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Ethnobotanical Research in Bangladesh – A Review

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Abstract

The ethnobotanical studies focus on how people of a specific culture, group, tribe, or geographic area make use of native (indigenous) plants. This paper reports the status of ethnobotanical knowledge from a historical perspective in recent years in the relatively small and diversity-rich territory of Bangladesh. Ethnobotanical research is now getting more focused on new areas such as ecosystem services, pharmaceutical prospecting, the growth of traditional medicine, value-added plant products, domestication of new crops, and raising awareness of the importance of biological diversity for resource management, environmental education, and conservation. We have also discussed some further thrust areas, constraints, and prospects of ethnobotanical research and mainstreaming ethnobotanical knowledge in national planning processes.

Keywords

domestication; food plants; germplasm conservation; local ecological knowledge; medicinal plants; pharmacology

Introduction

Ethnobotany is simply defined by its meaning: ethnos (nation, race, or people) and botany (the science of plants). An ardent American plant conservationist, John W. Harshberger (January 1, 1869 – April 27, 1929), coined the term *"ethnobotany"*. He defined ethnobotany as the discipline that examines how indigenous tribes used plants for clothing, shelter, and nourishment. Two separate areas of investigation have contributed to the discipline of ethnobotany: first, a long-standing interest in how human civilizations use plants in their local environments; and second, a more recent focus on how people perceive, categorize, and identify the natural world. The field is situated at the dynamic nexus of biology and the social sciences. Ethnobotany (broadly Ethnobiology), which has a long history and a strong scientific foundation, has been the primary biological science contribution. It investigates how much local ecological knowledge supports or contradicts the preservation of resources and helps address global issues including community health, dietary habits, and cultural heritage. It looks into how non-timber forest products benefit local people economically and environmentally, as well as how specific ecological knowledge and practices promote adaptability to a variety of changes, including modernization and climate change.

The ethnobotanical information and knowledge link with the UN Sustainable Development Goals (SDGs) and other important international obligations. Linked SDGs with targets are:

SDG 2 *End hunger, achieve food security and improved nutrition, and promote sustainable agriculture*.

SDG 15 *Protect, restore, and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, halt and reverse land degradation, and halt biodiversity loss*.

The importance of ethnobotany can be linked with Article 8(j) of the Convention on Biological Diversity (CBD) recognized as:

"Article 8(j) Subject to its national legislation, a contracting party is required to

- *respect, preserve, and maintain the knowledge, innovations, and practices of Indigenous and local communities embodying traditional lifestyles relevant to the conservation and sustainable use of biological diversity*;
- *promote the wider application of traditional knowledge, innovations, and practices with the approval and involvement of their holders*; and
- *encourage the equitable sharing of benefits arising from the use of traditional knowledge, innovations, and practices*."

A historical review/overview of ethnobotanical research in Bangladesh

"Applied Ethnobotany" (1) seems to be the first sole document on ethnobotany from Bangladesh, with a brief history of ethnobotany and field techniques. It is evident from the brief review of ethnobotanical research by Khan (2) that ethnobotanical studies in Bangladesh roughly date back to the 1970s. Scientists of the Bangladesh National Herbarium (BNH) conducted surveys in 1978 to gather information on plants that were known to be used in human fertility control, subsequently chemical investigations in pharmacological labs to confirm the activity of *Marsdenia tinctoria* R.Br. and *M. thyrsiflora* (Hook.f.) S.Reuss, Liede & Meve (2). The first paper on ethnobotanical records of Bangladesh might be by Hassan and Khan (3). In addition to BNH, several institutions, and organizations are working on various facets of ethnobotany, including the Bangladesh Forest Research Institute (BFRI), Botany, and other pertinent departments of several public and private universities.

Types of information generated

Food plants

Bangladesh is home to a diverse range of underutilized food plants (4-7). A good number of ethnobotanical studies have been conducted on food plants. Islam et al. (4) listed 481 food items comprising plants and animals and grouped them into 14 categories. Reviewing pertinent literature mostly on ethnobotanical studies, Alam (8) has given a long list of food plants from Bangladesh. The traditional slash-and-burn agricultural method used by ethnic tribes in the Chittagong Hill Tracts (CHTs) is referred to as *jhums* locally. *Jhums* are used to grow about fifty crops and other food plants (6, 8). In addition to the traditional *jhum* foods, the hill people gather food plants from other fallows or fallow *jhums*, ranging in number from 50 to 60 wild plant species. The main items that are collected from wild states are vegetables, oil seeds, rhizomes, bulbs, tubers, spices, and culinary herbs (8-17); culinary herbs make up the majority of food plants harvested in the wild. A good number of wild fruit plants also occur there. Fruits of about 70 plant species are edible (14, 18-21). The Hajong, an ethnic minority living in the northeast region of Bangladesh, obtain their food supplies from homestead forests (45%) followed by natural forests (40%), markets, and others (22). Because of their extreme reliance on forests, the Hajong tribe has evolved a kind of ecological equilibrium that can be interpreted as a balance between man and the surrounding plants and animals.

Medicinal plants

Most of the published ethnobotanical literature in Bangladesh focuses primarily on ethnomedicinal plants and uses. Many tribal members who live in isolated places still rely on the area's medicinal plants to heal various ailments. This knowledge is verbally passed down from generation to generation. Plant parts are utilized separately or in combination with other recipes. The majority of CHT communities have folk formularies of their own with distinct names. Their traditional "*Materia Medica*" is called *Talik* in the *Chakma* language (23). Notable ethnobotanical works of the last three decades of the last century centered around the documentation of medicinal plants and folk formularies (3, 17, 23–44). Uddin (45) made comprehensive documentation of 700 vascular plants used for 302 diseases, recorded through interviews with local healers' representatives from major tribal communities and 2295 prescriptions. Many other references can be found in this literature. In the Badarban district, people from three indigenous communities, *viz*., Chak, Marma, and Tripura, use 159 different plant species belonging to 132 genera and 62 families, for therapeutic purposes (46). They have highlighted that exotic plant species are also used in ethnomedicine along with native species and identified seven species, *viz*. *Agastache urticifolia* (Benth.) Kuntze, *Asarum cordifolium* C.E.C.Fisch., *Congea tomentosa* Roxb., *Engelhardia spicata* Lechen *ex* Blume, *Hypserpa nitida* Miers, *Merremia vitifolia* (Burm.f.) Hallier f., and *Smilax odoratissima* Blume, that have never been ethnobotanically and pharmacologically studied. The Rakhine people, who are dispersed across the Patuakhali and Barguna districts, use 86 plant species from 71 genera and 43 families to treat over 57 different physical disorders under 14 different illness categories (47). The Marma indigenous people employ 196 plant species from 164 genera and 75 families in their rich ethnomedical practices; 23 of these plants have been found to have new uses in ethnomedicine (43). Digestive issues typified as the most common ailment symptoms are treated with seventy-two plant species, followed by pain and inflammation (63 species). Of the plants used in traditional Bangladeshi medicine, 280 genera and 88 families are represented by a single species, while 22 genera are (globally) monotypic, having only one "Type species" (48). At Bangladesh Agricultural University's Botanical Garden, more than 570 species of medicinal plants, out of 1208 species in Bangladesh (49), are collected and conserved (50). People's perceptions about plant use in the COVID-19 pandemic and

cardiovascular diseases have also been discussed recently (51, 52).

Pharmacological

It has been stated under historical review that the ethnobotanical survey was started as a pharmacological work on plants known to be employed in human fertility control, followed by chemical investigations in pharmacological labs to confirm the activity of *Marsdenia tinctoria* and *M. thyrsiflora* (2). The compilation of traditional Chakma *Talik* by Khisa (23) is a sort of local pharmacopeia. Ethnopharmacological studies are also in progress (53). She studied five plants, *viz*. *Zingiber montanum* (J.Koenig) Link *ex* A.Dietr., *Uraria picta* (Jacq.) Desv. *ex* DC., *Diospyros malabarica* (Desr.) Kostel., *Cynometra ramiflora* L., and *Swertia chirayita* (Roxb.) H.Karst., were chosen based on potential antibacterial activity and identified 25 compounds. Khanom et al. (54, 55) evaluated the superoxide-scavenging, tyrosinase, and prolyl endopeptidase inhibitory activities of 15 Bangladeshi medicinal plants. Mazumder and Rahman (56) compiled the pharmacological and phytochemical analyses of 49 Bangladeshi medicinal plants, belonging to 36 families. Medicinal plants with higher amounts of antioxidants could pave the way for the development of innovative drugs to treat inflammatory and neurological diseases linked to oxidative cell damage. According to an ethnobotanical investigation, 84 different plant species were utilized in therapy by the Khyang tribe (57). Sixty-nine species were sequentially extracted with hexane, ethyl acetate, and ethanol, resulting in 197 extracts that were subjected to preliminary antimicrobial and cytotoxic screening. Hossan (57) has identified several compounds with anti-viral, anti-microbial, anti-influenza, and anti-cancer properties. He has also determined that CR, 062B-F2, and Cardamonin-Cu (II) exhibit strong, targeted antitumor activity, focusing on important signaling pathways related to tumorigenesis and facilitating additional preclinical testing.

Researchers in Botany and other allied departments of different public and private universities in Bangladesh are engaged in identifying noble compounds from different medicinal plants and their pharmacological uses (for example, 58). It is anticipated that further studies on the bioactivity and phytochemistry of other plants will lead to the discovery of novel drugs.

Other uses

There had also been documentation on different plants and plant parts used for many aspects of life and livelihoods like fuel wood, agricultural apparatuses, furniture, house construction, dugout making, rituals and ceremonies, dress and handicraft making, resins, dyes, hair wash, skin care, containers, and others (10, 17, 18, 29, 59–64). According to Partha (65), the Laleng (Patra) community uses 112 plant species belonging to 57 plant families for different purposes. For example, 58 plants are used for 42 human ailments and health issues, 52 plants for food, 11 for sacred ceremonies, 4 for charcoal-making, 13 for traditional drinks, 7 for domestic items, fish poison, needles, and other uses. Anisuzzaman et al. (32) reported that 86 plant taxa belonging to 84 genera under 46 families have economic importance to the Garo ethnic community living in the Madhupur forest. Apart from the ethnomedical uses, there are nine more uses: 9 for traditional toothbrushes, 14 for veterinary uses, 4 for monument making, 4 needles, 7 for religious worship, 4 for dye, 4 for fermenting media for liquor, 2 for musical instruments, 3 for toys and games, and 15 other purposes (32). The Mandi ethnic tribes used 109 plant species, belonging to 59 plant families, for food, ceremonies, taboos, ethnoveterinary therapies, the treatment of 38 prevalent human ailments, and pest management (66). The ethnic community in the Khulna region utilized 136 plant species from 114 genera and 52 families. Of these, 63 species were used for food, 45 for medical, 21 for construction, 17 for ornamentals, and 6 for other purposes (67). Ethnobotanical knowledge also helped to find (emergency) food materials during the lean period (Monga - shortage of food supply), for supplementing and/or replacing staples (68). Akter et al. (69) described 71 wild edible plants from Khagrachari that are suitable for human consumption all year round, particularly in times when there is an inadequate supply of agricultural products. The scope and integration of ethnobotanical knowledge about traditional uses in the Chittagong Hill Tracts (CHTs) are briefly discussed by some authors (6, 70, 71). Non-timber forest products, for example, bamboo, rattan, fuel wood, fruits, and different types of grasses, are a more reliant source of annual income from forest-based economic activities of ethnic communities; they collect, process, and sell about 40% of forest products at local markets in CHT to make cash (72).

Khisa (30) noted the ethnobotanical and cultural background of the ethnic communities in forest resource management in CHTs. Banik (71) briefly discussed the ethnobotany of bamboo and rattans from CHTs, Bangladesh. The role and scopes of ethnobotany in agroforestry, hill farming systems, biodiversity conservation, and other alternative livelihood options are discussed in many literature (9, 10, 30, 58, 73-75). Ethnomedicinal practice and documentation of indigenous knowledge associated with it also play a vital role in conserving biodiversity and traditional beliefs (63, 76).

Ethnobotanical research in academia

Researchers and students of different educational institutions are conducting ethnobotanical research for the partial fulfillment of their academic degree (*viz*., MS, MPhil, or PhD) requirements. Botany departments of public universities such as Dhaka University, Chattogram University, Rajshahi University, Jahangirnagar University, and other institutions, play a leading role in these endeavors; however, the majority of the research focuses on surveys of various natural habitats, protected forests, or geographic areas to identify or list the names of medicinal plants and their traditional uses. Ethnomedicine and some other ethnobotanical information and uses were reported in some studies (77-84). To discover novel drugs (candidates), ethnomedicinal plants have recently been the subject of phytochemical screening or pharmacognosy research and bioinformatics methods, such as molecular docking, molecular dynamics simulation, and others (85-90).

Researchers at the Bangladesh Agricultural University have conducted a series of studies on the nutritional and phytochemical profiling of different ethnobotanically important minor fruits and medicinal plants (92-97), and some other this sort of research is going on.

Gender and Ethnobotany

Observations from different fields and marketplaces show that most of the food plant knowledge is skewed towards a particular gender. Women are quite knowledgeable about food plants, the best fuel wood to use, health-related plants, skin care products, hair wash, seed preservation, and genetic variety preservation. Mohiuddin (62) examined the Marma and Murung tribes' knowledge of wild food plants, fuel wood, agro-biodiversity, and seed storage in the Bandarban Hill district. It was discovered that the women in both tribes were more knowledgeable about these topics from an indigenous perspective. However, when it comes to choosing species, raising nurseries, planting, silvicultural techniques, and managing (and conserving) home gardens, both men and women take an active role in the decision-making process (63). Generally, men performed labor-intensive tasks such as digging holes, pruning, planting species, and fencing, while women handled most of the seed selection, watering, fertilizing, and weeding, patterns of using medicinal herbs, storage, and pest control methods.

The elderly people act as the profile of the knowledge repository in this community regarding medicinal and other uses of plants (45), on the other hand, young people are apathetic to conserving traditional ethnobotanical knowledge. Generally, most of them are illiterate or have an educational level up to class five. Ethnobotanical information and their utilization also varied with the social status e.g., poorer vs. wealth class groups of the community.

Ethnobotany and domestication, commercialization, and germplasm conservation of novel climate-resilient crops

Even though SDG 2 and other related SDGs like SDG 3 (excellent health and well-being), SDG 12 (responsible consumption and production), and SDG 15 (life on land) strongly advocate for ending hunger and malnutrition by 2030 (<https://sdgs.un.org/goals>), the Asia-Pacific area still has a high rate of undernourishment, particularly chronic under nutrition, with an estimated 479 million undernourished individuals, or 58% of total global under nutrition (98). Food production and its nutritional content must be improved to meet the population's growing demand for food and better nutrition. On the contrary, out of 30,000 identified edible species, around 7,000 species have at least once been cultivated and/or harvested for food (99). Many of these regional, traditional crop species and variations have been supplanted by high-yielding staple crop cultivars created by contemporary breeding initiatives as a result of the Green Revolution which emerged as a serious threat to local biodiversity and its conservation. Moreover, only nine crops - wheat, rice, maize, sorghum, millets, potatoes, soybean, sugarcane, and sugar beet, account for 75% of the total energy absorption received from plants.

Ethnobotanical knowledge of nutrient-rich neglected and underutilized crop species (NUS; also called minor, indigenous, lost, native, traditional, or promising) may have a significant role in enhancing dietary diversity and combating malnutrition and famine throughout Asia and the Pacific (98). Climate change-associated environmental extremes, such as high/low temperatures and unpredictable rainfall, make it more difficult for agriculture to supply food to a growing world population. The NUS crops can yield more consistent harvests in adverse weather circumstances or on depleted soils because they are often less demanding of the environment, more tolerant to biotic stresses, locally adaptable, and more resilient to climate change (98). In addition, these crops highlight several new issues with the advancement of human welfare to eradicate poverty by generating income. Local street or informal markets in rural, and sometimes in urban, areas could be used as potential areas for ethnobotanical surveys and an indicator for selecting potential crops for domestication. From, the wide variety of (food) plants occurring in nature, people harvest these plants from wild states for their family consumption and uses. Sometimes either surplus of the wild harvests or harvested products are sold in the local/street market (Figure 1). Therefore, commodities that are sold in markets indicate the demand and readiness of (local) people to pay for these.

For example, swamp cabbage (*Ipomoea aquatica* Forssk.), sour grass (*Oxalis corniculata* L.), green amaranth (*Amaranthus viridis* L.), ivy gourd (*Coccinia grandis* (L.) Voigt), Indian pennywort (*Centella asiatica* (L.) Urb.), giant taro (*Alocasia macrorrhizos* (L.) G.Don), alligator weed (*Ludwigia repens* J.R.Forst.), elephant foot yam (*Amorphophallus campanulatus* Decne.), pipli (*Piper longum* L.), fig (*Ficus hispida* L.f.), water hyssop (*Bacopa monnieri* (L.) Wettst.), roselle (*Hibiscus sabdariffa* L.), pigweed (*Chenopodium album* L.), sesbania (*Sesbania grandiflora* (L.) Poir.), Bengal arum (*Typhonium trilobatum* (L.) Schott), water lily (*Nymphaea nouchali* Burm.f.), banana inflorescences (*Musa* spp.), marsh herb (*Enydra fluctuans* Lour.), showed good market potential for domestication and commercial cultivation (100). The retailers commonly gather them from multiple sources; those vegetables grow naturally in fallow fields, pond edges, roadsides, crop fields (not cultivated), and any other untended area. Since many of these crops are adaptable to a wide range of stresses, agricultural production systems will become more varied, sustainable, and climate-resilient (101). To improve food security, nutrition, and climate-resilient sustainable practices, wild and underutilized crops are acknowledged as valuable resources for agricultural diversification through introduction and domestication, a dynamic, ongoing process that heavily incorporates agricultural production practices and human preferences (102). In the case of underutilized species, breeding aims are likely to include characteristics like productivity, palatability, durability/ storage capacity, reproductive synchronization, and

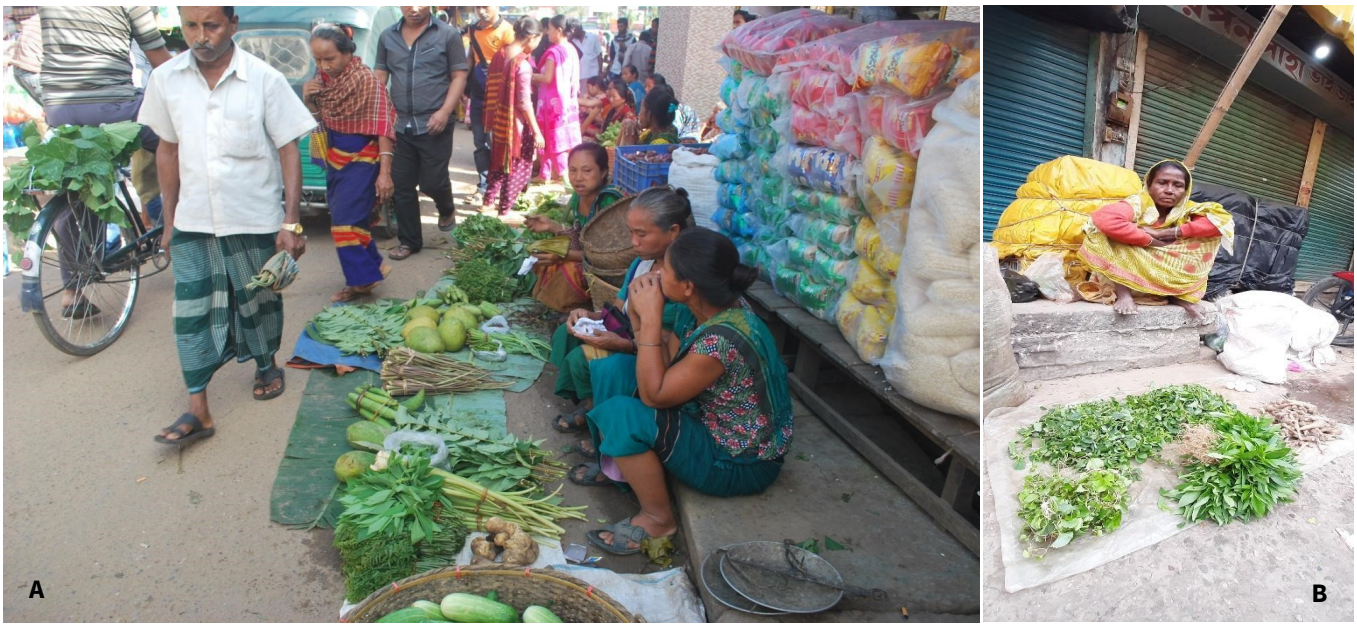

Figure 1: Street market. A. Tribal area, B. Mymensingh town.

harvest ability, which are critical to scaling up farming. In addition to *de novo* domestication (i.e., the introduction of domestication genes into non-domesticated plants), ethnobotanical data may also be helpful for re-domestications of crop wild relatives. This latter process represents a significant potential for adapting cultivated species to the climatic niche they frequent (103).

Soil degradation due to climate change-related natural calamities, massive deforestation, severe habitat destruction, and indiscriminate harvest of wild resources are creating severe pressure on natural resources and have led to the concept of domestication of many traditional plant resources. With indiscriminate harvesting, these resources are being eroded. Over-exploitation is a threat to non-wood forest products, and that can be adjusted through domestication. Their domestication and cultivation can ensure sustained production of the commodities. Alam (104) reviewed the domestication potential of some non-wood forest plants from Bangladesh. Ethnobotanical reports could be potential precursory documents for the domestication and cultivation of new crops (105). Wild food and plants for other uses have wide genetic bases (9, 10). No single individual of any species, however, contains all the genetic diversity of that species (106). Ethnobotany could be used as a tool not only for germplasm conservation (107, 108) but also for the conservation of biocultural diversity (109). The new perspectives of ethnobotany bear on both the conduct of basic science and the relationship between basic and applied science, for example, between knowledge and conservation of biocultural diversity. Home gardens act as the most important, popular, and successful method for conserving biodiversity in Bangladesh and other parts of the globe, because of the increasing pressure from humans and changes in land uses that are affecting the natural forest (63).

Mainstreaming ethnobotanical knowledge

Most ethnobotanical reports are either data or information about local non-traditional food plants or medicinal uses. Data are just facts, numbers, or informational fragments; they are not the information itself. Information is created when data are organized, structured, analyzed, processed, and presented in a way that makes sense or is helpful. Knowledge is the concise and appropriate collection of information in a way that makes it useful.

Most of the published ethnobotanical reports comprise information that needs to be codified and transformed into knowledge for integration in the development planning process. To reach ethnobotany in its mandated areas of development, data, and information on the following areas need to be documented:

- Habitat and Ecology
- Traditional ethnobotanical knowledge on food security, cultivation, domestication, agro-biodiversity and conservation, gender roles, and many more.
- Folk taxonomy
- Traditional ecological knowledge and natural resource management
- Post-harvest processing methods, value addition processes towards end uses, and market potentials
- Anthropology and Linguistics

Information needs to reach the planning and policy people. For an effective use of this branch of botany in sustainable development, it now needs to be mainstreamed in national policies concerned with sustainable development. Also, the academic curricula, research methodology, and dissemination process need to be reorganized. The action should also include increasing cooperation and creating cross-cultural partnerships.

Future Prospects

The ethnobotanists and the academic research in ethnobotany are somehow a bit isolated from the wider development community. The majority of ethnobotanical data is qualitative; hence, it must be converted into relative usage values that can be measured. It is evolving

from a traditional, simple descriptive approach to a more scientifically verifiable condition (110). Ethnobotanical research is nowadays becoming more interdisciplinary and has expanded into pharmacology, agronomy, forestry, ecology, alternate crops, traditional ecological knowledge, biodiversity conservation, ecosystem restoration, and many more disciplines like climate change and adaptation processes. Today, ethnobotany is getting more focused on new constituencies like pharmaceutical prospecting, development of the traditional medicine industry, value-added plant product development, domestication of new crops, ecosystem services, and catalyzing awareness of the value of biological diversity towards its conservation, resource management, and environmental education (105; 111). Ethnobotanical knowledge can be a promising potential source of nature-based solutions (NbS) for meeting various environmental and social benefits (112).

Conclusion

Indigenous societies acquired ethnobotanical knowledge through generations of interactions with the local environment. Moreover, non-indigenous people, including small-scale farmers and rural populations in industrialized countries, have also been demonstrated to hold similar knowledge. Ethnobotany studies should, therefore, be extended further beyond indigenous communities to rural people and farmer groups from non-indigenous communities. The ethnobotanists should respect native community cultures, and have an obligation to the scientific civic, and professional ethics, human rights, and native principles. A good ethnobotanist should be familiar with the flora of the region. Only a good herbarium can support the authentic identification of the documented plants of use. Additionally, ethnobiologists have contributed significantly to or may continue to contribute significantly to the efforts of indigenous and traditional peoples to preserve and perpetuate their natural and cultural heritage.

“It is therefore our responsibility - nay, our duty - to put ourselves in the forefront of ethnobotanical conservation. We cannot allow such precious funds of knowledge to become extinct” - Richard E. Schultes (1915-2001)

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Authors' contributions

Study conception and design: AKMGS, and MKA; data acquisition: MKA, and AKMGS; writing-original draft preparation: MKA; writing-review and editing: AKMGS, and MKA. Both authors have read and agreed to the published version of the manuscript.

Compliance with ethical standards

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