Ethnobotanical study of the medicinal plants used by rural and peri-urban communities along the bank of River *Ganga* extending from *Katwa* to *Kalna*, *Purba Bardhaman*, West Bengal, India

Saikat Mondal, Suvendu Pal, Arindam Ganguly, Samir Kumar Mukherjee

Correspondence

Saikat Mondal[1], Suvendu Pal[1], Arindam Ganguly[2*], Samir Kumar Mukherjee[3*]

[1]Department of Botany, Bankura University, Bankura, Pin: 722155, West Bengal, India
[2]Department of Microbiology, Bankura Sammilani College, Bankura, PIN: 722102, W.B., India
[3]Department of Botany, Bankura Sammilani College, Bankura, PIN: 722102, W.B., India

*Corresponding Authors: arindam_ganguly@yahoo.com; mukherjeedrsamirkumar@gmail.com

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Research

Abstract

Background: India, recognized as a mega-diverse country, has been a reservoir of ethnomedicinal knowledge since ancient times. Rural and tribal communities possess a deep understanding of local flora, which they utilize in traditional healing practices. Given the high cost and side effects of conventional medicines, a large section of the population still depends on traditional phytomedicines. The present study aimed to document the indigenous knowledge of ethno-medicinal plants used by the people residing along the banks of the River Ganga in West Bengal, India.

Methods: An ethnobotanical survey was conducted from May 2024 to April 2025. Data were collected through interviews, field observations, and group discussions with 180 informants. The collected information was analyzed using ethnobotanical indices, including Frequency of Citation (FC), Relative Frequency of Citation (RFC), and Fidelity Level (FL), to assess the cultural importance and usage consistency of the reported species.

Results: A total of 72 plant species belonging to 32 families were documented, with Fabaceae emerging as the most dominant family. *Centella asiatica* and *Hibiscus rosa-sinensis* showed the highest FC and RFC values, while *Aloe vera* exhibited the highest FL value. The most common ailments treated by these plants included digestive disorders, skin diseases, joint pain, diabetes, cold, cough, fever, and respiratory problems.

Conclusions: The rich ethnobotanical heritage of communities along the Ganga River and provides a valuable inventory of traditional herbal knowledge. Plants with high ethnobotanical index values hold promise as potential sources of novel alternative drugs. Urgent measures are required to conserve these threatened species.

Keywords: Ethnobotany, Indigenous knowledge, Ethnomedicine, Ailments, Quantitative ethnobotany.

Background

Ethnobotany, the study of the relationship between people and plants, plays a crucial role in preserving traditional knowledge related to medicinal plants (Nad *et al.* 2021). Herbal knowledge has been an integral part of human survival and well-being for centuries, particularly in rural and indigenous communities where access to modern healthcare may be limited (Nad *et al.* 2024). In India, where over 70% of the population still relies on traditional medicine, ethnobotanical knowledge is invaluable for treating a wide range of ailments, from minor cuts to chronic diseases (Sharma *et al.* 2018). Herbal medicine often utilizes locally available plants for the treatment of a wide range of ailments from common digestive disorders to different chronic diseases (Sinha *et al.* 2024). In many societies, traditional healers or "*Vaidyas*" in the Indian context, pass down the wisdom of medicinal plants through oral traditions, thus ensuring the continuity of this valuable knowledge (Rastogi & Shukla, 2015). The oral transmission of ethnic knowledge may lose with the time. The decline of traditional knowledge is a significant concern in the study of ethnobotany. So, it is he very essential to conserve and restore the valuable knowledge.

The River Ganga, a revered and sacred entity in India, has been central to the cultural and spiritual practices of the people living along its banks. For centuries, local communities in the *Purba Bardhaman* district, West Bengal, India have developed an intimate knowledge of the plants growing along the riverbank, which they use in traditional healing practices. These plants are not only valued for their medicinal properties but also hold cultural significance as they are tied to the customs and rituals of the communities (Saha *et al.* 2020). The rapid pace of modernization and the encroachment of urbanization along the Ganga River have led to the erosion of the knowledge systems that have been passed down through generations. The younger population is increasingly disconnected from traditional healing practices, and this knowledge is at risk of being lost forever (Gupta *et al.* 2016). Additionally, the encroachment on natural habitats and the loss of biodiversity threatens the very plants that have been used for centuries in the region. Thus, there is an urgent need to document and conserve the ethno-botanical knowledge of local communities along the River Ganga. The documentation of such knowledge has become increasingly important as modernization and urbanization threaten to diminish this traditional wisdom. A major concern is the loss of biodiversity and the decline of culturally significant plant species, making the preservation of ethnobotanical knowledge vital not only for health but also for cultural continuity (Roy *et al.* 2015). This makes ethnobotanical studies especially pertinent in the context of the Ganga River basin, where plant biodiversity is closely linked with the traditional knowledge of the local communities.

Several studies have documented the role of traditional herbal practices in various regions of India. Research by Jain (2014) and Mahato *et al.* (2019) highlights the extensive use of medicinal plants in states like Rajasthan and Odisha, where indigenous knowledge systems are rich and well-preserved. In West Bengal, herbal medicine plays a similar role, with local plants being used in a variety of traditional healing practices. The diversity of plant species in the region, especially along the riverbanks, is crucial for the local population's health needs (Chowdhury *et al.* 2017). In regions like the Sundarbans of West Bengal, ethnobotanical research has provided valuable insights into how local communities rely on the biodiversity of the river delta to meet their health and medicinal needs (Biswas *et al.* 2016). Traditional phytoremedies have been employed for centuries to alleviate various menstrual disorders (Ganguly *et al.* 2024). Such studies emphasize the importance of plants found in riverine ecosystems, particularly in areas with seasonal flooding, where plant species evolve to adapt to changing environments (Chattaraj *et al.* 2025a; Chattaraj *et al.* 2025b). In *Purba Bardhaman*, whereas the Ganga River flows through fertile agricultural plains, local knowledge of plant species is often intertwined with agricultural practices. Research by Chakraborty (2018) highlighted the diversity of plant species in this region, some of which are used for medicinal purposes by the local population. Mondal & Rahaman (2012) conducted a survey of certain medicinal plants used by tribal people of *Birbhum* district of West Bengal and *Dumka* district of Jharkhand. A study by Saha *et al.* (2020) conducted research in neighbouring areas of *Purba Bardhaman*, identifying common medicinal plants but acknowledging the lack of detailed studies on local plant use along the riverbanks of the Ganga.

While ethnobotanical studies have been conducted in various regions of West Bengal, there is a lack of focused research on the plant species used by local communities along the Ganga River from *Katwa* to *Kalna*. The absence of such focused research leaves a significant gap in understanding how local communities in this area use plant species for medicinal purposes, as well as how traditional knowledge is passed down. Additionally, the socio-cultural context and the community dynamics of local healers have not been extensively studied in the *Katwa-Kalna* region. Filling this gap is crucial not only for preserving the local medicinal heritage but also for understanding how traditional practices can complement modern healthcare.

Materials and Methods

Study area

The study area encompasses the riverbank stretch of the Ganga River from *Katwa* to *Kalna* in *Purba Bardhaman* situated between 23°65' N to 23°13' N latitude and between 88°13' E to 88°22' E longitude and the altitude ranges from 21-11 msl., West Bengal, India, a region characterized by a rich cultural heritage and diverse ecosystems. This stretch of the Ganga is known for its agricultural significance and unique biodiversity. The region is characterized by a wide variety of plants, many of which are utilized for medicinal purposes by the local people.

Purba Bardhaman, a district of West Bengal, is located in the eastern part of India. The geographic features of this area are including the fertile plains of the River Ganga, which support a variety of plant species that thrive in this rich alluvial soil. The environment is marked by a tropical monsoon climate, with seasonal flooding from the river that plays a crucial role in the dispersal of plant species across the region (Chakraborty, 2018). The climatic conditions and natural resources make this area ideal for the study of ethno-botanical practices.

Demography and data collection

In-depth, semi-structured interviews and surveys were conducted with key informants including local healers, elder community members, herbal practitioners and other knowledgeable individuals (Fig. 1). These interviews were focused on the identifying key medicinal plants used by the community, documenting the ailments for which these plants are used, understanding the preparation methods, dosages, and application practices and exploring the socio-cultural significance of herbal medicine within the community. The selection of participants was purposive, targeting individuals who are known to possess significant knowledge of local herbal practices. Interviews were conducted in the local language (Bengali) and translated as necessary for data analysis. A total 180 informants from different age groups and different occupations were interviewed to ensure a diverse range of perspectives. The herbal knowledge collected from one locality was further cross-checked with the other locality for accuracy.

Field visits were conducted to document plant species in their natural habitats along the riverbanks. This involved recording the presence of medicinal plants and their geographical distribution, collecting plant samples for identification and preservation and observing any unique ecological features of the area that may influence plant growth. Field notes were maintained to document the local environment, any cultural rituals associated with plant harvesting, and the specific locations where plants are commonly found. For explore the consensus on herbal knowledge among different community members focus group discussions were held. These discussions provided a platform for exchanging ideas, validating information and uncovering discrepancies or variations in knowledge among the participants. The discussions were the social transmission of herbal knowledge and the role of younger generations in maintaining or abandoning traditional practices.

Statistical analysis

The results of the interview, survey and group discussion were further analysed to determine the level of knowledge and use of plant species by different communities of the study area. To understand the potential use and to assess the importance of each plant species different indices were calculated in order. For the quantitative analysis, the following ethnobotanical indices will be employed such as Frequency of citation (FC), Relative frequency of citations (RFC) and Fidelity level (FL).

Frequency of citation (FC) is the sum of the number of informants who use the particular taxa traditionally. The FC value is calculated by using the formula

$$\mathrm{FC} = \sum_{i=i1}^{iN} \mathrm{URi}$$

Where, UR = use report and N = total number of informants interviewed (Ali *et al.* 2019; Prance *et al.* 1987).

Relative frequency of citation (RFC) **index:** Calculates the relative frequency of citation for each species in the present survey report. RFC index is detected by using the formula

$$\mathrm{RFC} = \frac{\mathrm{FC}}{\mathrm{N}}$$

Where, FC = Frequency of citation and N = total number of informants interviewed (Tardio and Pardo-de-Santayana, 2008).

Fidelity level (FL) calculates how a species is used for a particular treatment. The FL value is calculated by using the formula

$$\mathrm{FL} = \frac{NP}{NX} x100$$

Where, NP= number of informants demand the use of a particular species in particular disease, NX= total number of informants claiming the species for any disease (Musa *et al.* 2011).

Figure 1. Demographic data collection in the filed sites of *Purba Bardhaman*, West Bengal, India.

Results

In the *Katwa-Kalna* basin along the River Ganga, a diverse array of ethno-herbal plants was identified. The study recorded both scientific and common local names for those plants, reflecting their recognition in both academic and community contexts. Some of the most frequently used plants included *Hibiscus rosa-sinensis*, *Centella asiatica*, *Carica papaya, Aloe vera*, *Leonurus sibiricus*, *Bauhinia purpurea* etc. Each plant parts such as roots, leaves, flowers, fruits, seeds, stems or whole plants were found to be used in different ways, tailored to their medicinal applications. During the survey all the plants were collected from this area and identified by specialist and finally deposited in the form of herbarium specimen to the Bankura Sammilani College of Bankura University. Photograph of both the plants and informants were collected during survey.

Informant's demography

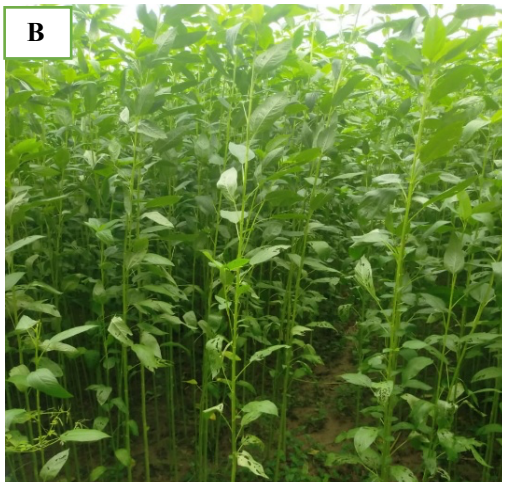
The survey work has done in different seasons throughout the last year. About 180 informants (Table 1.) interviewed which was divided into 5 categories on the basis of their age, gender and profession (Umair *et al.* 2017). Among the total informants 7 were young the age up to 25 years (3.89%), 25 people were between the age of 25 to 35 years (13.89%), 55 individuals were between the age of 35 to 45 years (30.56%), 68 people were between the age of 45 to 55 years (37.78%) and rest 25 people were more than 55 years old (13.89%). Based on educational qualification 72 (40.00%) were Illiterate. Rest 56 (31.11%), 22 (12.22%), 20 (11.11%) and 10 (5.55%) people had Madhyamik, Higher Secondary, Graduate and Post Graduate qualification respectively. Out of 180 informants 37 were farmer (20.56%), 85 were healer (47.22%), 7 were housewife (3.89%), 16 were trader (8.89%) and 35 were gardener (19.44%). Based on gender data 150 were male (83.33%) and rest 30 were female (16.66%). The main findings of the survey were to collect and gather ethno-herbal knowledge of local people, preparation-administration techniques, dosages, and also individual experiences related to the treatments. From the survey work it is clear that present generation are less interested about the traditional knowledge which is a serious threat for future.

Table 1. Informant's demography

Factors	No.	Categories	Number of participants	Percentage (%)
Age	1	Up to 25 (year)	7	3.89
	2	25-35 (year)	25	13.89
	3	35-45 (year)	55	30.56
	4	45-55 (year)	68	37.78
	5	above 55 years	25	13.89
Education	1	Illiterate	72	40.00
	2	Madhyamik	56	31.11
	3	Higher Secondary	22	12.22
	4	Graduate	20	11.11
	5	Post Graduates	10	5.55
Profession	1	Farmer	37	20.56
	2	Healer	85	47.22
	3	House wife	7	3.89
	4	Trader	16	8.89
	5	Gardener	35	19.44
Gender	1	Male	150	83.33
	2	Female	30	16.67

Taxonomic family wise distribution of the plants

The subsequent data provides an in-depth summary of the observed plants (Fig. 2). The informants reported 72 plant species (Table 2) which belongs to 32 families (Fig. 3). According to the current study report, 46 species (about 63.88%) were herbaceous growth habit, 16 species (about 22.85%) were shrubs and rest 10species (about 13.88%) were trees. The present study reveals that the family Fabaceae contributes the maximum medicinal plant species (8 species) in this area followed by Solanaceae (6 species), Poaceae (5 species), Amaranthaceae, Asteraceae, Acanthaceae, Convolvulaceae (containing 4 species on each family). The family Lamiaceae, Verbenaceae and Malvaceae contain 3 species, Rubiaceae, Cyperaceae, Cucurbitaceae, Aracaceae, Apocynaceae and Euphorbiaceae contain two species. The rest 16 families contain 1 species each. The study revealed that 4 species belong to the genus *Solanum*, 2 species belong to the genus *Amaranthus*, *Bauhinia*, *Cyperus*, *Ipomoea* contain 2 species. Rest species belong to one genus. Different plant parts are used to cure different disease by healers. Leaves are used mostly followed by roots, seed and fruits. Sometimes whole plants are used in different administrations. The local community members use different parts of different plant. The most abundant useful part is leaf (45%), followed by root (13%), seed and fruit (12% each), bark (6%), stem (5%), rhizome (3%), flower (2%) and rest rhizome, tubers used 1% each.



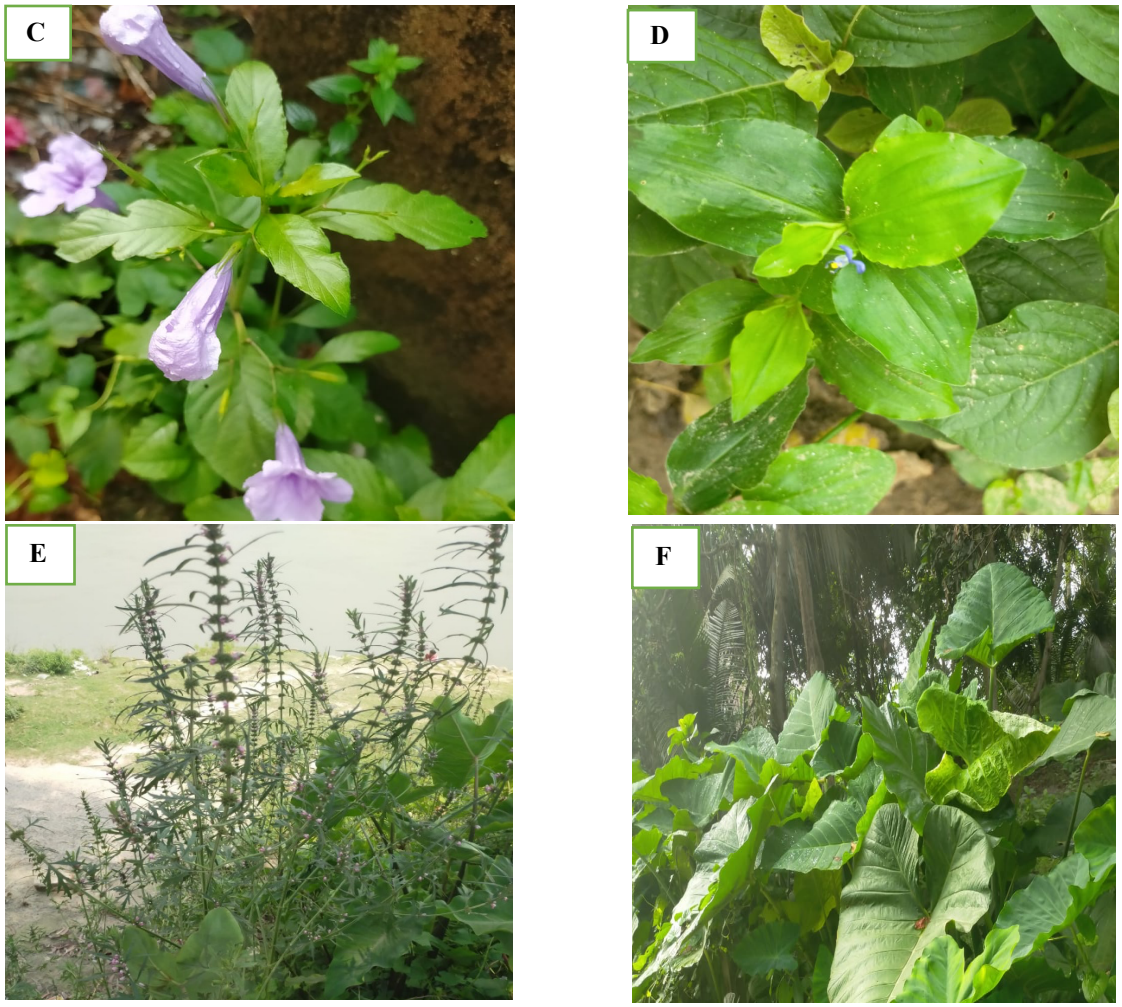


Figure 2. Representative ethnomedicinal plant species obtained from study area: (A) *Amaranthus spinosus,* (B) *Corchorus capsularis*, (C) *Ruellia tuberosa,* (D) *Commelina benghalensis,* (E) *Leonurus sibiricus,* (F) *Alocasia macrorrhizos.*

Table 2. Ethno-medicinal uses of the plants by the local communities of *Purba Bardhaman*, West Bengal, India.

Species	Family	Native name	Habit	Part(s) used	Uses	Mode of Preparation	Mode of administration
Ecbolium viride (Forssk.) Alston	Acanthaceae	**Nilkataful**	H	Root	Crushed roots are applied to treat jaundice.	Crushed root	Oral
Justicia adhatoda L.	Acanthaceae	**Basak**	S	Leaf and bark	Leaves and bark are boiled with water and applied to treat of cough, cold, asthma bronchitis and tuberculosis.	Leaves and bark are boiled with water	Oral
Peristrophe paniculata (Forssk.) Brummitt	Acanthaceae	**Kakjongha**	H	Leaf	Juice of leaf is applied in fever, cold and cough.	Juice of leaf	Oral
Ruellia tuberosa L.	Acanthaceae	**Potpoti- ful**	H	Leaves and roots.	Juice of leaves and roots are used to treat kidney disease and uterine disorder.	Juice of leaves and roots	Oral
Achyranthes aspera L.	Amaranthaceae	**Chat-chati**	H	Roots	Paste of fresh roots mixed with powder rice, coconut oil and applied in joint pain.	Fresh roots mixed with powder rice and coconut oil.	Poultice
Amaranthus spinosus L.	Amaranthaceae	**Kanta notaa**	H	Seed	The crushed seeds at empty stomach are used for jaundice.	Fresh seed	Oral
Amaranthus viridis L.	Amaranthaceae	**Note sak**	H	Leaf	Fresh leaves after cook used to treat urinary tract inflammation.	Boiled leaves	Oral
Ouret lanat a(L.) Kuntze	Amaranthaceae	**Chaya lata**	H	Young stem	Juice of leaf and young stem used to treat diabetes and kidney stone.	Fresh leaves and stem	Oral
Annona squamosa L.	Annonaceae	**Aata**	T	Fruit	Fruit is used to treat dysentery.	Fresh fruit	Oral
Centella asiatica (L.) Urban	Apiaceae	**Thaankuni**	H	Leaf	Fresh leaves are applied in dysentery.	Fresh leaves	Oral
Alstonia scholaris(L.) R.Br.	Apocynaceae	**Chatim**	T	Leaf, bark	Leaves pulp with coconut oil is used to treat various skin diseases.	Fresh leaf, bark with coconut oil	Ointment
Catharanthus roseus (L.) G.Don	Apocynaceae	**Nayantara**	S	Leaf and root	Juice of leaves and roots are used to treat diabetes.	Juice of leaves and roots	Oral
Alocasia macrorrhizos (L.) G.Don	Araceae	**Man kochu**	H	Rhizome	Help to treat impetigo and phlegmon.	Crushed rhizome with oil	Poultice
Areca catechu L.	Arecaceae	**Supari**	T	Seed	Used for promoting digestion.	Fresh seed	Oral
Cocos nucifera L.	Arecaceae	**Naricel**	T	Endosperm	Solid and liquid endosperms are applied in antithrombotic and hypolipidemic agents.	Solid and liquid endosperms	Oral

Pergularia daemia (Forssk.) Chiov.	Asclepiadaceae	**Chagalbati**	H	Leaf and stem	Poultice of crushed leaves and stem with mustard oil are applied to treat arthritis.	Poultice of crushed leaves and stem with mustard oil	Poultice
Aloe vera (L.) Burm.f.	Asphodelaceae	**Grito kumari**	H	Leaf	Pulp of leaves used to treat many skin conditions like burns, wounds, skin irritation, acne and psoriasis.	Pulp of leaves	Poultice
Acmella oleracea (L.) R.K.Jansen	Asteraceae	**Akarkara**	H	Leaf and flower	Crushed flower and leaves are applied to relieve toothaches and has anti pyretic agents.	Crushed flower and leaves	Ointment
*Blume alacera (*Burm.f.) DC	Asteraceae	**Kukur suta**	H	Leaves	Leaves pulp with coconut oil is used to treat various skin diseases.	Leaf with coconut oil	Ointment
Enhydra fluctuans Lour.	Asteraceae	**Helencha**	H	Leaf	Juice of leaves is applied to treat skin disease and inflammation.	Juice of leaves	Ointment
Mikania cordata (Burm.f.) B.L.Rob.	Asteraceae	**Asam- lata**	H	Leaves	Poultice of crushed leaves with mustard oil are applied to treat of swelling and joint pain.	Poultice of crushed leaves with mustard oil	Poultice
Heliotropium indicum L.	Boraginaceae	**Hatisur**	H	Leaf	Fresh leaves juice is applied in wound healing.	Fresh leaves juice	Ointment
Canna indica L.	Cannaceae	**Sarbajaya**	H	Rhizome	Crushed rhizome mixed with coconut oil used to reduce menstrual pains.	Rhizome with coconut oil	Poultice
Carica papaya L.	Caricaceae	**Pape**	S	Fruit	Unripen and ripen fruits are eaten for gastroenteritis and liver disorder.	Fresh fruit	Oral
Commelina benghalensis L.	Commelinaceae	**Kan-chira**	H	Leaf	Leaves with curcuma powder are applied to cure inflammation of the skin.	Leaves with curcuma powder	Ointment
Evolvulus nummularius (L.) L.	Convolvulaceae	**Bhuiakhra**	H	Root	Crushed roots are used to treat cuts, burns and wounds.	Crushed fresh root	Ointment
Ipomoea aquatic Forssk	Convolvulaceae	**Kolmisak**	H	Leaf and stem	Cooked leaves and stems are applied to treat diabetes.	Cooked leaves and stems	Oral
Ipomoea nil (L.) Roth	Convolvulaceae	**Nilkolmi**	H	Leaf	Cooked leaves are applied as diuretic agents.	Cooked leaves	Oral
Merremia hederacea (Burm.f.) Hallierf.	Convolvulaceae	**Holudkalmi**	H	Leaf	Juice of leaf are used to treat cold fever.	Juice of leaf	Oral
Coccinia grandis (L.) Voigt	Cucurbitaceae	**Tela kuchu**	H	Fruit and leaf	Fresh fruits and leaves are applied in cholesterol and blood pressure.	Fresh fruits and leaves	Oral

Luffa aegyptiaca Mill.	Cucurbitaceae	**Phural**	H	Fruit and seed	Fruit and seed crushed and mixed with mustard oil use as anti-pyretic properties.	Fruit and seed crushed and mixed with mustard oil	Ointment
Cyperus iria L.	Cyperaceae	**Aas ghas**	H	Root	Juice from root extracts is used as tonic of stomach aches.	Juice from root extracts	Oral
Cyperus kyllingia Endl.	Cyperaceae	**Sada aash**	H	Rhizome	Used in traditional medicine for their anti-oxidant and antipyretic properties.	Fresh rhizome	Oral
Acalypha indica L.	Euphorbiaceae	**Muktojhuri**	H	Leaf	Vapour of boiled fresh leaves are used in bronchitis, asthma and other disorder.	Fresh leaves with boiled water	Inhalation of vapour
Euphorbia hirta L.	Euphorbiaceae	**Bara dudhia**	H	Inflorescence and fruit	Fresh inflorescence and fruits with coconut oil are used in gonorrhoea.	Fresh inflorescence and fruits with coconut oil	Ointment
Albizia lebbeck (L)Benth.	Fabaceae	**Sirish**	T	Whole plant.	Whole plant is used to prevention of Scabies.	Fresh plant	Poultice
Bauhinia acuminate L.	Fabaceae	**Shet kanchan**	S	Leaf	Vapour of fresh leaves are used to treat asthma.	Fresh leaf	Inhalation of vapour
Bauhinia purpurea L.	Fabaceae	**Dev kanchan**	S	Bark and leaves	Bark and leaves are used to treat diarrhoea and sores.	Juice of leaf and bark	Oral
Caesalpinia pulcherrima (L.) Sw.	Fabaceae	**Radha chura**	T	Leaf and flower	Juice of leaves and flower are used to treat gastric and intestinal inflammation.	Juice of leaves and flower	Oral
Crotolaria pallida (Aiton) Dryand.	Fabaceae	**Jhun jhun**	S	Leaf and root	Leaves and roots are used to treat cutaneous disease.	Fresh Leaves and roots	Oral
Lablab purpureus (L.) Sweet	Fabaceae	**Shim**	H	Leaf	Juice of leaves is applied in spleen and stomach weakness.	Juice of leaves	Oral
Sennasophera (L.) Roxb	Fabaceae	**Kalka sunda**	S	Bark	Crushed bark with aloe gel used as anti-allergic agents.	Fresh bark with aloe gel	Poultice
Tamarindus indica L.	Fabaceae	**Tentul**	T	Leaf and seed	Crushed leaves and seeds with coconut oil are applied in wound healing.	Crushed leaves and seeds with coconut oil	Ointment
Anisomeles indica (L.) Kuntze	Lamiaceae	**Gal ghosh**	H	Leaves	Leaves are used to treat inflammatory, liver diseases and gastrointestinal diseases.	Leaf juice	Oral
Leonurus sibiricus L.	Lamiaceae	**Rakta-dran**	H	Leaf	Juice of leaf are used to treat menstrual irregularities.	Juice of leaf	Oral
Mesosphaerum suaveolens (L.) Kuntze	Lamiaceae	**Bilatitulsi**	S	Leaf	Fresh leaves with honey are applied to treat inflammation and cough.	Fresh leaves with honey	Oral

Corchorus capsularis L.	Malvaceae	**Mitha path**	S	Leaf	Fresh leaves are used to treat dysentery and antidiarrheal effect.	Fresh leaves	Oral
Hibiscus rosa sinensis L.	Malvaceae	**Jaba**	S	Flower and leaf	Crushed leaves and flower with coconut oil are used on scalp to treat hair fall problem.	Crushed leaves and flower with coconut oil	Poultice
*Sida acuta*Burm.f.	Malvaceae	**Berela**	H	Bark and seed	Juice of crushed Bark and seed are applied in diabetes.	Juice of crushed Bark and seed	Oral
Artocarpus heterophyllus Lam.	Moraceae	**Kathal**	T	Seed	Used as food and antidiabetic activities.	Fresh fruit	Oral
Psidium guajava L.	Myrtaceae	**Piyara**	T	Leaf and fruit	Fruits and leaves crushed and mixed with mustard oil use as anti-pyretic properties.	Fruits and leaves crushed and mixed with mustard oil	Ointment
Boerhavia diffusa L. nom. Cons.	Nyctaginaceae	**Punornaba**	H	Root	Juice of root is used to treat Jaundice.	Root juice	Oral
*Ludwigia parviflor a*Roxb	Onagraceae	**Bon-lobong**	H	Leaf and fruit	Crushed leaves and fruits are applied to treat dysentery.	Crushed leaves and fruits	Oral
Chloris barbata Sw.	Poaceae	**Chirghas**	H	Leaf	Leaf juice with coconut oil is used to treat skin disorder.	Leaf juice with coconut oil	Ointment
Chrysopogon aciculatus (Retz.) Trin.	Poaceae	**Chor kata**	H	Whole plant	Help to treat impetigo and phlegmon.	Pulp of whole plant	Ointment
Coix lacryma-jobi L.	Poaceae	**Adel**	H	Grain	Fresh grains in warm water are applied in nausea and vomiting.	Fresh grains in warm water	Oral
Digitaria ciliaris (Retz.) Koeler	Poaceae	**Crabgrass**	H	Seeds	Seeds are used as anti-inflammatory agents.	Fresh seed	Oral
Echinochloa colonum (L.) Link	Poaceae	**Shymaghas**	H	Seeds	Crushed seeds are applied in spleen and constipation.	Crushed seeds	Oral
Polygonum barbatum L.	Polygonaceae	**Bekhunjubaz**	H	Seed	Crushed seeds with curcuma powder are applied as antifungal agents.	Crushed seeds with curcuma powder	Ointment
Ixora coccinea L.	Rubiaceae	**Rangan**	S	Flower and leaf	Juice of leaves and flower are used to treat diarrhoea.	Juice of leaves and flower	Oral
Oldenlandia corymbosa L.	Rubiaceae	**Bali phul**	H	Leaf	Juice of leaf with coconut oil are used to treat fungal skin disease.	Juice of leaf with coconut oil	Ointment
Aegle marmelos (L.) Correa	Rutaceae	**Bel**	T	Fruit	Ripen fruits used as anti-diarrhoeal, antipyretic, anti-inflammatory agents.	Fresh ripen fruit	Oral
Cardiospermum halicacabum L.	Sapindaceae	**Ballon fol**	H	Leaf	Fresh leaf juice with coconut oil is used as antifungal agents	Fresh leaf juice with coconut oil	Ointment

Capsicum annuum L.	Solanaceae	**Morich**	S	Fruit	The fruit is used to improve digestion and circulation.	Fresh fruit	Oral
Datura metel L.	Solanaceae	**Dhutra**	S	Seed and leaf	Crushed leaves and seeds with mustered oil is applied in joint pain.	Crushed leaves and seeds with mustered oil	Poultice
Solanum lycopersicum L.	Solanaceae	**Tomato**	H	Fruit	Provide antioxidant properties and help to prevent cell damage.	Cooked fruit	Oral
Solanum torvum Sw.	Solanaceae	**Tita- bagoon**	S	Leaf and root	Juice of Leaf and root is applied used to treat fever, cough and liver problems.	Juice of Leaf and root	Oral
Solanum tuberosum L.	Solanaceae	**Alu**	H	Tubers and leaf	Crushed tubers and leaves are applied to quick relief in brittle bite.	Crushed tubers and leaves	Poultice
Solanum violaceum Ortega	Solanaceae	**Bon-bagoon**	S	Root	Juice of root are applied in amenorrhoea and puerperal disorder.	Juice of root	Oral
Clerodendrum infortunatum L.	Verbenaceae	**Bhat ful**	S	Leaf and root	Fresh leaves and roots boiled with salt and applied on asthma and cough.	Boiled leaf and root	Oral
*Lippia alba (*Mill.) N.E.Br. Ex Britton & P. Wilson.	Verbenaceae	**Sada matamtia**	H	Leaf	Juice of leaf are used to treat digestive disorder.	Juice of leaf	Oral
Phyla nodiflora(L.) Greene	Verbenaceae	**Bhuin okra**	H	Leaf and stem	Poultice of crushed leaves and stem with mustard oil are applied to treat arthritis.	Crushed fresh leaves and stem	Poultice

Note: Habit: H=Herb, S=Shrub, T=Tree.

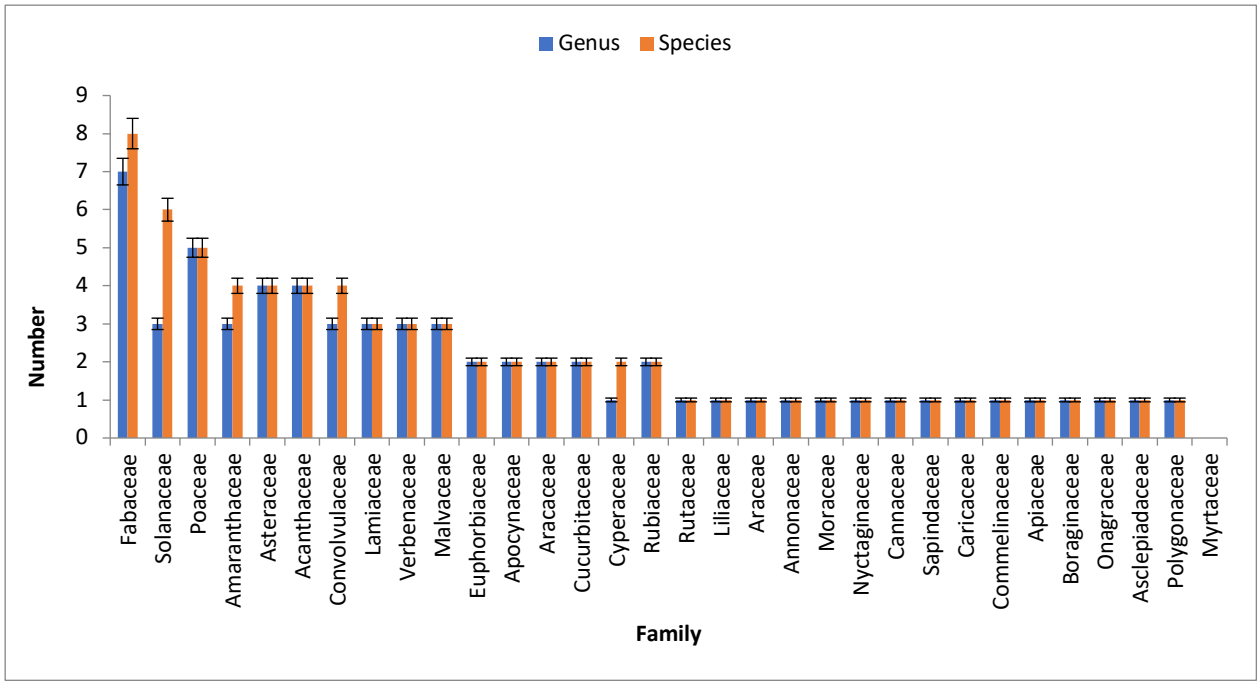


Figure 3. Taxonomic family wise distribution of plants used by the local communities of Purba Bardhaman, West Bengal, India. In this bar graph X- axis represent name of different families whereas, Y-axis represents the number of genus (blue color) and species (saffron color).

Types of plant species

The above survey study recorded 72 plant species for herbal treatment in different ailments (Fig. 4). The herb species is used more frequently as they are easily accessible. The herbs are used 63%, followed by shrubs and tree which are used 22% and 15% respectively.

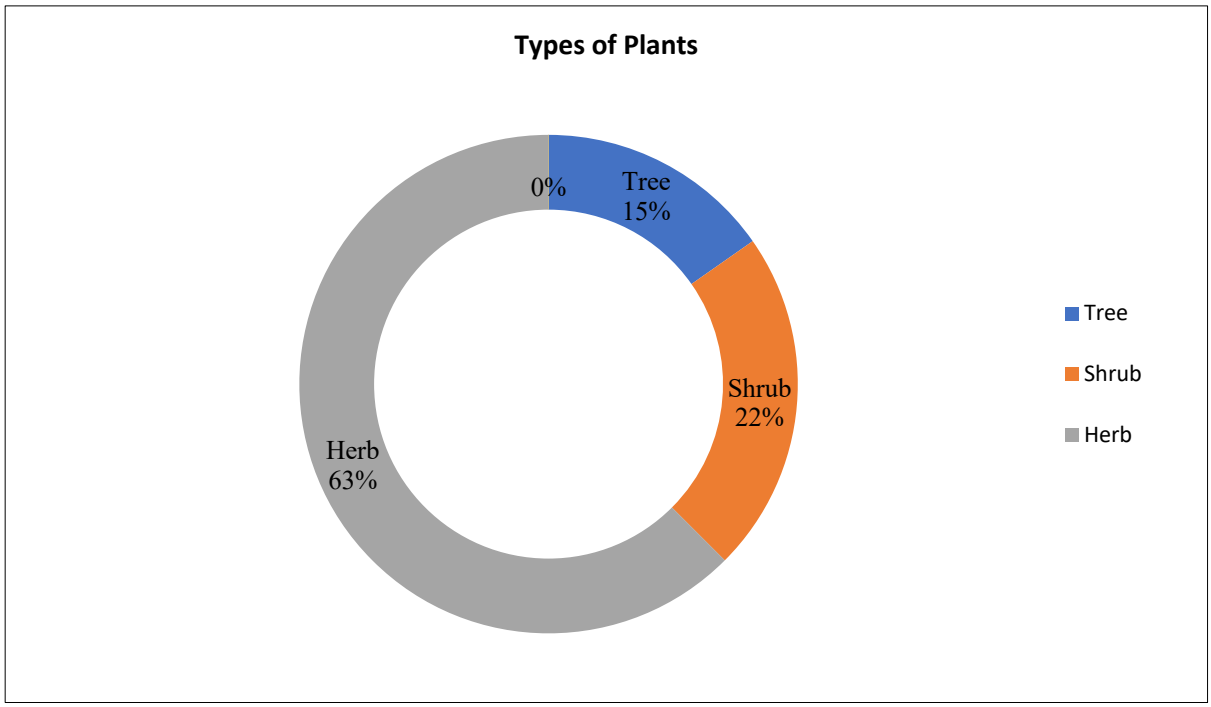


Figure 4. Habit of plants as Tree (blue in color), Shrub (saffron in color) and Herb (grey in color) of plants among collected ethno-medicinal plants used by the local communities of *Purba Bardhaman*, West Bengal, India.

Quantitative analysis

The Frequency of Citation, Relative Frequency of Citation and Fidelity level were calculated (Table 3) to determine the most useful plants used for different ailments in the said area. The RFC value ranges from 0.55 to 0.07. The highest RFC value was represented by two plant species *Hibiscus rosa-sinensis* and *Centella asiatica* (0.55), followed by *Carica papaya (0.54), Aloe vera* (0.51), *Leonurus sibiricus* (0.42), *Bauhinia purpurea* (0.39) etc. The lowest RFC value contain *Merremia hederacea* (0.07). The Fidelity level (FL) value ranges from 97.5 to 32. The most FL value was represented by *Aloe vera* (97.5), followed by *Solanum torvum* and *Hibiscus rosa-sinensis* (91.5 each), *Catharanthus roseus* (87), *Coix lacryma-jobi* (77.1), *Ruellia tuberosa* (75), *Sida acuta* (74) etc.The lowest FL value represented by species *Annona squamosa* (32).

Table 3. Quantitative analysis of the ethno-medicinal medicinal plants used species by the local communities of *Purba Bardhaman*, West Bengal, India.

Plant species	Frequency of Citation (FC)	Relative Frequency of Citation (RFC)	Fidelity level (FL)
Acalypha indica	35	0.19	50
Achyranthes aspera	45	0.25	56
Acmella oleracea	17	0.09	41
Aegle marmelos	47	0.26	63
Albizia lebbeck	33	0.18	45
Aloe vera	92	0.51	97.5
Alocasia macrorrhizos	47	0.26	36
Alstoniascholaris	45	0.25	34
Amaranthus viridis	62	0.34	63
Amaranthus spinosus	52	0.29	43
Anisomeles indica	42	0.23	52
Annona squamosa	52	0.29	32
Areca catechu	33	0.18	42.7
Artocarpus heterophyllus	75	0.41	67.7
Bauhinia acuminata	23	0.12	35
Bauhinia purpurea	71	0.39	62
Blumealacera	19	0.11	65.5
Boerhaviadiffusa	24	0.13	65.5
Caesalpinia pulcherrima	52	0.29	45
Canna indica	43	0.24	65
Capsicum annuum	61	0.34	63.5
Cardiospermum helicacabum	63	0.35	45.5
Carica papaya	98	0.54	92
Catharanthus roseus	86	0.48	87
Chloris barbata	35	0.19	41
Chrysopogonaciculatus	66	0.36	42
Clerodendrum infortunatum	36	0.20	65
Coccinia grandis	41	0.23	47.5
Cocos nucifera	69	0.38	45.5
Coix lacryma-jobi	36	0.20	77.1
Commelina benghalensis	63	0.35	75.5
Corchorus capsularis	40	0.22	41
Crotolaria pallida	32	0.18	62
Cyperus iria	33	0.18	50
Cyperus kyllingia	42	0.23	71
Centella asiatica	99	0.55	61
Datura metel	41	0.28	42
Digitaria ciliaris	64	0.35	63
Ecbolium viride	35	0.19	45
Echinochloa colonum	45	0.25	65
Enhydra flactuans	42	0.23	40
Euphorbia hirta	41	0.23	61

Evolvulus nummularius	34	0.19	45
Heliotropium indicum	62	0.34	65
Hibiscus rosa-sinensis	99	0.55	91.5
Ipomea aquatic	35	0.19	45
Ipomoea nil	31	0.17	37.5
Ixora coccinea	54	0.30	41.5
Justicia adhatoda	72	0.40	92
Lablab purpureus	32	0.18	37
Leonurus sibiricus	77	0.42	65
Lippia alba	61	0.17	42
Ludwigia parviflora	23	0.13	37
Luffa aegyptiaca	32	0.18	52
Merremia hederacea	14	0.07	42
Mesosphaerum suaveolens	32	0.18	52
Mikania cordata	15	0.08	41
Oldenlandiacorymbosa	32	0.18	65
Ouretlanata	55	0.31	32.5
Pergulariadaemia	24	0.13	41
Peristrophe paniculata	34	0.19	65.5
Phyla nodiflora	24	0.13	41
Polygonum barbatum	25	0.14	39
Psidium guajava	62	0.34	45.5
Ruellia tuberosa	35	0.19	75
Sennasophera	43	0.25	49
Sida acuta	47	0.26	74
Solanum lycopersicum	21	0.12	46.5
Solanum torvum	51	0.28	91.5
Solanum tuberosum	42	0.23	75
Solanum violaceum	41	0.23	67
Tamarindus indica	67	0.37	79

Discussion

The main aim of the present study is to gather and compilation of traditional knowledge on ethno-medicinal plants from the lower Gangetic region (*Katwa* to *Kalna*) as a major community of this region depends on the herbal medicine rather than modern-day allopathy drugs. The herbal medicine has less harmful side effects and easy for affordable compared to conventional medicine (Ganguly *et al.* 2021). The plants identified in this study not only provide therapeutic benefits but also play a crucial role in the cultural identity and daily lives of the communities. These plants are commonly used in cultural rituals, family healthcare, and as remedies for livestock ailments that are frequently encountered in the tropical climate of West Bengal (Mukhopadhyay *et al.* 2024). Mondal et al. (2015) reported about herbal medicinal knowledge among the local people of Burdwan district, West Bengal for treatment of different human ailments. Local healers and elder community members are the primary custodians of this knowledge, passing it down through oral traditions, thus intertwining ethnobotanical knowledge with the cultural fabric of the region (Chowdhury *et al.* 2017).

The family wise destitution of taxonomic study showed that Fabaceae is the most abundant family used for the ethno-herbal purposes followed by the family Solanaceae, Poaceae, Amaranthaceae, Asteraceae, Acanthaceae, Convolvulaceae, Lamiaceae, Verbenaceae, Malvaceae, Rubiaceae, Cyperaceae, Cucurbitaceae, Araceae, Euphorbiaceae. Pal et al. (2024) reported similar kinds of finding in ethnoveterinary practices for livestock ailments in *Purba Bardhaman* district of West Bengal. The family Fabaceae contain different types of bioactive and phytochemicals of different biological groups and thus this family is used in various herbal drugs purposes (Leonti *et al.* 2003; Molares and Ladio, 2009).

Among the different habits of the plant species herbaceous habit is the most frequent used as herbal drug followed by shrub and tree. Herb plants are used rapidly rather than shrub and tree for their widely distribution and easily accessible (Albuquerque *et al.* 2005). Different plant parts are used in different ailments purposes. Leaves are used higher percentage followed by roots, seed, fruit, bark and rhizome. Most of the plants store different bioactive elements in their leaf which can

acts as medicinal purposes. Leaves are the prime choice for herbal medicine purposes as reported by McGaw et al. (2020) in his review article.

Various plant parts are used for different ailments with different mode of administration (Table 2). The herbal-medicine may intake orally such as digestive disorder, cold, cough, fever, diabetes etc. Sometimes the medicine is applied as ointments in different skin diseases, hair fall problems, and wound healing agents. Sometimes the same is used as poultice in case of joint pain, arthritis, menstrual pains etc.

The perfect estimation of use frequency of different plant species is measured by quantitative ethnobotany indices such as Frequency of citation (FC), Relative frequency of citation (RFC) and Fidelity level (FL). The resultant plant species were collected from both the cultivated land and wild habitat. The highest Frequency of citation (FC), Relative frequency of citation (RFC)value was represented by two plant species *Centella asiatica* and *Hibiscus rosasinensis* (0.55), followed by *Carica papaya (0.54), Aloe vera* (0.51), *Leonurus sibiricus* (0.42), *Bauhinia purpurea* (0.39) etc. The species *Centella asiatica* has been reported as antimicrobial agent against different pathogens (Wong and Ramli 2021) and *Hibiscus rosa-sinensis* also has antimicrobial and antioxidant properties (Rassem *et al.* 2024). The plant species *Carica papaya, Aloe vera*, *Leonurus sibiricus*, *Bauhinia purpurea have* also antimicrobial activity (Dagne *et al.* 2021; Arbab *et al.* 2021; Ahmed *et al.* 2006; Negi *et al.* 2012). The lowest RFC value contain *Merremia hederacea.* The most FL value was represented by *Aloe vera*, followed by *Solanum torvum* and *Hibiscus rosa-sinensis*, *Catharanthus roseus*, *Coix lacryma-jobi*, *Ruellia tuberosa*, *Sida acuta* etc. These species also have different therapeutic effects (Mak et al, 2013; Diningrat *et al.* 2020; Arirudran *et al.* 2011; Rachel *et al.* 2008). The local people have not sufficient scientific knowledge, but they successfully use those plants for cure of different ailments. They have much satisfactory confidence about their ethno-herbal knowledge. These plants are fulfilled with different bioactive phytochemicals but sophisticated research work need for fill up the research gap. Azmin and Nor (2020) documented about the different bioactive composition of *Centella asiatica. Hibiscus rosa-sinensis* also full of different bioactive compounds which marked the plant as an ethno-herbal plant (Mejia *et al.* 2023). But it is not well established that which phytochemicals and their mode of action are responsible for particular ailments. So, further details investigation is needed for novel drug discovery from those plant species. The plants with high RFC and FL value may be used for further preliminary qualitative analysis for detection of different phytochemicals and then chromatographic separation and identification is needed followed by the advanced hyphenated techniques to isolate which are responsible for that remediation.

The present survey is the documentation of ethno-herbal knowledge of rural people of the lower Gangetic plains for human healthcare. The 72 plant species are cited (Table 2) for ethno-herbal treatments and most of these plants are used for curing single disease. From the present work, it is estimated that people of this area are much infected by skin diseases and digestive disorders and ethno-herbal knowledge is used most frequently to cure those ailments for poor rural areas. The plant species are applied to cure these diseases are wild habitat locally available. Few local people, without any educational qualification, have the historic knowledge of herbal plants and their application. That knowledge must be preserved by arranging social awareness programme in institutes or no governmental organizations for transfer the therapeutic knowledge of herbal-plants in next generation (Bonnaud and Fortane, 2021). Thus, the investigation of herbal knowledge can conduct for modern scientific approaches and can be developed in nature-based drugs.

The present study explores traditional knowledge on locally available 72 ethno-herbal plants, majority of which are from wild habitat, some of them are cultivated plants. For this reason, these are secure listed plants. But over grazing, over exploitation or unwise uses can hampered the natural habitat of the plant species and may changes those species from secure position. Thus, ethno-herbal knowledge may help in the sustainable utilization and proper conservation of these plant species in the Gangetic River basin (Dhar *et al.* 2000; Bhattacharjee *et al.* 2018, Samantaray *et al.* 2024).

Conclusion

This study documents the ethno-medicinal plants used by the local communities along the River Ganga from *Katwa* to *Kalna in Purba Bardhaman, West Bengal, India*, documenting both their medicinal applications and the community consensus on their uses. Through analysing informant consensus, the study found strong agreement among community members regarding the uses of these plants, indicating a well-established, shared knowledge base within the local culture. This consensus not only underscores the reliability of these plants for medicinal purposes but also highlights the cultural continuity of herbal knowledge within these communities. The preservation of ethno-herbal knowledge is essential for maintaining both community health and cultural heritage, as this knowledge represents a valuable resource for sustainable, low-cost healthcare rooted in local biodiversity. To protect and sustain this knowledge, future research should focus on

broader, encompass a larger sample size, allowing for a more comprehensive inventory of plant species. Collaborating with botanical institutions and educational bodies could facilitate the documentation of local knowledge and fostering a bridge between traditional practices and modern botanical science. Such collaborations could support educational initiatives that introduce younger generations to the value of ethnobotanical practices. Additionally, the plant species with high FC, RFC and FL value will provide effective alternatives drugs in future by biochemical, qualitative and quantitative test. However, the present survey plays an evidentiary role in collecting data on the herbal properties of 72 plant species for human healthcare. This documentation will preserve the golden knowledge before extinct and also sustainable utilization of importance plant species.

Declarations

List of abbreviations: FC= Frequency of citation, RFC: Relative frequency of citations, FL: Fidelity level, msl: mean sea level.

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Ethics Approval and Consent to Participate: This study was authorized by the Department of Botany, Bankura University, West Bengal, India. Consent was obtained from all participants before conducting interviews.

Consent for publication : The participant shown in Fig. 1 agreed to have their image published.

Conflict of interest: Not applicable. The authors declare that there is 'no conflict of interest' relating to publication or authorship.

Disclosure statement: The work is original and has not been published elsewhere, nor is it currently under consideration for publication elsewhere.

Authors' Contributions : Conceptualization – SKM; Literature work – SM, SP; Resources – SM, SP; Supervision – SKM, AG; Validation –SKM; Writing (original draft) – SM, SP AG; Writing (review & editing) – SKM, AG.

Data availability statement: The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

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