

Collection and Management of Selected Medicinal Plants in Rema-Kalenga Wildlife Sanctuary

Mohammad Zashim Uddin

Snigdha Roy

Department of Botany, University of Dhaka, Bangladesh

Abstract

*This paper explores linkages between two selected medicinal plants, menda (*Litsea glutinosa*) and bohera (*Terminalia bellerica*), and the livelihoods of local people living in the vicinity of the Rema-Kalenga Wildlife Sanctuary. We conducted four field trips to the study area and collected data from collectors and middlemen between February and June 2006. We interviewed a total of 67 people using semi-structured questionnaires (local people, members of local indigenous communities, and middlemen). We recorded their collection techniques, plant parts used, collection rates, market prices, market demands, monthly supplies, buyers, market chains, and management practices of medicinal plants. Study results suggest that many people are involved in the illegal collection and sale of both species. The demand for these species is high because of heavy use for both commercial and subsistence purposes. We conclude that there is a positive link between these two medicinal plants and local livelihoods. Therefore, co-management plans for Rema-Kalenga Wildlife Sanctuary should be developed with the participation of local residents to incorporate the cultivation and management of the target species. This would promote both improved livelihoods for local people, and better conservation and management of the wildlife sanctuary.*

1. Introduction

Medicinal plants are gaining popularity in many areas of the world. Currently, eighty percent of the world's population depends on herbal medicine for meeting their primary health care demands (WHO, IUCN and WWF 1993). Scholars have proposed various reasons for this popularity, including affordability, accessibility, availability, expense, few side effects, simplicity, safety, and changing needs and beliefs. Although modern medicine has played an important role in human health care, including dramatic declines in mortality and increases in life expectancy, it can have many drawbacks including high costs, adverse side effects and difficulties with availability, especially for rural populations. On the other hand, herbal medicines have entered the mainstream global economy. The annual worldwide growth rate for herbal medicines in 1991-1992 was between 5 and 15 percent. In 2001, the world market for traditional medicines (including herbal products and raw materials) reached US\$ 43 billion, as reported by the Secretariat of the Convention on Biological Diversity (UNEP 2001). Furthermore, traditional medicines and complementary or alternative medicines are now playing increasingly important roles in health care and health sector reform globally (UNEP 2001).

Active compounds from medicinal plants are used in most traditional medicines and can play an important role in advancing sustainable rural livelihoods through their conservation, cultivation, propagation, marketing and commercialization (Laird *et al.* 2004). In Bangladesh, studies investigating the sustainability of the commercial trade in medicinal plants are at an initial stage. To date, studies on medicinal plants have mainly focused on listing medicinal plants, their uses, chemical compositions, and modes of treatment (Khan and Huq 1975, Hassan and Khan 1986, Mia and Huq 1988, Khan and Mia 1989, Khan 1991, Alam 1992, Hassan and Huq 1993, Yusuf *et al.* 1994, Chowdhury *et al.* 1996, Alam *et al.* 1996, Hassan and Khan 1996, Ghani 1998, Uddin *et al.* 2001, Khan *et al.* 2002, Uddin *et al.* 2004, and Uddin *et al.* 2006). None of these studies have provided practical information about the collection and management of medicinal plants in relation to local livelihoods. In order to address this issue, this paper explores the linkages between two medicinal species – *menda* (*Litsea glutinosa*) and *bohera* (*Terminalia bellirica*) – and the livelihoods of local people in Rema-Kalenga Wildlife Sanctuary, Bangladesh.

2. Background

Rema-Kalenga Wildlife Sanctuary (RKWS) is located approximately 130 km east-northeast of Dhaka and 80 km south-southeast of Sylhet in Chunarughat Thana, a sub-district of Habiganj District, Sylhet. The sanctuary is bounded by Tripura State (India) to the south and east, and part of Kalenga Forest Range to the north and west. Geographically, the area lies between 24°06'-24°14'N latitude and 91°34'-91°41'E longitude (Fig. 1). The area falls under the Sylhet Hills zones (IUCN 2002), and the administrative area is known as the Rema-Kalenga Forest Range. The sanctuary is located in the Tarap Hill Reserve Forest, which was established under a declaration of the Forest Act of 1927. In 1982, the government designated 1,095 hectares of the Reserve Forest as the Rema-Kalenga Wildlife Sanctuary. In 1996 the sanctuary area was further expanded by 1,995 hectares via another declaration. RKWS is a habitat and species management area as defined by Green (1990), and it is managed mainly for conservation through management intervention. Rema-Kalenga is remote and inaccessible to visitors, particularly during the monsoon, due to lack of proper roads.

RKWS is part of the Tarap Hill system, which is a part of the southern hills of greater Sylhet district. It extends approximately 48 km from east to west. The sanctuary encompasses several hills of different elevations and low-lying valleys, with the highest peak at about 67m above sea level (Rizvi 1970). A series of ridges run in different directions, and valleys known locally as *longa* fill with water during monsoon, but dry up during the winter season. The main channels include the Karangi Chhara, Lokhmiya Chhara and Rema Chhara, with tributaries criss-crossing the sanctuary and constituting the major drainage system in the area. All three channels flow westward into the Khuai River.

Soils of the sanctuary vary from clay loam on level ground to sandy loam on hilly ground. The clay and sandy loams are exceedingly fertile and show low pH. In some cases, soil texture consists of yellowish-red sandy clay mixed with granules of magniferous iron ore (Ahmad 1970). The area enjoys a moist tropical climate characterized by a period of high rainfall from April to September, and five months of a relatively dry period from November to March (Rizvi 1970).

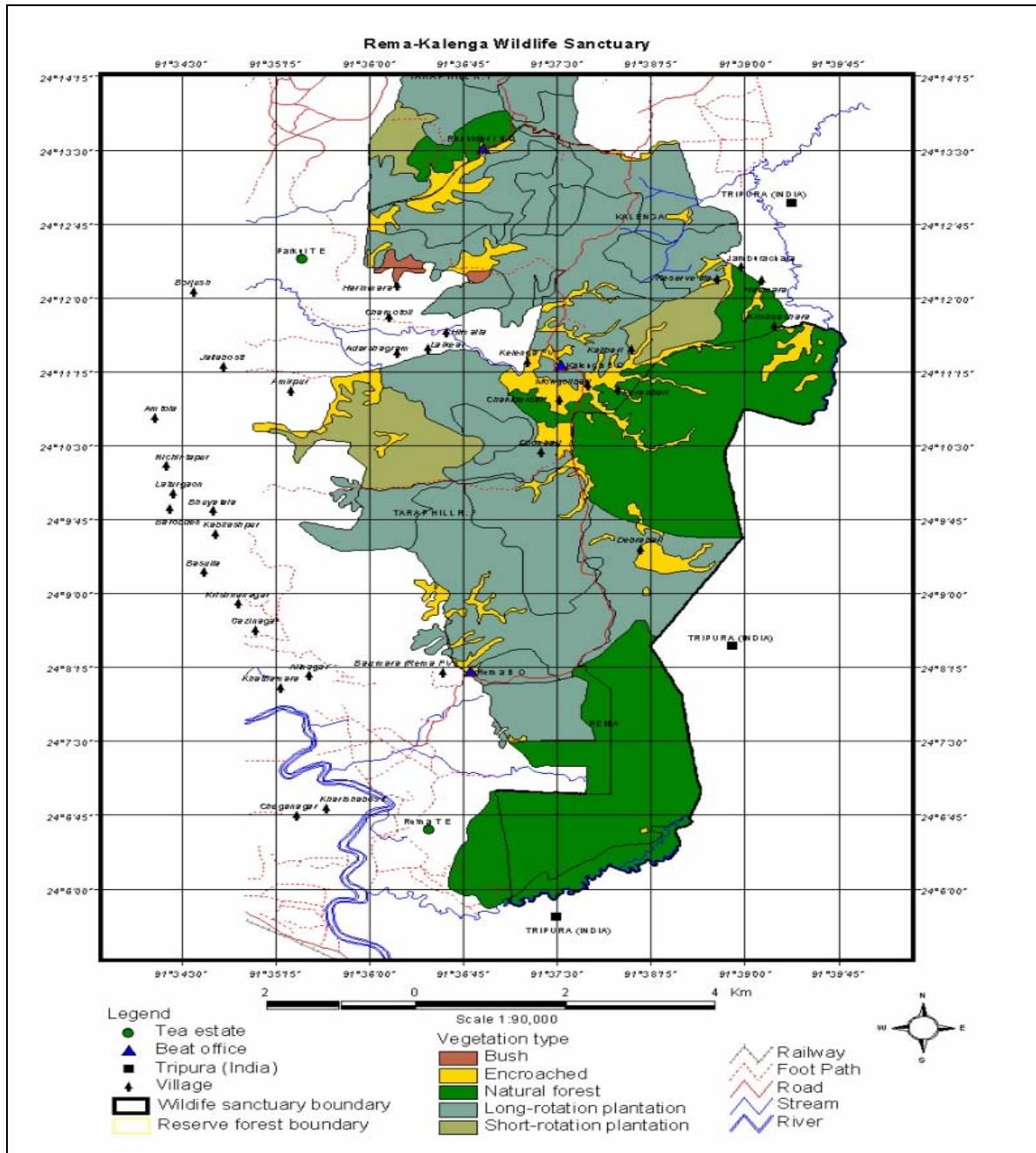


Figure 1: Map Showing the Study Area
(Source: Nishorgo Support Project, 2006)

The vegetation of the sanctuary is described as tropical evergreen and semi evergreen forest (Sarker and Haq 1985, Mountfort and Poore 1968 and Uddin 2002) dominated by *chaplai* (*Artocarpus chaplasha*), *gorjon* (*Dipterocarpus turbinatus*), *bonak* (*Schima wallichii*), *hargoja* (*Dillenia pentagyna*) and *kakra* (*Aporosa dioica*), and characterized by many giant climbers (Uddin 2002). The undergrowth is mostly dominated by members of the Acanthaceae,

Rubiaceae, Asteraceae, Poaceae, Cyperaceae, Zingiberaceae and Araceae families. Many orchids, ferns, epiphytes and parasites are also found in the forest. Uddin (2002) has inventoried 606 plant species in the Sanctuary, among which 82 have been identified as medicinal plants that play important roles in local livelihoods.

There are eight small indigenous groups (ethnicities) living in and outside the sanctuary: The Tripura (or Deb-Barma), Santal, Urang, Kharia, Kurmi, Goala, Munda, and Bunargi. Among these, Tripura make up approximately 90% of the total human population found in the Sanctuary. Their languages and cultural traditions are unique, and they depend mostly on wild plants for their food and primary health care. One important Tripura group resides in a valley named Debrabari, located in the middle of the sanctuary. They cultivate vegetables and fruit crops on the hill slopes.

Three blocks of plantations - *sal* (*Shorea robusta*), *shegun* (*Tectona grandis*, or teak) and *lohakat* (*Xylia kerii*) are located along the western edge of the sanctuary. There is a road on the western side that separates the sanctuary from the Kalenga Range and extends southwards to the Rema Beat Office. A watchtower was constructed near the Kalenga Beat Office by the Forest Department in 1995, to facilitate eco-tourists who wish to observe wildlife in nature. An artificial lake and a fruit orchard were also established near the tower to attract primates, jackals, wild boar, porcupine, squirrel and deer.

3. Methodology

We selected two important medicinal plants to focus on for the present study on the basis of their apparent significance to the study site:

- *Litsea glutinosa* (Lour.) C.B. Rob. Bangla name: *Menda*. English name: Indian laurel. Family: Lauraceae. General uses: Juice of the leaves and bark used in treatment of diarrhea, dysentery and also jaundice. Energy tonic produced from bark extract (Ghani 1998).
- *Terminalia bellirica* Roxb. Bangla name: *Bohera*. English name: Belliric myrobalan. Family: Combretaceae. General uses: The fruits possess antibacterial properties. Employed in the treatment of edema, piles and diarrhea. Also used for myopia, corneal opacity, pterygium, and immature cataracts; as well as various chronic and acute infections. The fruits also possess myocardial repressive properties (Ghani 1998).

We conducted a total of four field trips to Rema-Kalenga Wildlife Sanctuary and collected data using semi-structured questionnaires between February and June 2006. We were assisted by Forest Department personnel, local people, and some Nishorgo Support Project staff members in the field. We attempted to collect data at the main forest entry point (Kalenga Range Office), but after spending one day at the gate without meeting any collectors, we learned that the Forest Department had imposed a total ban on the collection of non-timber forest products (NTFPs), including *menda* and *bohera*, since 2005.

Accordingly, we changed our data collection strategy. We learned from local villagers that collectors use different paths to enter the forest illegally for collection. We visited five such paths on the edge of the Sanctuary to locate plant collectors. These paths were at Kalenga, Karangichhara, Chonbari, Debrabari and Krishnachhara. We met collectors at the entry points to these paths and interviewed them. We wanted to know their collection techniques, collection

rates, seasons, parts used, market prices, and perception about management techniques for the two study species. We also collected demographic data on the collectors including their age, main occupation, level of education and gender.

In addition, the collectors helped us to identify four markets where we could interview middlemen: Chunarughat, Shaeshtagonj, South Daorgach and Mirashi. However, we were only able to locate and interview middlemen at South Daorgach. Accordingly, we collected data on the number of collectors that came to each middlemen per day, the amount of raw material purchased per day, the purchase price, the selling price, monthly supply, market demand, the buyers, and market chains. We also recorded the ages, primary occupation, education and gender of the middlemen

We conducted four separate group discussions in the sanctuary area. One group discussion was with Forest Department personnel, and the other three discussions were with local people and collectors. We also conducted one group discussion outside the sanctuary with the middlemen at South Daorgach village. During group discussions, we focused mainly on the threats to medicinal plants and considerations for co-management of these two medicinal plants in relation to livelihoods. Finally, we tried to find links between medicinal plants and the livelihoods of local people in Rema-Kalenga Wildlife Sanctuary.

4. Results and Discussion

We interviewed a total of 67 people, 64 of whom were primary collectors in Rema-Kalenga Wildlife Sanctuary. The remaining three were middlemen working outside the reserve. Ten of the 64 primary collectors provided demographic data but refused to give us any data about their *menda* and *bohera* collection practices. The average age of the collectors was 37 years. Most collectors had completed primary education but some (5 collectors) were completely illiterate. Professionally, they were mainly small farmers, day laborers and small traders. Income from these professions is insufficient to support family expenditures year-round, so they partially depend on the collection and sale of *menda* and *bohera* to supplement their cash income. All collectors we interviewed were male; no female collectors were interviewed because we did not encounter any female collectors during data collection. Both indigenous communities (Tripura) and Bengalis were involved in the collection and processing of *menda* and *bohera*. Table 1 summarizes the demographic data we collected.

Table 1: Demographics of Local People Interviewed in Rema-Kalenga Wildlife Sanctuary

	Total people interviewed	Mean age	Education	Occupation	Ethnicity	Gender
Collectors	54	37	Primary (33) No education (5) Under SSC* (16)	Small farmer (49) Day labor (3) Small trader (2)	Deb-Barma (9) Bengali (45)	All male
Middlemen	3	48	Under SSC* (2) SSC* (1)	Small trader	Bengali (3)	All male

NOTE: SSC = Secondary School Certificate

The collectors are from villages near Rema-Kalenga including Chonbari, Laturgao, Chanpara, Simailla Bosti, Huglia Tilapara, Huglia Tilagao, Nishindapur, Taltola Shibir, Adarshagram, Dakhin Tila, Hatimaragram, Kalenga, Kalishiri, Bularjum, South Daorgash, Amrul Bazar, Jamburachhara and Mongoliabari. In general, collectors live one to four kilometers from the forest. Members of ethnic communities who are involved in collection live both within and outside the Wildlife Sanctuary; all are forest villagers who have agreements with the Forest Department that allows them to live in and near the Sanctuary.

Collectors partially depend on the Sanctuary for their subsistence. In the interviews they informed us that before 2005, they could enter the forest easily to collect *menda* and *bohera*, with permission from the Range Office. This is because the Range Office issued passes for medicinal plant and other NTFP collection on a daily or monthly basis. According to the interviewees, the amount of *menda* and *bohera* collected has decreased drastically over the last five years. In 2005, the Forest Department imposed a total ban on all NTFP collection from the forest. Therefore, current collection of medicinal plants (mainly *menda* and *bohera*) is carried out illegally, without permission from the forest Range Office.

4.1. Collectors

We surveyed collectors in the Sanctuary, and the data are presented in the Table 2. We found that an average of 3 people collect from the forest everyday. *Bohera* collection is seasonal, carried out mostly in September to November. During the harvesting season, collectors harvest approximately 2 kg of *menda* and 10.5 kg of *bohera* and per person per day. Collectors recalled that five years ago they were able to harvest 10 kg and 30 kg per person per day, respectively, from the same forest. When asked to explain the differences between the two time periods, they informed us that *menda* and *bohera* are now very rare and difficult to locate in the forest, due to over-exploitation, high market demand and unsustainable collection practices.

The average selling prices of *menda* bark and *bohera* fruits are Taka (Tk) 22 per kg and Tk 4 per kg, respectively (Table 2). On average, local people including both ethnic Bengalis and indigenous people earned Tk 44 per kg from *menda* bark collection and Tk 42 per kg from *bohera* collection. This is five times less than the amount they earned five years ago.

Table 2: Current and Previous Collection Rates and Market Price for Menda and Bohera

	Average number of collectors per day	Amount collected kg/person/day	Amount collected 5 years ago kg/person/day	Current market price Tk/kg	Average daily income Tk/person/day
Menda	3	2.0	10	22	44
Bohera	(Seasonal)	10.5	30	4	42

Collectors collect *menda* bark for the market and use the leaves for domestic purposes. To collect *menda* bark, collectors girdle the trees, irrespective of size and age, killing the trees. The extract from young leaves of *menda* can be used for various ailments so local people also collect leaves. Collectors gather *menda* bark all year round, although there is some preference for the dry season as the forest is hazardous during monsoon.

Collectors sell the mature fruit of *bohera* in the market. They collect ripe fruits from the trees and sometimes they also collect fallen fruits off the ground. *Bohera* collection usually takes place from September to November. Collecting the fruit may affect the regeneration potential. Sometimes collectors also collect stems and branches of this tree for firewood. This may affect both fruit production and regeneration.

4.2. Middlemen

We interviewed three middlemen (Table 3) in South Daorgach village, located near Satchari National Park in Sylhet. This village is the focal point of the raw medicinal plant parts business in the area. The middlemen purchase *menda* and *bohera*, which originate not only in Rema-Kalenga Wildlife Sanctuary, but also from other different sources including Satchari National Park, Lawachara National Park, homestead gardens, and even from India. Collectors cannot bypass the middlemen to sell their raw materials directly to consumers. We found that on average, three collectors sell *menda* to the middlemen each day. The middlemen buy an average of 24 kg per day of *menda* and 27.5 kg per day of *bohera*.

Middlemen purchase *menda* and *bohera* at an average price of Tk 25 per kg and Tk 4 per kg, respectively. They then sell the *menda* and *bohera* to owners of factories that produce herbal medicines, mosquito coils and incense sticks at an average price of Tk 35 per kg and Tk 1 per kg, respectively. Market demand for both NTFP in raw form is currently very high. The middlemen supplied an average of only 0.725 ton per month to consumers (Table 3). Their monthly income from *menda* is about Tk 7250. Local collectors cannot meet the high demand for *menda* from protected areas, homestead gardens and neighboring countries. While this kind of business in raw medicinal plants is illegal, to our knowledge the government lacks policies for monitoring and prohibiting the sale and purchase of these products.

Table 3: Rate of Exploitation of *Menda* and *Bohera* and Market Demands.

(Data Obtained from Middlemen)

NTFP Species	Average number of collectors per day	Average amount per day (kg)	Purchase price per kg (Tk)	Selling price per kg (middleman) (Tk)	Current market demand (tons)	Average monthly supply (tons)
Menda	3	24.15	25	35	Very High	0.725
Bohera	Seasonal (Mainly Sept.-Nov.)	27.5	4	10	Very high	Seasonal supply

4.3. Market Demand and Market Chain

Currently, the crude supply from the forests of both *menda* and *bohera* is very low while the demand is high. The gap between supply and demand contributes to illicit activities in the supply market. In order to increase the amount of product, middlemen adulterate pure *menda* bark with sawdust. In this way they cheat both buyers and end-consumers at the same time. To meet the high market demand, the middlemen also purchase medicinal plants collected from other protected areas as well as from India through various smuggling channels.

The main buyers of the medicinal parts of *menda* and *bohera* are the factory owners of traditional medicines (e.g., Ayurveda, Unani) – namely Hamdard, Shadhana Oushudhalaya, and Shakti Oushudhalaya – and factory owners of mosquito coils and incense sticks – including Lalmai Chemical, Mortein, Eagle, Elephant King, ACI Pharmaceuticals, and Globe. These factories are located mainly in Dhaka, Chittagong, and Comilla. Local people collect raw *menda* and *bohera* parts from the forest and transport the material to middlemen on foot, or occasionally using horses. The middlemen also purchase these materials from other sources and store them at their homes. The middlemen also have crushing machines to grind the materials prior to bagging. It is at this stage that sawdust is often added to the powdered plant material. Finally, they sell these materials to owners of traditional medicines and mosquito coil factories.

4.4. Local Perceptions of Management

We discussed management practices of *menda* and *bohera* with local people, collectors and middlemen. Most people informed us that they had no understanding before about management policies. They have no opportunity to manage medicinal plants in the protected area, since it is patrolled by the Forest Department. They would like *menda* and *bohera* to be managed in a sustainable manner in the Rema-Kalenga Wildlife Sanctuary. They recognize the high market value and demand for these two species. Local collectors indicated that they have never planted any saplings or seeds of either species. Most respondents, however, had positive attitudes toward co-management systems with equitable benefit sharing practices, and expressed a desire to work with the Forest Department. A few collectors stated that they had started to collect the seeds of *menda* or *bohera* from the forest and plant them in their home gardens. Collectors do not gather seedlings of these medicinal plants because the seedling survival rate is very low. Both species are very rare in the forest now.

4.5. Threats to Menda and Bohera

We conducted five group discussions with NTFP collectors, foresters, and middlemen. We focused mainly on threats to medicinal plants and co-management aspects of the two selected medicinal plants. Respondents pointed out a number of threats to *menda* and *bohera* in the forest: Middlemen suggested that the increasing demand for these species in the local market is one of the major threats. Currently herbal medicine is a growing market in Bangladesh, with many factories already established in different parts of the country. These factories need raw plant parts to manufacture herbal medicine. In addition, *menda* bark is used not only in herbal medicines but also in the manufacture of mosquito coils and incense sticks. Owners of these factories import a major portion of their raw materials from abroad and, according to the middlemen, only a small portion of the factory demand for *menda* and *bohera* is met from local forests. Nevertheless, this demand is enough for local people to harvest these plants from the forest and to note that the resource is being severely depleted. As a result, *menda* and *bohera* are vulnerable to disappearing in the forest.

Although the Forest Department does not allow the harvest of *menda* and *bohera* from RKWS, collectors continue to remove these plants illegally. In group discussions, forest personnel informed us that The Forest Act of 1927 was designed for the management of forests and forest products including medicinal plants, but illegal collection of plants is difficult to stop for various reasons. These include pressure from influential people and lack of personal security for foresters wishing to enforce the law, as well as poor socioeconomic conditions and the lack

of alternate livelihoods opportunities for local populations. These conditions encourage people to exploit *menda* and *bohera*; it also encourages middlemen to establish purchasing centers near forest areas. Whenever we visited middlemen they were uneasy about giving any information about medicinal plants, as they are wary of people trying to collect information and of foresters.

Many participants in the focus group discussion suggested that population pressure and poverty are both threats to medicinal plants in the forest. According to these people, human population density threatens resources in the Wildlife Sanctuary. They also suggest that, because the number of people living below the poverty line is so high, many people cannot cover their daily expenses from agriculture, day labor or trade. For this reason, the poor seek alternate sources of income by going to the forest and collecting medicinal plants to sell for extra money.

The above-mentioned factors all represent major threats to the long-term viability of *menda* and *bohera*. Focus group discussions further revealed that a number of smaller threats also affect medicinal plants, including fire, timber-oriented forestry practices, failure to utilize local knowledge, and bureaucratic processes. Although fires sometimes occur accidentally, manmade fires are a common phenomenon in the dry season, when huge amounts of leaf litter gather on the forest floor. Farmers sometimes intentionally start fires to clear out the underbrush for logging, and to facilitate loggers' free movement in the forest. Sometimes farmers intentionally start fires to promote sprouting of *Imperata cylindrica* (sun grass) in particular areas. These fires burn seeds, seedlings, propagules and bark, and interfere with regeneration dynamics of the NTFPs.

According to local foresters, timber-based forest management is another threat to medicinal plants. The Forest Department manages its forests for valuable timber species and other plants are treated as weeds in the forest. When managing forests for timber, foresters eradicate all such "weed" species annually. Because neither *menda* nor *bohera* produces timber, they are not managed under the current official forestry practices.

Both foresters and forest villagers claimed that a lack of awareness of local knowledge in the forestry planning process also threatens medicinal plants. Local villagers and field-based foresters have knowledge of specific habitats, ecology, keystone species, medicinal plants and other NTFPs. Government officials responsible for the formulation of forest management plans often fail to incorporate the local knowledge of these people in their plans. Top-down hierarchical bureaucracies such as the Forest Department lack mechanisms for incorporating local knowledge in planning and implementation efforts to protect locally important plants. This makes it more difficult for these plants to survive in nature reserves managed in this way.

At this point, *menda* and *bohera* are open-access resources. Whoever wishes to collect these plants can do so easily – if they can find any. Nobody manages these species in the forest, and the Forest Department treats these plants as "D-class timber" trees, having low timber value. The effective management of these two important medicinal trees will require the Forest Department to reformulate its policy so that the co-management approach currently being implemented also specifically addresses the conservation of these plants.

4.6. Co-Management: An Alternative Approach

Co-management approach for natural resource management is recognized in many areas of the world (Ostrom 1990, Bromley 1992, Narayan 1995, Connor *et al.* 1996, Mahanty 1999, UNDP 1999, Borrini-Feyerabend *et al.* 2000, Keen and Lal 2002). In our group discussion most participants agreed that co-management of *menda* and *bohera* could reduce current threats and pressures on these plants. When properly implemented, co-management creates opportunities for

local people to meet their basic needs without eroding protected areas. In this case, both the Forest Department and local NGOs can play vital roles by involving stakeholders, (resource users, forest villagers and ethnic communities) in sharing the responsibility of protecting these NTFPs. A Co-management Committee can be formed with these people that would engage local people in decision-making processes affecting their living environments and their well-being. The Forest Department can give collectors technical support for capacity building, NGOs can train collectors on the proper management of medicinal plants, and donors can provide collectors with microcredit schemes to establish medicinal plant nurseries. Buffer-zone plantations of medicinal plant saplings can also be established, and sustainable harvesting methods for mature plants can then be developed for these sites. Crude medicinal plant material can be sold in the local market under the supervision of the Forest Department. Finally, benefits from the sale of these products can be distributed equitably among local shareholders (collectors) and the Forest Department by the Co-management Committee. The Nishorgo Support Project (NSP) has already begun activities including group formation with local people, and programs to support motivation, capacity building micro-credit, nursery establishment, and awareness building.

5. Recommendations

To reduce threats to *menda* and *bohera*, we propose the following recommendations for the management of these medicinal plants in RKWS:

- 1. *Menda* and *bohera* cultivation and collection should be incorporated into protected area planning policy.** The Forest Department should incorporate enrichment plantations of these species in the forest in their management plans. These two species are in high demand in the local market for various purposes. Like timber, *menda* and *bohera* can contribute a substantial amount of cash to the forest economy. Every year, international manufacturers of herbal medicine import large amounts of raw *menda* and *bohera* from India. This fact shows the potential for earning a significant amount from the sale of these NTFPs on the global market.
- 2. Management plans should be based on local knowledge.** Field foresters should be able to contribute their knowledge to the formulation of protected-area management plans. This kind of local knowledge helps to identify dominant plants, timber plants, medicinal plants, firewood species, and NTFPs, as well as identifying stakeholders, resource users, sources of livelihood, and conflicts between collectors and the Forest Department. Such planning will promote the sustainable use of *menda* and *bohera* in the forest, among other species.
- 3. Efforts should be made to document local knowledge about medicinal plants.** Local people pass knowledge about plants and their habitats from one generation to the next. Currently, these people are losing their knowledge due to the influence of the modern culture that surrounds them. Many young people are not willing to learn about traditional plant knowledge, since they are trying to migrate to urban areas for education and jobs; thus local knowledge is rapidly being eroded. Surveys on local knowledge on medicinal and culturally important plants are essential. Proper recording and documentation of this knowledge can help to manage *menda* and *bohera* in the forest.

- 4. Collection of medicinal plants from the forests should be regulated.** Wise management requires that collectors seek permission for harvesting plant products in the wild from appropriate authorities. Regulators may check harvesting techniques, availability, and public interest in medicinal plants. Under current conditions, Forest Department personnel have little control over the collection of *menda* and *bohera*. A certain section of the local people benefit from these plants, by running illegal medicinal plant businesses under the noses of the administrators. As a result, high-value plants like *menda* and *bohera* are being degraded through unsustainable harvesting
- 5. Cultivate and propagate *menda* and *bohera*.** These species should be propagated and cultivated to meet the growing demand for herbal medicines. Cultivation is better than collecting raw materials from the forest, since there is little material remaining there at present. In this case, local people can be trained in the propagation and cultivation of these plants. The Forest Department should offer land and micro-credit loans to local people as incentives to cultivate these species. Those who already own land should also be given incentives to cultivate *menda* and *bohera* in their fields and homestead gardens.

6. Conclusions

In this study we have sought to describe links between medicinal plants and the livelihoods of local people in Rema-Kalenga Wildlife Sanctuary. We found a positive link between the two target medicinal plants and the livelihoods of local people. They earn a small amount of cash income from collecting and marketing *menda* and *bohera* from the forests, which subsidizes their daily expenditure. Local collectors are not totally dependent on medicinal plant collection. They collect other NTFPs including firewood, bamboo, cane, yams, aroids, orchids, ginger, honey, wild fruits and vegetables, thatching materials, climbers, leaves, and wildlife. Thus, although they are typically classified as small farmers or day laborers or small traders, they are engaged in diverse (and sometimes unsanctioned) livelihood strategies. They live in villages near the forest and supplement their subsistence by collecting products such as *menda* and *bohera* without permission from the Forest Department. They sell these products to the local middlemen to earn extra cash for their livelihood. The middlemen, in turn, depend on the medicinal plant trade for their own livelihood. They purchase medicinal plants from primary collectors who collect from protected areas and supply at least 50 different species of medicinal plant to various factory owners.

In summary, *menda* and *bohera* are two of the most important medicinal plants in the Rema-Kalenga Wildlife Sanctuary. These species are used not only in herbal medicines but also for other purposes. Current market demand is high for both species. Our results suggest that local people, members of indigenous (ethnic) communities, and middlemen are involved in the illegal collection and sale of these species. In this way the poor earn cash income to supplement their subsistence. Group discussions suggested linkages between medicinal plants and local livelihoods, and between. We conclude from this study that a positive link exists between the management, use and threats to selected medicinal plants (*menda* and *bohera*) and the livelihoods of local people in Rema-Kalenga Wildlife Sanctuary. Consequently, the management and harvesting of these plants should be incorporated into protected-area management policy.

Acknowledgements

We are highly grateful to Dr. Jefferson Fox for his necessary suggestions, comments and recommendations for the manuscript during the writing workshop. We are also thankful to Ms. Shimona Quazi for her valuable suggestions for the write up of the manuscript. We offer special thanks to Mr. Md. Rafiqul Islam who accompanied us during field trips and Mr. Md. Mizanur Rahman (ACF, Kalenga Forest Range) who supported us in the field. We remember all the fellow colleagues of Nishorgo Support Project with whom we spent a pleasant time at the Bangladesh Institute of Administrative Management. Finally, we are grateful to Forest Department and Nishorgo Support Project for the financial assistance for the research.

References

- Ahmad, N. 1970. *Working plan for the forests of the Sylhet division for the period 1963-64 to 1982-83*. Working Plan Division 2, CTG. E.P. Dacca, East Pakistan Govt. Press, pp. 1-22.
- Alam, M. K. 1992. "Medical Ethnobotany of the Marma tribe of Bangladesh." *Economic Botany*, 46(3): 330-330.
- Alam, M. K., Chowdhury, J. and Hassan, M. A. 1996. "Some folk formularies from Bangladesh." *Journal of Life Science*, 8(1): 49-63.
- Borrini-Feyerabend, G., Farvar, M.T., Nguingiri, J.C. and Ndangang, V.A. 2000. *Co-management of natural resources: organizing, negotiating and learning-by-doing*. Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ), The World Conservation Union (IUCN), Kasperek Verlag, Heidelberg (Germany).
- Bromley, D. (ed). 1992. "The commons, property and common property regimes." in *Making the commons work: Theory, Practice, and Policy*. Institute of Contemporary Studies, San Francisco.
- Chowdhury, J. Alam, M.K. and Hassan, M.A. 1996. "Some folk formularies against dysentery and diarrhea in Bangladesh." *Journal of Economic and Taxonomic Botany*. Additional Series 12: Scientific Publishers, Jodhpur (India). Pp.20-23.
- Connor, R., Houlbrook, R. and Tarihao, F. 1996. "Local conservation area ownership and traditional management." In Wallace, H. (ed.), *Developing Alternatives: Community Development Strategies and Environmental issues in the Pacific*, Victoria University, Melbourne.
- Ghani, A. 1998. *Medicinal plants of Bangladesh: Chemical constituents and uses*. Asiatic Society of Bangladesh, Dhaka, Bangladesh, pp. 460.
- IUCN, 1990. *IUCN Directory of South Asian protected areas*. The World Conservation Union (IUCN), Gland, Switzerland and Cambridge, UK, pp.24-30.
- Hassan, M. A. and Khan, M. S. 1986. "Ethnobotanical record of Bangladesh - 1: Plants used for healing fractured bones." *Journal of the Asiatic Society of Bangladesh* (Sc.). 12 (1 & 2) :33-39.
- Hassan, M.A. and Khan, M.A.1996. "Ethnobotanical record of Bangladesh - 2. Plants used for healing cuts and wounds." *Bangladesh Journal of Plant Taxonomy*, 3(2): 49-52.
- Hassan, M.A. and Huq, A.M. 1993. "Amader bonoushudi shampad" (Our wealth of forest medicine, in Bangla). Hassan Book House, Dhaka, Bangladesh.

- IUCN. 2002. *Bioecological Zones of Bangladesh*. IUCN-Bangladesh country office, Dhaka, Bangladesh, xii+141pp.
- Keen, M. and Lal, P. 2002. "Creating supportive frameworks for community based resource management." *Development Bulletin* 58: 46-51.
- Khan, M.S. 1991. National Conservation Strategy of Bangladesh – Towards sustainable Development: Genetic Resources in Bangladesh. Bangladesh Agricultural Research Council, IUCN, Dhaka. Pp. 162-172.
- Khan, M.S. and Huq, A. M. 1975. *Medicinal plants of Bangladesh* (a preliminary list giving action and uses). Bangladesh National Herbarium, Bangladesh Agriculture Research Council, Dhaka. pp-27.
- Khan, M.S. and Mia, M.M.K. 1989. *Bangladesh plants known to be effective in diarrhea diseases (wild and cultivated)* ICDDR, in press.
- Khan, M.S., Hassan, M.A. and Uddin, M.Z. 2002. "Ethnobotanical survey in Rema-Kalenga Wildlife Sanctuary (Habiganj)." *Bangladesh Journal of Plant Taxonomy*, 9(1): 51-60.
- Laird, S.A, Lisinge, E.E, Nkuikeu, R. and Lindsey, D. 2004. "Promoting sustainable livelihoods through commercialization of NTFPs: the case of Cameroon Medicinal plants in Trade." WWF. Cameroon, Yaounde.
- Mahanty, S. 1999. "Stakeholder organizations in the biodiversity conservation network." Unpublished paper prepared for the Biodiversity Conservation Network, Washington DC.
- Mia M. M. K. and Huq, A. M. 1988. "A preliminary ethnobotanical survey in the Jointipur, Tamabil and Jafflong area, Sylhet." *Bangladesh National Herbarium Bulletin*, 3, pp: 1-10.
- Mountfort, G. and Poor, D. 1968. "Report on the second World Wildlife Fund expedition to Pakistan." Unpublished report, p. 25.
- Narayan, D. 1995. *Designing Community Based Development*, Environmental Department, World Bank, Washington DC.
- Ostrom, E. 1990. *Governing the Commons: The Evolution of Institutions of Collective Action*. Cambridge University Press, Cambridge.
- Rizvi, S.N.H. 1970. *East Pakistan District Gazetteers for Sylhet*. Government of East Pakistan Services and General Administration Department, Dhaka, pp. 5-6.
- Sarker, S.U. and Haq, A.K.M.F. 1985. *Country report on national park, wildlife sanctuaries and game reserves of Bangladesh*. Prepared for the 25th working-session of IUCN's Commission on National Parks and Protected Areas. Corbett National park, India, 4-8 February 1985, 5p.
- Uddin, M. Z., Khan, M. S. and Hassan, M. A. 2001. "Ethnomedical plants records of Kalenga forest range (Habiganj), Bangladesh for malaria, jaundice, diarrhea and dysentery." *Bangladesh Journal of Plant Taxonomy*, 8(1): 101-104.
- Uddin, S. N., Uddin, M. Z., Hassan, M. A. and Rahman, M. M. 2004. "Preliminary ethno-medical plant survey in Khagrachari district, Bangladesh." *Bangladesh Journal of Plant Taxonomy*, 11 (2): 39-48.
- Uddin, M. Z., Hassan, M. A. and Sultana, M. 2006. "Ethnobotanical survey of medicinal plants in Phulbari upazila of Dinazpur district, Bangladesh." *Bangladesh Journal of Plant Taxonomy* 13(1): 63-68.
- Uddin, M.Z. 2002. *Exploration, Documentation and Germplasm Collection of Plant Genetic Resources of Rema-Kalenga Wildlife Sanctuary (Habiganj) in Bangladesh*. Unpublished Ph.D. Thesis, University of Dhaka.

United Nations Environment Programme. 2001. *Convention on Biological Diversity* (text and annexes). UNEP/CBD/94/1 (www.biodiv.org).

United Nations Development Programme 1999. *Pacific Human Development Report 1999: Creating Opportunities*. United Nations Development Programme, Suva.

WHO, IUCN and WWF. 1993. *Guidelines on the Conservation of Medicinal Plants*. World Conservation Union (IUCN), Gland, Switzerland.

Yusuf, M., Chowdhury, J. U., Wahab, M. A. and Begum, J. 1994. *Medicinal plants of Bangladesh*. Bangladesh Council of Scientific and Industrial Research, Dhaka, Bangladesh.