An Ethnobotanical survey of medicinal plants used by traditional healers in the Indian Sundarbans

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Research

Abstract

Background: The Indian Sundarbans, a deltaic ecosystem harbours a diverse array of mangroves and locally available medicinal plants with profound healing benefits. Ethnobotanical practices are inherent to the local communities shaping their healthcare and cultural traditions. As there is limited documentation on the detailed therapeutic potency of these local plants, our work tries to highlight some of them.

Methods: Information assembled on the basis of field surveys, by taking random personal interviews of the locals as per a pre-defined list of questionnaire and intensive discussions with the traditional health practitioners like the Gunins, Ojhas, Vaidya's etc. helped us in documenting some of the ancient traditional knowledge prevalent among these local communities.

Results: Our study revealed the therapeutic usage of 31 medicinally significant local plants and 10 prevalent mangrove species in curing a wide range of common as well as chronic ailments.

Conclusions: This study thus provides a foundation for future research that integrates traditional knowledge with scientific methods. Collaborative work needs to be encouraged involving the researchers, local communities, and government organizations as it might facilitate investigating the full potential of these plants, furthermore moving towards sustainable development and industrialisation leading to economic benefit of the locals and mankind, thus as a whole resulting in an improved livelihood. Ultimately, relying on these plant-based resources will not only benefit the people residing here but will also stand as a worldwide model, emphasizing the need for conserving our World heritage site.

Keywords: Ethnobotany, medicinal property, traditional knowledge, Sundarbans, survey

Background

The Sundarbans, located in the south eastern part of India, is among the world's most biodiversity-rich regions (covering approximately 10277 km^2) spanning from Hooghly River of West Bengal to the Baleshwar River of Bangladesh's Khulna (Mullick *et al.* 2024). This area has been declared a "World Heritage site" both by UNESCO (United Nations Educational, Scientific and Cultural Organization) and IUCN (International Union for Conservation of Nature) because of its unique floral and faunal aggregation (Mullick *et al.* 2022). It comprises a biodiversity consisting of 334 plant species belonging to 245 genera and 75 families, 165 algae and 13 orchid species (Labadi 1972). The foundation of any successful conservation strategy rests on the intricate interactions among human beings, plant life, animal species, natural forces, and the distinctive landforms specific to each ecoregion (Kassam et al. 2010). To devise an effective conservation plan, it is imperative to acknowledge the delicate balance between these elements. The indigenous tribal groups residing in the Indian Sundarbans

rely on the forest and natural resources for their survival. Ancient traditional knowledge emphasizing the therapeutic potency of the locally available plants has been religiously utilised by the commoners for curing several common as well as chronic ailments and for nutritional support (Acharya *et al.* 2022). Similarly, the cultural utilization of plants strongly implies their utility beyond scientific facts, based on the beliefs carried across generations (Kassam *et al.* 2010). This invaluable knowledge of the ethnobotanical potential is not merely a tradition; it is a critical aspect of the cultural heritage passed down through generations in the settler community of the Sundarbans. By recognizing and preserving this wisdom, the efficacy of the conservation efforts can be enhanced and sustainable practices for future generations can be promoted. The local residents here are being subjected to various challenges in their day-to-day life, that led them in creating their own way of living (Chowdhury *et al.* 2014). Due to inconvenience in transportation and limited healthcare exposure, the people residing here have slowly started shifting towards locally available medication (Chowdhury *et al.* 2014). However, due to increasing deforestation, habitat destruction, cultural pressure and lack of documentation, it is alarming that all the available traditional knowledge encircling the healing benefits of this rich biodiversity will be lost subsequently (Biswas *et al.* 2023).

This information can serve as a guideline for preserving this forest. There is thus an urgent requirement to preserve this rich indigenous knowledge of the medicinal plants of the Indian Sundarbans, in the form of documentary preservation and online database development. This research thus aims to briefly document the coastal traditional knowledge of the local communities based on the therapeutic usage of medicinal plants in the Sundarbans. We gathered data from local individuals, focusing mainly the herbal practitioners like Vaidya's, Baule, Gunins, and Ojhas. Vaidya's use different plant parts as medicine to treat humans and animals, whereas Gunins and Ojhas rely on mantras, rituals and plant parts for healing. The Baule accompanies forest wood cutters and honey collectors to protect them from tiger attacks and other challenges using mantras, rituals and plant-based medicines. They all worship forest goddess Bonobibi and Dakshin Roy (Mondal *et al.* 2012, Arbiastutie et al. 2021).

Materials and Methods

Study area

Our survey spots encircling the South 24 Parganas focused around Canning (S1), Pakhiralay (S2) and Gadkhali (S3) (Fig. 1). We interviewed 15 individuals based on a list of questionnaires throughout these spots emphasizing more on the local herb healers like the Gunins, Ojhas and Vaidya's. Alongside, we conducted interviews with local residents who have lived in the area since birth, along with their spouses and children. These discussions focused gathering detailed knowledge concerning the traditional usage of the locally available medicinal plants. Few of the plant specimens, noted by the gunins and ojhas, were collected and taken to the Botanical Survey of India, Howrah. There, they were identified by comparing them with existing plants verified by experts as part of conservation efforts.

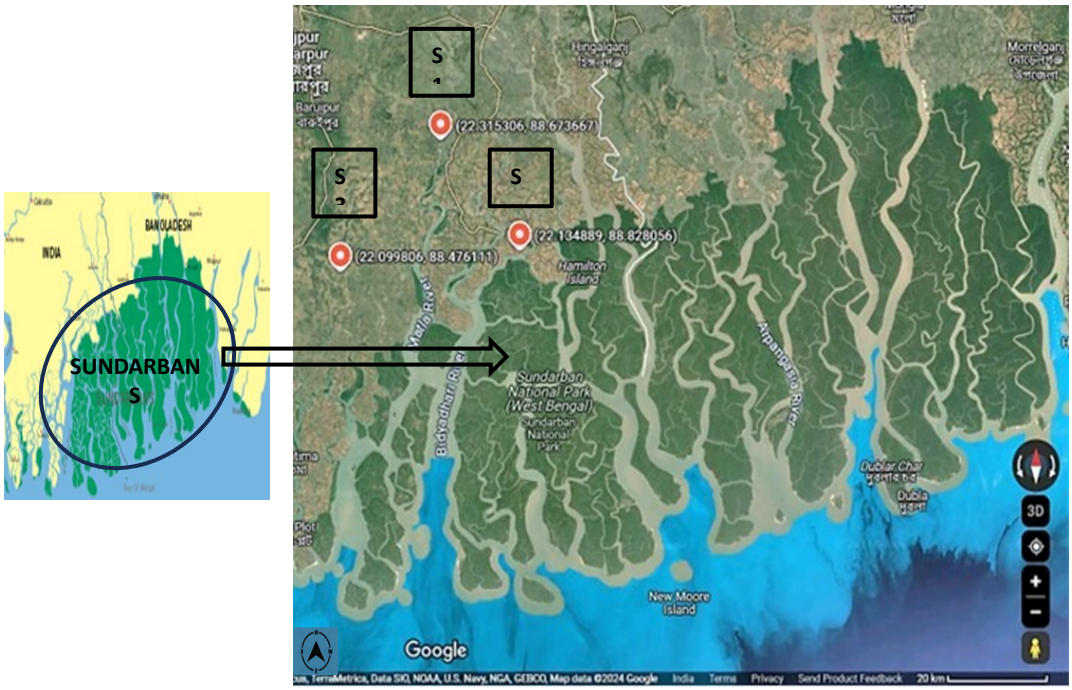

Figure 1. Map of Indian Sundarbans highlighting three of our survey spots

Results and Discussion

Upon surveying, we have listed below a list of medicinal plants highlighting the specific plant part responsible for their therapeutic property (Fig. 2, Table 1) that are commonly available in the heart of the Indian Sundarbans. In total, nearly 31 medicinal plants were recorded that belonged to 21 different taxonomic families (Fig. 3). Both the local as well as the botanical scientific names of all the listed medicinal plants have been provided that are extensively used by the locals of the Indian Sundarbans for treating a range of common ailments. The Munda tribes of the Sundarbans of Bangladesh rely on approximately 98 distinct medicinal plants, some of which are listed in this survey (Islam et al., 2022), showcasing a rich tradition for natural healing. Furthermore, a recent survey by Saradar et al. in 2024 showcased a similar array of mangroves in the Indian Sundarbans that locals use as effective remedies for a variety of health concerns. This highlights the invaluable relationship between indigenous knowledge and the richness of medicinal biodiversity in these regions. Besides, by manipulating the therapeutic potency of the widespread mangrove array, the local herbal practitioners were able to cure a diversified range of common as well as chronic diseases. For instance, *Acanthus illicifolius* leaves and stems can be used for curing fever, malaria, asthma, skin conditions etc. whereas, mangroves like *Avicennia alba* have proven their efficacy against smallpox, ulcer and leprosy treatment. *Bruguiera gymnorrhiza* on the other hand are able to treat diabetes, diarrhoea, dysentery, infertility etc. (Fig. 2) (Biswas *et al.* 2023, Mondal *et al.* 2012, Saradar *et al.* 2024). The usage of these mangrove species varies along with their location and availability, also depending upon the therapeutic knowledge of the locals living there (Mondal & Das 2023).

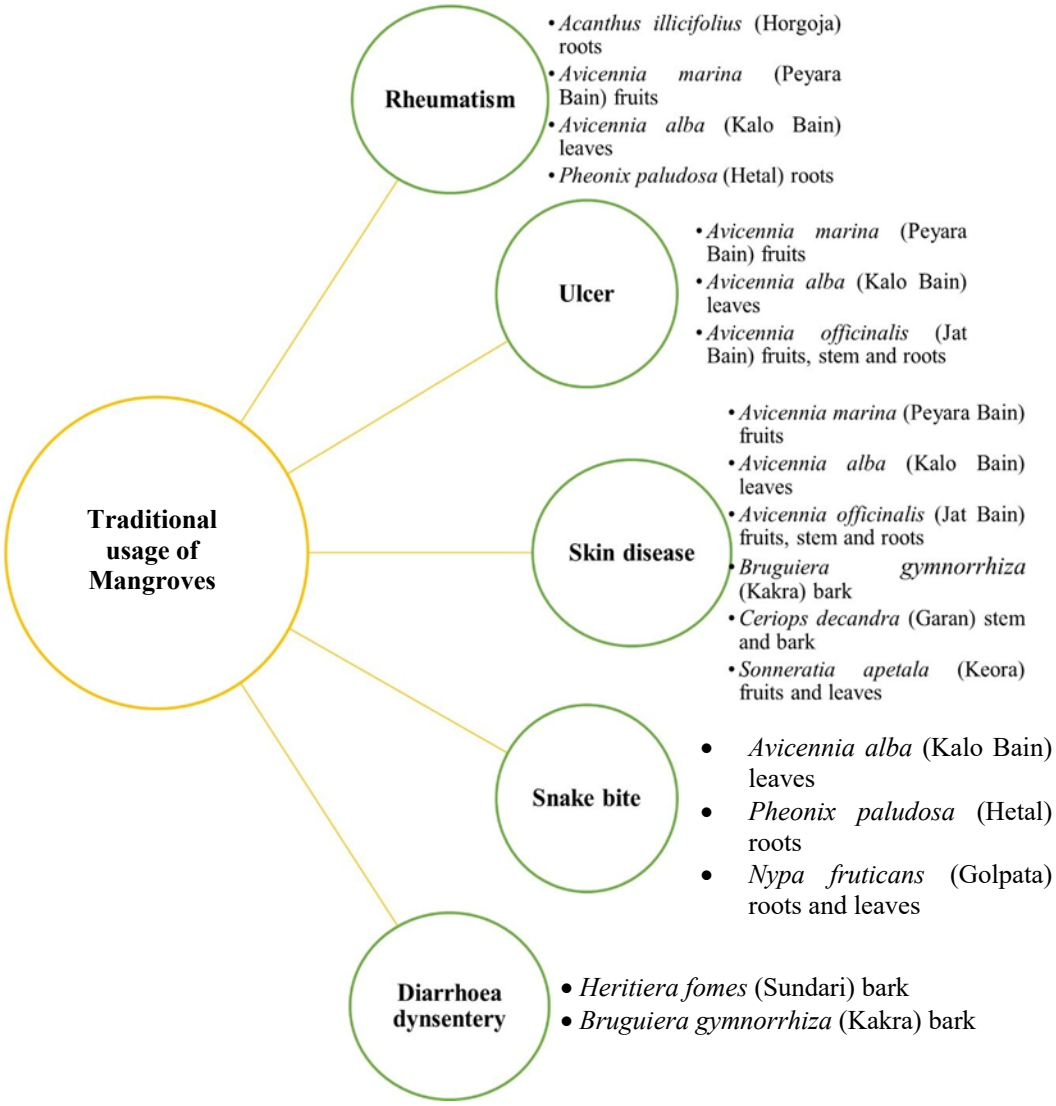

Figure 2. Traditional usage of mangrove plant parts against some common ailments faced by the locals

Table 1. List of medicinal plants prevalent in the Indian Sundarbans along with their therapeutic potentials

Therapeutic property	Scientific name	Local Name	Plant part used	Family
Antidiarrheal and antiemetic	*Cymbopogon citratus* (DC.) Stapf.	**Dhanwantari**	Leaves	Poaceae
	Cynodon dactylon (L.) Pers.	**Durva ghash**	Leaves	Poaceae
	Mangifera indica L.	**Mango tree**	Leaves	Anacardiaceae
	Syzygium cumini (L.) Skeels.	**Jamun**	Leaves	Myrtaceae
Antidiabetic	*Saraca indica* L.	**Ashok**	Flower	Fabaceae
Wound healing property	*Tinospora cordifolia* (Thunb.) Miers	**Gulancha**	Leaves	Menispermaceae
	Tagetes erecta L.	**Genda phool**	Leaves	Asteraceae
	Calotropis gigantea (L.) Dryand.	**Swet akanda**	Latex	Apocynaceae
	Mikania micrantha Kunth	**Japani lota**	Leaves	Asteraceae
	Euphorbia sp. L.	**Dudhi**	Latex	Euphorbiaceae
	Heliotropium indicum L.	**Hatisur**	Leaf extract	Boraginaceae
Anti-snake venom	*Nymphaea* sp. L.	**Water lily**	Roots	Nympheaceae
	Cissampelos pareira L.	**Nagdani**	Roots	Menispermaceae
	Aristolochia indica L.	**Ishwarmul**	Roots	Aristolochiaceae
Antibiotic (treats urinary infection)	*Clitoria ternatea* L.	**Shwet aparajita**	Leaves, Flowers and Roots	Fabaceae
	Saccharum officinarum L.	**Sugarcane**	Stem	Poaceae
	Aloe vera (L.) Burm.f.	**Aloe vera**	Leaves	Asphodelaceae
Anxiolytic	*Atermisia douglasiana* Besser	**Nagdhowa**	Leaves	Asteraceae
Antianemic	*Hygrophila auriculata* Schumach.	**Kulekhara**	Leaves	Acanthaceae
Treats ear ache	*Euphorbia tirucalli* L.	**Lankasij**	Latex and leaf extracts	Euphorbiaceae
	Lawsonia sp. L.	**Mehendi**	Leaves	Lythraceae
Antipyretic	*Ocimum sanctum* L.	**Tulsi**	Leaves	Lamiaceae
	Heliotropium indicum L.	**Hatisur**	Leaf extract	Boraginaceae
Antiulcer	*Abutilon indicum* (L.) Sweet	**Jhumko**	Entire plant	Malvaceae
Treats stomach ache	*Centella asiatica* (L.) Urban	**Thankuni**	Leaves	Apiaceae
Antiallergic	*Laportea interrupta* (L.) Chew	**Lal bichuti**	Roots	Urticaceae
Treats arthritis	*Saccharum officinarum* L.	**Sugarcane**	Stem	Poaceae
	Aloe vera (L.) Burm.f.	**Aloe vera**	Leaves	Asphodelaceae
	Justicia gendarussa Burm.f.	**Jagatmadan**	Leaves	Acanthaceae
Treats skin infection	*Achyranthes aspera* L.	**Apang**	Leaf decoction	Amaranthaceae
Treats bronchitis	*Justicia gendarussa* Burm.f.	**Jagatmadan**	Leaves	Acanthaceae
	Nasturtium sp.	**Durga thoba**	Leaves and Flowers	Tropaeolaceae

Relieves excessive menstrual bleeding	*Saraca indica* L.	**Ashok**	Tea made from raw bark	Fabaceae
Cures sting of wasps and hornets	*Stachyterpheta indica* (L.) Vahl	**Nileji**	Roots	Verbenaceae
Relieves dental and lower back pain	*Tricholepis glaberrima* DC.	**Brahmadandi**	Stem	Asteraceae
Treats muscle pain	*Justicia gendarussa* Burm.f.	**Jagatmadan**	Leaves	Acanthaceae
	Nasturtium sp.	**Durga thoba**	Leaves and Flowers	Tropaeolaceae
Treats conjunctivitis	*Heliotropium indicum* L.	**Hatisur**	Leaf extract	Boraginaceae
Immunity booster	*Nasturtium* sp.	**Durga thoba**	Leaves and Flowers	Tropaeolaceae
Treats sugar, dysentery, insomnia	*Hibiscus* sp. L.	**Panchamukhi joba**	Leaf decoction	Malvaceae

Our conducted ethnobotanical survey circumscribing the herbal healers like the Gunins, Ojhas and Vaidya's also revealed the plant part of each medicinal plant bearing the respective therapeutic property. Leaves possessed the highest medicinal potency followed by the barks and roots of the plants, whereas flowers bear minimum healing properties (Fig. 4).

Figure 3. (a-l) Few medicinal plants of Indian Sundarbans

a: *Centella asiatica*

b: *Clitoria ternatea*

c: *Justicia gendarussa*

d: *Stachyterpheta indica*

e: *Atermisia douglasiana*

f: *Nasturtium* sp.

Figure 3. g: *Euphorbia tirucalli*

h: *Tricholepis glaberrima*

i: *Hygrophila auriculata*

j: *Abutilon indicum*

k: *Cissampelos pareira*

l: *Heliotropium indicum*

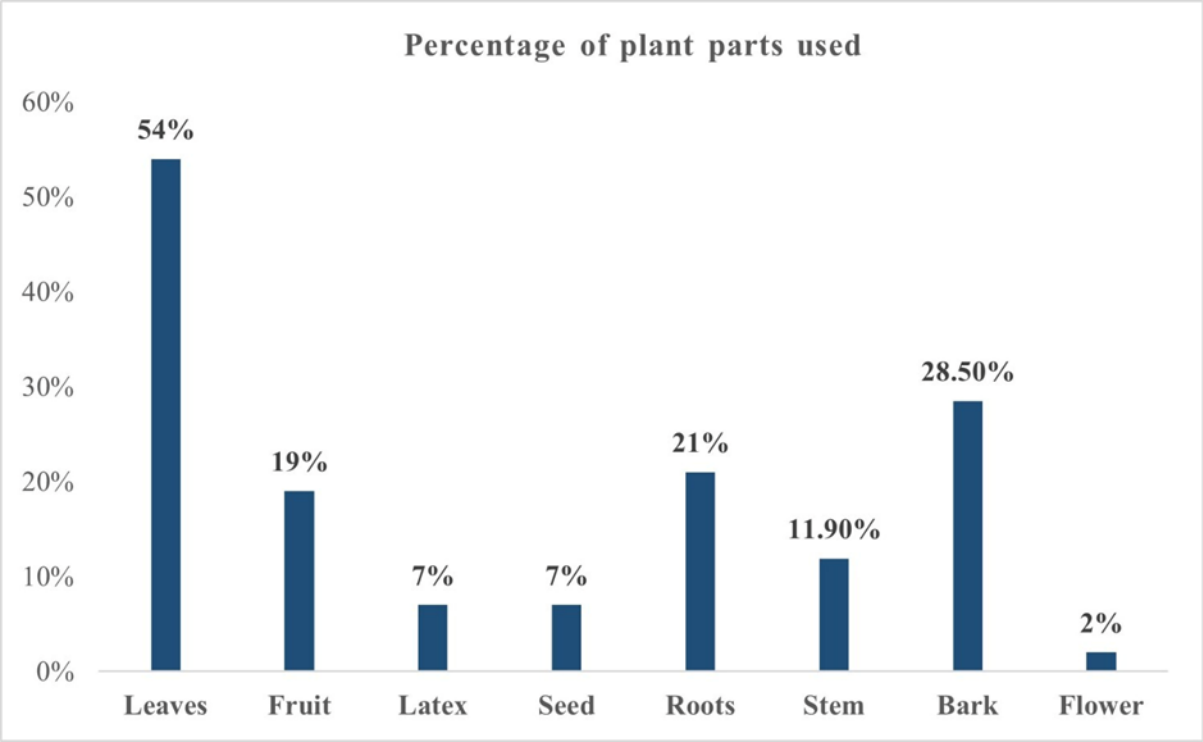

Figure 4. Percentage of medicinally important plant parts residing in the Indian Sundarbans used for curing various diseases

The public health care system in the Sundarbans experiences a deficit in the number of health centres and medical staff. A deteriorated and poor healthcare infrastructure prevails across almost 70% of the Sundarbans. Thus, due to lack of proper medical facilities, the locals became dependent on these traditional healers for their immediate treatment (Saradar *et al.* 2024). Research on community levels unveiled that the local people can make some savings on their medical expenses upon using locally available medicinal plants having no side effects as compared to the market available drugs (Table 2). This reflects enormous economic benefits for several households, contributing to the overall prosperity of the local communities.

Table 2. List of drugs available in the market against some common diseases and their side effects (MedlinePlus, U.S. National Library of Medicine, Healthdirect Australia, Drugs.com)

Disease	Market available Drugs	Side effects	Plant-based alternatives
Diabetes	Metformin	Hypoglycaemia, anaemia, lactic acidosis	*Bruguiera gymnorrhiza*, *Saraca indica*, *Nypa fruticans*
Snake bite	Antivenin	Dysphagia, Urticaria etc.	*Aristolochia indica, Nymphaea* sp., *Avicennia alba, Pheonix paludosa, Nypa fruticans*
Urinary tract infection	Nitrofurantoin	Renal failure, allergic reactions, yeast infection	*Aloe vera*, *Acanthus illicifolius*
Ulcer	Amoxicillin	Prolonged vomiting, severe diarrhoea, paleness	Members of Avicenniaceae, *Ceriops tagal, Heritiera fomes*
Rheumatoid arthritis	Hydroxychloroquine	Seizure, nausea, numbness, bruising etc.	*Saccharum officinarum*, *Aloe vera*, *Acanthus illicifolius*, *Avicennia marina*, *Avicennia alba*, *Pheonix paludosa*
Leprosy	Rifampicin	Drowsiness, heartburn, stomach cramps, nausea etc.	*Avicennia alba*, *Ceriops decandra*, *Excoecaria agallocha*
Small pox	Tecovirimat	Moderate diarrhoea, muscle stiffness, stomach discomfort etc.	*Avicennia alba, Avicennia marina*
Malaria	Doxycycline	Diarrhoea, irritation of the oesophagus, blisters, fast heart rate etc.	*Acanthus illicifolius, Ceriops tagal*

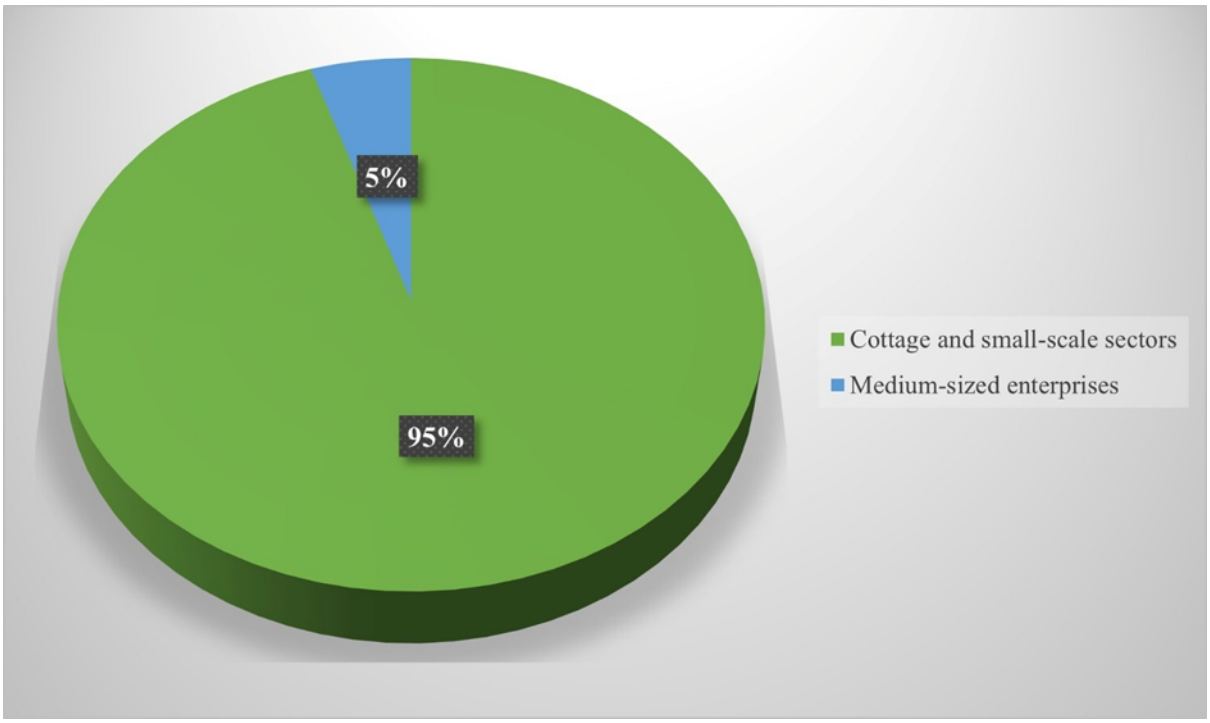

Figure 5. Distribution of traditional medicine manufacturers in India

Medicinal plants along with serving as a crucial hub for medical and herbal industry, plays a remarkable role in delivering health security and livelihood to a major sector of the local population. The demand for herbal alternatives has started increasing across the world. In India, licensed traditional medicine manufacturers belong mainly from the rural and small-scale sectors (Fig. 5). The market coverage of the AYUSH industry (Ayurveda, Yoga and Naturopathy, Unani, Siddha and Homeopathy) is worth 80 - 90 billion. Additionally, another ten billion revenue gets generated by exporting Indian medicinal plants and their products (United Nations Development Program 2010). Thus, considering the market value, the economic prospect of this sector proves to be extremely promising. The exponential increase in the demand for Complementary and Alternative Medicines (CAM) in the Western countries is driven mainly by the concerns generating over the negative impacts of chemical drugs and enhanced access to health information. Rigorous conservation strategies need to be adopted as the healing benefits of the Sundarbans' resident flora is under jeopardy due to inadequate natural product availability (Matavele *et al.* 2000, Sumadri *et al.* 2018, Vinoth *et al.* 2019). As a consequence, this natural repository hub of medicinal plants is under immense pressure attributable to serious threats involving climate change resulting from sea level rise, cyclonic disturbances, pollution and increased anthropogenic interferences causing habitat destruction (Biswas *et al.* 2023). Thus, there is urgency in implementing conservation strategies based on ecosystem management and pollution mitigation. Besides, afforestation, organising awareness programs, motivating and empowering the local communities by robust education and adopting eco-friendly practices, as well as delving into sustainable harvesting will enhance climate resilience (Patra *et al.* 2019). Government authorities should consider alternative income sources such as local tour guiding, agroforestry and cottage industry for the locals that will lead to their less dependency on the mangrove forest resources. Since winter serves as the main tourist attracting season, it is essential to start adopting ecotourism practices keeping in mind the island's carrying capacity. Furthermore, for improving the economic conditions of the local communities, policies based on exportation of medicinal plant parts, commercial hotel establishment and marketplaces in less vulnerable areas of the Indian Sundarbans can be adopted. For controlling poaching resulting in habitat loss, certain national policies need to be enforced. Initiative towards mangrove reforestation in newly unprotected lands should be taken by strictly monitoring their growth. Additionally, nurseries and herbariums for seed storage and cultivation of mangrove saplings is imperative (Nishat *et al.* 2014). These ventures are pivotal for safeguarding the ethnobotanically rich heritage of the Indian Sundarbans, parallelly improving the economic condition of the locals (Nishat *et al.* 2014). Such efforts will not only preserve the cultural integrity but will also provide valuable insights into sustainable living, economic benefit and traditional healthcare approaches.

Conclusion

Since ancient times, the medicinal properties of the local plants as well as the mangroves of Indian Sundarbans have been extensively used by the local communities. The people residing here have intensive knowledge about the traditional medical practices of these plants. Their cultural beliefs along with economic and infrastructure challenges made them rely on natural sources for treatment. This study documented some of the local knowledge and traditional practices adopted by herbal healers such as Gunin, Ojha etc. A total of thirty-one local and twenty-one mangrove species were recorded that are generally used to treat common as well as chronic ailments including ulcers, stomach and skin problems, urinary diseases etc. Chemical drug modernization is imposing pressure, but the traditional knowledge offers valuable insights of the healing benefits of natural products obtained from these plants. Thus, plant-based alternatives need to be industrialised for the economic benefit of the local populace as well as to mankind. It is obligatory to meticulously investigate the practical usage of these plants and the knowledge surrounding them to ensure proper utilization of plant resources, sustainable management, and strategic planning. This study thus elucidates the need for further research, involving phytochemical screening of these therapeutically important plants, in order to verify these traditional claims.

Declarations

List of abbreviations: UNESCO- United Nations Educational, Scientific and Cultural Organization, IUCN- International Union for Conservation of Nature, AYUSH- Ayurveda, Yoga and Naturopathy, Unani, Siddha and Homeopathy, CAM- Complementary and Alternative Medicines.

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Author contributions: Debleena Roy, who is also the corresponding author, designed the work outline; Renia Mullick executed it and wrote the research article; Dipu Samanta and Suchita Sinha supervised the work.

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