Towards exploration of plant-based ethno-medicinal knowledge of rural community: Basis for biodiversity conservation in Bangladesh

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Abstract

Because lack of data impedes the assessment of the conservation of medicinal plants, ethno-medicinal studies are important to fill this gap. This study considered the traditional use of plants for health care by the rural communities in two forested and non-forested regions of Bangladesh. A total of 230 respondents were interviewed accompanied by field observation and voucher specimen collection. Altogether, 68 species of medicinal plants belonging to 38 families distributing over 58 genera were recorded, of which 22 species were common in both regions. Trees were the most commonly utilized growth form and leaves were the most commonly used plant part. Forests and homesteads were the major sources of medicinal plants in forested and non-forested regions, respectively. High use versatility (Relative Importance >1) was represented by 14 species; *Emblica officinale* L. and *Allium sativum* L. were the most versatile species. Forty-one individual ailments were treated with the medicinal plants recorded. The ailment categories 'respiratory problems' and 'sexual problems' received the highest score from the calculation of informants' consensus factor (F_{ic}) in forested and non-forested regions, respectively. The findings could contribute in the pharmaceutical sector by directing further investigation of bio-active compounds in medicinal plants. Secondly, results could inform the clues for conservation strategies of forest resources in that region.

Key words: Medicinal plants, indigenous knowledge, informants' consensus factor, Bangladesh.

Introduction

Bangladesh has a total of 2.52 million ha forestland (17.08% of the total land with actual vegetation coverage of 6.7%), and forest area per 1000 people is only 6 ha (FAO 2010). About 74.5% of total populations live in rural areas (FAO 2010) and almost 80% of them are dependent on medicinal plants for primary health care (Chowdhury et al. 2009). Most of the rural people depend on medicinal plants growing in the homestead forests, also known as village forests (Halim et al. 2007), which cover about 13% of the total forestland area (Kibria et al. 2000). Out of the 64 districts of Bangladesh, 28 districts do

not have any public natural forests; of the state-owned natural forests, over 90% is concentrated in 12 districts in the country's eastern and southwestern regions (Hossain 2008), mainly made up of hill forest and mangrove forest ecosystems. There are 20 protected areas in Bangladesh covering almost 2% of the country's total area and 11% of the total forestland area (BFD 2008). Most of the protected areas are located in the hilly regions and are in the interspersion of human habitation for a long period. People living in and around the conservation areas rely extensively on forest products to meet their everyday needs including primary health care (Mukul et al. 2007). Out of 5000 plant species of Bangladesh, 500 are claimed to have medicinal or curative properties (Ghani 2003).

The medicinal plant sector in Bangladesh is recognized as a priority domain of intervention by many stakeholders (Thomsen et al. 2005). The sector is worth US$14 million with local supply comprised of 70% by volume and 40% by value (Dixie et al. 2003) with an estimate of around 12,000 tons of dried medicinal plants collected from rural and other naturally grown areas (Ahmed 2009). Ahmed also reported the existence of about 500 herbal industries in Bangladesh of which 20 are reasonably large and consume 80% of the total raw material demands. In conjunction with the increasing demand for traditional medicines in the country, research is being conducted on both the ethno-botanical documentation and pharmacological evaluation of the medicinal plants (e.g., Haque et al. 2000; Rahman et al. 2001; Lambertini et al. 2004; Uddin et al. 2006; Rahman et al. 2007; Mazumder and Rahman 2008; Rahman et al. 2008; Mollik et al. 2010).

The worldwide current trend towards unsustainable extraction of medicinal plants from natural habitats has resulted in over-harvesting, leading to threats to future productivity (Kala 2005). In contrast, careful exploitation of medicinal plants can provide an opportunity for local development (Purohit 1997). Guo et al. (1998) emphasized the exploration of traditional medicinal knowledge and experiences that may play a significant role in conserving local biodiversity. This is also necessary because such ethnographic research can provide important clues leading to new drugs for the modern pharmacies (Elujoba et al. 2005). Jain et al. (2010) reported the noteworthy contribution made by the traditional medicine to modern system where many drugs have been developed after analyzing the chemical constituents of plants traditionally used by the tribes and villagers. Therefore, taking all these dimensions of traditional medicine systems into consideration, the present study was conducted among local communities in two forested and non-forested regions of Bangladesh. Its aim was to assess the plant-based ethno-medicinal practice and document the traditional knowledge linked with it.

Methodology

Study area

The study was carried out in two different regions of Bangladesh: the northeastern hilly region and southeastern plains region which are the forested and non-forested regions respectively (Fig. 1). The former was represented by Rema-Kalenga Wildlife Sanctuary and the latter by the rural areas of Feni, a southeastern district devoid of natural forests.

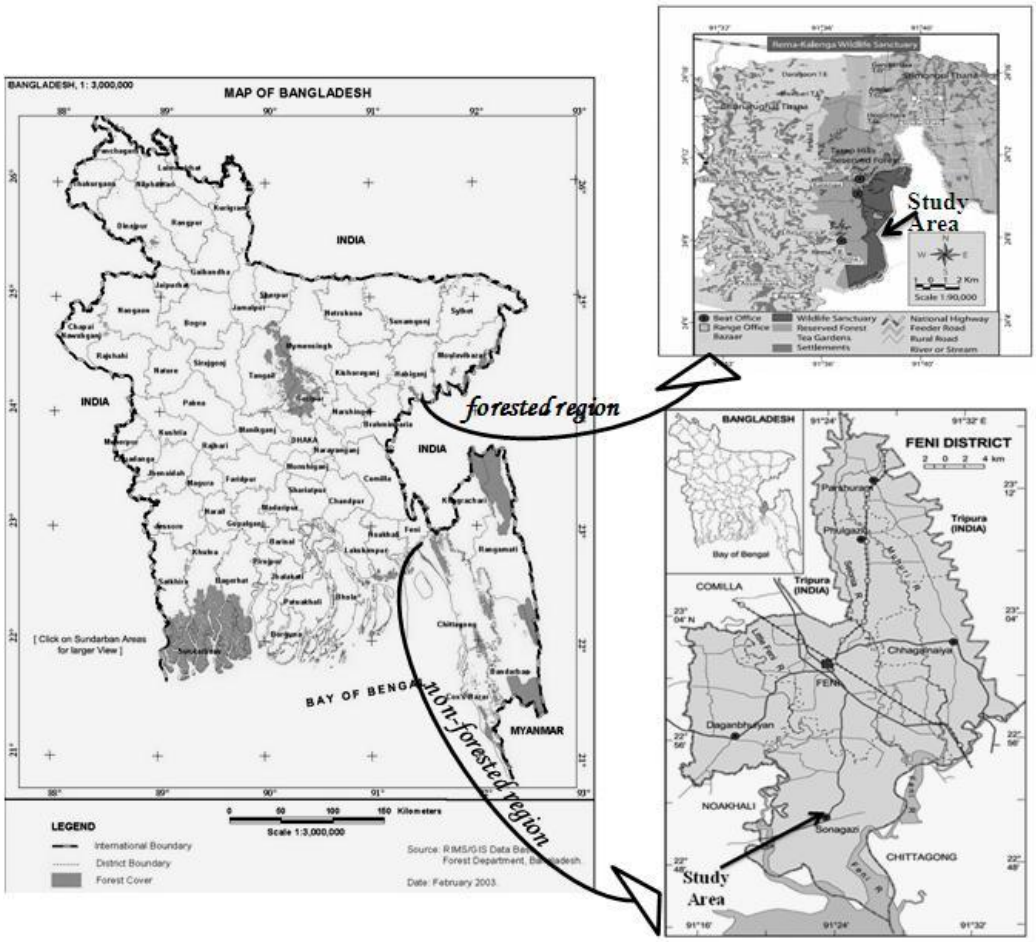

Figure 1. Location map of the study areas

Rema-Kalenga Wildlife Sanctuary (RKWS) lies between 24˚06'-24˚14'N latitude and 91˚34'-91˚41'E longitude (BCAS 1997). The vegetation of the sanctuary is characterized as tropical evergreen and semi-evergreen forest, with an estimated total of 606 plant species (242 herbs, 120 shrubs, 147 trees and 97 climbers) (Uddin 2001). A total of 36 villages having varying degrees of stake with the sanctuary have been identified; one located inside, nine at the boundary and 26 are outside. Agriculture is the primary occupation of the people living both inside and outside the sanctuary.

Feni district is a transitional zone between the southeastern vast hilly regions (Chittagong Hill Tracts) and other plains regions in the southern and middle of the country lying between 23˚01'N latitude and 91˚24'E longitude (Tageo 2010). The district supports a population of 1,196,219 with a literacy rate of 40.7%. Most people (36.67%) have agriculture as their major occupation. Feni is one of those 28 districts where literally no natural forests are located, rather marginal lands have become forested with the plantations of both indigenous and exotic tree species, where herbs and shrubs grow deliberately as understory (Chowdhury et al. 2009).

Data collection

The study was conducted from the middle of 2007 to the earliest of 2009, using a multi-stage random sampling method. In case of the forested region, RKWS was selected purposively because of its rich biodiversity. A total of 140 inhabitants living in the villages inside and at the boundary of the sanctuary were selected randomly for the study. In the case of non-forested region, Sonagazi was chosen from the six upazillas of Feni district because it is the southernmost region facing the Bay of Bengal and bordered by two rivers- the Feni and Choto Feni- to the east and west. Due to its geographical location, the upazilla is more or less flooded during the rainy season, resulting in deposition of sediments that increases the productivity of land, ultimately contributing to its botanical diversity. From the upazilla, three villages were selected at random; from each of the three villages, 30 households (irrespective of socio-economic condition) were selected randomly for the comprehensive study totaling 90 households. Thus a total of 230 households were selected from the two regions.

The method used to gather information was the qualitative approach of ethno-botanical interview. The interviewing team was composed of four members headed by the first author; voluntarily assisted by the other three who were post graduate students of the Department of Forestry and Environmental Science in the Shahjalal University of Science and Technology. At the family level, informal meetings were held in the interviewee's home using the native language (Bangla), sometimes with the participation of more than one randomly selected respondent together. In addition, six focus group discussions, three in each region, were arranged in the tea stalls of local market where the rural people usually get together, gossip and interact in the evening after the day-long business. All the data was collected from repeated conversations with the respondents living close to plants, to ensure the reliability of the information. This model is what anthropologists know as a semi-structured, focalized interview (Parada et al. 2009). The household heads were the key respondents, with help from other family members when necessary.

The main purpose was to obtain the information about medicinal plants used and/or known by the respondents and document the knowledge on their application. The plants used for medicinal purposes were first recorded using local names and conventional Bangla names. Although local names of plants vary from region to region within the country, established Bangla names have been well documented by Dey (2006) together with the various local names. Once local names had been obtained, the corresponding Bangla names were found by reference to Dey (2006). Voucher specimens of each medicinal plant species were also collected during the field visit and allotted collection numbers. The collected specimens were then dried and identified using standard literatures (e.g., Chevallier 1996; Das and Alam 2001; Dey 2006) along with the help of a professional taxonomist of Bangladesh Forest Research Institute (BFRI). Vouchers in the form of herbarium were deposited in the laboratory of the Department of Forestry and Environmental Science in Shahjalal University of Science and Technology, Bangladesh.

Data Analysis

Apart from the qualitative enlistment of the species (with scientific and Bangla names, family and habit), their parts used, and ailments treated; we calculated the relative importance (RI) for each species and informant consensus factor (F_{ic}) for each ailment category.

The relative importance (RI) of the species was calculated adopting Bennett and Prance (2000) according to the following formula, with "2", being the highest possible value, indicating the most versatile species (those species that have the greatest number of medicinal properties):

RI = NCS + NP

Where NCS is obtained by dividing the number of ailment category treated with a given species by the total number of ailment categories treated with the most versatile species and NP is obtained by dividing the number of individual ailments attributed to a given species by the total number of individual ailments attributed to the most versatile species.

The informant consensus factor (F_{ic}) was employed to indicate the homogeneity of the information. All citations were placed into ailment categories for which the species was claimed to be used. The F_{ic} value ranges from 0 to 1. A high value (close to 1) indicates that the species is relatively used by a large proportion of the informants indicating a more consistent use of the medical resources. On the other hand, a low value indicates that informants disagree on the species to be used in treatment within a category of ailment. In other words, the F_{ic} is an indicative value of how much the informants are consistent and the extent they agree about the use of certain plant species for treatment of a given ailment or ailment category (Hudaib et al. 2008).

The F_{ic} was calculated *sensu* Trotter and Logan (1986) according to the following formula:

$$F_{ic} = N_{ur} - N_t / N_{ur} - 1$$

Where N_{ur} is the number of use citations in each ailment category and N_t is the number of species used.

Results and discussion

Medicinal plants recorded

The local communities in both the forested and non-forested regions were found to use plants for health care purposes. Altogether a total of 68 plant species belonging to 38 families distributed over 58 genera were recorded from the study areas. Twenty-two species (32.35% of the total), 21 families (55.26% of the total) and 21 genera (36.21% of the total) were found common in both regions (Table 1). Among the medicinal plants, trees were the most frequent growth form (33.82%) followed by shrubs (26.47%), herbs (25%), creepers (11.70%) and palms (2.94%). In general, trees are the mostly used growth form of medicinal plants in rural Bangladesh as depicted in several studies (e.g.,

Miah and Chowdhury 2003; Mukul et al. 2007; Chowdhury et al. 2009) with a few exceptions as in Halim et al. (2007) where they found that trees were used least among a religio-cultural group in southwestern part of the country. Other than Bangladesh, trees were found dominant medicinal plants among the *Tharus*, a forest dweller community of Nepal (Ghimire and Bastakoti 2009) unlike in Ethiopia where it was dominated by herbs (Dawit and Estifanos 1991; Yineger et al. 2008).

Table 1. Frequency of number and growth form of medicinal plants reported in the study areas

Regional identity	Total plants reported	No. of family	No. of genus	Habit (% of total plants reported)				
				Herb	Shrub	Tree	Creeper	Palm
Forested	44	28	36	23	32	34	11	-
Non-forested	46	31	40	26	26	35	9	4
Common in both regions	22	21	21	8.82	7.69	13.24	1.47	-

Of the 38 families recorded with medicinal properties, six represented highest number of species such as Combretaceae, Compositae, Euphorbiaceae, Fabaceae, Liliaceae and Rutaceae, each having three species. Among the rests, 12 families were represented by two species each and the others had one species per family. The wide therapeutic use of some botanical families, recorded in the study areas, was also reported in other communities throughout the world. These are Apocynaceae and Asclepiadaceae among the *Jaintia* in India (Sajem and Gosai 2006); Fabaceae, Moraceae, Cucurbitaceae, Apocynaceae and Euphorbiaceae among the *Tharus* in Nepal (Ghimire and Bastakoti 2009); and Umbelliferae among the *Tibetans* of Yunnan Province in China (Liu et al, 2009). The list of medicinal plants recorded, their habits, families, parts used, ailments treated and relative importance are given in Appendix-A.

Source of medicinal plants

The communities of the forested region collected medicinal plants mainly from the forests around RKWS (72.72%). Homesteads and market served as the supplementary sources in equal proportion, 13.64% each. On the other hand, communities of non-forested region used their homesteads as the vital source (32.61%) of medicinal plants followed by anthropogenic environments (28.26%), markets (26.09%), homestead-and-market (8.69%) and cultivated habitat (4.35%). A variation in the source of medicinal plants was noticed in two different regions. Generally, homesteads (homegardens) are the traditional agroforestry practices in rural Bangladesh where a number of crops including trees are grown with livestock, poultry and fish mainly to satisfy the farmers' basic needs. These are primarily used to grow plants for household consumption, consequently food

and fruit species predominate there along with the species supplying timber, fuel wood, fodder and medicine. Since the communities in and around RKWS live in the vicinity of forest within easy reach of medicinal plants, they were found to be less concerned about the homegarden biodiversity. Conversely, due to the absence of natural forests around, the communities in Feni district were found to search for alternative sources other than homegardens, because a considerable portion of the landscape was covered by the anthropogenic environments. These comprise diverse habitats such as graveyards, jungles, fallow lands, hinterlands, roadsides, pond and canal banks and traditional village groves. The communities collect mainly herbaceous plants from these habitats because growth forms other than herbs are abundant in their homesteads. Stepp and Moerman (2001) and Gazzaneo et al. (2005) found the similar trend of collecting medicinal plants from anthropogenic habitats by the *Maya* communities of Mexico and the local herbal specialists of northeastern Brazil, respectively.

Forests are found as the fundamental source of medicinal plants in many other communities throughout the world. For instances, forest species formed 82.3% of the total medicinal plants collected by the *Baka Pygmy* community in Dja Biosphere Reserve in Cameroon (Betti 2004); more than 90% by the *Shaiji* group of southwestern Bangladesh (Halim et al. 2007); 85.71% by the local healers in Sekoru district of southwestern Ethiopia (Yineger and Yewhalaw 2007); 83.64% by the local community in Bale Mountains National Park of southeastern Ethiopia (Yineger et al. 2008); and 80.10% by the local people in Yunnan Province of southwestern China (Lee et al. 2008). Uniyal et al. (2000) revealed that medicinal properties of plant secondary metabolites are produced more in wild species grown under stress and competition and are not always expressed in fast-growing monoculture. Moreover, plants grow more slowly in wild populations and may have higher levels of active compounds. However, some species with multiple uses, either as vegetables or spices and condiments, were found cultivated in the non-forested region of our study areas. *Momordica charantia* L. and *Zingiber officinale* Rosc. are two such species.

Plant parts utilization

For curing ailments, use of both the above- and below-ground plant parts was reported in the study areas. The use of above-ground plant parts was higher in both the regions than the below-ground parts- constituting about 80% of the total species recorded. Varieties of plant parts utilized included the leaf, fruit, bark, root and others. Leaves were found to be the mostly used part in both the regions (Fig. 2). The category ‘others’ includes flower, seed, inflorescence, stem, twig, petiole, latex, bulb, tuber and whole plant. The ample use of leaves was due to its continuous temporal availability which has also been reported in many other communities (e.g., Giday 2001; Sajem and Gosai 2006; Yineger and Yewhalaw 2007; Langenberger et al. 2009; Rana et al. 2009). The plentiful use of leaves can ensure sustainable harvesting of medicinal plants (Halim et al. 2007) that provides an incentive to protect and maintain wild populations, their habitats and the genetic diversity (Schippmann et al. 2002). However, variations on the use of medicinal plant parts are also reported in the literature. For instances, roots were mostly used in southeastern Ethiopia (Lulekal et al. 2008), Yunnan Province of China (Liu et al. 2009), and Nawalparasi district of central Nepal (Ghimire and Bastakoti 2009); flowers in

northeastern Brazil (Almeida et al. 2006) and Manang district of central Nepal (Bhattarai et al. 2006); and twigs in Suriname (Andel and Havinga 2008).

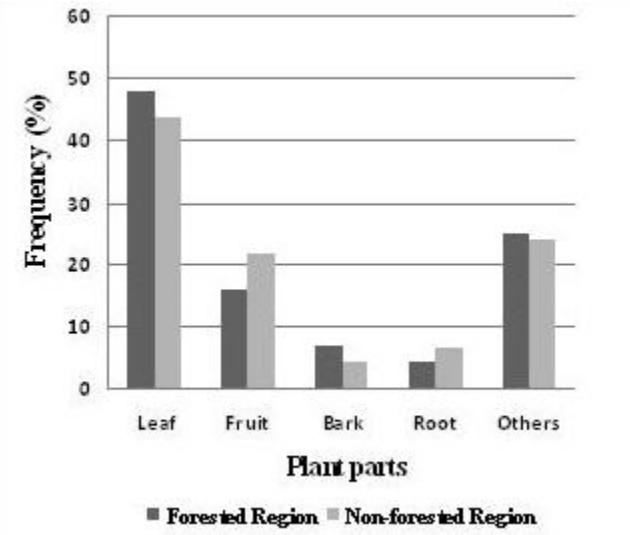

Figure 2. Various plant parts used in the study areas

Altogether 41 ailments were reported in the two regions among which, 18 (43.90%) were reported common in both the regions. When expressed region-wise, 33 ailments (80.49% of the grand total) were reported by interviewees in the forested area and 26 (63.41%) from the non-forested one. All ailments were treated with the medicinal plants recorded in the study areas. In some cases, different parts of an individual plant were used for treating different ailments; in other cases, different parts of more than one plant were mixed together and applied to treat a single ailment. Most plant parts were consumed orally after processing such as macerating, pounding, squeezing, blending, soaking or boiling in water, rubbing or burning. Some were taken raw and some after cooking as vegetables. Some were applied externally to different body parts, especially for treating cuts and wounds, scabies, pain or skin diseases.

Relative Importance (RI) of species and Informants' Consensus Factor (F_{ic}) on medicinal knowledge

In the forested region, five species were found with high use versatility (RI>1): *Clerodendrum viscosum* Vent. (1.10), *Trewia nudiflora* L. (1.10), *Terminalia chebula* Retz. (1.55), *Terminalia belerica* Roxb. (1.88) and *Emblica officinale* L. (2.00). These constituted about 11% of the total medicinal species recorded there. On the other hand, nine such species were reported in the non-forested region: *Aloe indica* Tow. (1.10), *Aegle marmelos* (L.) Correa. (1.30), *Mikania scandens* (L.) Willd. (1.35), *Swertia chirata* Ham. (1.55), *Plantago ovate* Forst. (1.55), *Cocos nucifera* L. (1.55), *Azadirachta indica* Juss. (1.55), *Piper betel* L. (1.55) and *Allium sativum* L. (2.00). These constituted about 20% of the total medicinal species recorded there. It is quite interesting that species with high use versatility are located more in the non-forested region than in the forested region. Five species out of those nine were not endemic to that area and bought from the

vendors in local market who collect them from outside the region. On the contrary, all of the five highly versatile species are indigenous to the forested region, and the community generally likes to use the species available in the surrounding forests rather than buying from market.

Table 2. Various ailment categories treated with medicinal plants in the study areas

Ailment category	Biomedical term	Region of availability
Dermatological	Cuts & wounds	Both
	Scabies	Both
	Skin diseases	Both
	Dandruff	Non-forested only
Gastrointestinal	Diarrhea	Both
	Dysentery	Both
	Flatulence	Both
	Gastric pain	Both
	Intestinal worm	Both
	Stomach trouble	Both
	Vomiting	Non-forested only
	Liver disease	Non-forested only
General health	Apathy to food intake	Both
	Cold	Both
	Chronic fever	Forested only
	Fever	Both
	Heart disease	Both
	Leg swelling	Forested only
	Stammering	Forested only
	Weakness	Forested only

	Heat stroke	Non-forested only
	Faintness	Non-forested only
	Oral disorders	Non-forested only
Faunal bites	Leech bite	Forested only
	Mosquito bite	Forested only
	Snake bite	Forested only
Jaundice		Forested only
Malaria		Forested only
Pain	Rheumatism	Both
	Head ache	Forested only
	Earache	Non-forested only
Respiratory	Asthma	Forested only
	Cough	Both
	Tonsil pain	Non-forested only
Sexual	Birth control	Forested only
	Female disease	Forested only
	Low sperm content in male	Forested only
	Premature ejaculation in male	Forested only
	Sexual weakness in male	Both
Urinary	Burning in urination	Both
	Diabetes	Both

All of the 41 ailments were grouped into predefined ethno-botany categories (Heinrich 2000), with the addition of a few others, forming 10 broad ailment categories altogether (Table 2) The F_{ic} values were assessed for the categorized ailments (Table 3) that indicate the degree of shared knowledge among the respondents for the treatment of the ailments by medicinal plants. The greater the consensus factor the more likely it is that the remedy

has bioactive molecules (Owuor and Kisangau 2006). Three ailment categories like faunal bites, jaundice and malaria were found only in the forested region and the remaining seven categories were found in both regions in various proportions. For instance, in some cases, all the individual ailments under one category were found in both regions and in some cases, only one or two from a category were found in one region and the remaining in another region. Among the 10 ailment categories in our study, respiratory problems (0.56) and sexual problems (1.00) scored the highest F_{ic} values in forested region and non-forested region, respectively. Thirteen species, representing about 30% of the total species recorded in forested region were used for the treatment of respiratory problems that included asthma and cough. On the other hand, only one species (2.17% of the total species recorded) was used for sexual problems that included a single ailment-sexual weakness in males- in the non-forested region. No consensus (F_{ic}=0) was found among the informants of the forested region for the categories malaria and pain, while no such ailment category with zero F_{ic} value was found in the non-forested region. This suggests the uniformity and rigidity in traditional ethno-medicinal knowledge is higher in the communities of the non-forested region. This may be because of their long time acquaintances with the region, whereas most of the communities of forested region have more recently migrated from other regions and settled in the public lands in and around RKWS. F_{ic} is an important tool for measuring the degree of shared knowledge among local communities and has been used by several other ethno-botanists (e.g., Heinrich 2000; Camejo-Rodrigues 2003; Owuor and Kisangau 2006; Ragupathy et al. 2007; Hudaib et al. 2008; Al-Qura'n 2009).

Table 3. Degree of local communities' consensus on managing various ailments with medicinal plants

Ailment category/ Regional identity	No. of plants species		Percentage of total species*		No. of use-reports		F_{ic}	
	Forested	Non-forested	Forested	Non-forested	Forested	Non-forested	Forested	Non-forested
Dermato-logical	7	11	15.91	23.91	9	14	0.25	0.23
Gastro-intestinal	17	18	38.64	39.13	29	33	0.43	0.47
General health	13	18	29.55	39.13	20	47	0.37	0.63
Faunal bite	3	-	6.82	-	4	-	0.33	-

Jaundice	5	-	11.36	-	10	-	0.55	-
Malaria	3	-	6.82	-	3	-	0.00	-
Pain	2	3	4.55	6.52	2	5	0.00	0.50
Respiratory	13	5	29.55	10.87	28	7	0.56	0.33
Sexual	5	1	11.36	2.17	6	3	0.20	1.00
Urinary	3	10	6.82	21.74	5	16	0.50	0.40

*Percentage sum exceeds 100 as some species are in use against more than one category.

Myths and traditional beliefs regarding medicinal plants

During the study, a number of myths and traditional beliefs were explored, most of which were common in both the regions. Some people possess keenness to raise certain species having medicinal properties, particularly *Azadirachta indica* Juss., *Punica granatum* L., *Lawsonia inermis* L., *Ocimum sanctum* L. and *Areca catechu* L. in their homesteads. *Azadirachta indica* Juss. is usually planted on the southern side of the homestead in the belief that air from the south is purified by its foliage. People took special care of this plant in terms of watering, supporting with sticks, and removing dried leaves and branches in the early stage. *Lawsonia inermis* L. and *Ocimum sanctum* L. are viewed as sacred plants by the Muslim and Hindu religious communities, respectively and are the most cared-for species in the study areas. The leaf of *Lawsonia inermis* L. is often used in dyeing the hand palms of women and children on religious occasions, and of bridal couples, and is more generally in the Muslim community. The younger family members sometimes put their own blood at the base of this plant at the time of planting, hoping for its long life. In the Hindu community, the leaf of *Ocimum sanctum* L. is used commonly in worship; the earth around the base of this species is kept neat and clean, with regular mud paste added by older women. Miah and Rahman (2006) also reported on these two plants and their religious significance having positive effects on the floral stock of the Muslim and Hindu homesteads in Bangladesh; while Chowdhury et al. (2010) reported the livelihood potential of the commercial farming of *Lawsonia inermis* L. in the central part of the country. Some species (e.g., *Aloe indica* Tow., *Kalanchoe pinnata* (Lamk.) Pers. and *Tagetes erecta* L.) are grown in earthen pots in the study areas and kept in front of dwelling houses, serving both beautification and medicinal purposes. *Tamarindus indica* (L.) Cogn. is planted either in the periphery of homesteads or in fallow lands of the back yard with a belief that evil spirits take shelter on its crown.

Conclusion

The rural communities of Bangladesh, irrespective of forested and non-forested regions, are dependent on medicinal plants for primary health care purposes. Although the choice, pattern and mode of using medicinal plants by the communities in two different regions vary to some extent; their knowledge is similar in many cases, e.g., usage of leaves in

higher proportions, preference for species grown wild, giving special care to certain species in homesteads, etc. These may give an important basis for guiding the conservation strategy for the regional plants since medicinal plants started disappearing rapidly due to their commercialization, increased demand and unsustainable harvesting (Rai et al. 2000). Moreover, traditional knowledge of the local communities in the study areas may provide the scientific communities with the clues for screening plants as a potential source for bioactive compounds that could result in discovery of novel antimicrobial agents. Already in many countries, scientific investigations of medicinal plants have been initiated because of their potential (Patrick 2002). The government may follow this thinking by launching programs in collaboration with Bangladesh Forest Research Institute (BFRI) and Bangladesh Council for Scientific and Industrial Research (BCSIR). This study can inform both local and global knowledge of the importance of medicinal plants and its conservation.

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Appendix A. Medicinal plants and their relative importance recorded in the study areas

Species		Habit	Family	Parts used	Ailments
Botanical Name	Local Name				
Abelmoschus moschatus Medik.	Bon Derosh	Shrub	Malvaceae	Root	Leg swelling
Adhatoda vasica Nees.	Basak	Shrub	Acanthaceae	Leaf	Asthma, Cough, Fever, Cold
Aegle marmelos (L.) Correa.	Bel	Tree	Rutaceae	Fruit	Heat stroke, ulcer, gastri indigestion, constipation
Allium ceipa L.	Piaj	Herb	Liliaceae	Tuber, leaf	Snake bite, Cold,
Allium sativum L.	Roshun	Herb	Liliaceae	Bulb	Head ache, Stomach trouble i heart disease, trouble in urinati
Alocasia indica Schott.	Harinpaya	Herb	Araceae	Whole plant	Gastric pain, Stomach trouble
Alocasia spp	Kochu	Herb	Araceae	Petiole, flower	Leeche bite, cuts & wounds
Aloe indica Tow.	Grito-kumari	Herb	Liliaceae	Leaf	Ulcer, constipation, skin dullne
Alstonia scholaris Br.	Chatim	Tree	Apocynaceae	Bark	Diabetes
Annas comosus (L.) Merr.	Anarosh	Shrub	Bromeliaceae	Tender leaf, ripe fruit	Intestinal worm, fever
Areca catechu L.	Shuari	Palm	Arecaceae	Seed	Flatulence, vomiting
Artocarpus heterophyllus Lmak.	Kanthal	Tree	Moraceae	Inflorescence	Apathy to food
Artocarpus lakoocha Roxb.	Dewa	Tree	Moraceae	Tender leaf	Asthma
Asparagus racemosus Willd.	Shotomuli	Creeper	Asparagaceae	Root	Low content of sperm in male
Azadirachta indica Juss.	Neem	Tree	Meliaceae	Leaf	Scabies, Skin disease, cuts & diabetes
Bambusa vulgaris Schred.	Barak Bansh	Tree	Graminae	Bark dust	Cut
Cajanus cajan (L.) Millsp.	Orhor	Shrub	Fabaceae	Leaf	Jaundice, Apathy to food intake
Calotropis	Aphon	Shrub	Asclepiadaceae	Leaf	Joint ache, rheumatism

gigantean L.					
Cassia angustifolia Vahl.	Sonamukhi	Shrub	Fabaceae	Leaf	Gastric pain
Cassia fistula L.	Sonalu	Tree	Fabaceae	Tender leaf	Intestinal worm
Cassia alata L.	Daad	Shrub	Fabaceae	Leaf	Scabies, skin disease
Centella asiatica (L.) Urban.	Thankuni	Herb	Umbelliferae	Whole plant	Stomach trouble, Dy Stammering, Cold, cough
Citrullus colocynthis (L.) Schrad.	Makal	Creeper	Cucurbitaceae	Fruit	Birth control
Citrus spp.	Komla	Tree	Rutaceae	Fruit skin	Stomach pain
Citrus aurantifolia (Chris. & Pan.) Sw.	Lemu	Shrub	Rutaceae	Leaf	Pyorrhea
Clerodendrum viscosum Vent.	Bhat	Shrub	Verbenaceae	Leaf, root	Fever, Gastric pain, Cough, Dy earache
Coccinea cordifolia L.	Telakucha	Creeper	Cucurbitaceae	Leaf	Diabetes
Cocos nucifera L.	Narkel	Palm	Arecaceae	Fresh juice, fruit	Burning in urination, heat diarrhea, dysentery
Curcuma longa L.	Holud	Herb	Zingiberaceae	Rhizome	Skin dullness, wounds in livest
Cynodon dactylon Pers.	Durba	Herb	Graminae	Tender leaf	Cut and wounds
Datura metel L.	Dhutura	Shrub	Solanaceae	Leaf	Scabies
Dillenia pentagyna Roxb.	Hargeza	Tree	Dilleniaceae	Bark	Cut, Mosquito bite
Elaeocarpus robustus Roxb.	Jolpai	Tree	Elaeocarpaceae	Fruit	Apathy to food
Emblica officinale L.	Amloki	Tree	Euphorbiaceae	Fruit	Jaundice, Asthma, Dysentery, Stomach trouble, Apathy intake, Fever, Weakness, gastric pain, ulcer
Ferula asafoitida L.	Heez Gaach	Shrub	Apiaceae	Slender stem	Asthma, Cough
Ficus hispida L.	Dumur	Tree	Moraceae	Inflorescence	Diabetes
Hibiscus rosa-sinensis L.	Joba	Shrub	Malvacea	Flower	Sexual weakness in male, dy skin problem in hand palm
Jatropha curcas L.	Jamalgota	Shrub	Euphorbiaceae	Latex	Scabies, Skin disease
Kalanchoe pinnata (Lamk.) Pers.	Pathor kuchi	Herb	Crassulaceae	Leaf	Cough in babies
Lawsonia inermis L.	Mendi	Shrub	Lythraceae	Leaf	Burning in urination, dandruff,
Leucus aspera Willd.	Dondo Kolosh	Herb	Lamiaceae	Leaf	Cough
Litsea polyantha	Menda	Tree	Lauraceae	Leaf	Diarrhoea, Dysentery

Juss.					
Mangifera indica L.	Aam	Tree	Anacardiaceae	Tender leaf	Asthma, teeth disease
Mikania scandens (L.) Willd.	Uzari/Refugee lota	Creeper	Compositae	Leaf	Cut, Jaundice, dysentery, diabe
Momordica charantea L.	Korola	Creeper	Cucurbitaceae	Leaf, fruit	Diabetes
Musa spp.	Kela	Shrub	Musaceae	Green fruit	Dysentery
Ocimum sanctum L.	Tulshi	Shrub	Lamiaceae	Leaf	Leg swelling, Fever, Cough, Co
Paederia foetida L.	Padra Pata	shrub	Rubiaceae	Leaf	Diarrhoea, Dysentery
Piper betel L.	Paan	Creeper	Piperaceae	Leaf	Flatulence, indigestion, conge muscles, cuts & wounds
Piper longum L.	Pipul Morich	Creeper (vine)	Piperaceae	Fruit	Cough, Asthma
Piper nigrum L.	Gol Morich	Creeper (vine)	Piperaceae	Seed	Cough, Asthma
Plantago ovata Forst.	Isopgul	Herb	Compositae	Seed coat	Heat stroke, gastric pain, consti
Punica granatum L.	Dalim	Tree	Puniaceae	Leaf	Intestinal worms
Solanum indicum L.	Bon Begun	Shrub	Solanaceae	Fruit	Flatulence
Sterculia villosa Roxb.	Udal	Tree	Sterculiaceae	Tender leaf & twig	Gastric pain, Stomach Premature ejaculation in male
Swertia chirata Ham.	Chirota	Herb	Sapindaceae	Whole plant	Chronic fever, gastric pain, liver disease
Syzygium cumini (L.) Skeels.	Jam	Tree	Myrtaceae	Seed	Diabetes
Tagetes erecta L.	Genda	Herb	Compositae	Tender leaf	Cut & wounds
Tamarindus indica (L.) Cogn.	Tentul	Tree	Fabaceae	Tender leaf, Fruit	Burning in urination, Rheu Female disease, diabetes
Terminalia arjuna Bedd.	Arjun	Tree	Combretaceae	Tender leaf, Bark	Heart disease, Apathy to food Weakness
Terminalia belerica Roxb.	Bohera	Tree	Combretaceae	Fruit	Fever, Apathy to food Weakness, Malaria, Jaundice, Asthma, Gastric pain, ulcer
Terminalia chebula Retz.	Hortoki	Tree	Combretaceae	Fruit	Fever, Apathy to food intake, trouble, Asthma, Weakness, gastric pain, ulcer
Trewia nudiflora L.	Chagol Ledi/ Motkila	Tree	Euphorbiaceae	Leaf	Chronic fever, Stomach Jaundice

Trigonella foenum-graceum L.	Methi	Shrub	Fabaceae	Seed	Diabetes
Vitex negundo L.	Ninda	Shrub	Verbenaceae	Leaf, branch	Toothache, tonsil pain
Zingiber officinale Rosc.	Ada	Herb	Zingiberaceae	Tuber	Cough, cold, Flatulence
Zingiber zerumbet Smith.	Ekangi	Herb	Zingiberaceae	Tuber	Gastric pain

F= Forested region, NF= Non-forested region, B= Both forested and non-forested region

* the values in parentheses in 5th column indicate the RI of species in non-forested region