

Ethnobotany of Medicinal Plants Used by Rakhine Indigenous Communities in Patuakhali and Barguna District of Southern Bangladesh

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A. T. M. Rafiqul Islam¹ , Mahadiy Hasan¹, Tahidul Islam¹, Ashikur Rahman¹, Shawon Mitra¹, and Subroto K. Das¹

Abstract

An extensive study has been made to identify, document, and investigate the ethnomedicinal plants used by Rakhine ethnic minorities in Patuakhali and Barguna District of southern Bangladesh for the term of April 2018 to June 2019. In this article, we have focused on the Rakhine population trends, management concerns, and some actions for conserving the Rakhine population diversity in the study area. In this study, we have identified the locations where Rakhine population lives in Patuakhali and Barguna districts. A total of 86 plant species belonging to 71 genera and 43 families were reported to be used for treating more than 57 various physical ailments under 14 illness categories from the study area. For each of the species, the botanic name, common name, Rakhine name, family, habit, parts used and traditional medicinal uses of the plant species have been presented. The maximum numbers of ethnomedicinal plant species were utilized to treat gastrointestinal complaints (43) taken after by the treatment of dermatological issues (36). The highly cited (75.60%) plant species were found to be *Ananas comosus* and *Aegle marmelos* used for gastro-intestinal (Stomach pain, indigestion, and dysentery) digestive disorders and subsequently followed by *Colocasia esculenta* (70.73%) used for cut, bleeding and wound healing. The results of this study have shown that Rakhine indigenous communities still depend on conventional plant-based medication to remedy various diseases and therapeutic purposes in the study area. Our findings have also shown that despite there have adequate phytodiversity in the natural habitat of the study area but the number of Rakhine population has been declining significantly day-by-day. As an ultimate result, we have lost the plant-based traditional medicinal knowledge of Rakhine indigenous communities in Bangladesh. As a rich source of traditional knowledge and cultural diversity, it calls for urgent initiatives to conserve the cultural heritage of the Rakhine community as well as the diversity of Rakhine ethnic group.

Keywords

traditional medicine, traditional knowledge, ethnobotany, conservation, medicinal plant, Rakhine indigenous community

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Introduction

Medicinal plants make a significant contribution to the primary health care needed by individuals around the world. In recent years, the world populations have focused their attention on therapeutic plants and plant-based products due to the side impacts of a number of artificial drugs as well as the improvement of sedate resistance to irresistible maladies. As a result, the demand for therapeutic plants has been expanding drastically day-by-day in both developing and developed countries for the utilize in traditional medicine (TM) and contemporary and alternative medicine (CAM).¹

On a report of World Health Organization, over 80% of the global population relies on herbal medicines for its essential healthcare necessities, and approximately 21,000 plant species seem possibly be utilized as therapeutic plants.² More than

¹ Department of Botany, University of Barishal, Barishal, Bangladesh

Corresponding Author:

A. T. M. Rafiqul Islam, Department of Botany, University of Barishal, Barishal 8200, Bangladesh.

Email: atmrislam@bu.ac.bd



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6000 plant species occur in Bangladesh, of which about 500 species are recognized as having medicinal or curative properties.³ A total of 85% of the people in Bangladesh reside in countryside areas and most of them rely on therapeutic plants for their essential healthcare needs.⁴ Bangladesh can be considered as a wealthy country in terms of ethnic diversity. Although the Government of Bangladesh has officially recognized a total of 27 ethnic groups (1.8% of the country's total population), various rights groups have claimed that there may be more than 45 minorities living in different parts of the country.^{5,6} Ethnic communities are supposed to be a rich source of ethno-medicinal information because of their indigenous traditional knowledge regarding the therapeutic uses of plants. Indigenous communities have utilized plants as a source of a medicine from the past based upon centuries-long conviction and perceptions throughout the world. Ethnic communities are mostly dependent on plants in most cases to fulfill their daily food supplies and daily health care treatments. Tribal populations mostly live in remote areas far from the mainland which remained to be detached from the mainland of the country. Thus, they have less access to modern medicinal facilities. This is probably because of why they still are dependent on plants for their daily medicinal use and dietary supplements. Other than that of these plants and plant products are more accessible and available in their area. The healing practices of indigenous communities have been recognized socially during all stages of anthropological culture and environmental evolution.⁷ Rakhine ethnic communities have a long history and diverse cultural backgrounds dating several thousands of years old and they practice their own traditional ethno-medicinal knowledge for primary healthcare reasons. The Rakhines are a minor ethnic group dwelling in the coastline areas of Patuakhali, Borguna, and Cox's Bazaar. Before the establishment of these 2 present-day countries, Rakhines are migrated to Bangladesh from Arakan in Myanmar in the late 18th century and settled in Patuakhali and Barguna districts in the 19th century.^{3,8} Several researchers,⁹⁻²³ in Bangladesh have earlier been working regarding on the ethno-medicinal study of therapeutic plants utilized by the different ethnic communities in different parts of the country. Unfortunately, there has been very limited information and written documents of indigenous knowledge regarding the uses of therapeutic plants by the Rakhine ethnic community in the Patuakhali and Barguna district of Bangladesh. Although some researchers,²⁴⁻²⁶ have worked on the study of the ethno-medicinal plant used by the Rakhine community of Cox's Bazar, Chittagong, and Patuakhali. However, this study is extremely rare and inadequate. There has no compelling evidence about the complete ethno-botanical investigation earlier done in these present investigated study areas. Thus, the current exploration is the first ever complete ethno-medicinal work in the documentation of therapeutic plants utilized by the Rakhine ethnic minorities in the Patuakhali and Barguna district of Bangladesh. The plant-based indigenous knowledge is particularly oral and has been transferred from one generation to the next through verbal communication.²⁷ Moreover, indigenous knowledge is confined to elder

members of the community and the younger generations have little or no knowledge in this particular aspect. On the other hand, the number of Rakhine population in Patuakhali and Barguna District of Bangladesh is decreasing day by day.²⁸⁻³⁰ That's why; indigenous knowledge may have disappeared due to a lack of proper written documentation. There are many reasons for the extinction of the indigenous knowledge, including the passings of tribal older without exchanging the conventional aptitudes to the other individuals of the family, the migration of individuals due to social issues, urbanization, and modernization, and the impact of advanced medication and exotic cultures are common.³¹ We are hypothesizing that, even in this modernized civilization, Rakhine indigenous community still relies on traditional plant-based medicine to cure various diseases and therapeutic purposes. We further speculate that the number of Rakhine in the study area is decreasing day by day and as a result, traditional plant-based knowledge is also being lost. We hypothesized that long-term and well-conducted studies based on local healers and residents of the Rakhine people using traditional therapeutic healing practices in Patuakhali and Barguna districts could enhance our knowledge of the subject and helping to develop better policies for control and exploitation of plant resources. Toward testing our hypothesis, investigations were carried out among the Rakhine indigenous communities in Patuakhali and Barguna district of southern Bangladesh.

In this manner, the general investigate objective of this study is to gather, identify, and report therapeutic plants and to collate the related indigenous information of the Rakhine community with respects to how they treat different human health complaints within the think about ranges of Patuakhali and Barguna locale of Bangladesh.

This investigation was also conducted with taking the underneath mentioned particular objectives: (1) to elucidate the diversity of medicinal plant use and utilization by the Rakhine community for health care reasons in the study area, and (2) to assess the cultural significance of each species of medicinal plants.

Materials and Methods

Study Areas

The study was conducted in different residing locations of the Rakhine community in Patuakhali and Barguna Districts under the Barisal Division of southern Bangladesh. Patuakhali and Barguna are 2 coastal districts of Bangladesh situated at the fringe of the Bay of Bengal. The coastal region of Bangladesh covers an area of about 47,201 km² and its coastline is 710 km long and there live about 130 million people.³²

The 2 study areas were subsequently divided into smaller study sites (S-1, S-2, S-3, S-4, S-5, S-6, S-7), where most of the Rakhine people live (Figure 1 and Table 1). The survey was performed in different locations of Kalapara Upazila (Patuakhali district) and Amtali Upazila (Barguna district). Survey areas were selected according to the maximum existence of Rakhine population in the areas. Kalapara Upazila is a local administrative region of Patuakhali district covering 483.08 km² areas and lies in between 21°48' and 22°05' north latitudes and in between 90°05' and 90°20' east longitudes.

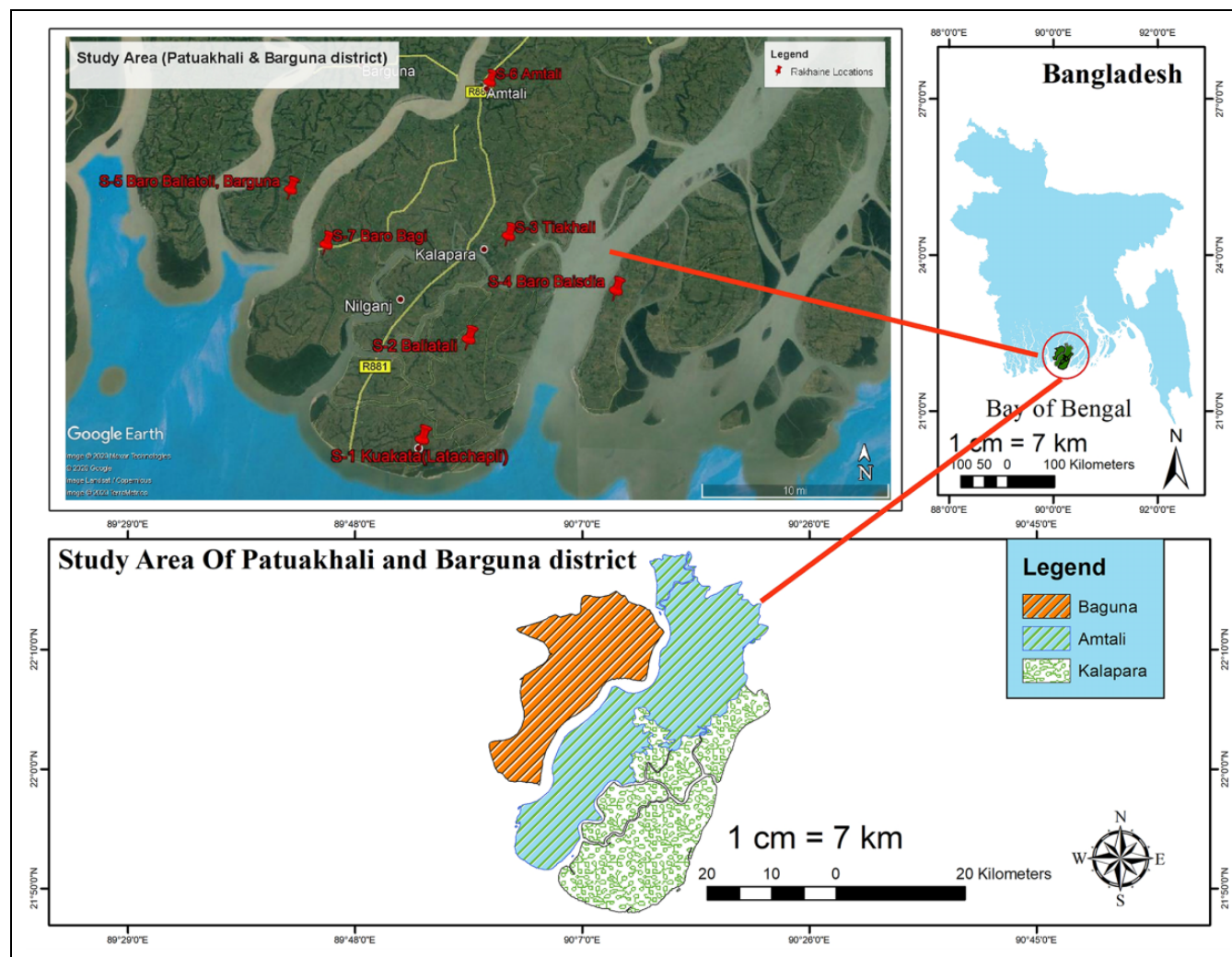


Figure 1. Detailed study area map showing the locations covered the fieldwork.

Kalapara Upazila is demarcated and delimited by Amtali Upazila on the north, the Bay of Bengal on the south, Rabnabad Channel, Galachipa Upazila on the east, and Amtali Upazila on the west.^{33,34}

On the other hand, Amtali Upazila is a local administrative region of Barguna district covering 720.76 km² areas and located in between 21°51' and 22°18' north latitudes and in between 90°00' and 90°23' east longitudes. It is bounded by Patuakhali sadar Upazila on the north, Bay of Bengal on the south, Galachipa and Kalapara Upazila on the east, Barguna sadar and Mirzaganj Upazila (Patuakhali) on the west.^{33,34}

The study areas enjoy a tropical maritime climate characterized by high rain during monsoon. The study areas are characterized by calcareous alluvium, gray floodplain and grey piedmont soils. These types of soils are containing acid phosphate and are saline and the P^H values are neutral to slightly alkaline.³⁵ The study areas consist of coastal mangrove and wetland ecosystems and include both subtropical mixed evergreen and mangrove forests. Therefore, an abundance of mixed evergreen and mangrove plants can be seen throughout the study area. The most commonly found mangrove plants of this region are *Barringtonia asiatica*, *Erythrina variegata* L., *Nypa fruticans*, *Sonneratia apetala*, *S. caselaoris*, *Avicennia officinalis*, *Excoecaria agallocha* and *Bruguiera gymnorrhiza* e.t.c. Moreover, few

representations of *Heritiera fomes* and *Ceriops decandra* were also noticed in the areas. In addition to the mixed evergreen plants like *Albizia lebbeck*, *Cassia fistula* L., *Acacia nilotica*, *Borassus flabellifer* L., *Calotropis procera*, e.t.c. are commonly found in the areas.

Sampling of Informants

During the study period from April 2018 to June 2019 in separate seasons such as summer, monsoon, winter and spring, several repeated field trips were conducted to search for ethno-medicinal information from the Rakhine community in the study area. The investigation was done by adopting random interviews among the male and female informant members of the Rakhine community. Elderly Rakhine informants with age ranging from 45 years old to above were selected due to their vast traditional knowledge about the use of plant and plant products in their daily lives. The educational background and expertise in the use of traditional medicinal plants of the informants were also taken into consideration and priority was given to senior members of the family.

A total of 41 individuals were interviewed in this study. They were mainly made up of elderly people from Rakhine tribes including the Traditional Health Practitioners (THPs) among the Rakhine

Table 1. Location of the Study Areas Where Rakhaine People Live.

Sl. No.	District	Upazilla (sub-district)	Locality (study site)	Latitude	Longitude	Name of Para
1	Patuakhali	KalaPara / Khepupara	Kuakata (Latacapli) Baliatali/boultali Tiakhali	21° 56' 12.85" N 21° 54' 31.26" N 21° 59' 19.74" N	90° 08' 54.63" E 90° 12' 31.74" E 90° 15' 10.09" E	Naiori Para, Kalachan Para, Amkhol Para, Mou thou Para, Thonju Para, Misri Para, khajura, Dior amkhola Para, Pakshia Para, Noya Para (1), Betkata Para, Kuakata, Boultali, Keng Para, Tulatuli Para, Noya Para (2), Noya Para (3), Hari Para, Choyani Para, Mel Para
2	Barguna	Galachipa Barguna Sadar Amtali	Baro Baisdia (Moudubi) Baro Baliatali Amtali	21° 53' 35.63" N 21° 01' 04.93" N 22° 07' 53.43" N	90° 20' 12.14" E 90° 03' 36.52" E 90° 14' 21.01" E	Chatian Para Baliatali Para Chaton Para, Gora Thakur Para, Agathakur Para, Talukder Para, Manu khaing Para, Nameese Para, Soudagar Para, Lau Para, Kabiraj Para, Tati Para
		Taltali	Baro Bagi	21° 58' 49.66" N	90° 05' 15.25" E	Taltali

* Para: The bunch of houses is termed as Para, part of a village; it is a Bengali word.

community (Figure 2). The senior family members of the Rakhine community were asked to mention which plants they used and how they use it in curing diseases in daily lives. They were asked through field interviews, group interview guided field walks by receiving open-ended and semi-structured questionnaire (see Supplementary file) techniques according to Martin.³⁶ To facilitate better communication and understanding, Bengali and Arakanese language were used which is made possible by the help of a local native language translator guide.

Data Collection and Identification

For data collection in the survey areas, we first sought permission from the administrative authorities and later from the tribal chiefs of the Rakhine community. At first, it was clearly explained to the Rakhine informants about the objectives of the investigations because they did not want to disclose the information. The following information was collected by asking them according to the prepared questionnaire such as—(1) Rakhaine name of the plant (2) Habit (3) Plant parts used (4) Name of ailments (5) Mode of preparation e.t.c. They were shown photography of plants instantly downloaded from the internet using smartphones for local identification. The collected information and specimens were recognized, confirmed, and depicted up to species using different standard literature books³⁷⁻³⁹ such as the Encyclopedia of Flora and Fauna of Bangladesh published by Asiatic Society of Bangladesh.^{40,41} The plant species were identified further by consulting Prof. Dr. AHM Mahbubur Rahman, a taxonomist at the Department of Botany, Rajshahi University, Bangladesh. The plant scientific names have been checked with the different websites of plant database such as the International Plant Names Index, <http://www.theplantlist.org>, <https://www.mpbdb.info>. The samples collected, voucher specimens were prepared and more preserved at the Herbarium of Department of Botany, University of Barisal.

Data Analysis

All types of primary field data of the bio-resources were analyzed and computed to determine the informant consensus factor (ICF), citation

frequency (Cf) as well as preparing graphs, charts, etc. using Microsoft Excel spreadsheets following the mentioned statistical equations.

$$\text{Informant consensus factor, } (Icf) = \frac{N_{ur} - N_{taxa}}{N_{ur} - 1}$$

Where N_{ur} denotes the number of useful reports in each ailment category and N_{taxa} is the number of species used for this ailment category.⁴²

$$\text{Citation frequency, } (Cf \%) = \frac{n}{N} \times 100$$

Where, n is the number of people interviewed citing species and N is the total number of people interviewed.⁴³

Results

Rakhine Locations in Patuakhali and Barguna District

In the present study, we investigate the locations in Patuakhali and Barguna district where Rakhine peoples live (Tables 1 and 2). Mainly, Rakhine peoples live in Kalapara / Khepupara and Galachipa Upazila (Sub-District) under Patuakhali District. They also live in Amtali, Taltali and Barguna Sadar Upazila under Barguna District of Bangladesh. In Kalapara / Khepupara and Galachipa Upazilla under Patuakhali district has 4 localities (3 in Kalapara and 1 in Galachipa) namely Kuakata (Latacapli), Baliatali/boultali, Tiakhali and Baro Baisdia (Moudubi), while Barguna Sadar, Amtali and Taltali upazilla under Barguna district has 2 localities namely Baro Bagi and Baro Baliatali where Rakhine peoples live in comprising with some Para (The bunch of houses is termed as Para, part of a village; it is a Bengali word). The names of the Para are mentioned details in Table 1. According to the latest population census report conducted by Bangladesh Bureau of Statistics in 2011, a total of 1310 Rakhine ethnic minorities live in the whole of Patuakhali district, and 1201 of them exists in Kalapara Upazila. The



Figure 2. Data collection and field interview with A) General Rakhine and B) Traditional Health Practitioners (THPs).

Table 2. Distributions of Rakhine Population in the Study Area.

Sl. No.	District	Upazila (sub-district)	Union/Paurashava	No. of Rakhaine population
1	Patuakhali	Galachipa	Baro Baisdia	87
			Galachipa Upazila Total=	87
			Kala Para	50
			Kalapara Paurashava	50
			Baliatali Union	246
			Dhulasar Union	186
			Lalua Union	13
			Lata Chapli Union	483
			Mithaganj Union	23
			Kuakata Paurashava	109
			Tiakhali Union	91
			Kala Para Upazila Total=	1201
			Patuakhali Paurashava	22
			Sadar	
			Patuakhali Sadar Upazila Total =	22
2	Barguna	Amtali	Amtali Paurashava	2
			Barobagi Union	635
			Chhota Bagi Union	13
			Nishanbaria Union	182
			Sonakata Union	168
			Amtali Upazila Total=	1000
			Barguna M.Baliatali Union	59
			Sadar	
			Barguna Sadar Upazila Total=	59
			Barguna District Total=	1059

* Union: The smallest rural administrative and local government units in Bangladesh.

* Data Source: Population & Housing Census, 2011; Bangladesh Bureau of Statistics (BBS).

highest concentration is found in Lata Chapli Union of Kalapara Upazila, where 483 people reside in. On the other hand, the total Rakhine population of Barguna district has valued in 1059; and 1000 of them live in Amtali Upazila. The highest

Table 3. Demographic Scenario of the Informants.

Variables	Categories	No. of person	Percent
Informants type	Traditional health practitioners among Rakhine	8	19.52
	General Rakhine	33	80.48
Gender	Male	28	68.29
	Female	13	31.70
Age	45-55	21	51.21
	56-65	13	31.70
	66-Above	7	17.07
Education levels	Able to read and write	14	34.14
	Primary (Elementary)	19	46.34
	Secondary to Higher	8	19.51

concentration is found in Baro Bagi Union of Amtali Upazila where 635 tribal Rakhine people reside (Table 2).

Demographic Data of the Informants

Among the interviewed 41 Rakhine peoples, 8 people of which are THPs and at the same time medical health professional practitioners and the remaining 33 people are general Rakhine people. Most of the informants were Male (68.29%) and high percentages (51.21%) of informants were around 45-55 years old (Table 3) and nearly half (46.34%) were educated up to Primary (Elementary) level.

Medicinal Plants Recorded in the Study Area

In the present study, we conducted our survey at 15 Para of 5 Upazila in Patuakhali and Barguna district of Bangladesh. We have documented a total of 86 plant species belonging to 43 plant families with medicinal values (Table 4). These are also used by Rakhine indigenous communities for 14 illness categories (Table 5) with different formularies in the study

Table 4. List of Plant Species Used as Medicinal Purposes by Rakhine People in the Study Area.

Scientific name, (Vouchers), Family	Common name (English name)	Rakhine name	Local name (Bengali name)	Habit	Part used	Ailments	Preparation and use	Number of informants citing species (n)	Citation frequency (%)	Conservation (IUCN) status
<i>Justicia adhatoda</i> L. (BUH-R01) Acanthaceae	Malabar Nut	Marhugri; Bosa	Basok	Shrub	Leaf, Root	Diabetes, Fever, jaundice	For the treatment of diabetes, 50 gm of fresh roots are boiled and mixed with 125 ml of cow's milk and given orally once a day. In addition, leaf juice is eaten to cure fever and jaundice.	9	21.95	NE
<i>Achyranthes</i> <i>aspera</i> L. (BUH-R02) Amaranthaceae	Chaff-flower	Cingchida; Chaim-per-on	Apang	Herb	Root	Diarrhea, dysentery, cholera	The juice is firstly extracted from the roots and then used in combination with the juice extracted from the roots of <i>Urena lobata</i> and the bark of <i>Psidium</i> <i>guajava</i> is used to treat cholera, dysentery and diarrhea.	11	26.82	NE
<i>Allium sativum</i> L. (BUH-R03) Amaryllidaceae	Garlic	Korechonfrui; Kasamphru	Rasun	Herb	Bulb	Hair fall, gastric, cough, high blood pressure, leprosy	Bulb paste applied on the head to prevent hair fall. The bulb is eaten after a meal to treat Gastric; Cough is cured by mixing leaf paste with cow's or goat's milk, heating slightly in a steel plate and drinking 1 teaspoon twice a day for 4 to 5 days. Garlic is eaten with hot rice to control high blood pressure. Leaf paste is used for 3 months to cure leprosy.	17	41.46	NE
<i>Mangifera indica</i> L. (BUH-R04) Anacardiaceae	Mango	Srepen; Sarabam	Amm	Tree	Leaf, Root	Dental problem, Mouth wash, Skin irritations, Frightened child	A mouthwash made from the leaves to treat dental problems. Leaf paste is also used to cure skin irritation. When the children are scared, a piece of root is tied with a thread around the neck of the frightened child.	13	31.7	DD

(continued)

Table 4. (continued)

Scientific name, (Vouchers), Family	Common name (English name)	Rakhine name	Local name (Bengali name)	Habit	Part used	Ailments	Preparation and use	Number of informants citing species (n)	Citation frequency (%)	Conservation (IUCN) status
<i>Centella asiatica</i> (L.) Urb. (BUH-R05) Apiaceae	Asiatic pennywort	Mekhro; Mrukhu	Thankuni	Herb	Leaf	Adult malnutrition	One spoon leaves extract and 2 teaspoon honey is taken orally.	15	36.58	LC
<i>Calotropis</i> <i>procera</i> (Aiton) W.T.Aiton (BUH-R06) Apocynaceae	French-cotton	Morhuroy; Muhurong	Akondo	Shrub	Leaf	Catarrh, rheumatic pain, toothache	The leaf paste is made and mixed with salt and used for inhalation in catarrh. The leaves are warmed and then these warm leaves are applied externally twice a day to treat rheumatic pain. Latex of this plant is applied on the painful tooth.	7	17.07	NE
<i>Catharanthus</i> <i>roseus</i> (L.) G.Don (BUH-R07) Apocynaceae	Cape periwinkle	Sagusonga	Nayantara	Shrub	Leaf	Jaundice, diabetes, malaria, dengue fever	In the treatment of dengue fever, malarial fever and diabetes, prepared leaf extract is mixed with camphor and the patient is instructed to take 1 teaspoon twice daily.	14	34.14	NE
<i>Alstonia scholaris</i> (L.) R.Br. (BUH-R08) Apocynaceae	Devil's tree	Silema	Chattim	Tree	Bark	Continuous fever, malaria	About 250 gm bark is boiled in 1 liter of water for 60-90 minutes and the resulting decoction is taken with 2 teaspoons at 3 times in daily (morning, afternoon, and night) for 3-4 days.	13	31.7	LC
<i>Colocasia</i> <i>esculenta</i> (L.) Schott (BUH-R09) Araceae	Taro	Pring	Kochu	Herb	Leaf, petiole	Wounds	Plant sap is directly used to treat wounds.	29	70.73	LC
<i>Borassus</i> <i>flabellifer</i> L. (BUH-R10) Araceae	Palmyra Palm	Thanben	Taal	Tree	Leaf	Fat reducer	One pinch leaf ash took with 1 glass boiled rice starch after the meal.	9	21.95	NE

(continued)

Table 4. (continued)

Scientific name, (Vouchers), Family	Common name (English name)	Rakhine name	Local name (Bengali name)	Habit	Part used	Ailments	Preparation and use	Number of informants citing species (n)	Citation frequency (%)	Conservation (IUCN) status
<i>Cocos nucifera</i> L. (BUH-R11) Arecaceae	Coconut	Uningbeng; Unchi; Unn-ssthei	Narikel	Tree	Root, fruit (seed oil)	Ringworm, Eczema, Stomach-ache, Rheumatism and back pains	Powdered naphtheline dissolved in coconut oil applied to the infected region. Root and rice diffused water taken orally to treat stomach-ache. Treatment of rheumatism and back pain is massaged externally with coconut oil.	13	31.7	NE
<i>Nypa fruticans</i> Wurmb (BUH-R12) Arecaceae	Nipa Palm	Riu	Golpata	Shrub	Young shoots, Inflorescence	Toothache, headache	Ash of burned nipa material against toothache and headache. Sugary sap from fluorescence is used to making alcoholic beverages, syrup, sugar, and vinegar.	15	36.58	LC
<i>Areca catechu</i> L. (BUH-R13) Arecaceae	Betel Palm	Kuachibaowng	Supari	Tree	Root, seed	Diarrhea, dysentery, and malaria	To prevent diarrhea, chew the roots and make juice and take 2 teaspoons twice a day. In addition, seeds are used in the treatment of malaria and dysentery.	17	41.46	NE
<i>Aloe vera</i> (L.) Burm.f. (BUH-R14) Asphodelaceae	Aloe Vera	Kolodru; Kala daru	Ghrito- kumari	Herb	Leaf	Skin disease	Leaf paste is used externally on the skin for various types of dermatitis.	21	51.21	NE
<i>Mikania micrantha</i> Kunth (BUH-R15) Asteraceae	Bitter vine	Annagnoi	Riot Iota	Herb	Leaf	Stomach aches, malarial fever, eczema, wounds	Leaf juice is taken orally to cure stomach problems and to cure malarial fever. In addition, leaf sap is used externally to treat eczema and wound healing.	27	65.85	NE
<i>Eclipta prostrata</i> L. (BUH-R16) Asteraceae	False daisy	Naipong	Kesuti, Kesraj	Herb	Leaf	Malaria, indigestion, ulcer	Half teaspoon of leaf juice is mixed with honey and taken thrice daily till cure as a remedy for malaria, indigestion, and ulcer.	23	56.09	LC

(continued)

Table 4. (continued)

Scientific name, (Vouchers), Family	Common name (English name)	Rakhine name	Local name (Bengali name)	Habit	Part used	Ailments	Preparation and use	Number of informants citing species (n)	Citation frequency (%)	Conservation (IUCN) status
<i>Xanthium</i> <i>indicum</i> DC. (BUH-R17) Asteraceae	Rough cocklebur	Fangepay	Hagra	Herb	Leaf, root	Malaria, rheumatism, tuberculosis	Leaf extract is taken orally in the treatment of Malaria, rheumatism, and tuberculosis.	13	31.7	NE
<i>Ananas comosus</i> (L.) Merr. (BUH-R18) Bromeliaceae	Pineapple	Nandachi, Nendasa	Anaras	Herb	Leaf, fruit	Stomach pain, indigestion	Leaf extract is taken 1 cup to prevent stomach pain instantly and 1 cup twice daily for indigestion.	31	75.6	NE
<i>Heliotropium</i> <i>indicum</i> L. (BUH-R19) Boraginaceae	Indian heliotrope	Chau	Hatisur	Herb	Whole plant	Thrush, diarrhea, diabetes, venereal diseases	A decoction of entire plants is utilized to treat thrush, loose bowels, diabetes, venereal malady, and frequent excretion of urine.	19	46.34	NE
<i>Carica papaya</i> L. (BUH-R20) Caricaceae	Papaya	Tempuji; Ptega	Pepe	Evergreen tree	Fruit, leaf	Diarrhea, dengue	Leaves and unripe fruit are eaten orally and taken inside the body internally in the treatment of digestive disorders, diarrhea. Leaf juice is taken orally to cure dengue fever until it is completely healed.	25	60.97	DD
<i>Garcinia cowa</i> Roxb. (BUH-R21) Clusiaceae	Cowa fruit	Ciyoti	Kau Phol	Tree	Fruits	Dysentery	Fruits are taken internally for the treatment of dysentery.	23	56.09	NE
<i>Terminalia</i> <i>catappa</i> L. (BUH-R22) Combretaceae	Indian Almond	Laiseben	Kanth badam	Tree	Leaf	High blood pressure	Leaf is made into a paste and shaped the pill and taken thrice in a day after meal.	16	39.02	LC
<i>Terminalia</i> <i>chebula</i> Retz. (BUH-R23) Combretaceae	Black Myrobalan	Fongkhoci; Tamada	Horitoki	Tree	Fruit	Digestive problems, constipation	The fruit is used internally to treat constipation and digestive disorders.	17	41.46	NE
<i>Terminalia arjuna</i> (Roxb. ex DC.) Wight & Arn. (BUH-R24) Combretaceae	Arjuna	Tama	Arjun	Tree	Leaf, bark	Scabies, itching	The treatment of scabies and itching is done by boiling the leaves and bark and taking a bath with this warm water for 3 consecutive days.	26	63.41	NE

(continued)

Table 4. (continued)

Scientific name, (Vouchers), Family	Common name (English name)	Rakhine name	Local name (Bengali name)	Habit	Part used	Ailments	Preparation and use	Number of informants citing species (n)	Citation frequency (%)	Conservation (IUCN) status
<i>Ipomoea aquatica</i> Forssk. (BUH-R25) Convolvulaceae	Swamp Morning Glory	Koyenja; Conzoye	Kolmi	Herb	Leaf, stem	Diabetes, ringworm	Young shoots taken orally to treat diabetes. Paste made from buds is used to treat ringworm.	19	46.34	LC
<i>Kalanchoe</i> <i>pinnata</i> Pers. (BUH-R26) Crassulaceae	Life plant	Royechaopembao; Raikkapombom	Pathorkuchi	Herb	Leaf	Stomach ache, constipation, kidney stone	Chewing the green leaves. Leaf extract, toddy sugar, and potash alum took orally.	26	63.41	NE
<i>Coccinia grandis</i> (L.) Voigt (BUH-R27) Cucurbitaceae	Ivy Gourd	Kemuben; Kamui-apang	Telakucha	Climber	Leaf, apical stem	Diabetes	One spoon leaf extract or 6 to 7 leaves taken orally every morning for 1 month helps in controlling diabetes.	15	36.58	NE
<i>Momordica</i> <i>charantia</i> L. (BUH-R28) Cucurbitaceae	Balsam-apple	Tit korola	Korolla	Climber	Leaf	Cuts and wounds	Glue of the leaves is utilized as a disinfectant and applied as a poultice on cuts and wounds.	27	65.85	NE
<i>Cuscuta reflexa</i> Roxb. (BUH-R29) Cuscutaceae	Dodder	Jigro	Swarnalata	Herb	Stem	Jaundice	In the treatment of jaundice, 2 teaspoons of juice got from the squashed stem are taken orally twice every day for 3-4 days.	12	26.26	NE
<i>Dillenia indica</i> L. (BUH-R30) Dilleniaceae	Elephant Apple	Debropay; Dabroti	Chalta	Tree	Bark, fruit	Thrush, coughs	Bark is used as a mouthwash to treat thrush; Fruits are taken internally to treat abdominal disorders. The combination of fruit juice and sugar are used against coughs.	14	34.14	LC
<i>Euphorbia hirta</i> L. (BUH-R31) Euphorbiaceae	Asthma Weed	Dudhia	Dudhia	Herb	Whole plant	Bronchitis, asthma, hay fever, emphysema, coughs	The entire plant is decocted and utilized in the treatment of bronchitis, asthma, emphysema, feed fever, hay fever, coughs, and colds.	19	46.34	NE
<i>Albizia lebeck</i> (L.) Benth. (BUH-R32) Fabaceae	Siris Tree	Kaucoben	Siris tree	Tree	Bark	Septisemia	Half spoon powdered bark is taken after meal once per day.	13	31.7	NE

(continued)

Table 4. (continued)

Scientific name, (Vouchers), Family	Common name (English name)	Rakhine name	Local name (Bengali name)	Habit	Part used	Ailments	Preparation and use	Number of informants citing species (n)	Citation frequency (%)	Conservation (IUCN) status
<i>Albizia saman</i> (Jacq.) Merr. (BUH-R33) Fabaceae	Raintree	Chanben; Kammorsung	Raintree	Tree	Leaf	Insomnia, malaria	To get rid of insomnia, 1 cup of leaf extract is taken daily for 3 to 4 days. 1 kg leaves boiled in 2-liter water and finally make 1 litre infusion then taken 3 spoons in the morning before the breakfast to treat malaria.	16	39.02	NE
<i>Acacia nilotica</i> (L.) Willd. ex Delile (BUH-R34) Fabaceae	Gum arabic tree	Liaben	Babla	Tree	Bark, leaf	Diarrhea, dysentery	Leaf and barks are boiled in the water and then this slightly warmed water is taken to treat diarrhea and dysentery.	18	43.9	LC
<i>Mimosa pudica</i> L. (BUH-R35) Fabaceae	Sensitive Plant	Repa; Shraprem	Lozzaboti	Herb	Root, leaf	Wet dream, jaundice, and boils	Cuttings root in 1 breathe at Saturday / Tuesday and put in emulate and wear in the waist. The paste of leaves taken for treating jaundice and boils.	25	60.97	LC
<i>Pterocarpus santalinus</i> L.f. (BUH-R36) Fabaceae	Red Sandalwood	Nanchani	Rokto chandan	Tree	Wood	Skin disease, headache	Paste prepared from wood and applied externally as a cooling application to boils, skin inflammatory, swollen limbs, ophthalmic, headache and sore eyes. Pods are used as a remedy of malaria, diabetes, and dysentery.	11	26.82	NT
<i>Cassia fistula</i> L. (BUH-R37) Fabaceae	Golden Shower	Mumgbum	Sonalu, Badorlathi	Tree	Ripe pods	Diabetes, dysentery, malaria		17	41.46	LC
<i>Senna alata</i> (L.) Roxb. (BUH-R38) Fabaceae	Ringworm Bush	Daud	Dadmardan	Shrub	Leaf, bark	Skin diseases	A paste made from bark and extract of leaves are used to treat various skin diseases such as ringworms, scabies, eczema and parasitic skin diseases.	15	36.58	LC

(continued)

Table 4. (continued)

Scientific name, (Vouchers), Family	Common name (English name)	Rakhine name	Local name (Bengali name)	Habit	Part used	Ailments	Preparation and use	Number of informants citing species (n)	Citation frequency (%)	Conservation (IUCN) status
<i>Tamarindus indica</i> L. (BUH-R39) Fabaceae	Tamarind	Tatu	Tentul	Tree	Leaf	Menstruation	Two tea spoonful's of leaf juice is taken 2 times in a day and proceeded for 7-8 days to forestall unnecessary feminine cycle (menstruation). Flower extract is taken twice or thrice daily to cure cough.	19	46.34	LC
<i>Clitoria ternatea</i> L. (BUH-R40) Fabaceae	Butterfly pea	Aowmabeowabong	Oporajita	Herb	Flower	Cough		16	39.02	NE
<i>Erythrina variegata</i> L. (BUH-R41) Fabaceae	Coral Bean	Kachaipan	Pania Mandar	Tree	Leaf, bark, flower	Liver complex, cough	An infusion of the bark is utilized in the medication of liver ailments and to induce sleep. The flowers decoction is used to soothe coughs.	18	43.9	LC
<i>Lathyrus sativus</i> L. (BUH-R42) Fabaceae	Chickling Pea	Taowa	Khesari dal	Herb	Seed	Eczema, allergy	250 gm seeds are boiled in water with 4-5 leaves of <i>Datura metel</i> in a pot until the water dries up and obtained juice from the dried portion. 4 drops of juice drunk orally twice in a day on an empty stomach for 3 weeks.		31.7	NE
<i>Clerodendrum infortunatum</i> L. (BUH-R43) Lamiaceae	Glory Tree	Khaukhau; Go-mokha	Vatt	Shrub	Leaf	Helminthiasis, night fever	2-3 raw leaves are taken directly once before breakfast in the morning and once at night after suppers for 3 days.	17	41.46	NE
<i>Mentha piperita</i> L. (BUH-R44) Lamiaceae	Peppermint	Proy	Pudina	Herb	Leaf	Tooth pain	Leaf paste, rock salt, and potash alum mixed in a ratio of 2:1:2 to make mixer and then applied on teeth gum.	21	51.21	NE
<i>Vitex negundo</i> L. (BUH-R45) Lamiaceae	Chinese chaste tree	Soyamvhonroi	Nishinda	Leaf	Leaf	Malaria, dysentery	The leaf is used as preventative medicine for malaria; Also used in the treatment of bacterial dysentery.	13	31.7	LC

(continued)

Table 4. (continued)

Scientific name, (Vouchers), Family	Common name (English name)	Rakhine name	Local name (Bengali name)	Habit	Part used	Ailments	Preparation and use	Number of informants citing species (n)	Citation frequency (%)	Conservation (IUCN) status
<i>Ocimum tenuiflorum</i> L. (BUH-R46) Lamiaceae	Holy basil	Numbuli	Tulshi	Herb	Leaf	Coughs, cold	One to 2 teaspoons of leaf extract mixed with honey is taken twice daily to treat cough.	24	58.53	NE
<i>Ocimum basilicum</i> L. (BUH-R47) Lamiaceae	Sweet Basil	Numbuli	Babui tulsi	Herb	Leaf	Coughs	Half cup leaf juice is taken orally in the first part of the day and night to relieve from cough.	27	65.85	NE
<i>Leucas aspera</i> Link (BUH-R48) Lamiaceae	Leucas	Chuai-konae	Swetadrone	Herb	Leaf	Body pain	Internally leaf juice is consumed for pain or inflammation inside the body. Dried leaf powder is taken through the nose to prevent bleeding from wounds or sores in the nose.	23	56.09	NE
<i>Barringtonia asiatica</i> (L.) Kurtz (BUH-R49) Lecythidaceae	Fish poison tree; Sea poison tree	Cheche	Samudra hizal	Tree	Seed	Coughs	One seed grinded with honey to make a paste and taken orally thrice per day after meal.	26	63.41	LC
<i>Lawsonia inermis</i> L. (BUH-R50) Lecythidaceae	Henna	Dabang	Mehedi	Shrub	Leaf	Leprosy, wounds, ulcers, and herpes	The leaves are used externally to treat various dermatitis diseases including leprosy such as ulcers, wounds, and herpes.	28	68.29	NE
<i>Punica granatum</i> L. (BUH-R51) Lythraceae	Pomegranate	Dalongroy	Dalim	Shrub	Leaf	Piles	4-5 raw leaves chewed in a day.	11	26.82	LC
<i>Bombax ceiba</i> L. (BUH-R52) Malvaceae	Red Silk Cotton Tree	Lepaiben	Shimul	Tree	Bark, root	Ringworm, physical weakness	The bark is boiled in water and rubbed into paste then applied to the wounded region. The young root is eaten as an energy source.	29	70.73	LC
<i>Hibiscus rosa-sinensis</i> L. (BUH-R53) Malvaceae	Chinese hibiscus	Nepe	Jaba ful	Shrub	Flower	Menstruation	Flowers are used to promote irregular menstruation.	26	63.41	NE

(continued)

Table 4. (continued)

Scientific name, (Vouchers), Family	Common name (English name)	Rakhine name	Local name (Bengali name)	Habit	Part used	Ailments	Preparation and use	Number of informants citing species (n)	Citation frequency (%)	Conservation (IUCN) status
<i>Abroma</i> <i>augustum</i> (L.) L.f. (BUH-R54) Malvaceae	Cotton Abroma	Tongkangja	Ulothkombal	Shrub	Leaf	Diabetes	Boiled leaf extract is taken in as a treatment to diabetes.	18	43.9	NE
<i>Azadirachta</i> <i>indica</i> A.Juss. (BUH-R55) Meliaceae	Neem	Tamabe; Tamma	Neem	Tree	Leaf, root	Chickenpox, high blood pressure, and gastritis	Boiled leaf extract used during a bath as a treatment to chickenpox. Half cup of root extract is taken 2 to 3 times in a day until the chicken pox is healed. In addition, root extract is also taken for the treatment of hypertension and gastritis.	23	56.09	LC
<i>Stephania</i> <i>japonica</i> Miers (BUH-R56) Menispermaceae	Snake Vine	Chilenfoi	Thanda manic	Climber	Leaf	Migraine	Leaf paste applied on carbuncle; Paste is also applied on the forehead to reduce migraines.	9	21.95	NE
<i>Tinospora</i> <i>cordifolia</i> Miers (BUH-R57) Menispermaceae	Heart-leaved moonseed	Sensomanoi	Guloncho	Herb, climber	Stem, root	Diarrhea and dysentery, urinary disease (Meho)	Extracts of root and stem are used for the treatment of diarrhea and dysentery. Leaves are eaten to treat urinary disease (Meho).	17	41.46	NE
<i>Ficus benghalensis</i> L. (BUH-R58) Moraceae	Banyan	Nyaung motesate	Bot gach	Tree	Leaf, BARK	Dysentery, diarrhea	The leaves are used to remedy of dysentery and diarrhea.	12	29.26	NE
<i>Moringa oleifera</i> Lam. (BUH-R59) Moringaceae	Horseradish Tree	Dendalum	Sazina	Tree	Leaf, root	Asthma	Young leaves are taken internally to increase the milk flow in nursing mothers; Root juice is used internally in the treatment of asthma, enlarged spleen and liver, bladder, and kidney stones.	22	53.65	NE
<i>Musa paradisiaca</i> L. (BUH-R60) Musaceae	Banana	Ghaatpyawsee; Kela	Kola	Shrub	Fruits	Diarrhea	Unripe fruits and their sap are eaten, as a treatment for diarrhea.	25	60.97	NE

(continued)

Table 4. (continued)

Scientific name, (Vouchers), Family	Common name (English name)	Rakhine name	Local name (Bengali name)	Habit	Part used	Ailments	Preparation and use	Number of informants citing species (n)	Citation frequency (%)	Conservation (IUCN) status
<i>Syzgium cumini</i> (L.) Skeels (BUH-R61) Myrtaceae	Indian black-berry	Cha-briishi	Jam, Kalojam	Tree	Seeds	Diabetes, dysentery	Dried and powdered seeds are made into tablets. Two tablets are taken daily till cure.	21	51.21	LC
<i>Psidium guajava</i> L. (BUH-R62) Myrtaceae	Guava	Goyabay; Goiom-bong	Peyara	Tree	Leaf, fruits	Dysentery, diarrhea, diabetes	Leaves and fruits are used as a cure for diarrhea and dysentery. Water from soaking the fruit is used to treat diabetes.	19	46.34	LC
<i>Syzgium</i> <i>aromaticum</i> (L.) Merr. & L.M.Perry (BUH-R63) Myrtaceae	Clove	Liliniye	Lobongo	Tree	Fruits	Stomach upsets, chills, and impotence	Clove can be boiled in hot water and drunk regularly as a tea to treat stomach parasites, stomach upsets, colds and impotence.	18	43.9	NE
<i>Syzgium jambos</i> (L.) Alston (BUH-R64) Myrtaceae	Rose apple	Jaimbuk tabri	Jamrul, Golapiam	Tree	Leaf	Body pain, rheumatic pain, muscle pain, urinary problems	The leaf paste is applied to the sore spot to relieve the pain. The leaves are also boiled in water to get relief from urination.	15	36.58	LC
<i>Boerhavia diffusa</i> L. (BUH-R65) Nyctaginaceae	Spreading Hogweed	Perunoa	Punarnava	Herb	Leaf	Jaundice	In the treatment of jaundice, leaf decoction is taken internally and in the treatment of snake venom is used as an antidote.	14	34.14	NE
<i>Oxalis corniculata</i> L. (BUH-R66) Oxalidaceae	Yellow Sorrel	Menoichabi; Kamduahung	Amrul	Herb	Whole plant	Influenza, fever, enteritis, diarrhea	The whole plant parts is used in the form of juice and taken orally to treat influenza, fever, enteritis, diarrhea, and poisonous snake bites.	26	63.41	NE
<i>Phyllanthus</i> <i>emblica</i> L. (BUH-R67) Phyllanthaceae	Emblic / Amla	Gefruci; Sesathe; Chele-chibong	Amloki	Shrub	Fruits	Distaste	Powdered fruit (excluding seed) is taken orally half spoon per day.	25	60.97	NE

(continued)

Table 4. (continued)

Scientific name, (Vouchers), Family	Common name (English name)	Rakhine name	Local name (Bengali name)	Habit	Part used	Ailments	Preparation and use	Number of informants citing species (n)	Citation frequency (%)	Conservation (IUCN) status
<i>Piper betle</i> L. (BUH-R68) Piperaceae	Betel Pepper	Poa	Pann	Herb, climber	Leaf	Wounds, ulcers, boils, bruises, Diabetics	Bettle leaves are extracted and taken orally once time per day for 3 months to treat diabetics. In the treatment of wounds, boils, ulcers, and bruises, leaf is used.	27	65.85	NE
<i>Piper nigrum</i> L. (BUH-R69) Piperaceae	Black pepper	Noroketibe	Golmorich	Shrub	Seed	Gastric, indigestion	In the treatment of gastric and indigestion seeds are taken internally. It is taken orally to relieve nausea due to food poisoning, stomach chills, dysentery, cholera, diarrhea, and cold.	16	39.02	NE
<i>Peperomia pellucida</i> Kunth (BUH-R70) Piperaceae	Man to mam	Chasherrow	Luchipata	Herb	Leaf, stem	Bronchitis, asthma gout, headache	In the treatment of gout, arthritis, bronchitis, headache and asthma, leaf is used.	10	24.39	NE
<i>Cynodon dactylon</i> (L.) Pers. (BUH-R71) Poaceae	Bermuda grass	Seray	Durba gash	Herb	Whole plant	Cut and wound, bleeding during menstruation	The leaves are crushed and applied to minor wounds to stop bleeding as a styptic. Juice prepared from the whole plant parts and 15 gm is taken internally twice per day to reduce excess bleeding during menstruation.	25	60.97	NE
<i>Nigella sativa</i> L. (BUH-R72) Ranunculaceae	Black Cumin	Sembanee; Kaillazera	Kalozira	Herb	Seed	Headache, rheumatic pains, asthma, and coughs.	Ripe seeds are used to treat headache, rheumatic pains, asthma, and coughs. Seeds are beneficial for the digestive system.	12	29.26	NE
<i>Ziziphus mauritiana</i> Lam. (BUH-R73) Ranunculaceae	Indian Jujube	Jikrao; Zebai	Boroi	Tree	Root	Wounds, ulcers	Powder made from the leaves is applied externally to the wound site to heal old wounds and is used internally to treat ulcers.	13	31.7	NE

(continued)

Table 4. (continued)

Scientific name, (Vouchers), Family	Common name (English name)	Rakhine name	Local name (Bengali name)	Habit	Part used	Ailments	Preparation and use	Number of informants citing species (n)	Citation frequency (%)	Conservation (IUCN) status
<i>Aegle marmelos</i> Corrêa (BUH-R74) Rutaceae	Golden apple	Araici; Orai-si-apang	Bael	Tree	Leaf, fruit	Dysentery, vomiting	In the treatment of dysentery, a paste made of about 100 grams of leaves is mixed well with a cup of water and taken internally once a day for 3 days. A glass of juice prepared from the fruit is immediately drunk to prevent vomiting.	31	75.6	NE
<i>Citrus limon</i> (L.) Burm.f. (BUH-R75) Rutaceae	Lemon	Chemfraji; Kowazi	Lebu	Shrub	Fruit	Malaria, scurvy	Fruits are eaten in treating malaria and other fevers. An ounce of lemon is given each day to prevent scurvy.	14	34.14	NE
<i>Citrus grandis</i> Osbeck (BUH-R76) Rutaceae	Pomelo	Kauchi	Jambura	Tree	Leaves, flowers, and fruits, and seeds	Coughs, fevers, and gastric disorders	Leaves, flowers, fruits, and seeds are used internally to treat coughs, fevers, and gastric disorders.	16	39.02	NE
<i>Datura metel</i> L. (BUH-R77) Solanaceae	Thorn Apple	Pathainchunchen; Row-shan-thei	Dutra	Herb	Leaf	Arthritis	Leaf paste is mixed with kerosene and salt and applied externally to the affected pain region. Fitkiri (potash alum) mixed with leaf paste is used for polish in the swelling area after injection.	11	26.82	NE
<i>Nicotiana tabacum</i> L. (BUH-R78) Solanaceae	Tobacco	Chi	Tamak	Herb	Leaf	Gangrene	Powdered leaf applied to the wounded region.	7	17.07	NE
<i>Solanum torvum</i> Sw. (BUH-R79) Solanaceae	Turkey berry	Tit bayun	Tit Begun	Herb	Leaves and fruits	Fever, wounds, tooth decay, reproductive problems, and arterial hypertension.	Leaf extracts are used to treat wounds, fever, tooth decay, arterial hypertension and reproductive problems.	18	43.9	NE
<i>Solanum lycopersicum</i> L. (BUH-R80) Solanaceae	Tomato	Khorobaiyon	Tomato	Herb	Leaf	Tuberculosis	In the treatment of tuberculosis, half a cup of leaf extract mixed with sugar is taken twice a day.	16	39.02	NE

(continued)

Table 4. (continued)

Scientific name, (Vouchers), Family	Common name (English name)	Rakhine name	Local name (Bengali name)	Habit	Part used	Ailments	Preparation and use	Number of informants citing species (n)	Citation frequency (%)	Conservation (IUCN) status
<i>Cissus</i> <i>quadrangularis</i> L. (BUH-R81) Vitaceae	Devil's Backbone	Zejonglasa	Harjora	Climber	Root, leaf	Fractured bones	Powder made from the root is applied to heal broken bones and injured ligaments and tendons.	28	68.29	NE
<i>Zingiber officinale</i> Roscoe (BUH-R82) Zingiberaceae	Ginger	Senn	Ada	Herb	Root, rhizome	Indigestion, colds, coughs, influenza	The root of this plant is taken internally to prevent nausea. Root extracts and paste is also used for the treatment of colds, influenza, coughs, indigestion, shortness of breath, chills and peripheral blood circulation.	29	70.73	DD
<i>Curcuma amada</i> Roxb. (BUH-R83) Zingiberaceae	Mango Ginger	Cheifusi	Aam Ada	Herb	Root (bulb)	Indigestion, skin wounds	The bulb is taken internally to treat digestive problems such as wind, stomach pain, indigestion, appetite, constipation, colic, bad breath, and loss of hiccups. The bulb of this plant is also used in the treatment for coughs and other chest complaints like as bronchitis. Moreover, in the treatment of wounds, bruises, sprains and ulcers, the mashed or grated root is applied externally on the skin.	22	53.65	NE
<i>Curcuma</i> <i>aromatica</i> Salisb. (BUH-R84) Zingiberaceae	Wild Turmeric; Wild Ginger	Falau	Shoti	Herb	Rhizome	Jaundice	Rhizomes are steamed or boiled after drying and grinded into powder and eaten orally to treat jaundice.	18	43.9	NE

(continued)

Table 4. (continued)

Scientific name, (Vouchers), Family	Common name (English name)	Rakhine name	Local name (Bengali name)	Habit	Part used	Ailments	Preparation and use	Number of informants citing species (n)	Citation frequency (%)	Conservation (IUCN) status
<i>Elettaria cardamomum</i> Maton (BUH-R85)	Cardamom	Alachi	Elachi	Shrub	Fruit, seed	Indigestion	In the treatment of indigestion, seeds are taken internally.	17	41.46	NE
Zingiberaceae <i>Curcuma longa</i> L. (BUH-R86)	Turmeric	Noyeging	Holud	Herb	Rhizome	Digestive problem, skin complaints, jaundice, liver disease, menstrual problem, rheumatism, cough, and tuberculosis.	Rhizome is taken internally in the treatment of digestive and skin complaints, poor circulation, uterine tumors, jaundice, liver disease, menstrual problems, rheumatism, and to relieve cough and tuberculosis. Externally, the rhizome is used to treat a range of skin conditions including itch, insect bites, small injuries, sores and ringworm. The powdered rhizome is used in a treatment for sores and rashes in infants.	21	51.21	DD

*IUCN Red List Categories (2017) Version 2017-1.

NE, not evaluated; DD, data deficient; LC, least concern; NT, near threatened; VU, vulnerable; EN, endangered; CR, critically endangered; EW, extinct in the wild; EX, extinct.

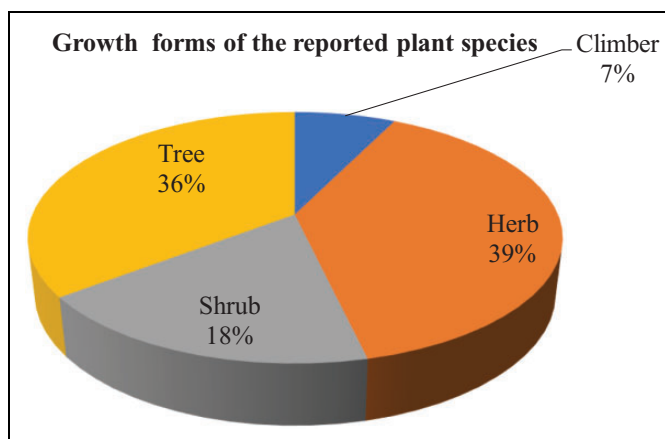
Table 5. Ailment Categories and Informant Consensus Factor (ICF).

Sl. No.	Category of ailment	No. of taxa (N _{taxa})	No. of use reports (N _{ur})	Informant consensus factor (ICF)
1	Gastro-intestinal complains: Diarrhea, Dysentery, Gastric, Stomach pain, Indigestion, Digestive disorders, Constipation, Cholera, Ulcer	43	193	0.78
2	Oral and dental problems: Mouth wash, Toothache, Tooth decay, Thrush	6	9	0.37
3	Dermatological problems: Leprosy, Ringworm, Eczema, Skin disease, Scabies, Scurvy	36	51	0.30
4	Respiratory problems: Cough and cold, Asthma, Bronchitis, Influenza	17	26	0.36
5	Liver disease: Jaundice	7	8	0.14
6	Diabetes: Diabetics	10	33	0.71
7	Fever: Malaria, Dengue, Common fever, Night fever	16	35	0.55
8	Head ache	3	4	0.33
9	Inflammation and pain: Rheumatic pain, Back pain, Body pain, Muscle pain, Waist pain	4	11	0.70
10	Cardiovascular diseases: Hypertension/High blood pressure	4	6	0.40
11	Female problems: Menstruation	3	5	0.50
12	Cut, wound, and bleeding	8	31	0.76
13	Urinary disease: Meho (endocrinological disorders)	2	3	0.50
14	Other disorders: Hair fall, Gangrene, Fat reducer, Septicemia, Insomnia, Wet dream, Adult malnutrition, Kidney stone, Helminthiasis, Piles, Migraine. Distaste, Boils, Vomiting, Arthritis, Tuberculosis, Fractured bones	18	57	0.69

area. The recorded plant species were put in order to their botanic name, family, common name (English name), vernacular name (Rakhine name), local name (Bengali name), habit, parts used, ailments and mode of uses (Table 4). Among the reported 86 plant species, 39% herbs, 36% are trees, 18% shrubs and 7% are climbers identified based upon their habit-wise obtainability in the survey area (Figure 3). Among the families studied, Fabaceae was noticed to be the topmost described family with regard to the number of plant species containing 11 plant species, followed by 6 plant species containing Lamiaceae ranked the second and 5 species consisting Zingiberaceae family placed third. Moreover, Arecaceae, Myrtaceae, and Solanaceae families each have 4 species and Apocynaceae, Combretaceae, Malvaceae, Piperaceae families are each consists of 3 plant species. Rutaceae, Myrtaceae, Menispermaceae, Cucurbitaceae, and Apocynaceae belong to each 2 plant species. Besides this, other of the remaining families is represented by 1 species (Figure 4).

Medicinal Ailments and Uses of the Reported Species

Traditional medicinal uses of plant species reported by the informants from the Rakhine community living in the research area were investigated (Table 4). The Rakhine community uses a varied collection of plants as medicine to treat a multiplicity of ailments. A add up to 86 plant species beneath 71 genera of 43 families have been archived which are utilized for the treatment of 57 different physical sicknesses beneath 14 sickness categories (Table 5) with distinctive formularies. The maximum numbers of ethno-medicinal plant species were utilized

**Figure 3.** Habit-wise analysis of therapeutic plant species utilized by Rakhine people in the study area.

to treat gastrointestinal complaints (43) followed by the treatment of dermatological problems (36). Only 2 species were documented for the treatment of urinary diseases such as meho (endocrinological disorders).

We have noticed that the Rakhine community has used multiple plants and plant parts to prepare medicines for the treatment of a single disease. The most commonly used part of the plant for the preparation of medicine is the leaf, as well as other plant parts such as root; rhizome and bulb (16%), stem and young shoots, fruit, bark, seed, flower, and inflorescence are also used as active ingredients for preparing raw materials of medicine (Figure 5).

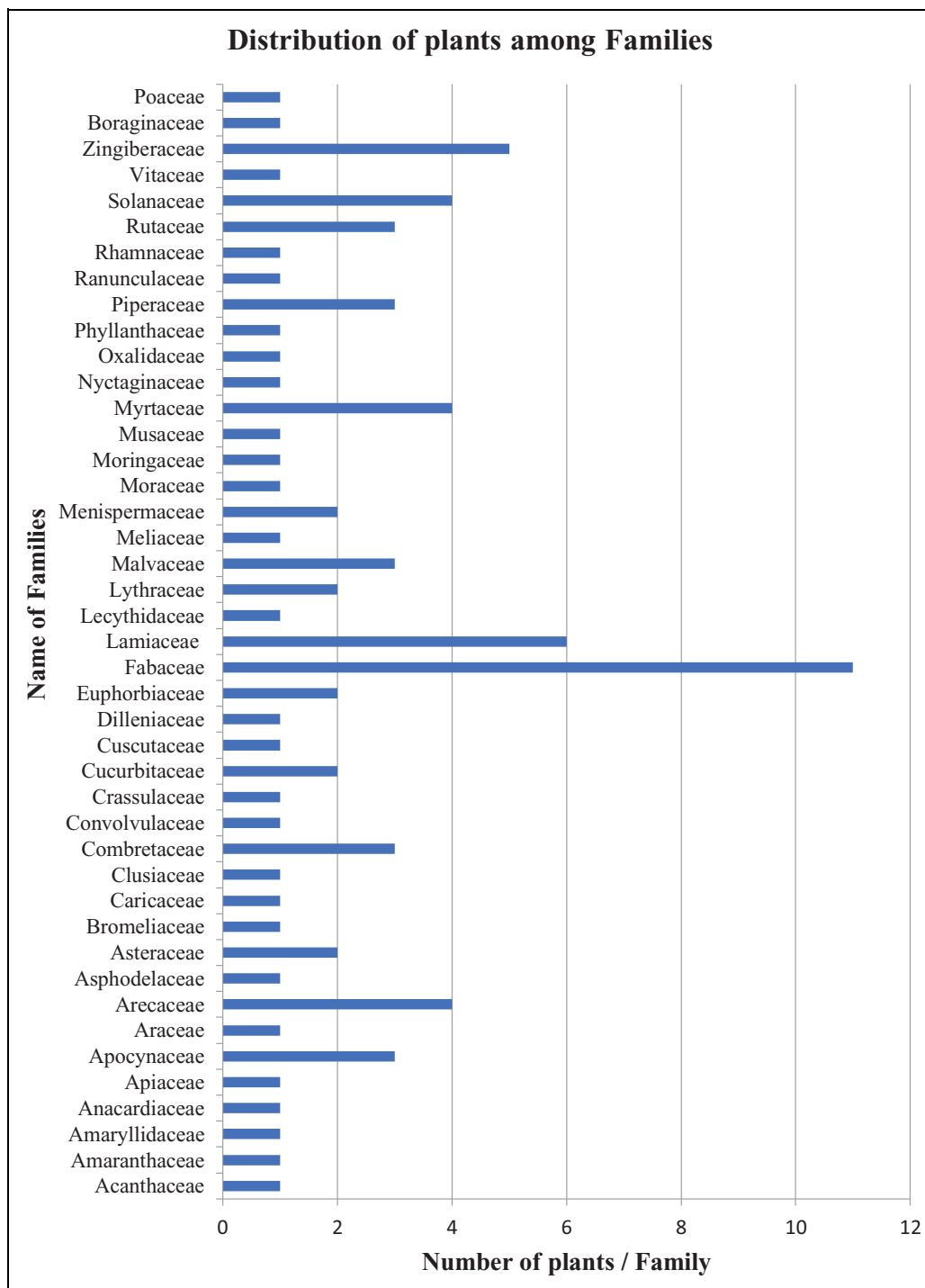


Figure 4. Family-wise distribution of medicinal plant species in the study area.

Modes of Preparation and Administration

The most notable methods of preparation are juice (extract or sap of any plant part), paste and decoction (boiling plant parts) and powder; mixtures (soaking plant parts in water) and shower also utilized once in a while. Ingredients prepared as pastes, juices or decoctions are blended with a variety of spices, honey,

milk, oils or other pharmacological agents. Medications that are prescribed orally are mainly used for cough and cold, fever, diarrhea, dysentery, gastric, abdominal pain, indigestion and digestive disorders. In addition, leaf juice and paste are used directly on skin lesions in cases of wounds and dermatitis. And in the case of painful diseases, the paste of the leaves is massaged at the place of pain.

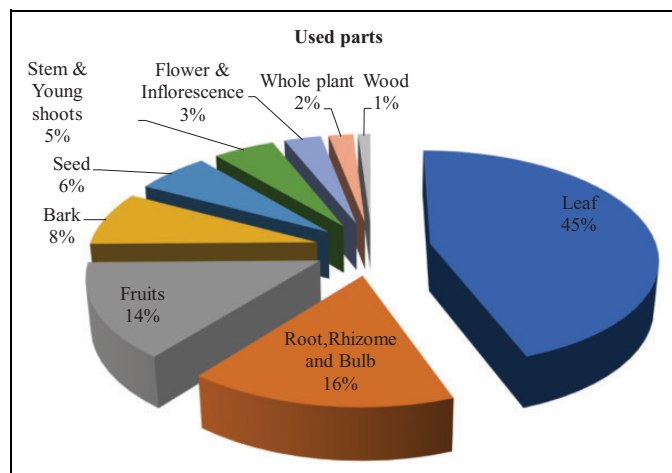


Figure 5. Plant parts used of studied medicinal plants species by the Rakhine community in the study area.

Informant Consensus Factor (ICF)

Informant consensus factor was analyzed and estimated for evaluating the homogeneity of the use of the medicinal plants and determining the plants which are particularly attractive in the detection of organic functional compounds. Table 5 showed the ICF values achieved for the classified ailment. The ICF values were fluctuated from 0.14 to 0.78 in this study. The highest ICF value was found in the ailments categories are gastrointestinal complaints (0.78) and subsequently followed by a cut, wound and bleeding (0.76), diabetics (0.71), and inflammation and pain (0.70) while the lowest ICF value was 0.14 for liver disease (jaundice).

Citation Frequency (Cf)

The highly cited (75.60%) species were *Ananas comosus* and *Aegle marmelos* and used for gastro-intestinal digestive disorders. Rakhine people commonly use these plants in large quantities to cure stomach pain, indigestion, dysentery, vomiting, etc. In addition, *Colocasia esculenta* (70.73%), *Lawsonia inermis* (68.29%), *Momordica charantia* (65.85%), *Mikania micrantha* (65.85%), *Piper betle* (65.85%), *Cynodon dactylon* (60.97%) all of these plants have been cited most frequently for cut, bleeding and wound healing. Besides, *Ocimum basilicum*, *Barringtonia asiatica*, *Zingiber officinale* were cited maximum times for colds and coughs whereas *Cissus quadrangularis* cited maximum for fractured bones. Frequency of citation was ranged from 17.07 to 75.60 in the investigated medicinal plant species (Table 4).

Conservation Status of the Reported Species

Conservation status of the species reported in this study has been assessed according to the IUCN Red List of Threatened Species (Table 4). According to the IUCN Red List Categories and Criteria (<https://www.iucnredlist.org>), the plants reported in this study include 4 plant species Data Deficient (DD),

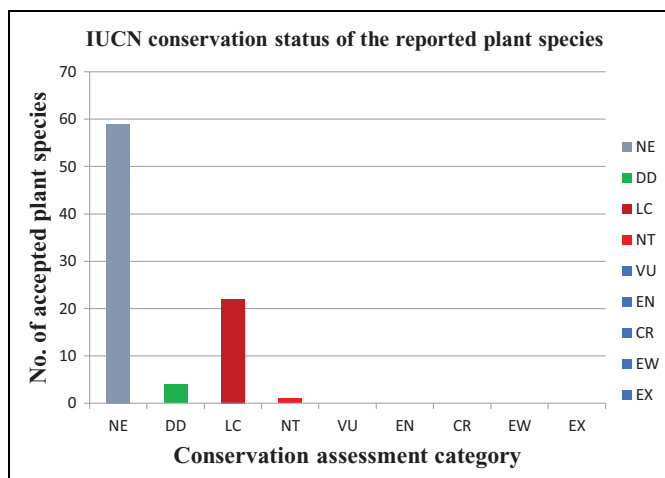


Figure 6. Conservation status of the reported plant species according to IUCN red list categories and criteria.

22 Plant species Least Concern (LC), 1 plant namely *Pterocarpus santalinus* L.f. Near Threatened (NT) and rest of the plant species are included in the Not Evaluated (NE) category (Figure 6). We also evaluate the current availability status of the medicinal plants reported in this study in their natural habitat. This was noticed through visual observation based on our plot inventories (density of living trees and stumps) and interviews with forest rangers and local people during the field investigation. Observed conservation status of the listed medicinal plants at the local level was measured following the IUCN Red List Categories and Criteria, version 2020-2.⁴⁴ The documented species in the study were categorized into 5 types (Critically Endangered (CR), Endangered (EN), Vulnerable (VU), Near Threatened (NT) and Least Concern (LC)) depending upon their current conservation rank in the environment.

It is to be very promising and encouraging news that, none of the reported 86 plant species under 71 genera of 43 families have faced any critically endangered and endangered status. However, 7 species namely *Garcinia cowa* Roxb., *Syzygium jambos* L., *Nypa fruticans* Wurmb., *Dillenia indica* L., *Bombax ceiba* L., *Terminalia arjuna* (Roxb. ex DC.) Wight & Arn., and *Pterocarpus santalinus* L.f. are not so common in the study area and might be in a vulnerable status (Figure 7). In addition, rest of the plant species have been found in sufficient numbers in their natural habitat. The accessible species were also found as wild and cultivated in the natural habitat.

Discussion

The Present Status and Trends of Rakhine Indigenous Population in the Study Area

Several researchers²⁴⁻²⁶ have worked on the ethno-botanical use of the Rakhine community in Patuakhali and Cox's Bazar, but none of them has shed light on the whereabouts and location of Rakhine whereas we did it. The localities of the Rakhine community that we identified in the study area are very similar



Figure 7. Photos of the vulnerable medicinal plant species in the study area. (A) *Garcinia cowa*, (B) *Syzygium jambos*, (C) *Nypa fruticans*, (D) *Dillenia indica*, (E) *Bombax ceiba*, (F) *Terminalia arjuna*.

to the BBS (2011) Population and Housing Census report, except for 1 locality. Our study found the existence of several Rakhine families in Taltoli Upazila of Barguna district but according to the BBS (2011) report, no Rakhine population was present in Taltoli Upazila. While this study does show the existence of Rakhine people in the study areas but they are minor in numbers in terms of population. According to several reports published in a number of renowned national dailies^{30,45} of Bangladesh, the number of population of the Rakhine community in Patuakhali and Barguna districts is declining day by day⁴⁶. These reports say the community had around 100,000 people more than a few decades ago, but currently there has only around 2,500 Rakhine peoples in 2015 and it was reported 144 Paras in Barguna and 93 Paras in Patuakhali in 1948, but at present days this number has concluded to 26 and 13 correspondingly. The Population and Housing Census 2001 report conducted by the Bangladesh Bureau of Statistics³³ stated that a total of 526 tribal Rakhine members live in the entire Patuakhali district and out of the maximum 474 people live in kalapara Upazila. On the other hand, 667 Rakhines were found in Barguna district, out of which a maximum 460 live in Amtali Upazila. However, according to the latest population census report of 2011, the number of Rakhine population in the study

areas has increased slightly. In that report, the total number of Rakhine population in Patuakhali region was 1310 whereas 1059 was the total number of Rakhine population in Barguna region.³⁴ Decline in the number of Rakhine population has been attributed due to oppression and land grabbing by local powerful people in the areas of Patuakhali and Barguna district. In these 2 districts, about 95% of the Rakhine population declined in the last 100 years, whereas 81% of the Rakhine reimbursements were unlawfully grabbed. 19 Buddhist temples had existed in the areas but now remaining only 1 since 2015. The 150-years-old Rakhine cemetery placed in Taltali Upazila of Barguna District has been forcibly occupied by local land grabbers. Rakhine land in Patuakhali district has been occupied by politicians.^{28,30,47}

Demographic Data of the Informants

The informants in this study mostly ranged from 45 to 55 years old (51.21%), 56 to 65 years old is 31.70%, and remaining 17.07% of the aged 66 to above. It reflects the older profile of this community's knowledge base on the use of medicinal plants.¹⁰ It is, however, of great concern that the Rakhines are slowly losing their earlier glorious heritage of plant-based

knowledge about the medicinal uses of plants. The younger generation, on the other hand, is showing no interest in or even neglecting toward conventional medication system and is looking to add a new dimension to modern therapy.¹⁹⁻²¹ They always prefer to go to health centers or doctors than their parents. The current generation has lost interest in continuing their parents' profession because it does not contribute adequate financial aid. Most of the young generation is becoming dependent on modern and synthetic medicine. Due to the deforestation and destruction of plant habitats as a result of various anthropogenic activities, there has a shortage of plant resources required for fulfilling the present necessities for the preparation of medicines. Our observations coincide with those reported by several other,^{9,10,13,19,20,21} researchers.

Medicinal Plants Recorded in the Study Area

In our study we identified and documented 86 plant species belonging to 43 families from the studied area whereas Hanif et al.,²⁴ identified 34 plant species belonging to 24 families by studying on the Rakhine tribe dwelling in the Chittagong Hill Tracts of Bangladesh. In addition, Uddin and his colleagues conducted an ethnomedicinal study on the Rakhine ethnic community in the Cox's bazar district of Bangladesh, describing the ethnomedicinal use of a total of 72 plants belonging to 51 families. Moreover, Joy et al.,²⁶ described 15 plant species belonging to 12 families by studying from 2 areas of Rakhine tribal communities in the Patuakhali district. Rahman et al.,³⁵ identified and documented a total of 265 plant species belonging to 75 families and 204 genera from Kuakata National park of Patuakhali district in Bangladesh. It was also found in this study that Fabaceae family is the most commonly used medicinal plant by the Rakhine community. Many researcher from home⁹⁻²¹ and abroad^{27,31} reported similar findings that, Fabaceae family consists a big number plant species. The dominance of this family can be explained by the predominance of the higher global number of species (19,400 species) included in this family worldwid,^{48,49} and of course the higher diversity of plants belonging to this family and the presence of maximum number of species in the current study area. Rahman et al.,³⁵ in his study at Kuakata National Park, presented exactly the same picture of the plant abundance of Fabaceae family. The most commonly used medicinal plants in our study were herbs (39%) and trees (36%). This is probably due to the fact that, this geographical area naturally has an abundance of trees and herbs. And this is very easy accessible to the Rakhine community as well as traditional healers. Similar results were observed with other studies conducted in different regions of Bangladesh.⁹⁻²²

Medicinal Ailments, Uses and Administration of the Reported Species

The results show that Rakhine ethnic groups of Patuakhali and Barguna districts still depends on plant-based medicinal treatment for both common and complicated diseases. It was

observed that Rakhines are used different plant and plant parts for the medication of different diseases and illnesses as remedy in daily life. The maximum commonly treated disease/illness are gastro-intestinal tract disorders (GIT) and respiratory problems such as Diarrhea, Dysentery, Gastric, Stomach pain, Indigestion, Digestive disorders, Constipation, Cholera, Ulcer, Cough and Cold, Asthma, Bronchitis, Influenza e.t.c. Moreover, dermatological ailments like Leprosy, Ringworm, Eczema, Skin disease, Scabies, Scurvy and general weakness with burning and headache (GBH); fever; jaundice; menstrual problem; vomiting; insomnia; leucorrhoea and high blood pressure (HBP), toothache, inflammation and pain, urinary diseases are also treated by various medicinal plants. The results from this study are consistent with other researchers,^{9,10,11,13} where they reported that the maximum number of plants is used to treat gastrointestinal complaints. In addition, in the case of Informant consensus factor (ICF) value, our findings demonstrate harmony with several other researchers^{9,10,18} who have worked on different ethnic communities in different parts of the country and found that gastrointestinal digestive disorders had the highest ICF values. In a quantitative ethnobotanical study in the Barisal district of Bangladesh, Hossain and Rahman,⁵⁰ reported the highest ICF value was found in the cut, wound, and bleeding (0.951) and these results are often in similar with our findings, which reinforce the findings of the original research.

Our research shows that people in the Rakhine community choose to use the leaves of plants in most of the time as for medicine. This is probably due to the cheap availability of leaves and the fact that the leaves can be easily collected, preserved, processed, and handled. Exactly the same kind of observation as our observation has been mentioned by previous researchers⁵¹⁻⁵⁵ in their research. It is much easier to collect leaves than roots, stems, flowers and fruits and it can be used very easily as medicine.^{55,56} "The leaves are the main photosynthetic organs containing photosynthates that might be responsible for medicinal values."^{57,58} Another reason for using leaves could be concerning the conservation of the plants as excessive use of roots, seeds, flowers, fruits, and even sometimes the whole plant might be the cause of death of the plant or make hindrance in regeneration and putting the species in a vulnerable condition.^{50,58}

The maximum number of applications of medicine is orally administered. It is also called an internal application. That means, Rakhine community preferred to take medicine by orally. Like other ethnic communities, Rakhine peoples believe that taking medicine internally into the body is most effective. Comparative discoveries were also reported by other researchers.²⁴⁻²⁶ Topical or close applications of plants as medicines are also largely favorable to them in additional cases.

Conservation Status of the Reported Species

Of the 86 medicinal plant species reported in this study, all but 7 were found to be adequate in their natural and cultivated habitat, and 7 plants were shown to have Vulnerable (VU)

observed status. Of these, 1 plant namely *Pterocarpus santalinus* L.f. has been described as Near Threatened (NT) in the IUCN (2017) Red List category⁵⁹ and *Syzygium jambos*, *Nypa fruticans*, *Dillenia indica* and *Bombax ceiba* plants have been described as List Concern (LC). In a study conducted of wild edible minor fruits used by local people in the Barisal region of Bangladesh, Islam and his co-researchers²³ reported the *Garcinia cowa* Roxb. plant as a vulnerable and *Syzygium jambos* L. plant as an endangered species. As these plants are wild and are being used indiscriminately by humans for their needs, as a result, their numbers in natural habitats are declining day by day. For example, the leaves of the Nipa plant are widely used by the local peoples for roofing and fencing, resulting in a shortage of *Nypa fruticans* plants in the area.

Limitations of the Study

In this study, we have tried to uncover the information about what plants are used and how to use (method of usage of herbal preparations) these plants by Rakhine indigenous community to cure their disease in daily life, but most of the cases, we have had very little success; because Rakhine traditional healers believe that if they disclose the knowledge to us particularly to urban people it might diminish the effect of medicinal properties of the plants. Similar observations were also reported earlier by other researchers.^{9,10,13,20,21,60} Most of the THPs we interviewed confess that they protect plant knowledge from the public and each other with care for professional aims. We have seen that knowledge here is passed on orally from one generation to the next. The transfer of knowledge outside the family was possible only in the case of adequate payment. This kind of privacy ensured one's strength and importance in the local society. Also, strict privacy prohibits the general public from using therapeutic plants arbitrarily. However, they shared part of their knowledge with us.

Conclusion

This research focuses on the listed documentation of plant species and traditional herbal uses by the Rakhine tribal communities in Patuakhali and Barguna districts of southern Bangladesh. This study also depicts the diversity of ethnic plant species in the area as well as the present-day obtainability status of the species. The study draws more attention to the alarming and vulnerable present status of Rakhine tribal communities in the study areas. Rakhine ethnic groups are important and valuable anthropological human resources for their traditional ethno-medicinal knowledge in Bangladesh. The Rakhine community plays an important role in the conservation of medicinal plants by planting in the vicinity of their dwelling places for medicinal and cultural purposes. However, it has been observed that despite the considerable plant diversity in the study area, the number of Rakhine is declining day by day due to oppression and land grabbing by local influential.

As an ultimate result, we lost plant-based traditional medicinal knowledge of Rakhine indigenous communities in

Bangladesh. But their traditional knowledge about plants could be an important source of information for searching for new drug discoveries. The present-day status of Rakhine tribal community in the research areas demands urgent attention for research and development efforts to preserve their traditional ethno-medicinal knowledge. So, further research suggested might be the searching way of conservation techniques of Rakhine people and their traditional ethno-medicinal knowledge. We suggested proper take care of Rakhine indigenous communities as well as preserve their conventional knowledge about plants in the research area.

Therefore, immediate action should be needed from the government side to conserve the Rakhine ethnic groups' diversity in the study areas. And this is essential for the conservation of Rakhine ethnic diversity and heritage in study area. In addition, successful conservation strategies should be developed and priority given to sustainable harvesting of the plants which include proper steps for the propagation and conservation of the medicinal plants including the vulnerable species.

Authors' Note

Ethical approval was taken from the Research and Ethics Committee, Department of Botany, University of Barisal. We also sought permission from the administrative authorities of Patuakhali and Barguna district and later from the tribal chiefs of the Rakhine community in the study area. ATMRI was the principal investigator of the research project. He generated the idea, drafted the proposal, carried out all field surveys, collected the plant materials, and wrote the final manuscript for publication. MH, TI, and AR were assistants of the principal investigator and assisted during the field study. SM and SKD were involved in the preparation of the manuscript to be submitted. All authors have read and agreed to the manuscript.

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Declaration of Conflicting Interests

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ORCID iD

A. T. M. Rafiqul Islam, MSc  <https://orcid.org/0000-0001-5743-0608>

Supplemental Material

Supplemental material for this article is available online.

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