NBU 00011569	PT	P	NE	Wp-oil decoction, decoction, extract, Sd-powder	Oral, Topical, Gargle	Gastritis, Jaundice, Appetizer, Dysmenorrheal Pain , Wound Healing, Anthelmintic, Mouth Ulcer	0.25	0.16	100
Convolvulaceae	<i>Ipomoea carnea</i> Jacq.	Dhol kolmi	NBU 00011615	S	P	NE	Le-paste, decoction	Oral, Topical	Diabetes , Anti-Fungal Lotion	0.09	0.12	59
Crassulaceae	<i>Bryophyllum pinnatum</i> (Lam.) Oken	Patharkuchi	NBU 00011585	H	A	NE	Le-extract	Oral	Kidney Stone , Diuretic, Dyspepsia	0.21	0.07	64.2
Cucurbitaceae	<i>Coccinia grandis</i> (L.) Voigt	Telakochu	NBU 00011604	C	P	NE	Le-decoction, Rt-decoction	Oral	Diabetes , Reducing High	0.15	0.11	75

Dioscoreaceae	<i>Dioscorea alata</i> L.	Chupri alu/ Kham alu	NBU 00011621	C	P	NE	Rh-cooked	Oral	Blood Pressure, Arthritis Dyspepsia, Appetizer	0.05	0.12	68.2
Ebenaceae	<i>Diospyros malabarica</i> (Desr.) Kostel.	Deshi Gab	NBU 00011763	T	P	NE	Ba-extract, Le-paste	Topical	Jaundice, Wound Healing	0.04	0.20	69.4
Euphorbiaceae	<i>Croton bonplandianus</i> Baill.	Chirchira/ Morichi	NBU 00011760	H	P	NE	Le-extract	Topical, Ophthalmic	Reddish Eye, Wound Healing	0.06	0.10	63.2
Euphorbiaceae	<i>Tragia involucrata</i> L.	Chotra pata	NBU 00011614	H	P	NE	Le- extract, decoction with goat milk	Oral	Blood pressure, Better lactation	0.11	0.10	61.1
Fabaceae	<i>Abrus precatorius</i> L.	Kunch	NBU 00011729	T	P	NE	Rt-decoction, Le- extract, Sd- powder	Oral, Topical	Jaundice, Dog Bite, Wound Healing, Gonorrhea	0.22	0.10	72.2
Fabaceae	<i>Acacia auriculiformis</i> Benth.	Sonajhuri	NBU 00011616	T	P	LC	Ba- decoction, Le- decoction	Oral, Topical	Dermatitis ,Fever, Cough	0.21	0.08	64.2
Fabaceae	<i>Caesalpinia bonduc</i> (L.) Roxb.	Katakaranja / Natagach	NBU 00011592	C	P	NE	Rt-decoction, Sd-powder, Le- paste	Oral , Topical	Malaria ,Diabetes, Liver Problems, Irregular Menstrual Cycle ,Eczema	0.17	0.16	86.2
Fabaceae	<i>Crotalaria pallida</i> Aiton	Atashi	NBU 00011594	H	A	NE	Rt-extract, Sd- decoction	Oral	Indigestion, Anaemia	0.09	0.12	54.5
Fabaceae	<i>Grona triflora</i> (L.) H.Obashi & K.Obashi	Dirghamul	NBU 00011767	H	P	NE	Rt-decoction, paste	Oral	Fever, Diarrhea, Diuretic	0.10	0.17	66.6
Fabaceae	<i>Mimosa pudica</i> L.	Lojjaboti	NBU 00011613	H	P	LC	Rt-Decoction	Oral	Menstrual Problems, Dysentery	0.13	0.09	75
Fabaceae	<i>Mucuna pruriens</i> (L.) DC	Alkushi/ Badorbicha	NBU 00011761	C	P	NE	Fr-extract Sd- powder, Rt-extract, decoction	Oral, Topical	Infertility, Erectile Dysfunction, Low Sperm Count, Libido Booster, Diuretic, Arthritis, Scabies, Bowel problems	0.37	0.12	90.9
Fabaceae	<i>Senna sophora</i> (L.) Roxb.	Fotagach	NBU 00011736	H	P	NE	Rt-paste	Topical	Ring worm ,Prickly heat	0.13	0.09	56.3

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Fabaceae	<i>Senna tora</i> (L.) Roxb.	Chabuk gach	NBU 00011572	H	A	NE	Sd-powder, Le-paste decoction	Oral, Topical	Constipation , Ringworm, Skin Rashes	0.10	0.17	46.6
Fabaceae	<i>Tamarindus indica</i> L.	Tetul	NBU 00011574	T	P	NE	Fr –wf , Rt-decoction	Oral	Fever , Constipation	0.08	0.15	61.5
Lamiaceae	<i>Anisomeles indica</i> (L.) Kuntze	Gopali	NBU 00011603	H	A	NE	Le-paste	Topical	Antiseptic , Wound Healing	0.10	0.11	55
Lamiaceae	<i>Clerodendrum infortunatum</i> L.	Lal Bhat/Bhand i	NBU 00011611	S	P	NE	Le-extract	Oral	Fever , Anthelmintic, Dysentery	0.17	0.10	77.7
Lamiaceae	<i>Leucas aspera</i> (Willd.) Link	Dandakalash/ Kanshisa	NBU 00011629	H	A	NE	Fl-extract, Le-extract	Oral	Infant Dysentery , Cold ,Cough , Diabetes, Anthelmintic	0.28	0.10	72.2
Lamiaceae	<i>Ocimum gratissimum</i> L.	Lobongo Tulshi/ Bon Tulshi	NBU 00011730	H	P	NE	Le- extract, decoction, Whole leaf	Oral, Ophthalmic, Nasal, Chewing, Gargle	Cold , Cough , Fever, Sore Throat, Migraine Pain, Pneumonia, Bad Breathe, Diuretic, Cataract	0.26	0.19	76.4
Malvaceae	<i>Abroma augusta</i> (L.) L.f	Ulatkambal	NBU 00011619	T	P	NE	Rt-powder, decoction, Le-extract, decoction	Oral, Topical	Leucorrhea , Dysmenorrheal Pain, Irregular Menstrual Cycle, Gonorrhea	0.19	0.12	85.7
Malvaceae	<i>Bombax ceiba</i> L	Shimul	NBU 00011609	T	P	NE	Ba-paste, Rt-extract	Oral, Topical	Acne , Leucorrhea	0.10	0.11	80
Malvaceae	<i>Sida rhombifolia</i> L.	Swet Berela	NBU 00011756	S	A	NE	Rt- paste, decoction	Oral, Topical	Wound Healing, Cardiovascular Pain	0.13	0.09	56.3
Malvaceae	<i>Triumfetta rhomboidea</i> Jacq.	Jongli Okra	NBU 00011588	H	A	NE	Le- paste,Rt-paste, oil decoction	Oral	Fracture, Hydrocele ,	0.09	0.12	54.5
Malvaceae	<i>Urena lobata</i> L	Bon Okra	NBU 00011593	S	A	NE	Rt-extract, Le-decoction	Oral	Diabetes , Diarrhea, Dysentery	0.12	0.15	53.8
Meliaceae	<i>Azadirachta indica</i> A.Juss.	Jaat Neem	NBU 00011735	T	P	NE	Le-extract, decoction, St-decoction, Twig	Oral, Topical, Toothbrush	Chicken pox , Diabetes, Measles, Scabies, Ringworm, Malaria,	0.23	0.22	67.5

Meliaceae	<i>Melia azedarach</i> L.	Ghor neem	NBU 00011612	T	P	NE	Le-extract, paste, decoction,	Oral, Topical	Toothache, Anti-fungal lotion, Anthelmintic Headache, Nervous Problems, Malaria, Eczema, Antibacterial lotion	0.25	0.11	45
Menispermaceae	<i>Stephania japonica</i> (Thunb.) Miers	Maknadi	NBU 00011578	C	P	NE	Rt-decoction	Oral	Asthma , Fever	0.07	0.17	60
Menispermaceae	<i>Tiliacora acuminata</i> (Lam.) Hook. f. & Thoms..	Tikagachi	NBU 00011766	C	P	NE	Rt-paste, extract	Topical	Wound Healing, Snake Bite	0.18	0.06	63.7
Menispermaceae	<i>Tinospora sinensis</i> (Lour.) Merr.	Gulanchar	NBU 00011586	C	P	NE	St- decoction	Oral	Diabetes , Cholesterol	0.13	0.09	81.25
Moraceae	<i>Artocarpus heterophyllus</i> Lam.	Kathal	NBU 00011573	T	P	NE	Le-paste, Fr-wf, Rt-decoction	Oral, Topical	Indigestion , Asthma, Wound Healing, Skin Rashes	0.15	0.15	69.2
Moraceae	<i>Artocarpus lacucha</i> Buch.-Ham.	Bonkathali	NBU 00011605	T	P	NE	Fr-extract, decoction, wf, Le- paste	Oral, Topical	Bone Health , Weight Loss Tonic, Dyspepsia, Skin Rashes	0.31	0.09	50
Moraceae	<i>Ficus benghalensis</i> L.	Bot	NBU 00011754	T	P	NE	Ba-decoction, St-latex, Le-extract	Oral, Topical	Wound Healing , Diarrhea, Fever, Erectile Dysfunction	0.25	0.09	50
Moraceae	<i>Ficus racemosa</i> L.	Joggo Dumur	NBU 00011753	T	P	LC	Le-extract,, Rt-decoction	Oral, Topical	Stomach Ulcer , Skin rashes	0.10	0.11	60
Moraceae	<i>Ficus religiosa</i> L.	Ashwath, Pipli	NBU 00011740	T	P	NE	Le-extract, Rt-decoction	Oral, Topical	Gonorrhea , Asthma, Diarrhea	0.16	0.10	66.6
Moraceae	<i>Ficus rumphii</i> Blume	Pakur	NBU 00011741	T	P	NE	Le-decoction, Fr-wf	Oral	Dyspepsia , Diarrhea	0.09	0.12	54.5
Moraceae	<i>Streblus asper</i> Lour.	Sheora	NBU 00011607	T	P	NE	St-twig, Ba-paste, decoction	Oral, Topical, Toothbrush	Toothache, Better lactation	0.11	0.10	72.2
Moringaceae	<i>Moringa oleifera</i> Lam.	Sojna	NBU 00011620	T	P	NE	Fr-Cooked, Le- extract, FL-extract, Rt-decoction	Oral	Reducing High Blood Pressure , Chicken Pox, Diuretic,	0.16	0.23	100

									Jaundice, Liver Problems, Menstrual Abnormalities, Diabetes			
Musaceae	<i>Musa paradisiaca</i> L.	Kola	NBU 00011610	H	P	NE	St-extract, paste, ash, Le-extract, Fr-whole fruit	Oral, Topical	Skin Burn , Intestinal Disorders, Piles, Constipation	0.29	0.08	64.2
Myrtaceae	<i>Psidium guajava</i> L.	Peyara	NBU 00011590	T	P	NE	Le-extract, decoction, whole leaf, St- twig	Oral, Tothbrush, Chewing	Diarrhea , Dysentery, Toothache, Pyorrhea, Bad Breathe	0.16	0.17	63.3
Myrtaceae	<i>Syzygium cumini</i> (L.) Skeels	Kala Jam	NBU 00011742	T	P	NE	Fr -wf , Le-extract, Sd-powder	Oral	Dysentery, Blood Purification , Diabetes	0.19	0.09	68.75
Myrtaceae	<i>Syzygium jambos</i> L.(Alston)	Golap Jam	NBU 00011749	T	P	NE	Fr-wf	Oral	Anaemia , Gastritis	0.15	0.07	69.2
Nyctaginaceae	<i>Boerhavia diffusa</i> L.	Punarnaba	NBU 00011752	H	A	NE	Rt- extract, oil decoction	Oral, Topical	Rejuvenating Tonic , Anti-ageing lotion	0.09	0.12	72.7
Oleaceae	<i>Nyctanthes arbor-tristis</i> L.	Shiuli/ Sefali	NBU 00011589	T	P	NE	Le-extract, Fl-extract, Ba-decoction	Oral, Ophthalmic	Fever , Diabetes, Conjunctivitis, Fetal Growth	0.15	0.15	81.4
Orchidaceae	<i>Bulbophyllum leopardinum</i> (Wall.) Lindl. ex Wall.	Gachhia	NBU 00011768	A H	P	LC	Rt-paste ,decoction	Oral, Topical	Wound Healing, Sexual Stimulant	0.09	0.12	59
Oxalidaceae	<i>Oxalis corniculata</i> L.	Tok pata/ Ambuli	NBU 00011758	H	A	NE	Le-paste, extract, decoction, whole leaf	Oral, Chewing	Jaundice, Dysentery, Diarrhea , Scurvy	0.18	0.12	63.6
Passifloraceae	<i>Passiflora foetida</i> L.	Jhumkalata	NBU 00011732	C	P	NE	Le- extract, decoction	Oral, Aural	Diarrhea ,Earache	0.08	0.15	61.5
Phyllanthaceae	<i>Phyllanthus emblica</i> L.	Amloki	NBU 00011570	T	P	NE	Fr- powder, extract, whole fruit, Le-extract	Oral, Topical	Gastrointestinal Disorders , Appetizer, Scurvy, Ringworm	0.22	0.10	66.6
Piperaceae	<i>Piper longum</i> L.	Pipul	NBU 00011597	C	P	NE	Fr-powder, Wp-extract	Oral	Better Lactation, Menstrual Pain, Asthma , Fever	0.11	0.19	80

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Piperaceae	<i>Piper nigrum</i> L.	Golmorich	NBU 00011628	C	P	NE	Fr-powder, decoction with <i>Leea indica</i>	Oral	Cough , Cold , Asthma, Fever	0.22	0.10	72.2
Plumbaginaceae	<i>Plumbago zeylanica</i> L.	Chitrak	NBU 00011627	H	A	NE	Le-paste, Decoction	Oral, Topical	Wound Healing , Cough, Cold,	0.14	0.12	59
Poaceae	<i>Chrysopogon aciculatus</i> (Retz.) Trin.	Chorkata	NBU 00011583	H	P	NE	Le-decoction, Rh-decoction,	Oral	Shoulder Pain , Urinary Tract Infection, Cholera	0.12	0.15	42.3
Poaceae	<i>Cynodon dactylon</i> (L.)Pers.	Durba	NBU 00011596	H	P	NE	Rh-extract, Wp-paste, extract	Oral , Topical	Jaundice , Wound Healing, Leucorrhea, Menstrual Bleeding, Baby Conception	0.15	0.18	100
Poaceae	<i>Digitaria ciliaris</i> (Retz.) Koeler	Timathi	NBU 00011751	H	P	NE	Rh-decoction, Le-extract	Oral	Dysentery , Ulcer, Heart pain, Joint pain	0.22	0.10	61.1
Poaceae	<i>Kyllinga nemoralis</i> (J.R. Forst & G.Forst.)Dandy ex Hutch. & Dalziel	Motha ghas	NBU 00011584	H	P	LC	Rh-extract	Oral	Dysentery , Indigestion	0.08	0.15	53.8
Polygonaceae	<i>Rumex dentatus</i> L.	Jongli Palang	NBU 00011746	H	B	NE	Le-paste, extract, Rt-decoction	Oral, Topical	Rheumatic Pain, Arthritis, Piles, Eczema,	0.31	0.09	68.8
Polygonaceae	<i>Rumex maritimus</i> L.	Bonpalak	NBU 00011755	H	B	NE	Le-paste, extract, Rt-decoction	Oral, Topical	Leucoderma Wound Healing, Anti Allergic(skin) , Eczema, Anthelmintic, Diuretic	0.31	0.09	62.5
Pontederiaceae	<i>Eichhornia crassipes</i> (Mart.) Solms	Kocuripana	NBU 00011600	A	P	NE	Wp- paste	Topical	Wound Healing , Jaundice	0.04	0.20	58.33
Rhamnaceae	<i>Ziziphus jujuba</i> Mill.	Bon Kul	NBU 00011579	Q	P	NE	Le-paste, Rt-decoction	Oral, Topical	Scabies , Diabetes,	0.13	0.09	68.7
Rubiaceae	<i>Meyna laxiflora</i> Robyns	Moyna kata	NBU 00011739	S	P	NE	Fr-extract	Oral	Gastritis , Indigestion	0.13	0.08	53.3
Rubiaceae	<i>Mitracarpus hirtus</i> (L.) DC.	Jongolband ha	NBU 00011769	H	A	NE	Wp-paste, oil decoction	Oral, Topical	Asthma , Joint Pain, Skin Rashes	0.12	0.15	57.6
Rubiaceae	<i>Neolamarckia cadamba</i> (Roxb.) Bosser	Kadam	NBU 00011734	T	P	NE	Le-extract	Oral	Anthelmintic, Nervous problems	0.11	0.05	55.5

Rubiaceae	<i>Oldenlandia corymbosa</i> L.	Suipata	NBU 00011738	H	A	NE	Le-paste, decoction	Oral, Topical	Dyspepsia , Antiseptic lotion	0.08	0.15	53.8
Rubiaceae	<i>Spermacoe alata</i> Aubl.	Chiki	NBU 00011764	H	A	NE	Le-extract, decoction	Oral	Indigestion, Spasmodic pain	0.11	0.11	52.6
Rubiaceae	<i>Tabernaemontana divaricata</i> (L.) R.Br. ex Roem. &Schult.	Tagar	NBU 00011731	S	P	NE	Rt-extract, St-extract, twig	Oral, Topical, Toothbrush	Anthelmintic, Ringworm, Toothache, Fever	0.29	0.08	71.4
Rutaceae	<i>Aegle marmelos</i> (L.) Correa	Bel	NBU 00011568	T	P	NE	Le-extract, Fr-powder, extract , Rt-extract	Oral	Dysentery , Diarrhea, Stomach Ulcer, Stomachache, Cough, Better Lactation, Stroke Rheumatic pain, Toothache	0.50	0.07	71.4
Rutaceae	<i>Glycosmis pentaphylla</i> (Retz.) DC.	Atishar/ Kendal	NBU 00011625	S	P	NE	Rt- oil decoction, St-extract	Topical, Toothbrush	Toothache	0.13	0.09	81.2
Rutaceae	<i>Murraya koenigii</i> (L.) Spreng.	Karipata/ Narasingha pata	NBU 00011571	T	P	NE	Le- extract, decoction	Oral, Topical	Diabetes, Indigestion, Rheumatic Pain, Anti Hair Fall tonic	0.25	0.09	56.2
Schizaeaceae	<i>Lygodium flexuosum</i> (L.) Sw.	Jhirjhira	NBU 00011770	C	P	NE	Le-paste, decoction	Oral, Topical	Dyspepsia , Antiseptic lotion, Snake Bite	0.21	0.08	64.2
Scrophulariaceae	<i>Scoparia dulcis</i> L.	Chinipata/B ondhonia	NBU 00011617	H	P	NE	Rh-extract	Oral	Diabetes, Jaundice	0.11	0.10	61.1
Simaroubaceae	<i>Ailanthus exelsa</i> Roxb.	Prithwiraj	NBU 00011745	T	P	NE	Le- extract, Rt-decoction	Oral	Body weakness tonic, Protein Tonic	0.09	0.12	63.6
Smilacaceae	<i>Smilax zeylanica</i> L.	Chagalboti	NBU 00011587	C	P	NE	Wp-paste, Rt-decoction	Oral, Topical	Eczema, Gonorrhea	0.09	0.12	59
Solanaceae	<i>Datura metel</i> L.	Dhutura	NBU 00011576	S	P	NE	Le-paste, oil decoction, Fr-powder	Oral, Topical	Pain Killer , Rheumatic Pain, Scabies, Neurodegenerati ve Disease	0.20	0.11	80
Solanaceae	<i>Physalis minima</i> L.	Bontapari	NBU 00011595	H	A	NE	Le-deoction, Fr-extract	Oral	Fever , Anthelmintic	0.15	0.07	53.8
Solanaceae	<i>Solanum nigrum</i> L.	Kakmachi	NBU 00011757	H	P	NE	Le-extract, decoction, Fr-extract	Oral	Cough , Cold, Gastric Ulcer	0.17	0.10	55.5

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Solanaceae	<i>Solanum sisymbriifolium</i> Lam.	Katabegun	NBU 00011626	H	A	NE	Fr-extract	Oral	Indigestion	0.07	0.17	56.7
Solanaceae	<i>Solanum torvum</i> Sw.	Titbegun	NBU 00011581	H	P	NE	Fr-extract	Oral	,Anthelmintic Diabetes, High blood pressure	0.05	0.10	66.6
Solanaceae	<i>Solanum virginianum</i> L.	Bonbegni	NBU 00011744	H	A	NE	Rt-decoction, Le-paste	Oral, Topical	Eczema, Painkiller	0.18	0.06	54.5
Verbenaceae	<i>Lantana camara</i> L.	Gisani Ful	NBU 00011631	S	P	NE	Le-paste, oil decoction	Topical	Ringworm , Skin Rashes, Body ache, Wound Healing	0.15	0.15	61.5

¹**Habit:** H-Herbs, S-Shrubs, T-Tree, C-Climber, AQ-Aquatic, AH-Arial Herb, PT-Parasitic Twiners

²**Life Span:** A-Annual, B-Biennial, P-Perennial

³**IUCN category:** NE-Not Evaluated, LC-Least Concerned, DD-Data Deficient

⁴**Plant parts used:** Rt-Root, St-Stem, Ba-Bark, Le-Leaf, Fl-Flower, Fr-Fruit, Sd-Seed, Wp-Whole plant, wf-Whole fruit, Rh-Rhizome

⁵**UV:** Use Value; ⁶**RFC:** Relative Frequency of Citation; ⁷**FL:** Fidelity Level

*Main therapeutic uses of plants are in bold text

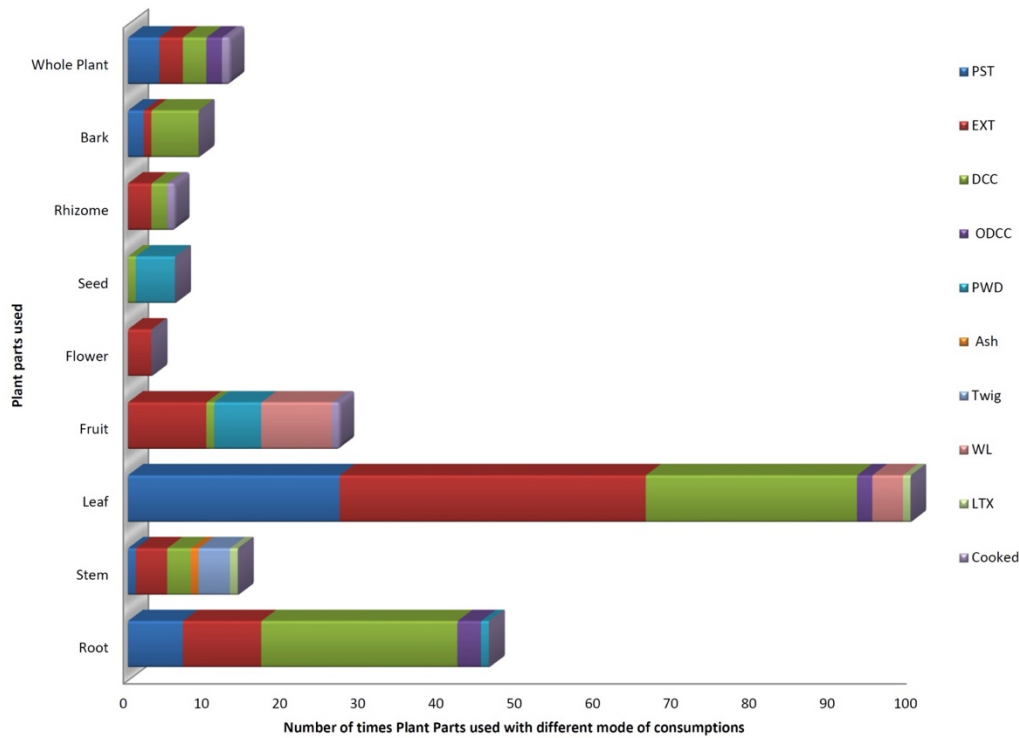


Figure 3. Graph showing different plant parts used with their mode of consumptions (PST= Paste, EXT= Extract, DCC= Decoction, ODCC= Oil Decoction, PWD= Powder, WL= Whole Leaf, LTX= Latex)

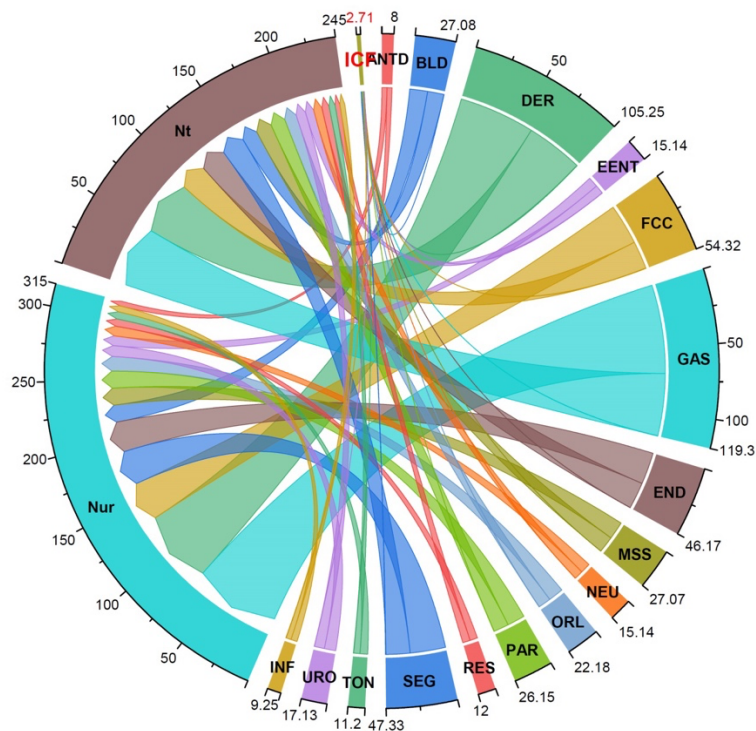


Figure 4. Chord diagram representing the Informant Consensus factor attributes for different ailment categories (ANTD= Antidote, BLD= blood circulatory system disorders, DER= dermatological problems, EENT= ear-eye-nose and throat problems, FCC= Fever, cough and cold, GAS= gastrointestinal disorders, END= endocrine related disorders, MSS= muscular and skeletal disorders, NEU= neurological problems, ORL= oral problems, PAR= parasitic diseases, RES= respiratory problems, SEG= Sexual and Gynecological Disorders, TON=tonic, URO=urological disorders, INF= infectious diseases)

The RFC values of the documented plant species range from 0.05 to 0.23 with an average RFC value of 0.12. *Moringa oleifera* Lam. (0.23) plant was recorded with the highest RFC followed by *Azadirachta indica* A.Juss. (0.22), *Ocimum gratissimum* L. (0.19) and whereas *Neolamarckia cadamba* (Roxb.) Bosser (0.05), *Trema orientalis* (L.) Blume (0.05), *Commelina diffusa* Burm.f. (0.06), *Tridax procumbens* L. (0.06), *Ageratum houstonianum* Mill. (0.07) and *Alstonia scholaris* (L.) R.Br. (0.07) were recorded with the lowest RFC values. A higher RFC value indicates that the plants are most commonly used and are popular among the local inhabitants.

Fidelity Level

In the present study, the fidelity level ranges between 42.3 to 100% (Table 4). Fidelity level (FL) was calculated for the plants that were used for various kinds of ailments viz. leucorrhea, rejuvenating agent, malaria, diabetes, dysmenorrheal pain, jaundice, toothache, cataract, reducing high blood pressure, men infertility, fever, cough, asthma, arthritis, diarrhea, etc. In this study four medicinal plants, viz., *Cuscuta reflexa* Roxb., *Heliotropium indicum* L., *Cynodon dactylon* (L.) Pers., *Andrographis paniculata* (Burm.f.) Nees and *Moringa oleifera* Lam. were depicted with an FL range of 100% followed by *Mucuna pruriens* (L.) DC. with 90.9%.

Table 5. Informant consensus factor (ICF) of reported plant species against different category of ailments

Disease category	No. of use reports (N _{ur})	Number of Plant Species used (N _i)	ICF
Antidote (Dog bite, Snake bite etc.)	4	4	-
Blood circulatory system disorders (Anemia, High Blood Pressure, Blood purifier, Cardiovascular disorders, Cholesterol)	14	13	0.08
Dermatological Problems	60	45	0.25
Eye ,Ear ,Nose ,Throat problems	8	7	0.14
Fever ,Cough and Cold	32	22	0.32
Gastrointestinal Disorders (Appetizer, Constipation,Indigestion,Diarrhea,Dysentery,Gastritis,Piles,Stomachache)	70	49	0.30
Endocrine Related Disorders (Jaundice, Liver problems, Diabetes)	25	21	0.17
Muscular and Skeletal Disorders	14	13	0.07
Neurological Problems (headache, migraine pain, neurodegenerative diseases, stroke)	8	7	0.14
Oral problems (Bad breathe, Scurvy, Toothache, Pyorrhea)	12	10	0.18
Parasitic (Anthelmintic, Malaria)	14	12	0.15
Respiratory Problems (Asthma)	6	6	-
Sexual and Gynecological Disorders (Libido Booster, Erectile Dysfunction, Sexual Stimulant, Low sperm count, Dysmenorrhea, Menstrual problems, Hydrocele, Leucorrhoea, Fetal Growth, Pregnancy, Better lactation)	28	19	0.33
Tonic (Protein Tonic, Hair Tonic, Rejuvenating Tonic, Weight Loss Tonic)	6	5	0.20
Urological disorders (Kidney Problems, Kidney Stone, Diuretic, Urinary Tract Infection)	9	8	0.13
Infectious (Chicken pox, Measles, Cholera, Pneumonia,)	5	4	0.25

Interplay between surveyed plants and variables as observed through Heatmap and PCA

PCA was used for the reduction of data and transforming the raw data into principal components or principal factors. Principal component analysis converted high-dimensional data into fewer dimensions or principal factors with minimal loss (Fig. 5). Here the variables mainly form two separate clusters when the first cluster represents UV and FL (both PC1 and PC2 positive). While RFC is present alone in the fourth cluster where PC1 represents a positive value and PC2 represents a negative value. The PCA showed 80.72% overall data variability as only PC1 and PC2 were used to make the biplots. From the factor loading plot, it was observed that the studied plants occupied all four quadrants. Heatmap was also used for arithmetic hierarchical clustering. Heatmap is a technique of data visualization where two-dimensional data can be graphically represented through color gradients. In the present study, the Heatmap result also supports the PCA analysis result (Fig. 6).

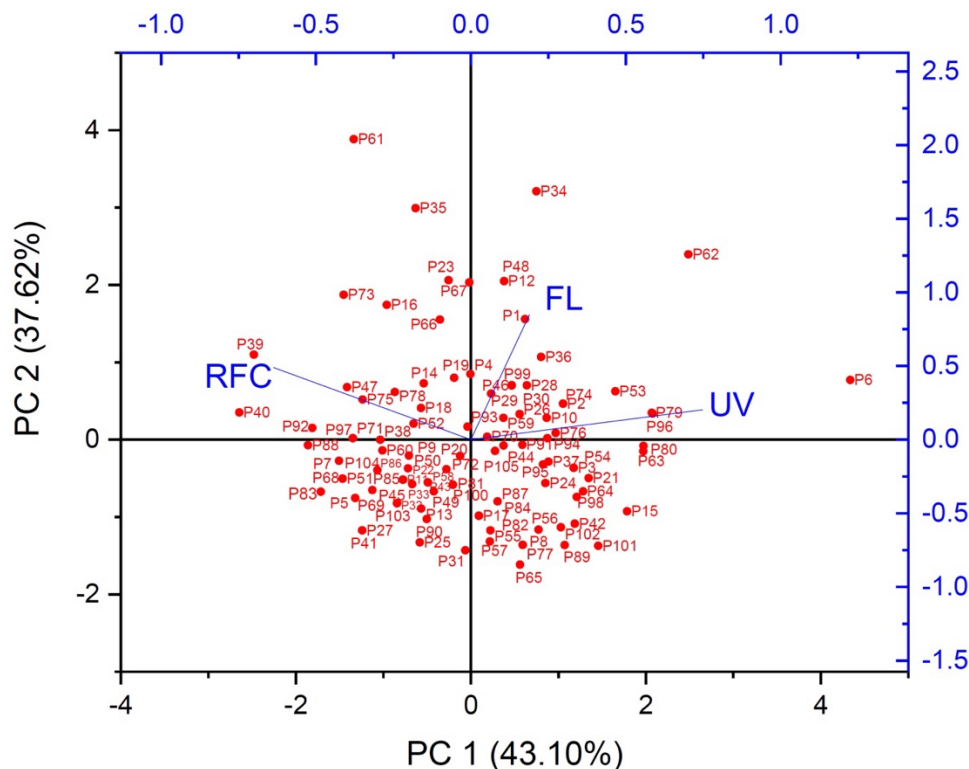


Figure 5. Principal component analysis of studied plants on the basis of various quantitative ethnobotanical indices (Plant codes are according to Table 4 and here RFC= Relative Frequency of Citation; FL= Fidelity Level; UV= Use Value)

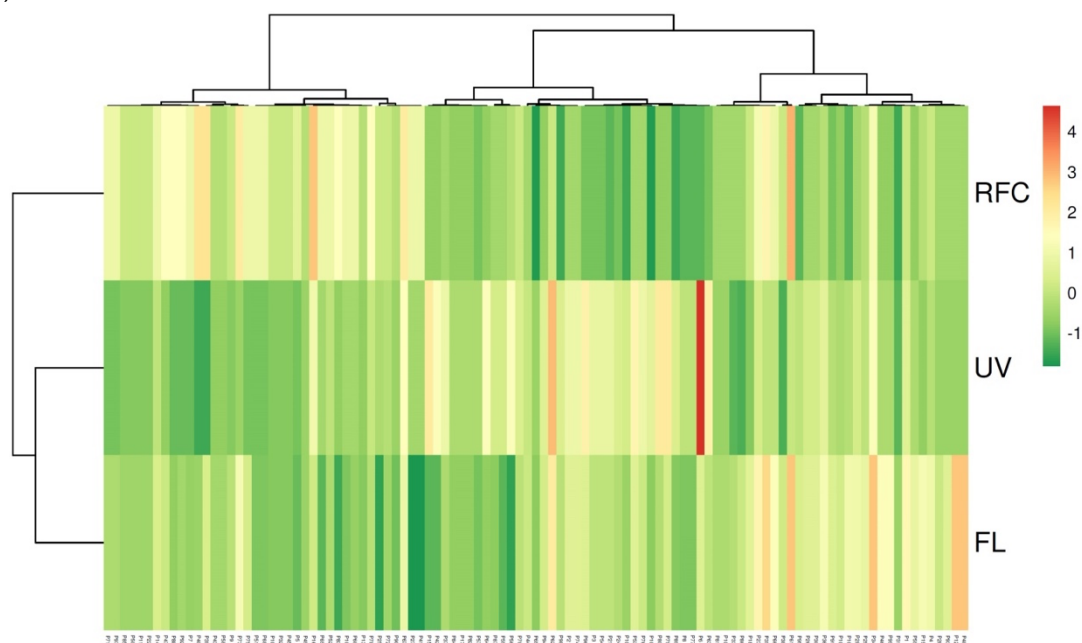


Figure 6. Heatmap analysis of studied plants on the basis of various quantitative ethnobotanical indices (RFC= Relative Frequency of Citation; UV= Use Value; FL= Fidelity Level)

Phytochemicals, Synthetic drugs and their targets

In the present study phytochemicals and targets of the three most popular plants namely *Cuscuta reflexa*, *Heliotropium indicum*, and *Cynodon dactylon*, were obtained. These plants were cited by informants for Dysmenorrhea, Cataracts, and Jaundice respectively. From *Cuscuta reflexa*, 118 protein targets were documented from 29 phytoconstituents. Similarly, 82 protein targets from 69 phytochemicals and 128 protein targets from 31 phytochemicals were obtained from *Heliotropium indicum* and *Cynodon dactylon* respectively (Fig. 7). Mining of

synthetic drugs and drug targets was executed for three disease categories viz. Dysmenorrhea, Cataracts, and Jaundice. For Dysmenorrhea, 93 human targets were obtained from 16 synthetic drugs. In the case of Cataract, 297 targets were mined from 15 synthetic drugs and in jaundice 318 unique targets were collected from 32 synthetic drugs. Only approved synthetic drugs were incorporated for the current study, and experimental, investigational, and withdrawn drugs were screened out. The detailed data files are provided in Supplementary File 1 (for *Cuscuta reflexa*), 2 (for *Heliotropium indicum*), and 3 (for *Cynodon dactylon*).

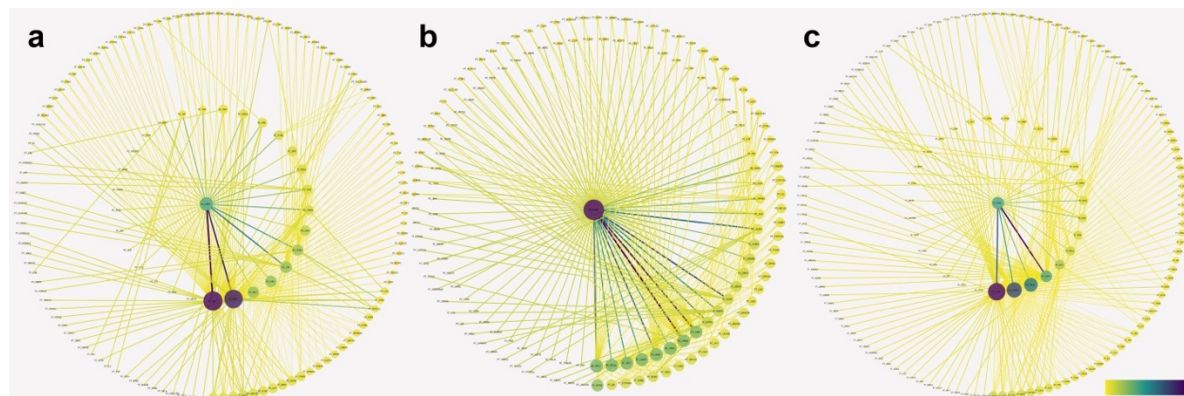


Figure 7. Plant-phytochemical-protein interaction network, where central node denotes the plant, middle nodes denote the phytoconstituents and the outer nodes denote the protein targets. a. *Cuscuta reflexa*-phytochemical-protein interaction network (*Cuscuta reflexa*- PL_CREF), b. *Heliotropium indicum*-phytochemical-protein interaction network (*Heliotropium indicum*- PL_HIND), c. *Cynodon dactylon*-phytochemical-protein interaction network (*Cynodon dactylon*- PL_CDAC) (Here PL, PC and PT refers Plant, Phytochemicals and Plant target respectively)

Network construction and analysis

Two networks each were constructed for all three plant-disease categories. In the case of *Cuscuta reflexa*, 10 targets (ABCB1, ABCG2, ALOX5, CA2, CYP1A2, NEU1, PDE5A, PTGS2, RPS6KA3, and SLCO1B1) which were common in both phytochemical and synthetic drug targets were obtained from a set of phytochemicals as well as synthetic drugs. Acetylsalicylic acid, Celecoxib, and Naproxen were the most potent synthetic drugs, whereas Kaempferol, Quercetin, and Hyperoside were the potent phytoconstituents that act against dysmenorrheal targets (Supplementary File 1). In the disease category, Cataract, among 10 promising phytochemicals of *Heliotropium indicum*, three of them namely (2S,3R)-((1R,7aS)-hexahydro-1H-pyrrolizin-1-yl)methyl 2,3-dihydroxy-2-isopropylbutanoate, (2S)-7-hydroxyflavanone and Naringenin 5-methyl ether were the most potent. Here 10 targets likely ACHE, CHRM1, CHRM3, CHRM4, CYP1B1, CYP17A1, PTGS1, ABCG2, AKR1C3, and GRIN1, appeared to be the common targets from both phytochemicals and synthetic drug targets (Supplementary File 2). Acetylcholine, Carbamoylcholine, and Dexamethasone were the most persuasive synthetic drugs. According to informants and herbal healers, *Cynodon dactylon* acts well against jaundice. Here 13 common human protein targets were obtained viz. ABCB1, ABCG2, CA12, CA2, CA7, CYP1A1, CYP1A2, CYP1B1, DPP4, F2, LCK, PTGS2, and TTR (Fig 8) (Supplementary File 3). Here Tricin, Apigenin, and Luteolin were found to be the most potent phytochemicals and Zinc chloride, Ketoconazole, and Nintedanib appear to be the most potent synthetic drugs.

Discussion

The greater parts of informants were males (69.83%), followed by female informants (30.16%). Study reports by Mir *et al.* (2022) also showed similar results. The majority of respondents (35.19%) were between the ages of 51 and 60, followed by those over 60 (27.37%), 41-50 years (20.11%), 31-40 years (12.29%), and 20-30 years (5.02%), in that order. In the current study, it was observed that older individuals possess a large proportion of ethnic knowledge than young people due to their yearlong ethnic practice and infield experience. Similar observations were also found in the research of other workers (De Almeida *et al.* 2010; Rana *et al.* 2019; Khoja *et al.* 2022). A major fraction of these informants were elementary or primary education recipients (38.54%), followed by a large percentage of illiterate persons (26.25%). A fair number of informants were upper primary education recipients, followed by a comparatively smaller percentage of people who hold a secondary (6.70%), higher secondary (5.02%), and a graduation degree (2.79%).

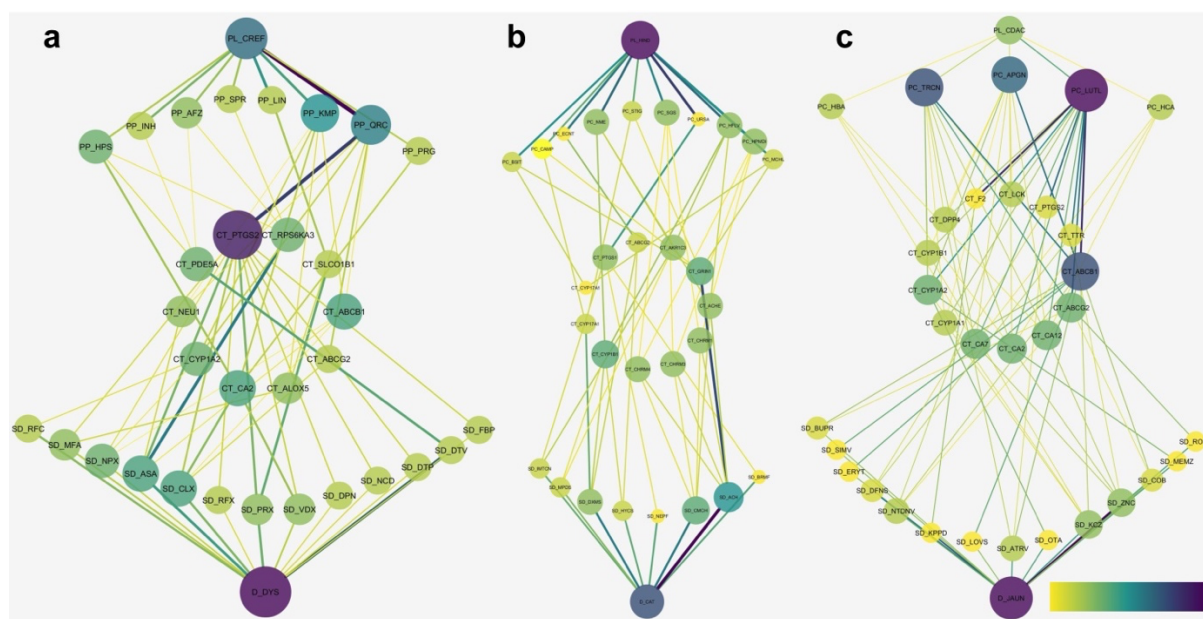


Figure 8. Interrelation between bioactives from medicinal plants and synthetic drugs against each set of reported diseases over some common protein targets, A. *Cuscuta reflexa*-Phytochemicals-Synthetic Drugs-Dysmenorrhea network (*Cuscuta reflexa*- PL_CREF; Dysmenorrhea- D_DYS), B. *Heliotropium indicum*-Phytochemicals-Synthetic Drugs-Cataract network (*Heliotropium indicum*- PL_HIND; Cataract- D_CAT), C. *Cynodon dactylon*-Phytochemicals-Synthetic Drugs-Jaundice network (*Cynodon dactylon*- PL_CDAC; Jaundice- D_JAUN). (Here PL, CT, SD and D refers Plant, Common Target, Synthetic Drug and Disease respectively)

Illiterate and comparatively less educated people in this area shared more information. They were small-scale farmers or daily wage workers who could not afford modern medicines and hence relied completely on their age-old traditional knowledge and herbal practices. There was a lack of ethnomedicinal as well as ethnic knowledge observed in the comparatively educated inhabitants. It was probably due to their changing behaviors and faded belief in traditional healing practices.

Due to the presence of rich and varied bioactive components (Wink 2013), plants belonging to the family Fabaceae were the most utilized in traditional herbal therapies. Other researchers from neighboring geographic regions (Ahirwar 2022; Ullah *et al.* 2014; Khan *et al.* 2015; Faruque *et al.* 2018) also found Fabaceae to be the most dominant plant family, whereas several previous researchers from different regions of the globe found Asteraceae as the most used plant family (Bano *et al.* 2014). Moraceae was reported as the dominant family in a study in the northern Terai part of West Bengal (Raj *et al.* 2018). Previous works in this area also documented the individuals of Fabaceae as the first choice for the herbal healers as well as the indigenous communities in the study area (Das & Chakraborty 2019). These reports support the abundance of this family in the sacred groves of Dakshin Dinajpur district. Herbs were predominantly used in this study area due to their comparatively easy collection and preparation procedure and frequent availability. Similar statements were also drawn by several other workers from different places (Shrestha *et al.* 2003; Kayani *et al.* 2015). The use of perennial plants over annual or biennial herbs was observed during the study. It might be because perennial plants live for a longer period than the other forms, and therefore these could be available throughout the year.

Indigenous people utilize different plant parts for curing different types of illnesses (Hosseini *et al.* 2021). According to local indigenous people, different parts of a plant are often used to cure different types of ailments. For example, roots of *Caesalpinia bonduc* (L.) Roxb. is used to treat malaria and irregular menstrual cycle problems whereas seeds and leaves are used to treat diabetes and eczema, respectively. The leaf part was the most utilized plant part in the present study. Previous studies in this area showed similar results (Chowdhury *et al.* 2014), whereas several other researchers found the 'root' as the most utilized part (Saikia 2006; Teklehaymanot & Giday 2010). Many other researchers who worked in this field (Faruque *et al.* 2018; Rana *et al.* 2019; Basualdo *et al.* 1995; Singh *et al.* 2018; Umair *et al.* 2017) also found the leaf to be the most utilized plant part. In most herbal preparations, leaves are frequently used due to the presence of various bioactive compounds and secondary metabolites (Kayani *et al.* 2015). Besides, leaves are predominantly used because of the conservation purpose of plants, as the collection of whole plants or roots could restrict the plant colony and push it into endangered conditions (Khan *et al.* 2015;

Ghorbani *et al.* 2011; Kadir *et al.* 2012). Here, the most frequent mode of preparation of herbal medicines was extraction and decoction. The extract is the simplest way to consume and prepare herbal medicine hence it was most preferred, and the decoction method is very popular in brewing herbal medicine. Various researchers have documented these methods as the most preferable (Gurdal & Kultur 2012; Bibi *et al.* 2015). Besides, different modes of application including internal and external applications or consumptions were also documented during the study. Oral consumption was the most common, as it is the easiest way of obtaining medicine.

The ICF values acquired for different ailment categories indicate the level of knowledge shared by the informants concerning the use of ethnomedicinal plants in the treatment of disease (Cakilcioglu *et al.* 2011). Sexual and gynecological disorders obtained the highest ICF value. A former population-based cross-sectional study revealed that women living in the rural part of India have a high chance of gynecological disorders (Bang *et al.* 1989). It might be because women in rural areas may have limited access to education and information about reproductive health, leading to a lack of knowledge about safe sex practices and contraception. They may also have limited autonomy in decision-making about their reproductive health and may face pressure to engage in early marriage, early childbirth, and multiple pregnancies, all of which increase the risk of gynecological disorders. Besides, medical resources were scarce as well as doctors with whom they could consult. Hence, they were largely dependent on herbal medicines obtained from the plants of the sacred groves. *Cuscuta reflexa* Roxb. is frequently used to treat dysmenorrhea. It was also documented in an earlier study (Roy *et al.* 2017) conducted in the Terai and Duars regions of West Bengal. *Mucuna pruriens* (L.) DC is widely used in various sexual disorders. In a previous study in India (Singh *et al.* 2018), liver disorders were reported with the highest ICF value. In the present study, *Cynodon dactylon* (L.) Pers. is predominantly used against jaundice along with *Abrus precatorius* L., *Achyranthes aspera* L., and *Diospyros malabarica* (Desr.) Kostel. To season the fishing nets, fruits of *Diospyros malabarica* (Desr.) Kostel. are also used by indigenous communities. Some researchers from neighboring countries (Faruque *et al.* 2018; Umair *et al.* 2017; Yaseen 2015) reported gastrointestinal diseases with the highest ICF values. Gastrointestinal problems are a major issue in rural parts of the Indian subcontinent (Mutheeswaran *et al.* 2021). This might be due to the hot and humid weather and the rich oily, and spicy food habits of the inhabitants. *Ichnocarpus frutescens* (L.) W.T. Aiton, *Digitaria ciliaris* (Retz.) Koehler. and *Amaranthus spinosus* were used in the treatment of diarrhea and dysentery, along with widely known *Mangifera indica* L. (Tchoumba Tchoumi *et al.* 2021) and *Psidium guajava* L. (Hirudkar *et al.* 2020). In addition to this, a large number of plants (45 plants) were recorded, which were used in various dermatological ailments. Along with common plants like Jaat neem (*Azadirachta indica* A.Juss.) and Ghorneem (*Melia azedarach* L.), some unusual plants such as *Ageratum conyzoides* L., *Lantana camara* L., *Senna tora* (L.) Roxb. and *Solanum virginianum* L. have also been documented, which are used against ringworm and eczema. *Ziziphus jujuba* Mill. was also reported for the treatment of scabies (Alsayari & Wahab 2021). Medicinal herbs that are extensively used by the local indigenous people have a higher Fidelity Level than those plants that are not as much of popular (Khan *et al.* 2015). Plants with higher Fidelity levels are the first choice of herbal medicine for treating a particular disease (Rajakumar & Shivanna 2009; Islam *et al.* 2014). One such plant is *Heliotropium indicum* L., which is commonly used to treat cataracts. Kyei *et al.* (2016) supported it by stating that *Heliotropium indicum* L. can be used to delay galactose-induced cataracts. The network pharmacological study of *Cuscuta reflexa* Roxb., *Heliotropium indicum* L., and *Cynodon dactylon* (L.) Pers. highlights the potential of traditional medicinal plants as a source of natural compounds with therapeutic potential. By utilizing advanced computational tools, the study was able to identify the specific phytochemicals within these plants that target human proteins. From the above study it was observed that the ethnomedicinal information given by the local indigenous people was found to be correct, as the *in-silico* study revealed that these plants contain such phytochemicals that target human proteins against those diseases, the same as the synthetic drugs. Further phytochemical, as well as pharmacological, approaches are required to justify these findings.

However, when the current study's medicinal plant data were compared to previously published reports in this study area (Mitra & Mukherjee 2010; Talukdar & Talukdar 2012; Chowdhury *et al.* 2014; Das & Chakraborty 2019; Kundu & Bag 2012; Sur *et al.* 1990), it was discovered that ethnomedicinal data for 57 new plants were recorded (Table 6). Also, among the common plants that have been studied previously, several new pieces of information have been documented in the present study. Besides, several unique medicinal plants with new therapeutic uses have been documented in this study. Rhizomes of *Lygodium flexuosum* (L.) Sw. is used in the treatment of poisonous snake bites. It is the first report of this plant for the said ailment category. *Tiliacora acuminata* (Lam.) Hook. f. & Thoms., a sacred grove-specific woody climber, has also been recorded and is used to treat wounds and snake bites.

Table 6. Comparative analysis of common ethnomedicinal plants with the previously published works in Dakshin Dinajpur district

Plant Name	Previous Study/Studies	Present Study
<i>Abroma augusta</i> (L.) L.f	The plant cures leucorrhea. A paste of root bark and two peppers is prepared and given thrice daily for three months to a woman who fails to conceive. (Sur et al., 1990). Young petiole cut into small pieces and kept in a glass of water for overnight and infusion is used at early morning in empty stomach to cure "Meho" (gonorrhea) and physical weakness (Chowdhury et al., 2014). Leaf and bark reduces blood sugar, kidney/urinary tract infection, reduces urine sugar, male sterility, sexual diseases of female (Das and Chakraborty, 2019).	Root decoction used to cure leucorrhea, consumption of root powder with lukewarm milk used to lessen dysmenorrheal pain, leaf decoction used to cure, irregular menstrual cycle, leaf extract used in gonorrhea.
<i>Abrus precatorius</i> L.	Seed powder in induction of abortion, paste in arthritis (Talukdar and Talukdar, 2012). Fresh root decoction used for "Meho" (gonorrhea) and jaundice (Chowdhury et al., 2014).	Root decoction used to treat jaundice; leaf extract used in dog bite and wound healing, seed powder used to cure gonorrhea.
<i>Achyranthes aspera</i> L.	A paste prepared with lime (kalichun) and leaf of non-flowering plants is applied to cure eczema. (Sur et al., 1990) Paste made of leaves in case of Apang and in paste out of green leaves from Bot. Then it is applied on boil (Kundu and Bag, 2012). Root infusion is used for malarial fever, induction of abortion, prevention of post abortion bleeding, leaf extract facilitate delivery, also used in bronchitis (Talukdar and Talukdar, 2012). Joining of bones, rheumatism reduces urine sugar, male sterility, piles, menstrual problem, urinary tract infection (Das and Chakraborty, 2019). Stem and root (2-3 piece) decoction mixed with "Ada" (<i>Zingiber officinale</i>) is used in jaundice (Chowdhury et al., 2014).	Root extract of <i>Achyranthes aspera</i> with banana (<i>Musa paradisiaca</i>) leaf extract used to cure jaundice, root decoction used in leucorrhea, leaf paste in dog bite.
<i>Aegle marmelos</i> (L.) Correa	Raw fruits used against constipation and extreme sun heat (Talukdar and Talukdar, 2012).	Leaf extract mixed with fruit powder with ice cold water used to cure dysentery and diarrhea, raw fruit extract used in stomach ulcer and stomachache, leaf extract with

	Reduces blood sugar, dysentery, stomach/liver problem (Das and Chakraborty, 2019). One teaspoonful of young, dried fruit powder mixed with water is given at early morning in empty stomach to cure dysentery and gastric problems (Chowdhury et al., 2014).	honey used in cough, root extract with goat milk used in the treatment of stroke, sometimes root extract at nighttime used for better lactation.
<i>Ageratum conyzoides</i> L.	Plant paste used in sores, cut and various ailments (Talukdar and Talukdar, 2012).	Leaf paste used in the treatment of ringworm and applied on wounds as an antiseptic.
<i>Alstonia scholaris</i> (L.) R.Br.	Bark reduces urine sugar, male sterility (Das and Chakraborty, 2019). Stem bark paste applied on breast for better lactation (Chowdhury et al., 2014).	Stem and bark decoction used to cure severe fever, root powder with lukewarm water at night used in neurological problems
<i>Amaranthus spinosus</i> L.	Whole plant and leaf reduces urine sugar, male sterility (Das and Chakraborty, 2019).	Root decoction used to treat Dysentery and diarrhea
<i>Andrographis paniculata</i> (Burm.f.) Nees	Used in treating worm infection, antidiabetic, indigestion (Talukdar and Talukdar, 2012). Leaf and whole plant used in fever, worm, stomach/liver problem (Das and Chakraborty, 2019). Leaf decoction used for cold and cough, diabetes and leaf paste applied on hair before 30 minutes of bath to control dandruff (Chowdhury et al., 2014).	Leaf extract used as anthelmintic tonic, it is also used in dysentery.
<i>Azadirachta indica</i> A.Juss.	Used as insecticidal, preventive of chicken pox, anti-diabetic, dried leaf powder used on skin as paste (antiseptic), root paste in treating syphilis (Talukdar and Talukdar, 2012). Stem bark and leaves boiled with water and applied on carbuncle, boil and skin diseases for quick healing (Chowdhury et al., 2014).	Leaf extract twice a day for chicken pox, measles and as an anthelmintic tonic; leaf decoction on empty stomach used in diabetes, stem decoction with <i>Ada</i> (<i>Zingiber officinale</i>) used in the treatment of Malaria; brushing with raw twig in case of toothache; leaf extract and boiled water with leaf used to treat measles, scabies, ringworm and as an anti-fungal lotion.
<i>Blumea lacera</i> (Burm.f.) DC.	Stomach/liver problem, loss of appetite (Das and Chakraborty, 2019). Root (2-3 pieces) decoction mixed with "Ada" (<i>Zingiber officinale</i>) and pinch of salt is given to cure flatulence and indigestion problem (Chowdhury et al., 2014).	Leaf extract used to purify blood and in neurological disorder.
<i>Boerhavia diffusa</i> L.	A paste is made with about 1 gm of root, a little ginger and two peppers. It is taken for 7 days once in the morning to cure asthma (Sur et al., 1990).	Root extract used as rejuvenating tonic; root decoction with coconut (<i>Cocos nucifera</i>) oil used as anti-ageing lotion.

	<p>Plant infusion is used in asthma and bronchitis. Leaf extract in eye complaints, root is chewed as energy tonic (Talukdar and Talukdar, 2012).</p> <p>Leaf used in rheumatism, urinary tract infection (Das and Chakraborty, 2019).</p> <p>Whole plant decoction is given to cure burning sensation during urination (Chowdhury et al., 2014).</p>	
<i>Bombax ceiba</i> L.	<p>The root is taken with sugar in empty stomach in the morning for 7 days to cure spermatorrhoea (Sur et al., 1990).</p> <p>Fresh root (1-2 years old plant) used in "Meho" (gonorrhea) and physical weakness (Chowdhury et al., 2014).</p>	Bark paste applied to cure acne; root extract with garlic (<i>Alium sativum</i>) used to cure leucorrhea.
<i>Borassus flabellifer</i> L.	<p>Fresh root decoction mixed with the roots of <i>Achyranthes aspera</i> are boiled and gargle to cure toothache (Chowdhury et al., 2014).</p>	Raw fruit extract used in the treatment of diarrhea and dysentery.
<i>Calotropis gigantea</i> (L.) Dryand	<p>A leaf warm with "Ghee" is applied to relief from paralysis, rheumatism and body pain (Chowdhury et al., 2014).</p>	Leaf extract is used to cure severe fever, it is also applied o wounds for rapid healing; Leaf latex applied on attacked area followed by hot water treatment as a cure of swollen joint.
<i>Centella asiatica</i> (L.) Urb.	<p>It is used in amoebic dysentery (Sur et al., 1990).</p> <p>Fresh leaves (5-6) chewed at early morning preferably in empty stomach to control diabetes, chronic dysentery, blood stool and diarrhea (Chowdhury et al., 2014).</p>	Leaf paste used to treat ulcer; leaf decoction used in gastritis and dysentery.
<i>Coccinia grandis</i> (L.) Voigt	<p>Leaf used in treating diabetes (Talukdar and Talukdar, 2012).</p> <p>Fresh leaf juice is given to control diabetes, cold and cough.</p> <p>Decoction of leaf also applied on head to reduce the body temperature (Chowdhury et al., 2014).</p>	Leaf decoction used in the treatment of diabetes; it is also used in reducing high blood pressure; root decoction used to cure arthritis.
<i>Crotalaria pallida</i> Aiton	<p>There root pieces are tied with the help of thread in the head, neck, and lower abdomen respectively to cure swelling of the body (Sur et al., 1990).</p>	Root extract used in indigestion; seed decoction used to treat anemia.
<i>Croton bonplandianus</i> Baill.	<p>The latex of the plant is applied to check bleeding (Sur et al., 1990).</p> <p>Used in antiseptic, coagulant (Talukdar and Talukdar, 2012).</p> <p>Latex of the plant used to stop bleeding from cuts and wounds (Chowdhury et al., 2014).</p>	Leaf extract used as an eye drop for reddish eye; it is also used in wound healing.

<i>Cuscuta reflexa</i> Roxb	Plant juice mixed with 50 g of <i>Polygonum</i> sp. (Bishkatal) and 3 peppers is given for abortion (Sur et al., 1990). Whole plant decoction intake in empty stomach to cure "Meho" (gonorrhea) (Chowdhury et al., 2014).	Oil decoction of whole plant used in wound healing; decoction used as anthelmintic tonic; extract is commonly taken to get relief from dysmenorrheal pain; seed powder used in the treatment of jaundice, gastritis and mouth ulcer; it is also used as appetizer.
<i>Cynodon dactylon</i> (L.) Pers.	Decoction of root is diuretic and used in secondary syphilis. The plant juice is astringent and used in hysteria, epilepsy, fever, insanity, chronic diarrhea, dysentery, ophthalmic and in injury (Talukdar and Talukdar, 2012). Whole plant chewed and the paste applied on cuts and wounds for stop bleeding. Fresh plant decoction mixed with one slice of <i>Curcuma longa</i> is given to cure leucorrhea and infertility (Chowdhury et al., 2014).	Rhizome extract is most commonly used to cure jaundice; whole plant paste used to heal wounds; whole plant extract used in the treatment of leucorrhea, menstrual bleeding and it is also helpful in baby conception.
<i>Datura metel</i> L.	Root juice is mixed with the decoction of 'Halud' and rubbed over the affected area to cure rheumatism (Sur et al., 1990). Leaf paste applied as massage balm to get relief from rheumatic pain (Chowdhury et al., 2014).	Leaf paste used to cure scabies; oil decoction of leaf applied in the treatment of rheumatic pain; fruit powder used to treat neurodegenerative diseases; it is also used as pain killer.
<i>Ficus racemosa</i> L.	Receptacle cooked as vegetable used in anemia and nutrition deficiency. (Talukdar and Talukdar, 2012)	Leaf extract applied on skin to prevent skin rashes; root decoction used in the treatment of stomach ulcer.
<i>Heliotropium indicum</i> L.	Leaf used in rheumatism, fever, typhoid, cold-cough (Das and Chakraborty, 2019). Root paste warm with mustard oil and massage to cure rheumatism (Chowdhury et al., 2014).	Leaf extract applied on eyes two drops/ twice a day to cure cataract, it is also consumed on empty stomach for gastritis.
<i>Leucas aspera</i> (Willd.) Link	Paste of young leaves when applied cures ringworm (Sur et al., 1990). Fresh root decoction given in empty stomach and taking smell of the plant used to treat asthma and tuberculosis (Chowdhury et al., 2014).	Flower extract infant dysentery; leaf extract with honey used to treat cough and cold; leaf extract on empty stomach used to treat diabetes; it is also used as an anthelmintic tonic.
<i>Mangifera indica</i> L.	Tender leaf decoction used for stomachache. Bark decoction mixed with lime water is given to cure dysentery and diarrhea (Chowdhury et al., 2014).	Leaf decoction used in the treatment of sore throat; whole leaf chewed in the treatment of toothache; leaf extract used to cure dysentery.
<i>Melia azedarach</i> L.	Leaf, bark, root bark, flower, fruit, seed reduces blood sugar, fever, contraception (Das and Chakraborty, 2019).	Leaf extract taken in the treatment of malaria, leaf paste used as antibacterial lotion, leaf paste applied to cure eczema; leaf

<i>Mimosa pudica</i> L.	<p>Root reduces blood sugar, stomach/liver problem, reduces urine sugar, male sterility, sexual diseases of female, menstrual problem (Das and Chakraborty, 2019).</p> <p>Fresh root boiled with water and used as gargle to cure toothache. Root decoction also used for leucorrhea and blood dysentery (Chowdhury et al., 2014).</p>	<p>decoction used in the treatment of headache and nervous problems. Root decoction commonly used in the treatment of menstrual problems; it is also used in dysentery.</p>
<i>Moringa oleifera</i> Lam.	<p>Leaf, fruit reduces blood sugar, rheumatism, cardiac problem (Das and Chakraborty, 2019).</p>	<p>Cooked fruit used as diuretic; leaf extract used to reduce high blood pressure; it is also used in the treatment of chicken pox and diabetes; flower extract used to cure jaundice and liver problems; root decoction used in the treatment of menstrual abnormalities.</p>
<i>Mucuna pruriens</i> (L.) DC	<p>Root, seed reduces urine sugar, male sterility, male sexual problem, sexual diseases of female, rheumatism (Das and Chakraborty, 2019).</p> <p>The seeds are fried with "Ghee" and sugar and make pills. Each pill taken during bedtime for sexual stimulant and vitality (Chowdhury et al., 2014).</p>	<p>Fruit extract used to cure bowel problems; seed powder commonly used to treat erectile dysfunction and low sperm count, it is used as libido booster; it is also used as diuretic; root extract with warm milk taken at bedtime to treat infertility, it is also applied to treat scabies; root decoction used to treat arthritis.</p>
<i>Murraya koenigii</i> (L.) Spreng.	<p>Fresh leaf decoction is given at early morning to control blood sugar (Chowdhury et al., 2014).</p>	<p>Leaf extract given at empty stomach to control diabetes; it is also used in indigestion; leaf extract with <i>Hibiscus</i> petals used as anti hair fall tonic; leaf decoction is used in the treatment of rheumatic pain.</p>
<i>Nyctanthes arbor-tristis</i> L.	<p>The seeds are powdered and mixed with coconut oil and kept in sunlight. When applied to the scalp, it prevents premature whitening of hairs (Sur et al., 1990). Stem bark and leaf decoction is given to control of remittent fever and blood sugar (Chowdhury et al., 2014).</p>	<p>Leaf extract on empty stomach used to cure fever; it is also used to treat diabetes; flower extract applied on eyes drop by drop to cure conjunctivitis; Bark decoction taken as a precaution of fetal growth.</p>
<i>Ocimum gratissimum</i> L.	<p>Leaf decoction mixed with a few drops of honey is given at early morning for come out of dry cough (Chowdhury et al., 2014).</p>	<p>Leaf extract used as diuretic, using leaf extract as eye drop is good for cataract, it is also used in the treatment of migraine pain; leaf decoction used to treat cough, cold, fever and sore throat; to cure pneumonia leaf decoction with honey is given; chewing whole leaf is good to rid of bad breathe.</p>

<i>Oroxylum indicum</i> (L.) Kurz	The root is applied to cure diseases of gum. (Sur et al.,1990)	Root decoction used in the treatment of kidney pain; root extract with honey used in cardiovascular diseases; fruit powder with cold water used to treat diarrhea.
<i>Oxalis corniculata</i> L.	Leaf juice used in cataract and conjunctivitis (Talukdar and Talukdar, 2012). Leaf decoction used to cure smokers cough (Chowdhury et al., 2014).	Leaf extract used to treat jaundice; leaf decoction used to cure diarrhea and dysentery; applying leaf paste and chewing whole leaf is good for scurvy.
<i>Piper longum</i> L.	Whole plant cooked as vegetable is given after childbirth for better lactation and relief from birth pain (Chowdhury et al., 2014). Root, stem, fruit Reduces blood sugar, menstrual pain, colic pain, cold-cough (Das and Chakraborty, 2019).	Fruit powder with lukewarm water used to cure asthma; same medication also used in fever; fruit powder with warm milk used in the treatment of menstrual pain; Whole plant extract taken twice a day for better lactation.
<i>Phyllanthus emblica</i> L.	Infusion of dried fruits useful in acidity, constipation, insomnia and also in diabetes (Chowdhury et al., 2014). Dried fruit and seed used in acidity, blood sugar, purging, leucorrhea, biliary colic, insomnia (Das and Chakraborty, 2019).	Fruit powder with cold water used in the treatment of gastrointestinal disorders, fruit extract used to treat scurvy; whole fruit used as appetizer; leaf extract used against ringworm.
<i>Psidium guajava</i> L.	Tender leaves (2-3) chewed to cure mouth ulcer, pyorrhea, bad breath and sluggish fever. Stem bark infusion mixed with lime water used to cure diarrhea and dysentery (Chowdhury et al., 2014).	Leaf extract is very useful in diarrhea and decoction in dysentery; chewing whole leaf to cure pyorrhea and toothache; brushing with stem twig to get rid of bad breath.
<i>Scoparia dulcis</i> L.	The plant is used to cure gonorrhea (Sur et al.,1990). Leaf and plant body reduces blood sugar, anti-inflammatory, sore throat, cough (Das and Chakraborty, 2019). Fresh leaves decoction is given at early morning to cure dysentery (Chowdhury et al., 2014).	Leaf paste with <i>Cajanus cajan</i> leaf used to cure jaundice; leaf decoction used in the treatment of diabetes.
<i>Sida rhombifolia</i> L.	Root is burnt and mixed with powdered hoofs of dead cattle and used for curing wound in the shoulder of the cattle. The decoction of the root bark is applied to cure eczema. (Sur et al.,1990)	Root paste used in wound healing; root decoction used in the treatment of cardiovascular pain.
<i>Solanum nigrum</i> L.	Root mixed with pepper and ginger is fed to cows to reduce gas formation in the stomach. (Sur et al.,1990)	Leaf extract, decoction used in the treatment of cough and cold; fruit extract used in gastric ulcer.
<i>Solanum torvum</i> Sw.	Ripe fruit or root decoction is added to mustard oil and boiled. It	Fruit extract used in the treatment of high blood pressure and diabetes.

	is applied to cure boils (Sur et al., 1990).	
<i>Solanum virginianum</i> L.	Root used in cold-cough, rheumatism, fever, influenza, enlargement of liver and spleen (Das and Chakraborty, 2019). Mature fruits crushed with "Golmarich" (<i>Piper nigrum</i>) and make paste, which is used as massage to reduce pain, swelling of arthritis and paralysis (Chowdhury et al., 2014).	Root decoction used as painkiller; application of leaf paste for curing eczema.
<i>Stephania japonica</i> (Thunb.) Miers	Fresh leaf applied on carbuncle or boil for rupture and relief from pain (Chowdhury et al., 2014).	Root decoction used in the treatment of asthma. It is also used in fever.
<i>Syzygium cumini</i> (L.) Skeels	Fresh leaf decoction mixed with pinch of table salt is given in empty stomach to control dysentery (Chowdhury et al., 2014).	Raw fruit eaten for blood purification; leaf extract used to cure dysentery; seed powder used in the treatment of diabetes.
<i>Tamarindus indica</i> L.	Leaves and fruits used as cooling agents, helps in digestion and rehydration. (Talukdar and Talukdar, 2012) Leaf, bark, fruit and seed reduces blood sugar, dysentery, stomach/liver problem, pox, rheumatism (Das and Chakraborty, 2019).	Fruit used in cold-fever; root decoction used to treat constipation.
<i>Tinospora sinensis</i> (Lour.) Merr.	Aqueous root extract used in treating fever (Talukdar and Talukdar, 2012). Branch used in stomach/liver problem, jaundice, loss of appetite, fever, rheumatism, gall bladder infection, blood purifier (Das and Chakraborty, 2019). Stem (1.5 kg) boiled with water (3 lit) and make into 1 lit from there half cup of mixture is given daily in empty stomach to control blood sugar, cholesterol and physical weakness (Chowdhury et al., 2014)	Stem decoction in empty stomach for the treatment of diabetes and cholesterol.
<i>Tragia involucrata</i> L.	Root and fruit used in stomach/liver problem, rheumatism, irregular stool, asthma (Das and Chakraborty, 2019).	Leaf extract used in the treatment of high blood pressure; leaf decoction with goat milk used for better lactation.
<i>Trema orientalis</i> (L.) Blume	The leaf is burnt, and the ash is mixed with mustard oil and applied to cure scabies. (Sur et al., 1990) Root decoction used in menorrhagia. (Talukdar and Talukdar, 2012)	Leaf decoction used to treat fever and body pain.

Among all the good things, it is a matter of concern that, many sacred groves with higher natural resources are under threat due to excessive anthropogenic activities and over-exploitation of natural resources, as a result of which medicinal plants are disappearing in a vigorous manner (Savithramma *et al.* 2013). Therefore, it should be our objective to draw the kind attention of the local and indigenous communities as well as the concerned authorities to protect these abodes to nurture nature. It is important to publish and propagate the sacred biodiversity, traditional forests, and wetlands of all regions of the country where all communities have their folklore practices, and the current state of biodiversity will be registered subject to the prior permission and consent of the community.

Conclusion

The current study depicted that the indigenous people of this district still believe in the healing power of nature and believe in the infallible herbal gift of nature, i.e., the plants. Sacred groves here act as a repository of such valuable gifts, as well as a storehouse of herbal medicines. They are like a haven for these medicinally important plants. A sustainable system grew up around these groves where nature and humankind dissolve like a homologous solution in a symbiotic manner. The survey also showed that the local Rajbanshi and ethnic people of the study area possess vast knowledge in the ethnobotanical field and rely on their knowing for curing various ailments. Study reports of previous workers (Das & Chakraborty 2019) also supported this statement. We gathered several such data on plant-based healing sources and formulations and tried to quantify the societal importance of each plant with the help of various statistical indices. In this study, we tried to convert the raw ethnomedicinal knowledge of informants to scientific data that can play a pivotal role in finding new drugs or bioactive compounds of interest as well as to draw the kind attention of the concerned authorities to protect repositories of these valuable assets, the sacred groves. There are still a lot of protected and unexplored sacred groves in all corners of the district which is very important for finding and conserving various ethnomedicinal resources present in them. We have to find, document and protect them for us, for mankind.

Declarations

List of abbreviations: ICF- Informant Consensus Factor, UV- Use value, FC= Frequency of Citation, RFC= Relative Frequency of Citation, FL= Fidelity Level, THP= Traditional Health Practitioner, BMC= Biodiversity Management Committees

Ethics approval and consent to participate: Prior oral consent was taken from the communities conserving sacred groves and every single informant. The study was carried out maintaining the scientific sanctity and without harming any plant or animal or destroying the natural plant resources of the sacred groves.

Consent for publication: Prior consent was taken from all the informants during the present study and ethnomedicinal survey was carried out with only the participants who were willing to share their ethnic knowledge. All participants shown in images agreed to have their image published.

Availability of data and materials: Information or data related to this study may be availed upon reasonable request.

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

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Author Contribution: KS: Writing - Original Draft, Investigation, Methodology, Software, PR: Investigation SP: Validation, Formal analysis, CC: Writing- Reviewing and Editing, MC: Conceptualization, Supervision

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