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Management of medicinal plants in Bangladesh: issues and challenges of sustainability



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Abstract

Medicinal plants (MP) are a vital component of non-timber forest products (NTFP) and play a significant role in the health care of rural people all over the world. Collection of MP is also making an important contribution to poor people's livelihood, but in countries with high population density, like Bangladesh, the pressure on natural forests is hard. In that case, marginal or small-scale cultivation of MP significantly can contribute to poor people's livelihood and reduce the pressure on natural forests. A sustainable cultivation of MP can therefore be seen as an act of nature conservation. The present study aims to evaluate the farmer's perceptions as well as the present research and policy-making processes related to the NTFP sector, especially the MP cultivation. The result of this study points out problems for the sector to develop due to lack of processing technology, reliable transportation of products, capacity building of farmers, micro financing, comprehensive policy-making, coordination between agencies and research institutes, poor extension and research imperatives, market supervision, land use change and fragmentation etc. However, the current forest policy is only briefly addressing the issues of NTFP. Farmers and other stakeholders, e.g. traditional healers, are not involved in the policy-making, thus leading to an impractical management system. It is according to the results of this study of utmost importance to create a harmonization of practitioners' experiences, research and policy attributes to make the cultivation of MP economically and ecologically sustainable.

Keywords: Research, policy, stakeholder, cultivation and conservation

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Glossary of Terms

- Ayurved** A branch of medical science/ practice, which deals exclusively with herbals, plants or plant parts as active ingredients in the preparation and formulation of medicines. It is linked to and originates from the Hindu and Sanskrit culture.
- Baidya** Traditional healer practicing both herbal medicine and spirituality
- Bepari** Person that buys medicinal plants and / or plant parts from the small farmers or collectors and sells it on to the wholesalers or industrial processing units.
- Division** A division is the apex field level administrative unit in Bangladesh. Each division consists of several districts.
- District** Local administrative units under the supervision of the division. There are 64 districts in Bangladesh. Each district has several sub-districts called Thana.
- Headmen** Head of a cluster of villages. They are under respective Circle Chiefs (traditional king) and responsible for revenue collection and informal village administration.
- Herbal Medicine** Preparations or derivatives of plants that are used in the treatment, cure, mitigation and management of various physical and mental diseases or ailments, and external or internal injuries of man and / or other animals.
- Kabiraj** Traditional healer or practitioner within the Ayurvedic system
- Karbari** Traditional head of the Para (hamlet) which is a unit that is smaller than the village. He is also under respective Circle Chiefs (traditional king) and responsible for revenue collection and informal village administration.
- Taungya** A plantation system practiced mostly in the hill forest whereby the forest department provides land, planting inputs and technical supports to the forest villagers and through prescribed management, the villagers get a share of the harvested products.
- Thana** A unit of police administration within Bangladesh. Usually the lowest tier of formal government administration. They are under the jurisdiction of the District
- Unani** A branch of medical science/ practice, which uses medicinal plants and plant parts as well as some essential chemicals in the preparation of medicines. It is linked to and originates from the Muslim culture.
- Union** The lowest administrative unit of local government in rural areas of Bangladesh.

Introduction

Forests and forest products have played a vital role in the livelihoods of people for centuries and are still of paramount importance. According to the World Bank (2002), more than 1.6 billion people throughout the world are relying heavily on forests for their livelihoods and some 350 million people are depending only on forests, both for their subsistence and income. Forestry sector creates employment for about 12.9 million people with a value addition of US\$ 354 billion (FAO 2007), which is gradually increasing compared to previous years. Preservation of major forest resources and alleviation of poverty is now a big concern all over the world. The situation is more critical in developing countries due to poverty and rapidly increasing populations leading to a decreasing availability of livelihood support.

Under these circumstances non-timber forest products (NTFP) nowadays plays an anchor role in fostering livelihood thereby reducing dependency on major forest resources. The term NTFP can best be described by using a commonly used definition given by FAO as “goods of biological origin other than wood derived from forests, other wooded lands and trees outside forests” (FAO 1999). Study evident that, smallholder living in forest margins in diverse parts of the world earns a significant amount (10-25percent) of their household income from various types of NTFP (Wunder 2001). In this regard, Asia is undoubtedly the world’s largest producer and consumer of NTFP. An estimation of Beer & McDermott (1996) showed that about 30 million people in Southeast Asia significantly depend on the use of NTFP. Apart from the socio-economic potentials, NTFP are in recent time’s also gaining national and international attention for their conservation potential from the belief that, the collection and use of NTFP has a potential of being ecologically less destructive than timber harvesting and because of that less destructive harvesting methods it reduce the impacts on major forest resources (CBD 2003; Arnold & Pérez 2001).

Bangladesh is a land hungry deltaic country of South Asia with an area of 147 570 sq. km and among the most densely populated countries of the world with a density of 979 people per sq. km (BBS 2008). This huge population is creating an enormous pressure to the limited natural resources to sustain their livelihood whereby the forest and forest resources of Bangladesh are depleting at an alarming pace which compelled the government to declare logging bans in different forest areas of the country, i.e. early 1970s in Sal forest, late 1990s in the hill forest (Government of Bangladesh 1994). This moratorium on major forest resources opened up a new window for the NTFP sector to grow as an alternative livelihood means to the rural poor of Bangladesh who relies on forests. However, this also gives us an alarming signal since it is also a risk of

over harvesting due to the high demand, which might lead to total extinction of several species from natural habitat.

NTFP sector in Bangladesh provides major employment opportunities to the about 550 000 marginal poor people in the rural areas and contributes approximately US\$ 51 million (1 US \$ = 38.9 Taka as on 1994) to the country's economy annually, which is expected to grow to US\$ 75 million by 2013 (Government of Bangladesh 1994). This drift is gaining momentum day by day in the backdrop of the depletion of major forest resources, one of the highest rates of deforestation in south Asia (FAO 2009).

Medicinal plants (MP) have a global recognition in health care apart from sourcing monetary benefits to the local people and forest users. It has a rich history and traditional cultures that have developed the primary health care of the local communities based on medicinal plants and related knowledge (Caniago & Siebert 1998). According to FAO 2007 an estimated 121 505 tonnes of MP and aromatic products extracted globally out of which 90 181 tonnes are from Asia and according to Subrat (2002) this figure is expanding by 15 to 20 percent annually. Among the 422 000 plants species documented worldwide 12.5 percent are reported to have medicinal value (Rao *et al.* 2004). Despite of the deafening escalation of synthetic drugs in the last couple of decades, medicinal plants still play a vital role in the life and living of rural people in many parts of the world, especially in the developing countries (WHO 1990). Furthermore, herbal medicine is getting a momentum also in the western world to such an extent that it is relevant to raise concerns related to the issue of the sustainability in their production and management. There is a risk of over exploitation to try to meet this growing demand without a proper consideration of the stock actually available for future use (Ros-Tonen 2000).

As mentioned earlier, the major forest resources of Bangladesh are depleting at an alarming pace putting enormous pressure on the country's scarce remaining resources, which is further aggravated due to the socio-economic and political conditions of the country. Due to this depletion, there are also immense pressures on the non-timber forest resources. A recent FAO report (2009) on the State of the World Forest has also triggered attention due to the increasing trade and commercialization of MP that also posed threats to wild collection. The situation in Bangladesh is not different and the present study is intended to clarify the opportunities of medicinal plant cultivation and related activities with a particular focus on such issues as farmer's perceptions, research and policy implications.

Measured by employment, MP along with bamboo and rattan rank first with 1.5 million people dependent on compared to other NTFP of Bangladesh (Basit 1995). More than 500 plants species have been reported to be available

in Bangladesh having medicinal values (Yusuf *et al.* 1994). The commercial aspect of MP is not negligible as there are more than 300 Ayurvedic and Unani pharmaceuticals made from them and nine are reasonably big. Nowadays a significant number of MP is being used even in beauty care (Akhter *et al.* 2008). According to Dixie *et al.* (2003) the total size of the MP market at wholesale price was estimated to US\$ 14 million p.a. – corresponding 17 500 tonnes of raw material (12 500 from local source and 5 000 imported). Local supply accounts for 70 percent by volume or 40 percent by value. Out of the 12 500 tonnes of locally collected raw material, 11 000 tonnes are extracted from wild collection. Due to indiscriminate harvesting of these raw materials by unskilled labour severely affecting the existence of various important MP species.

Very recently, commercial cultivation of MP is gaining momentum as a mean of livelihood because of its potential market both nationally and internationally. Considering its market potential and the shortfall from natural sources, commercial cultivation could be a good solution for enduring livelihood support apart from saving remaining natural stock of medicinal plants. However, despite of such growing concern and potential there has been very limited information on MP – especially on the socio-economic attributes, policy imperatives and research issues in context of Bangladesh.

Farmers' hopes and aspirations are often ignored in formulating plans and programs and hence the issues of livelihood remain unexplored. There has been no or very limited efforts to explore the field reality that is influencing the overall MP cultivation attributes. Most of the academic research works remain scattered and disorganized and there has not been any significant attempt to systemize and synthesize the key findings of these studies (Khan & Rashid 2006). Studies on socio-economic status, market potential and policy aspects of MP are strikingly scarce. In the same vein, there has not been any adequate attempt to examine and develop a relatively holistic perspective on the subject (i.e. NTFP) by focusing on such dimensions and issues as stocktaking of field level practices and challenges, relevant national policy and institutional framework and current research. The policies on sustainable MP utilization are also not well defined or non-existent, and there is a considerable potential in learning from different countries of the region. Therefore, the sustainable management of MP resources is an important conservation and development issue requires urgent support. Without integrating issues related with the farmers' needs, it is of no use to try to delineate a policy or an action plan, which in the end will fail to address the prevailing challenges and constraints of the sector.

However, due to the fragile mechanism of acquiring information from different countries' experiences, studies etc. those can guide the sustainable use of NTFP remain very weak, which reiterated the needs for institutionalization

of this sector to attain desired goals. There is prevailing a big gap between *farmers* and *other professionals* that needs to be bridged in order to ensure sustainable management and conservation of major NTFP of Bangladesh and especially medicinal plants. Unregulated harvesting, over exploitation and lack of standard commercial processing of the medicinal plants and plant originated products, this sector is still facing a hard time, despite of having all potentials to flourish (Zuberi 1999). Under this surge various issues like livelihood and subsistence, market and marketing channels, cultivation and disease management, credit facility, training and capacity building etc. needs to explore. Furthermore, policy and institutional support should also be studied by giving utmost concentration to the issues.

Considering all these salient features, the present study aims to ascertain the situation of MP sector to suggest a better strategy for the sustainable conservation and management of MP and its potentials so that a future strategy can be delineated considering its overall prospect to cater the needs nationally as well as globally. Keeping all these attributes in mind the proposed study aims at fulfilling the following objectives:

1. To explore the field level practices and challenges in relation to the overall management perspectives to attain sustainability in this sector
2. To analyze the relevant national policy and institutional framework for the conservation and sustainable use of MP
3. To determine current research trend and the gaps prevailing in MP sector

Study Sites and Methods

The present study has mainly focused on the field level practices and challenges observed by farmers regarding cultivation, management and related activities on one side and the research and policy matters on the other side. This has been achieved through interviewing and discussing the issues with personnel from different institutions.

Study sites

The study was conducted in two phases to address different target groups. One group consisted of *farmers* and the other of *other professionals*. To accomplish the first part of the study, respondents' survey and field visits were made to reveal farmers' perception based on their experiences regarding the cultivating of medicinal plants (MP) and related activities. Two study sites were selected, one in the Natore district, a northern region of Bangladesh, and another in the south-eastern hilly region of Bangladesh called Bandarban district (Fig.1).

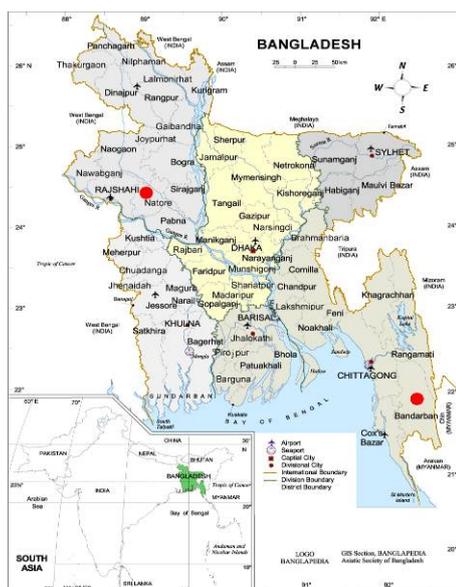


Fig. 1 Map of Bangladesh showing two study locations

While the second part of the study consisted of key informant interviews with representatives from different research institutions, universities, government departments, national and international NGOs and leading herbal pharmaceutical industries. Furthermore, publications and documents from several other organizations were analyzed. All these institutions were selected based on their importance within the non-timber forest product sector and

with a certain focus on MP. The guiding principles for selecting the two field study sites and institutions were based on the following attributes:

1. Laxmipur Kholabaria Union of Natore district is the pioneer to introduce commercial cultivation of MP along with traditional agricultural practices, especially *Aloe vera*.
2. Shoalok Union under Bandarban district is famous for its traditional healers (*Baiddhas*) from time immemorial, especially among the ethnic people that are heavily dependent on MP for their day-to-day health care.
3. The selections of institutions were made based on their involvement in the MP sector, e.g. the Bangladesh Forest Research Institute was selected as a leading institution due to its mandate by the Forestry Master Plan (FMP) to conduct research on Non-timber Forest Products (NTFP).

The study was conducted between August and December 2008. Between the two study sites, the first site namely Natore is mostly a plain alluvial land crisscrossed by rivers and water bodies that is under the jurisdiction of Rajshahi Division. Out of six Thanas from Natore district, Natore Sadar (central) Thana was selected considering its importance in terms of MP cultivation and finally Laxmipur Kholabaria Union under this thana was chosen for the study. (Fig. 2).

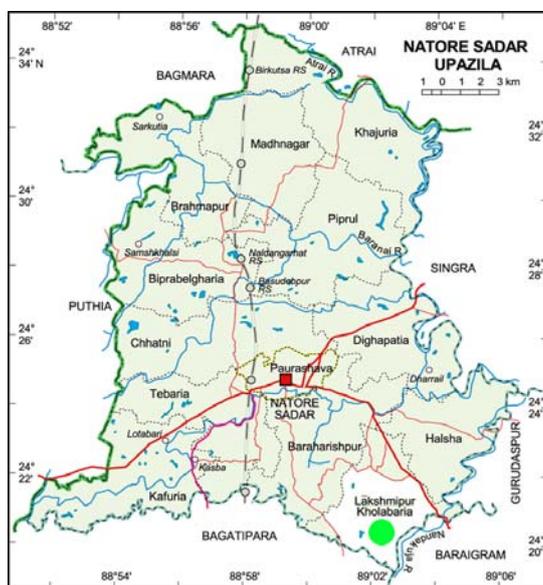


Fig. 2 Map showing the Laxmipur Kholabaria Union of Natore Sadar Thana

The second site was selected from the Bandarban district of Chittagong Hill Tracts under Chittagong Division, which is renowned for its rich indigenous culture and heritage endowed with natural resources. Out of seven Thanas of Bandarban, the Bandarban Sadar (central) Thana was selected purposively keeping in mind the rich tradition of *Baidhyas* and their availability in that locality (Fig. 3).

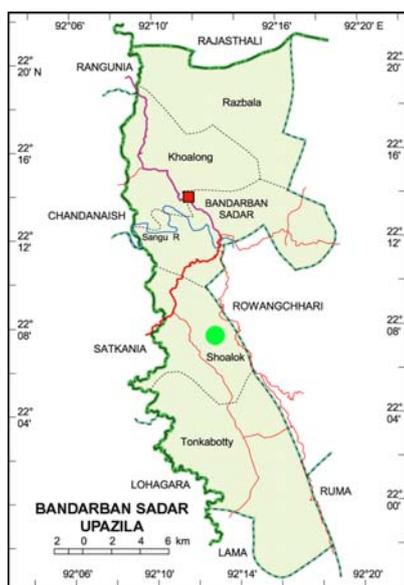


Fig. 3 Map showing the Shoalok Union of Bandarban Sadar Thana

Methods

For the study purposes, several terms were frequently used. They are:
Farmers: designated cultivators, traditional healers and small-scale traders engaged in medicinal plants cultivation and related activities.

Other Professionals: is covering people working in relevant research institutions, government agencies, academia, NGO's as well as commercial entrepreneurs.

Sustainability: That the MP cultivating farmers have continuous sources of income that will ensure their means of survival (economic sustainability) as well as protect the remaining natural stocks of medicinal plants (ecological sustainability).

Livelihood: the income needed to meet basic requirements of a family like food, medicine, shelter etc.

During the survey, three different types of semi-structured (open-ended) questionnaires (Flick 2006) were used to collect the preferred information on MP and related activities. Two questionnaires were used in the *farmers* survey;

one for cultivators in Natore (Appendix-I), another for the traditional healers in Bandarban (Appendix-II). A third one was used for *other professionals* (Appendix-III) to get a comprehensive view on MP and its related issues like cultivation and management issues, research, policy attributes etc. Apart from the questionnaire survey, focused group discussions (FGDs) were arranged with *Bepari* (local traders), *Kabiraj* (traditional healers) and with people and leaders of the local communities.

Sample size and sampling

As mentioned earlier that the present study was conducted between two broad sample groups, one is *farmers* and the rest is *other professionals*. Sample sizes were based on the number of population and availability of the required population.

Survey at Natore and Bandarban study sites

For conducting the questionnaire survey in Natore study site (Appendix- I) 28 farmers were interviewed with a sampling intensity of 25 percent. Sample populations were selected after a half-day long general meeting in the presence of about 50 villagers representing different professions and interest groups (farmers, local traders, *kabiraj*, teachers, local government members etc.). From this general meeting twenty farmers were selected based on their involvement in MP cultivation in terms of land holding size. The remaining eight respondents were chosen directly from the field while visiting the pre-selected twenty farmers. This classification of farmers were done based on the land ownership in order to; marginal farmers are farmers possessing less than 0.13 ha, poor farmers is having 0.13 to 0.65 ha, medium farmers between 0.65 and 1.3 ha and large farmers were those with more than 1.3 ha farmland. Based on this classification the selection for the study was made. Nine farmers each belonging to the marginal and small farmer categories and five each belonging to the medium and large farmer categories. Among these 28 respondents, 24 were male. The four women belonged to marginal or small farmers.

In Bandarban, study site the questionnaire survey (Appendix-II) was conducted among 11 *Baiddyas* who were actively engaged in the profession. The sampling intensity was 90 percent. Of them, five were from the Headmen Para (hamlet) and six were from the Talukder Para. Out of these 11 respondents, only one was female. The traditional healers were identified and selected with the help of local Headmen and Karbari and with the help of a community organization named Bangladesh Institute of Theatre Arts (BITA), that have been working in the locality for a long time.

The literacy rate in both the study areas is 37.8 and 27.8 percent, respectively and low compared to the national standard (51.6 percent). However, among the respondents 19 were found having primary education followed by secondary and higher secondary with four and three respectively in Natore

study area. However, in Bandarban stud area eight respondent were having primary education followed by one each from secondary and higher secondary education. In total three respondents from both study sites were found having any formal literacy.

The demographical nature of the Natore study area is quite similar compared to other plain agrarian parts of the country. On the other hand Bandarban is having landscape ecological differences compared to other parts of the country, since the whole district is blessed with medium to high hill range with the presence of diversified ethnic groups. The general demographic attributes in both the study area are presented in the Table 1.

Table 1. Demography and landholdings sizes in Natore and Bandarban study area

Parameters	No. of respondents	Minimum	Maximum	Mean \pm Std Deviation
Age (years)	28	26	65	44.07 \pm 12.59
	11	39	72	59.82 \pm 10.52
Household size(No.)	28	3	9	5.43 \pm 1.45
	11	4	7	5.36 \pm 0.81
Landholding size (ha)	28	0.0	4.55	0.862 \pm 1.13
	11	.80	2.8	1.82 \pm 0.63

During the respondent survey, the research team (consisted of my research assistant and me) was actively engaged in conducting the questionnaire survey with the assistance from a key local person who was selected based on his involvement in MP cultivation and a good acceptance among the local villagers. The farmers' survey was mainly performed in the farmers' fields in order to get a view of their farm experiences along with the questionnaire survey. While conducting the questionnaire survey the research assistant was also engaged in taking notes to ensure the acquiring of maximum information. A voice recorder was used with prior informed consent of the respondents. However, the female respondents were reluctant to be interviewed in the field site so these interviews were conducted in the village setting. The interview time varied depending on whether it was carried out on the farm site or in the village. Interviews conducted at the field took longer time since we (respondents and the research team) were simultaneously engaged in discussing and observing the field conditions. The average time for each respondent survey was 2.45 hours. The interviews in the village setting were based only on our questionnaire.

Apart from the questionnaire survey, three dual moderator FGDs were organised (Marshall & Rossman 1999). In order to ensure that the discussion sessions would move smoothly one of my research assistants was acting the role of moderator while I ensured that all the desired issues and/or topics were covered during the FGD. Of these three FGDs, two were arranged in the

Natore study site (with *Beparis* and *Kabirajis*) and only one in the Bandarban study site (with community leaders and villagers). The first FGD consisted of six local traders (*Beparis*) in order to share information about the markets and marketing channels of MP and products available in the study area and the second FGD were conducted with five *Kabiraj* to get their views on their profession and related issues. The final FGD was performed with seven respondents selected from community leaders popularly known as Headmen and Karbari and villagers. The outcomes of the FGDs were summarised using inductive coding method (Flick 2006; Frankfort-Nachmias & Nachmias 1996) so make grouping based on similarity or dissimilarity of the opinion and according to the priority mentioned by the respondents.

Survey of the institutions

The institutional survey was performed based among the *other professionals* group to get required information. Twenty-three personnel representing the selected institutions (Table 2) were interviewed using a semi-structured questionnaire (Appendix-III) to acquire the desired information on different aspects of MP viz. cultivation and management paradigm, research and policy issues etc. Among the twenty-three respondents, six were female. Apart from the formal interviews, various research and field documents, e.g. National Forest Policy, Forest Act and Forestry Master Plan etc., were studied and analyzed to get a clearer view of the policies in practice through the subject. Personal observations, maintenance of a field diary were some other modes used apart from the formal interview process.

Data analysis

During the survey, mostly qualitative data were obtained and hence the analysis was done based on descriptive statistics. All the information collected through the interviews and the questionnaire surveys were documented in a field diary as well as on the original questionnaire sheets and were translated into English when necessary. The answers were then grouped and posted into excel data sheet for further processing by using the statistical package for the social sciences (SPSS Version 15.0). Data obtained from respondent's survey were further analysed using the technique of inductive coding (Flick 2006; Frankfort-Nachmias & Nachmias 1996). The outcome of the questionnaire survey was compiled and coded with numbers ranging mostly from 1-4 or more where applicable. In case of closed ended answers like giving direct views like 'yes' or 'no' 1 and 0 code was used throughout the process. This inductive coding technique provides further scope for getting insights of the issues. The most frequently mentioned responses were including for the coding to analyse the data to conclude. Descriptive statistics was also applied to summarize and to give pictures as per the objective of the study and accordingly graphs and charts were produced to discuss the different attributes of the findings. Furthermore, a policy discourse analysis manly by interviewing policy maker as

well as the relevant documents was done to determine the realistic scenario of NTFP especially in MP cultivation and related activities. The answers and perceptions of the respondents from the *farmers* and the *other professionals* were then ranked as per the preferential choice of the respondents and numbered accordingly for further interpretation.

Table 2. List of institutions with number of personnel interviewed

Institution Type	Name of the institution	No of personnel interviewed
Secretariat, Government of the Peoples Republic of Bangladesh	Ministry of Environment and Forest	1
Research Institutes	Bangladesh Forest Research Institute	6
	Bangladesh Council for Scientific and Industrial Research	1
Government Departments	Bangladesh Forest Department	3
Universities	Jahangirnagar University	1
	Institute of Forestry and Environmental Sciences, University of Chittagong.	2
	Patuakhali University of Science and Technology	1
International Organizations	Arannyak Foundation, USAID	1
	Swiss Development Cooperation(Intercooperation)	1
National NGOs	Proshika- A centre for human development	2
Herbal Pharmaceuticals	Kundeswari Pharmaceuticals	1
	Hamdard Laboratories	1
	Square Herbal and Neutraceuticals Ltd.	1
Farmers Organization	Kholabaria multipurpose medicinal plant farmers association	1

Ethical considerations during the study

The study engaged *farmers* and *other professionals* to get the ideas and views on MP and related issues. To perform the questionnaire survey all necessary measures were taken to ensure that the ethical aspects of the farmers and other professionals interviewed are guaranteed. However, before the interviews and group discussion, the study objectives and possible outcomes were described

to the respective respondents. While interviewing individual respondents from governmental institutions permission from higher authority was confirmed. National rules and regulations on accessing and using information were fully obeyed during the study period. During the interviews, voice recorder was used to record interviews upon permission and consent from the respondents.

Conditions limiting the study

The study was conducted in a setting of state emergency due to political crisis, which significantly influenced the notion of the study since it was difficult to get relevant permissions and access to visit and acquire information due to the restrictions imposed by the interim government.

The study was quite challenging since it was mainly based on questionnaire survey in order to fulfil the objectives of the study. While conducting the survey, the farmers were quite reluctant in the beginning. They were suspecting me as a representative of the government, hence were non-cooperative. However, when they realized my identity and my objectives, they showed an immense enthusiasm and cooperation. Conducting a survey that includes different categories of people is rather a difficult task since everyone has their personal interest and demands utmost attention. During the institutional survey of *other professionals*, many of them especially the personnel from state agencies were disinclined to interact freely due to the bureaucratic barrier (a common and persistent characteristics in countries like Bangladesh, where official rules and regulations obstruct the officials in any kind of open interaction.).

However, this type of socio-economic study through survey opened up a new horizon in front of me about the life and livings of the rural people and the prevailing disparities. Through this endeavour, I came across the reality of MP sector quite comprehensively.

Results

The medicinal plant (MP) cultivation and related activities like traditional healing practices are of immense importance in terms of conservation as well as for economic purposes since they play a significant role in livelihood. The present study aimed at looking into these issues so that conservation and production issues can be integrated while practicing MP cultivation.

Medicinal plant cultivation and cultivators in the study area

The commercial cultivation of MP started in early 1990s in the Natore district and is now expanding all over Bangladesh in different magnitude. In the study area several different species are cultivated and among them *Aloe vera*, *Bombax ceiba*, *Asparagus racemosus*, *Withania somnifera*, *Ipomoea digitata*, and *Scoparia dulcis*, are the major ones. Land with good drainage and open sunlight is most suitable for cultivation of these species. Often sandy loam soil is considered the best. Both organic and chemical fertilizers are used. Cow dung is the most widely used manure followed by chemical fertilizers, e.g. Urea, Triple Super Phosphate and Murate of Potash. The commercially cultivated MP are harvested within a year and hence can provide yearlong income if the species selection is carefully done.

The cultivators of MP are mostly belonging to the traditional farmers that from generation to generation are practicing agricultural crops, e.g. rice, wheat, and sugarcane. The MP cultivation and management is often a labour intensive work. Apart from the farmer himself, both family labour and hired labour are engaged in the cultivation and management activities. Small farmers try their best to accomplish all the work by themselves with additional help from family members, since hiring labour requires a money marginal. Women are mostly dealing with harvesting activities and supporting cultural practices, like weeding. Nevertheless, due to the socio-cultural scenario in the study area women are not comfortable in engaging themselves too much in activity in the field.

Management of medicinal plants– related issues

Medicinal plants cultivation as a profession

In the study area, the farmers have been cultivating MP for a fairly long time. The minimum and maximum range is 2 to 20 years (8.18 ± 5.09 , mean value and standard deviation). A majority of the respondent farmers are cultivating MP as a secondary profession. Only, 29 percent of the surveyed farmers had MP cultivation as primary profession, while the remaining 71 percent were practicing it as a secondary profession. Mostly marginal farmers cultivate MP as

their main livelihood profession. Out of nine surveyed marginal farmers, six adopted it as their mainstay of livelihood.

The practice of *Baidya* as a profession is also often a secondary occupation. Out of 11 respondents, 10 described it as their secondary occupation. However, this profession is in practice for quite a long time. The minimum practicing year was six while the maximum was 32 years (20 ± 8.91 , mean value and standard deviation).

The income from MP related activities was also significantly correlated to the size of farmers' households ($0.531, p < 0.01$) as well as to the amount of land owned by the farmer ($0.443, p < 0.05$) in the Natore district. The yearly income from MP cultivation ranged from US\$ 511 to US\$ 5 372, while the income from practices within traditional medicine in the Bandarban district ranged from US\$ 438 to US\$ 1 402 (1 US\$ = 68.5 Taka as on April, 2009).

Commonly used and cultivated MP in Natore and Bandarban study areas

The Natore study area is mostly famous for its *Aloe vera* cultivation (many people know it as *Aloe* village), though more and more species are being cultivated in the area (Fig. 4)



Fig.4 A farmer working with his *Aloe vera* cultivation

The most commonly and commercially cultivated MP based on land coverage are *Aloe vera* (38 percent), *Bombax ceiba* (27 percent), *Asparagus racemosus* (16 percent) and others including *Withania somnifera*, *Adhatoda vasica*, *Ocimum sanctum*, *Ipomoea digitata*, and *Abroma augusta* (19 percent). Detailed lists of

commonly cultivated and available MP at Natore study area are presented in Appendix –IV. Commonly used plants in the practice of *Baidhya* range from herbs to tree species. The lists of MP used by the *Baidhyas* in their treatment of different ailments are presented in the Appendix – V.

The *Baidhyas* often need a diversity of plant species for their practice. As the MP is getting more and more scarce, they often try to maintain a stock of living specimen in their homestead as much as possible. The survey explored a good stock of MP maintained by six (6) *Baidhyas* in their home garden commonly used for treating patient as a complement to harvest from the wild and purchasing at markets (see Appendix VI).

Sources of planting material

Farmers normally plant seedlings of *Aloe vera*, while *Bombax ceiba* and *Asparagus racemosus* are raised from seeds. A large proportion of the respondents (46 percent) are depending both on other farmers and on market sources to procure the desired seeds and seedlings, while the majority solely depends on local farmers. The sources of planting materials used for the cultivation is presented in the Fig .5

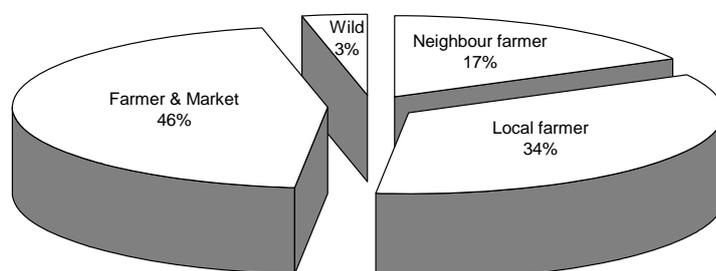


Fig.5 Sources of planting materials used by the farmers for cultivation

The *Baidhyas'* main supply today is the local markets, since the natural forest are depleting at an alarming rate. Three of the respondents mentioned Rainkhiong Reserved Forest as a reliable source especially for rare and endangered species, like *Plumbago rosea*, *P.zeylanica* and *Sida acuta*. All the eleven respondents mentioned local markets and traders as the major sources followed by own cultivation and city whole sellers. According to the views of eight respondents,

MP are getting scarcer day by day due to the rapid destruction of natural forest while as per the remaining three respondents claimed that there is nothing available in natural forests anymore.

Disease management

The emergence of plant diseases in the Natore study area is not sporadic yet. During the survey, the respondents mentioned three specific problems, i.e. root rot on *Aloe vera* and *Withania somnifera*, leaf spot on *Aloe vera* and scale insects on *Adhatoda vasica*. The farmers had informed the forest protection division of BFRI about their problems, but so far no measures had been suggested. However, the *Baidhyas* did not mention anything about disease problem in the small-scale medicinal plant gardens maintained at their homesteads.

Factors influencing cultivation

The farmers of the Natore study area had become cultivators of MP since the activity was considered to give a quick return in terms of economic value. Out of 28 respondents 17 mentioned *quick returns* as their main reason followed by *market potential* (four respondents). The other two deciding factors were neighbours' positive experiences. Detailed views of the respondents' grouped based on size of the farms are presented in the Fig. 6

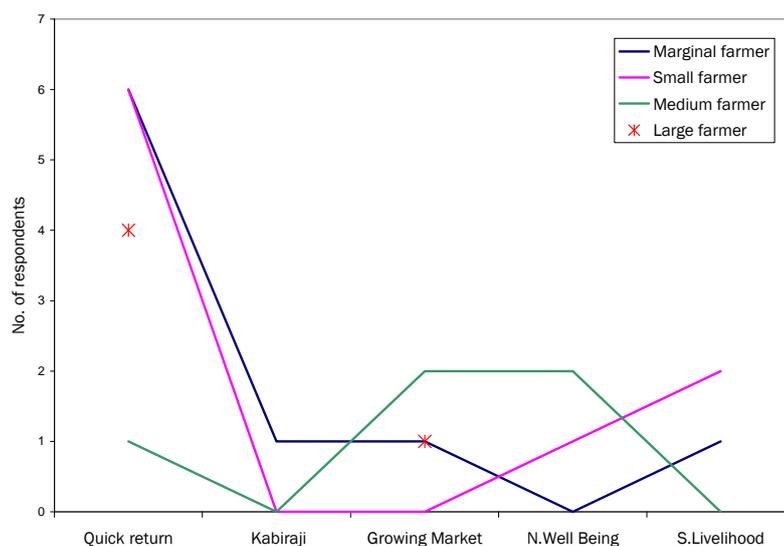


Fig. 6 Factors motivating farmers to adopt medicinal plants cultivation

On the other hand, traditional healers adopted this profession as heredity since their ancestors were engaged in the profession. Only two of them were involved the traditional profession mainly out of personal interest.

Medicinal plants farming and traditional healing practice as livelihood

From this study it was revealed that 71.5 percent respondents viewed MP cultivation as a promising mean of livelihood provided the government ensured a pro-farmer forest policy with all support needed to flourish the sector, while the remaining 28.5 percent respondents fully agreed about its potentiality as a livelihood source within existing setting. However, despite of different opinion about the role of MP cultivation in livelihood it is apparent that, by adopting MP cultivation in their agricultural field farmers' changes their socio-economic status significantly that was also observed during field visits and discussions. The following case study of a MP farmer's can best described livelihood issues in the study area based on medicinal plants cultivation.

Box-1 Fazlul's journey to uncertainty and glorious return to life

The mild winter sun was about to set when we met Fazlul (Pseudonym) on our way back for the day. Fazlul, a man in his 30's, was wearing an appearance of contentment and hard earned victory over death. An hour and a half long discussion with him opened a new horizon of hardship and fortune fiction in front of us.

.....it was a miserable time that we passed. In the year 1998, we were forced to leave our adored home and village because of huge debts and liability (my father went abroad to change our destiny and returned home bringing even more misfortune to us).

Hence, they left the village to go to the capital bringing an endless uncertainty by selling all their assets (2.4 ha of land). Fazlul and his younger brother took jobs in a garments factory with a salary of US\$ 25 each per month. This amount [US\$ 50] was too little to support a six-member family. His two younger sisters also started to work at the garments industry, even though it was little (insufficient money) to survive on in the capital. After work, he started selling juice of *Aloe vera* (mixing with other stuffs) as part time occupation. He used to collect the *Aloe vera* from his village, where *Aloe vera* cultivation is quite popular.

..... I started selling juice and managed to earn US\$ 75 more from that. We both (me and my younger brother) started jointly and shortly our monthly income [apart from the job salary] rose to US\$ 145. I kept selling (Aloe juice) until 2001. Then I left my job and returned to the village leaving my family in Dhaka. After returning, I discovered the good days of the villagers [earnings from *Aloe vera* cultivation]. I started doing business of *Aloe vera* (my brother kept a shop in Dhaka to sell the aloe leaves I sent him)

After half a decade of long hardship and struggle, he managed to come at the

end of the tunnel where hope and aspiration were blinking. Fazlul started earning good money from the business and soon bought 0.2 ha of land and brought back all of his family members (2 sisters, father and mother). How is life now? Fazlul explains:

Now I have also started cultivating *Aloe vera* on one acre of leased land and is expecting to earn US\$ 1 750 per annum [net profit]. I have got married and have two children. Life is now quite blissful for us. My parents are enjoying their old age with their grand daughters. It is only the medicinal plants, which survived me from the edge of demise and has kept me going. Now this [medicinal plants] is the only dream, expansion of cultivation of medicinal plants and I am planning [next year] to expand the cultivation in terms of area and species types.

To practice *Baidhya* as a profession for livelihood is rather difficult nowadays. The respondents' views were mostly three types supported by their own reasoning. Four respondents claimed it was possible to make a living based on this profession while five described it as difficult. The remaining two respondents thought it was impossible to sustain a livelihood through the practice of *Baidhya*. The *Baidhyas* perception about their life and living based on their profession can be delineate through the following case study insights of the profession.

Box- 2 The vanishing glory of traditional indigenous healing practice of Chiitagong Hill Tracts

It was a scorching sunny day when we went in search of Mati Lal (Pseudonym), a popular *Baidhya* (medicine man) of Headmen Para in Shoalok. He was busy cleaning his typical bamboo hut and the premises on the eve of Baisabi (a very big event in the life of a Buddhist). He was rather good in speaking Bengali and we started discussing with tea and tobacco brought from his own tea stall near his homestead.

...I have been in this practice for the last 11 years. I learned this knowledge of treatment from my uncle who is living in Lusai, India. Every year I have to go there in search of new knowledge...

He came along with two of his practice books written in Marma language. While looking into those, our eyes were drawn to the view of a nice, small medicinal plant garden rich with a variety of species. He was very enthusiastic when showing his belongings to us [which is a rare response compare to that what we received from other *Baidhyas*]

It is a challenging profession nowadays. There are no more herbs and shrubs with medicinal value in the forest. With the destruction of the mother [big trees], the sons [herbs and shrubs] are at the edge of extinction. How can one expect the children to survive without their mother? I failed to treat my wife [she died 2 years back] because I could not manage to get hold of the exact plants and materials. It is full of forgery everywhere.

Mati Lal reports that his income from the practice is very small and uncertain. The practice of *Baidhya* is getting more difficult day by day as the raw materials are getting scarce and he has to depend on local traders for a supply that are often adulterated. Is he prepared to teach his sons this knowledge?

.....No . . . No they [boys] do not have love and respect for the living spirit and if you do not love them [living spirits] they will not reside in you. It will be a dangerous teaching before you are ready to be taught. It's not so easy. [The practice of *Baidhya*] Needs devotion and interest to learn...

How to improve the condition? According to Mati Lal's opinion three things would make him happy: regular supply of authentic crude drugs; institutional training arrangements and public awareness and respect for the living spirit (the sacred one) and some handy accessories for processing ingredients for medicine preparation.

Land use system and issues of land fragmentation

The land use system in the Natore study area is representative to other parts of Bangladesh. Farmers utilize their land for general agriculture purposes, like paddies, winter crops and horticultural crops, but the farmers also use available suitable land for the cultivation of medicinal plants, especially *Aloe vera*, *Bombax ceiba*, and *Asparagus racemosus*. Among the surveyed farmers a major portion of their land is being used for ordinary agriculture (26.9 percent) followed by homestead land (14.5 percent). The percentage of land use for different medicinal plants cultivation has been delineated in Fig. 7.

Land leasing criteria: Because of the promising return from medicinal plant cultivation, more and more farmers are now interested in introducing MP, but the availability of land is the limiting factor. As a result, land leasing is getting more and more popular. There are two types of land leasing systems in the study area. The first is based on hard cash demanded by the landowner (usually US\$ 2 700 for one ha of land). By giving, that amount of money to the landowner the leaseholder can enjoy the land until the landowner is able to pay back the money to the leaseholder. The minimum period is one year or one

growing season. The leaseholder only needs to pay the annual land tax, which is very nominal, i.e. approximately US\$ 21 per year. A legal agreement is signed on judicial stamp to validate the leasing agreement. The other system is based on an annual lease system, whereby the leaseholder has to pay lease money worth US\$ 218 per ha annually to the landowner and consequently can continue to use the land until the owner gives notice well ahead of next growing season. There is no legal agreement for this type of land leasing system it is rather an agreement based on mutual trust. In the Bandarban study area such a leasing system is absent since, all farmers have sufficient land for swidden farming (locally called *jhum*).

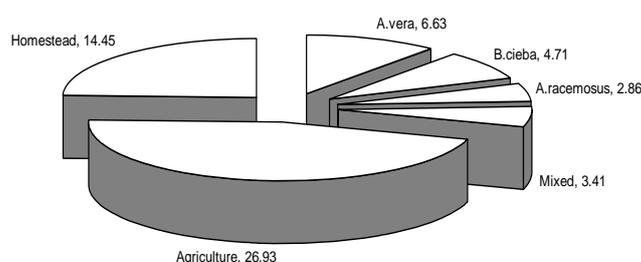


Fig. 7 Land use system in the study area

Division of land ownership - a pragmatic issue: A serious problem in Bangladesh is that each existing homestead is divided upon the maturity of the children. When the children are getting married, they receive a small bit of land. Therefore, the availability of suitable land for MP cultivation is being reduced day by day in terms of per capita ratio in the study area. This is not economically sustainable in the long run. Twenty respondents out of 28 fully realized the upcoming challenges that they are going to face, while four stressed that they are already been victims of this kind of land fragmentation whereby they inherited less land from their parents. The remaining four respondents viewed it as a manageable problem since they intended to buy additional land for their siblings (these respondents all belong to the large farmer category). However, in the case of the Bandarban study area the issue

was not to date directly influencing their profession since most of the *Baidhyas* are either collecting MP from natural forest or purchasing from the market.

Market and marketing system

Regarding the market potentials of MP, the respondents described it based on three preferential scores. Thirty-six percent of the respondents perceived it as very good followed by 35 percent who regarded it as good and the remaining 29 percent described it as promising and with a potential.

The MP and its different parts like root powder, bark powder etc. are mainly marketed in two modes in the study area, one is through local *Bepari* (traders) and the other is through direct sale. About 59 percent of the respondents use both modes, while 26 percent depends solely on local *Bepari* and 15 percent sell their products directly to the potential buyer. In the case of *A. vera*, the fresh leaves are generally marketed, while in case of other MP species both fresh and dried products are available for sale. Regarding the potentials of the further processing of MP and related products, all respondents strongly supported the view, provided technology, finance, infrastructure and market are ensured. As mentioned earlier, 59 percent of the farmers depend on *Bepari* for selling their production and hence the role of *Bepari* is inevitable. The role and characteristics of *Bepari* can best be visualised through the following description:

Box-3 *Bepari*- the matchmaker of farmer and his income

Local small traders, popularly known as *Bepari*, are mainly local villagers those are affluent economically to invest money for buying MP and related products from the farmers field. Written agreement is mostly done through farmers cooperative and verbal agreement is done directly between *Bepari* and individual farmers to buy MP from the farmer. Some farmers belonging to the medium and large farmers' categories do also act as *Bepari*. These *Beparis* marketed products to the large *Beparis* in the city known as wholesalers. *Beparis* have good connection with the city wholesalers and hence they are aware of the market demand. Due to this, sometime they manipulate the pricing at farmers' level putting all the blame on the wholesalers.

However, despite of their profit mentality they are indispensable to market the produce since the individual farmers do not have the access to the wholesale market or to the big traders.

The market value of the MP and products is fluctuating significantly depending on the availability of the products and the demand. The major product, *A. vera* leaves, most often sold based on advance agreement with the local *Bepari* while in the case of other products the price is quite fluctuating due to their demand and its availability (Appendix- VII). The income from MP cultivation and related activities is quite promising compared to the income from other

agriculture practices. It is generally about twice that of traditional farming, like rice cultivation. While discussing the insights of the MP market in the study area in general, *Beparis* viewed it as disorganised and influenced by city wholesalers, hence they are compelled to manipulate farmers. Some of the salient issues influencing the marketing according to the interviewed *Beparis* are:

- Absence of governmental supervision or monitoring is leading to poor cultivation and management and this is influencing the price
- Absence of effective farmers' cooperative to protect farmers' right
- Poor liaison or networking between farmers and potential buyers
- Absence of storage facilities to preserve the excess produces

During the FGD the *Beparis* were asked concerning their views on different issues, but they also sketched the marketing channel as presented in Fig.8

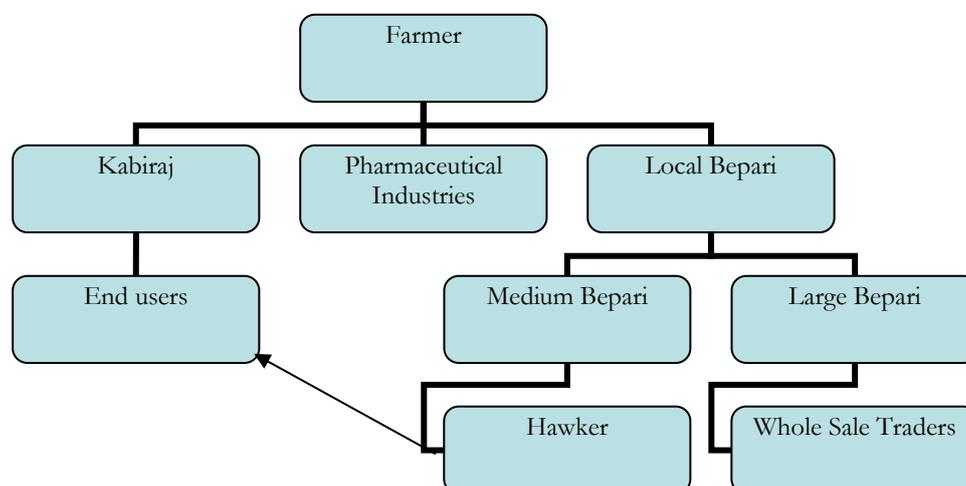


Fig. 8 Marketing channel of medicinal plants in the study area

To achieve a better marketing strategy the *Beparis* mentioned several issues that need to be addressed properly in order to give desired results. Some of the major findings according to their ranking were to

- ensure primary and secondary processing technology
- impart training and capacity building of farmers for primary processing
- give credit and infrastructural support by the government and other organizations
- formulate a governmental policy and action plan including NTFP and giving the utmost importance to commercial and ecological aspects
- formulate an agreement with potential buyers, i.e. big wholesalers, pharmaceutical companies

Farmers cooperative

In the Natore study area, there exists a farmers' cooperative named "Kholabaria Herbal Medicine Village Organization" established in the year 2004. At present the number of members of the cooperative is about 170, including farmers, local traders, small vendors, and *Kabiraj* (healers). Among the respondents, 23 are members of organizations while the remaining five stand outside. The members need to pay a monthly membership fee of TK 10 and are supposed to attend monthly meetings apart from any emergency call-ups. The executive body consists of six members and is headed by a president nominated by the members. However, the traditional healers of Bandarban do not have any platform of their own where they can meet and share the pros and cons of their profession.

The notion behind establishing the cooperative is to protect the farmer's rights and interests. In the Natore study area, 54 percent of the respondents expressed their satisfaction about the role that the organization is fulfilling on their behalf. However, 32 percent raised issues concerning conflicts of interest and abuse of power by the representatives and 14 percent of the respondents believed that the current representatives were inefficient and biased in addressing their hopes and aspiration.

Micro-credit support

According to the respondents there is a mixed opinion concerning the micro-credit support for MP cultivation. Marginal and small farmers need the credit badly since they often lack running capital for buying inputs viz. seedling, fertilizer etc, while the medium and large farmers are concerned about the high interest rate of the micro credit that threatened to become detrimental instead of beneficial. In case of the *Baidhya* only 3 of the informants wanted a governmental support to buy handy tools for the preparation of medicines.

Institutional attributes of MP cultivation and related activities

Medicinal plant cultivation as a mean of livelihood is fairly a new concept in Bangladesh even though it started sporadically a decade or two ago. Commercial projects are still in a nascent stage and need profound attention as well as support from the government. The interviews revealed that the government intervention is lacking in the study area. Regarding the NGO support, the respondents of the Natore study area mentioned only one local organization named LUSTER, which is assisted by Swiss Development Cooperation and International Finance Corporation

On the other hand, the presence of institutional support to the practice of traditional healing is also lacking in the Bandarban study area. Out of eleven

respondents, nine expressed a negative opinion concerning lack of any intervention from the government or other organizations. However, two of them referred to some kind of training and workshop that they attended few years ago. They urged support on quality planting material, training on modern methods of medicine preparation, handy accessories and community owned land for raising MP garden and a platform for the Baidhya with legal protection.

Challenges of MP cultivation

While asking about the prevailing problems in regard to the cultivation, management and marketing of MP, the respondents mentioned the following issues as salient ones and in the need to be addressed properly:

- Acute shortages of suitable land
- Absence of quality planting material and cultivation techniques
- Lack of government and policy support
- Poor marketing system influenced by intermediaries
- Lack of processing technology, infrastructure and capacity building
- Lack of cash incentives in the form of micro credit
- Weak coordination among various organizations including farmers

Challenges in the profession of Baidhya

In exploring the problems prevailing in this profession, a majority of the *Baidhyas* (10 out of 11) mentioned the issue of adulteration as the major threat to their profession followed by the unavailability of required MP. Long duration of the treatment procedure and lack of interest among the young generation were also mentioned by seven respondents each as challenges in the *Baidhya* profession. The detailed responses from the *Baidhya* are presented in Fig. 9.

The issues of conservation

Conservation is a crucial issue in order to attain sustainability. When asked about the role of biodiversity conservation for a sustainable development of the MP cultivation as a profession the respondents raised the issues of subsistence, which will ultimately pave the way towards conservation in favour of their own interest. The survey ended up with two types of outcome where 89 percent respondents were agreed fully agreed about the issue of conservation with reservation that livelihood issue should be in priority. However, eleven percent respondents were not certain about the role of conservation on sustainable development.

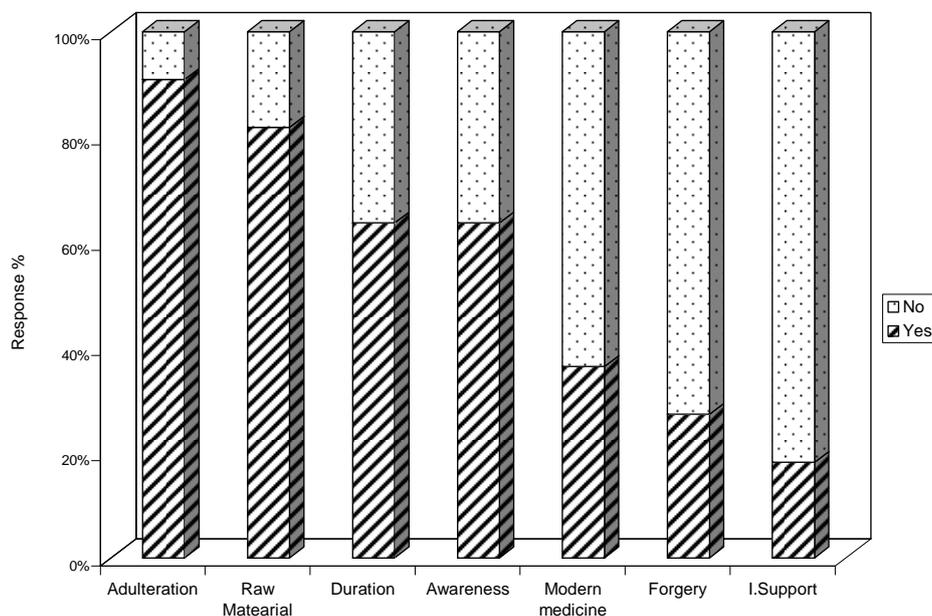


Fig. 9 Respondents views about the challenges of *Baidhya* profession

Questions concerning conservation issues were also discussed as it is directly related with the profession of *Baidhyas*. In the Bandarban study area all the respondents expressed their concern about the conservation to sustain their practice. According to them, due to the growing scarcity of the required MP and other medical ingredients their profession is on the edge of extinction since it is highly questioned due to the poor efficacy of their medicines because of massive adulteration. In order to ensure a livelihood out of MP and related activities, like traditional healing practices, the *Baidhyas* need sustained supply of raw material. On the other hand, issues of livelihood are a big challenge, which disintegrate the conservation perspectives. Harmonizing between conservation and production is quite a challenging task that needs research, policy support as well as the farmers' best practices.

The challenges and suggestive measures coming out of the respondent survey denote a possible way out to sustain the profession of *Baidhya*. The challenges of practicing *Baidhya* are according to themselves:

1. The rapid destruction of natural forests as well as the habitats of MP, which also is induced by political decision (e.g. leasing of forest land for commercial rubber cultivation, commercial horticulture, plantation of fast growing exotic tree species for fuel wood and timber etc.)
2. Poverty and lack of livelihood support through the profession of *Baidhya*
3. Too easy access to modern medicines and lack of awareness by the new generation

4. A higher abundance of adulteration due to the increasing demand
5. Absence of governmental support to this sector

However based on the FGD and survey of *Baidhyas* at the Bandarban study area several measures were described for the future development of the traditional healing practice which is presented in Fig. 10

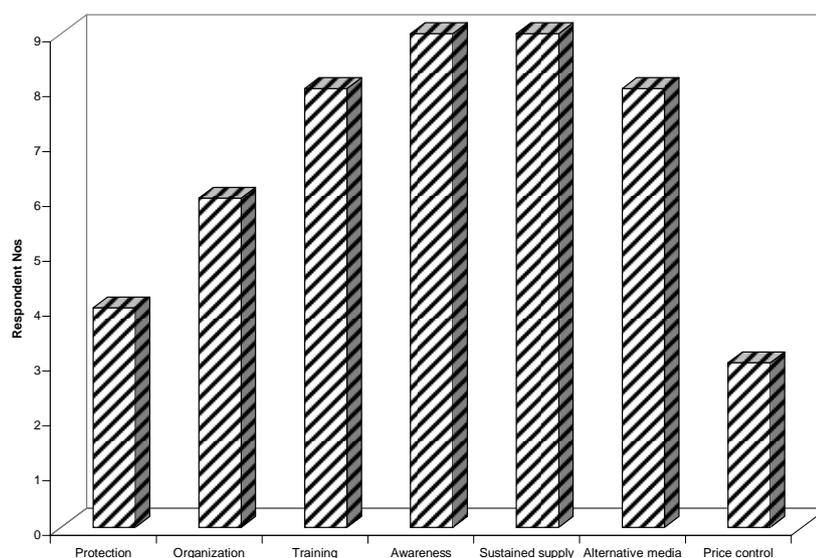


Fig. 10 The respondents' views in developing *Baidhya* profession in the study area

The *Kabiraj* of the Natore study site also took part in a FGD, where five *Kabiraj* (traditional healers) were involved in discussions concerning the prospects and challenges of the profession in a local context as well as on a more general level. There are about 29 active *Kabiraj* in the study area though nowadays many other people from the village claim to be *Kabiraj* to earn money from visitors. The interviewed *Kabiraj* mentioned several issues influencing their profession were mostly similar as the results revealed in the Bandarban study except for some few issues like the absence of a professional platform and sustained supply of raw material with reasonable price. However, they opined similar goals for the future development of their profession emphasising a formulation of a new forest policy that gives priority to MP and related activities.

Regarding the possible introduction of new species, the respondents, both the *farmers* and *other professionals*, mentioned several species ranked according to their preference and based on economic potentialities in Table 3 and 4.

Table 3 List of potential medicinal plants based on future potentiality (farmer's choice)

Species	Type of Plant	Ranking of Preferences
<i>Withania somnifera</i>	Shrub	1
<i>Adhatoda vasica</i>	Shrub	2
<i>Andrographis paniculata</i>	Herb	3
<i>Ocimum sanctum</i>	Shrub	4
<i>Piper longum</i>	Vine	5
<i>Rauwolfia serpentina</i>	Herb	6
<i>Terminalia chebula</i>	Tree	7
<i>Terminalia belerica</i>	Tree	8

Table 4. List of potential medicinal plants based on future potentiality (Other professionals' choice)

Species	Type of Plant	Ranking of Preferences
<i>Adhatoda vasica</i>	Shrub	1
<i>Asparagus racemosus</i>	Creeping	2
<i>Withania somnifera</i>	Herb	3
<i>Bombax ceiba</i>	Tree	4
<i>Andrographis paniculata</i>	Herb	5
<i>Ocimum sanctum</i>	Shrub	6
<i>Piper longum</i>	Vine	7
<i>Ipomoea digitata</i>	Shrub (climber)	8

Future development perspectives- Farmers' views

The NTFP sector is undoubtedly a promising sector, but it needs proper attention by the respective authority. From our study, it revealed that, a comprehensive action plan supported by the national forest policy could play a significant role in fostering MP cultivation and traditional healing practices as experienced in Natore and Bandarban. The respondents of Natore and Bandarban came up with various suggestions that they recognized as crucial to make this sector flourish. The following suggestions were some of the major outcomes from the survey:

- The formulation of a farmers' oriented policy giving priority to and emphasis on NTFP and MP
- Credit and technology support to interested stakeholders including entrepreneurs
- Training and capacity building of the farmers and other professionals
- Community land allocation in the form of Community Based Natural Resource Management (CBNRM) due to land scarcity
- Ensuring user rights to the forest dependent people
- Modern cultivation and management techniques to be made available to farmers
- Strong extension mechanism to deliver technology with GO and NGO collaboration
- Infrastructure support, e.g. storage facilities and processing units.

- Socio-economic study needs to be carried out in the form of action research
- Stakeholders' rights, demand and access to be ensured in the process from planning to execution

Institutional survey

As mentioned earlier an institutional survey was carried out to ascertain views of researchers, forest managers, policy planners, academics, NGOs, commercial entrepreneurs and community based organizations on research, policy attributes, extension mechanism, prevailing practices and challenges etc. Major activities of the departments e.g. research institutes, forest agencies, NGOs etc. vary according to their institutional mandate. The surveyed institutions have different mandates and hence they conduct their research work accordingly. Table 5 summarised the ongoing research activities and programme of the various institutions

Table 5. Ongoing research activities by different institutions on medicinal plants

Institution Type	Activities
Bangladesh Forest Research Institute (BFRI)	Cultivation and management of six commercially important MP Diagnosis of leaf spot of <i>Aloe vera</i> Diagnosis of root rot <i>A. vera</i> and <i>Withania somnifera</i> Diagnosis of scale insect of <i>Adhatoda vasica</i>
Bangladesh Council for Scientific and Industrial Research(BCSIR)	Vegetative propagation of <i>Woodfordia fruticosa</i> , <i>Terminalia chebula</i> , <i>Plumbago indica</i> Fruit quality improvement of <i>Terminalia chebula</i> , <i>T. belerica</i> , <i>Embllica officinalis</i>
Bangladesh Forest Department (BFD)	Product development based on MP Establishment of MP garden and demonstration plot in different forest areas Seedling raising of commercially demanding MP
Universities	Indigenous knowledge on MP by ethnic communities MP status survey on regional basis Phytochemical studies and identification of active ingredients in important MP
NGOs	Easy propagation technique of MP in members' nursery Capacity building on cultivation and management of important MP Value addition to the MP and products Market study to ensure sustainable MP cultivation
Herbal and Pharmaceutical Companies	New product development based on <i>Unani</i> and <i>Ayurvedic</i> formula Establishment of large scale MP plantation for sustained supply of raw material

While asking about the formulation of the research plan and activities in general it revealed that most of the research, institutions formulated their research plans with active consultation of different stakeholders and hence a priority research agenda was selected. In case of universities, there was no rigid policy rather it depended on researcher's interest, available funds and scope of collaborative research work with national and international organizations. Apart from organizations engaged in higher research, NGOs formulated their action plan according to the available donor support, farmers demand and possible scopes of liaison with partner institution. Commercial enterprises fully considered the commercial aspects in selecting their action plans

Challenges in conducting research on medicinal plants

While asking about challenges in research/operation in the field the respondents highlighted several issues. Out of 23 respondents ten mentioned insufficient funding and its delayed allocation as a major obstacle and this were followed by nine respondents that complaint about poor research coordination. Furthermore, eight respondents each mentioned acute shortages of work force, problems with logistics and lack of political influence at field level as important constraints.

The survey revealed different research gaps prevailing in the MP sector and many respondents emphasized the need of research on socio-economic level and policies (16 out of 23). Eight respondents demanded an inventory of MP and the creation of a reliable database. Studies on active ingredients, chemical characterization, management and the development of processing technology were mentioned by seven respondents and five demanded action research and mentioned issues of overlapping. Four respondents each mentioned tree improvement through phenotypic selection and documentation of indigenous knowledge.

Extension mechanism

Most of the research institutions mentioned about the presence of technology transfer mechanism. The commercial companies mentioned several mechanisms to deliver their product information to the stakeholders like patient, doctor by using electronic and print media. Research institutions are participating in different outreach programmes, like tree fair, farmer's day, and training courses, to reach farmers and other stakeholders with their developed technology. On the other hand, the state forest agency provides technical support to interested clients by arranging visits to plantations and demonstration plots of medicinal plants. The academic institutions usually organizes seminars, symposia and participate in national and international conferences apart from producing scientific journals, articles and documents to share contemporary issues of NTFP with the scientific community. NGOs mobilizing the grass root communities, acting as networking agencies by

bridging institutions and farmers in a scale to mitigate problems prevailing in this sector. They also provide management solutions with support from the research institutions. On other hand, the herbal pharmaceutical companies also arrange medical symposia to introduce their products to physicians and practitioners of traditional medicine apart from launching promotional activities in printed media, TV and others.

Policy imperatives

The respondents' views on the role of policy and governmental intervention towards conservation and farmer's needs were supportive to their own institutional mandate (Goals and objectives) except in a few cases. Out of eleven respondents from research institutions, Bangladesh Forest Department and the Ministry of Environment and Forest, nine expressed their positive opinions in favour of the current policy and the government interventions, only three opined differently mentioning drawbacks and loopholes of the current policy claiming that they are not enough farmers oriented. However, all the respondents from NGOs and academic institutions mentioned current policy imperatives as inefficient and not enough contact with the reality to address the farmer's needs. Three respondents from herbal pharmaceutical companies and one from the farmer's cooperative described the current policy as faulty as it was not addressing the demands needed for the development of entrepreneurship.

Policy issues greatly influenced the management and conservation of NTFP in Bangladesh. All respondents felt the need of a pro-farmer formulation of a policy that can address the interests of the different stakeholders. However, mixed opinion derived from the respondents on whether the current research and policy interventions properly addressing the needs of the people. Out of 23 respondents, 14 gave negative opinions and described the role of current research and policy as unfavourable to the MP sector, while the remaining nine claimed it as pro-people. Respondents mainly from research institutes and state forest agency described the current research and policy is addressing farmers need (according to them it is a dynamic process). While the others mainly from academic institution and NGOs described the current policy as an outcome of top-down approach that needs massive restructuring in relation to approach and implementation mechanism to address the burning issues like market, infrastructure, capacity building and conservation.

Future directives for NTFP development

Respondents specifically suggested several measures on the development of the NTFP sector in general and the cultivation of MP. They pointed out the needs to highlight the potentials of NTFP in fostering livelihood as well as conservation of natural resource through arranging farmers' day. In Table 6 are some of the major outcomes of the questionnaire survey summarized.

The respondents also clearly pointed out the different roles to be played (Table 7.) by various institutions in the sustainable development of the MP sector, one of the important sub sectors of NTFP.

Table 6. Suggestions for the future development of the medicinal plant sector

Organization Type	Suggestions for future development
Research Institutions	Comprehensive land use policy; Training and capacity building; Adequate fund; Mitigation of role conflict; Entrepreneurship development; Coordination between organizations and farmers
Government Agencies	Socio-economic study and action research; Donors support on technology, training and finance Manpower and logistics; Quality planting material; Adequate fund; Active law enforcement; Eradication of political influence in management
NGOs	Inventory for data base; Awareness and capacity building Quality planting material; Processing technology; Market study
Academic Institutions	Bottom-up approach of policy planning ; Coordination Policy emphasizing NTFP; Farmers incentives programme; Establishment of institute for NTFP research and management; CBNRM approach; Skilled manpower, Adequate research fund;
Herbal Producers	Socio-economic study and action research Quality planting material; Modern technology; National policy to promote alternative medicines; Strong market supervision; Socio-economic and on farm research study; Communities involvement in policy formulation

Table 7. Institutional responsibility for developing medicinal plant sector

Institution Type	Role to be played
NGOs	Networking between farmer and institutions like BFRI, BFD etc. Micro credit support with minimum interest rate Community mobilization and awareness Training and capacity building Extension agent
Research Institution	Development of quality planting material Cultivation and management technology Detailed resource inventory Action research
Forest Department and other government agency	Infrastructure Detailed resource inventory and data base preparation Monitoring and evaluation Market promotion of NTFP

Research on NTFP

In Bangladesh, the Bangladesh Forest Research Institute (BFRI), the Bangladesh Council for Scientific and Industrial Research (BCSIR) and different academic institutions, carries out most of the research work on NTFP and especially on MP. These institutes are mandated to conduct studies related to NTFP and MP. After analyzing, the various research activities of BFRI and BCSIR the following scenario can be depicted:

The Bangladesh Forest Research Institute: From 1958 to 2000 BFRI conducted several studies on NTFP, viz. bamboo, rattan, medicinal plants and others. Out of about 800 research articles, field documents and other publications only 96 studies were related to NTFP and only 16 to MP. Among the 44 developed technologies until 2000, only one was related with propagation and conservation of MP, which predicted the impact of improving status of declining resources and ensuring additional income of the rural people and state forest agency.

The Bangladesh Council for Scientific and Industrial Research (Chittagong): In order to ascertain the status of performed and on-going research activities in relation to the MP 68 publications of BCSIR (that has the mandate for research on MP and related activities) were synthesized. BCSIR has so far developed 516 industrial processes out of which 25 are linked with MP and their chemical contents. However, out of these developed processes only six are commercially leased out. Others are still in the process of verification and patenting.

Discussion

The cultivation of medicinal plants (MP) and related activities has showed promising result in the short run and hence the need for sustainable cultivation and management is becoming a crucial factor. In order to ensure economic and ecological sustainability there must be a synergy between conservation and production. Bangladesh and other South Asian developing countries are still facing a hard time despite of having all potentialities to flourish (Zuberi 1999; Mahapatra & Mitchell 1997). Under this surge various issues like livelihood, market and marketing channels, cultivation and disease management, land use systems and land fragmentation issues, micro-credits, training, institutional capacity building etc., are needed to ensure sustainability in the management of MP sector.

Field reality- The farmers' voice

The present study focused on the field reality of medicinal plants cultivation and its management. Due to a logging ban (imposed since late 1990s) in the natural forests of Bangladesh the exploitation pressure is now diverting towards NTFP, especially for the subsistence livelihood by the poor villagers. In order to create alternative livelihood, commercial cultivation of prioritized MP could be a good way to contribute to the livelihood as well for conservation of the depleting natural resources. Keeping this in mind, the present study tried to explore feasibility of MP cultivation in farmers field through exploring the farmers' voice on the following aspects, that they believed are a challenging dilemma to attain sustainability in MP cultivation and management.

Sustainable livelihood and conservation

Medicinal plant cultivation and its management demand amid attention by different quarters, e.g. researcher, policy planner, entrepreneurs and farmers, to attain sustainability in its management and conservation. It is possible to improve the livelihood of rural marginal farmers by creating possibilities for a commercial cultivation of medicinal plants. The present study experienced the potential of MP as livelihood through studying the farmers in the Laxmipur Kholabaria Union who improved their living standard considerably. Among 28 respondents, 17 changed to MP cultivation considering it gave a quick return compared to general agriculture. Many marginal and poor farmers fully depend on the income of MP, which the traditional agriculture fails to provide. Five farmers (marginal and poor) even leased land to expand their cultivation since they experienced outstanding profit. This lesson can be examined further to formulate livelihood project, especially for the poor and marginal farmers. From our study, it revealed that many farmers have bought agricultural land with incomes from MP cultivation. There is an urgent need to emphasize NTFP in our forest policy by mentioning detailed in statements. The *Baidyas*

of Bandarban demanded community managed plantations to ensure a sustained supply of quality planting material as well as raw material needed for the profession.

Such possibilities of using public land under community land management have also been univocally established by several studies (Khan & Rashid 2006; Hamilton 2004; Rashid & Rashid 2002; Arnold & Pérez 1998). Creating a more favourable environment by restructuring the policy with positive visualization by the respective national authorities can ensure livelihood based on MP and related activities. There is also a possibility that community empowerment can contribute to this as experienced in India through the 73rd Panchayati Raj amendment (Bhattacharya & Hayat 2004).

Keeping conservation in mind, wild harvesting of medicinal plants from natural forests is a big concern in terms of sustainability and there is a constant problem in giving a steady supply to the market. Wild harvesting, growth exploitation, habitat loss and unregulated trade of medicinal plants further extend the problem. The present survey of *Baidhyas* in Shoalok Union expressed their concern and urged for the protection of the remaining natural forests to sustain livelihood through the practice of *Baidhyas*, since the annual deforestation rate of Bangladesh today is 3.4 percent (FAO 2007). This concern is equally applicable in the case of commercial cultivation where monoculture of medicinal plants is a common practice for economic reason in Natore. Being a profitable crop farmers are extensively cultivating *Aloe vera* that has already resulted in some negative symptoms like disease infestation, which in the end may disrupt economic and ecological stability (Fig. 11). Immediate attention and support through research and policy restructuring is needed. Commercial cultivation of MP confining to only a few species as observed in the Laxmipur Kholabaria Union will affect the sustainability in the end.

However, we found that marginal and small farmers are quite aware about the issues in the study area. In order to tackle the disease problem they are practicing a mixed cropping system, e.g. *Bombax ceiba* with banana, mango and guava, *Withania somnifera* with winter crops etc. (Fig. 12)

To preserve our remaining natural forest, regional and international cooperation can be sought as Sri Lanka did for the conservation of MP and its habitat as mentioned by Hoareau & DaSilva (1999). Other studies have expressed the same urged for coordinated efforts to conserve natural forests and protected areas (Ji *et al.* 2004; Dold & Cocks 2002). It is important to find a balance between wild harvesting and commercial cultivation otherwise the natural sources will be over harvested due to the lucrative demand (Ros-Tonen 2000). Unsustainable harvesting and collection will in the end affect the livelihood of rural marginal farmers and a further depletion of the resources

(Nazir *et al.* 2007; Bhattacharya & Hayat 2004; Mahapatra & Mitchell 1997). However, cultivation in degraded marginal lands could give people an opportunity for livelihood apart from reducing pressure on major forest resources (APFD 2002).



Fig. 11 A farmer-showing roots rots disease in his *Aloe vera* field



Fig. 12 Mixed cultivation of *Bombax ceiba* with mango tree

Market and marketing

In general, the market for MP in Bangladesh is disorganized and heavily influenced by intermediaries. However, market potentials vary based on the demand and characteristics of the market (Arnold & Pérez 1998). The farmers in the Laxmipur Kholabaria Union marketed their products mainly through two modes, one is direct sale and the other is through local *Bepari*. Fifty nine percent of the farmers used both modes to market their harvest. A majority of the respondents (farmers) mentioned the influence of intermediaries and the absence of governmental intervention as responsible for poor marketing system. Due to influence of local traders and wholesalers the farmers are often compelled to sign irrational agreements that force them to sell their products at a fixed price no matter if the market demand is increasing or not. For that, during times of high prices and high demand, farmers are losing their profit share. On the other hand, local *Beparis* mentioned the challenges of marketing during the FGD, where they blame city wholesalers for manipulating the market in the study site. The poor cultivation and management techniques followed by poor networking with potential buyers also aggravating the situation. The respondents from *other professionals* also mentioned the limitation of intervention from government in linking farmers with potential buyer. Our study revealed that in spite of the expressed need in the survey as well as in the FGD there is no on-going effort in linking farmers with potential buyers. The large-scale buyers like pharmaceutical companies required raw material that needs to comply with their required quality and quantity.

However, Tewari & Campbell (1995) suggest that a governmental intervention on the market and trade might have negative impact as they takeover the role previously played by traders and intermediaries. Such condition may further enhance due to strict governmental rules and regulations due to the massive influence of political leaders as noticed by Tripathy *et al.* (2003). Despite of the mentioned importance of an improved production and commercialization of NTFP, the cultivation, production and marketing is continuing in the traditional way (Mahapatra & Mitchell 1997). Credible marketing system hampered due to poor communication, infrastructure, like storage facilities, and lack of farmers' friendly credit facilities that are low in interest and easy to get. So ensuring a credible marketing channel is a prerequisite for the expansion and sustainability of medicinal plants sector, especially in developing countries (Khan & Rashid 2006 & Halder (*unpublished*)).

Value addition in raw material and products is a need of time to enhance quality in order to compete with other rivalry. This can be done through adopting biotechnology to produce uniform and high quality planting materials; semi-processing of the raw material to a value added product by adopting modern system of improved drying, grading and storage techniques as mentioned by Calixto (2000).

Training and capacity building

The farmers of the Natore study area and the traditional healers of the Bandarban study site all urged for extensive training to improve their skills to face the upcoming challenges. The respondents complained about that the absence of institutional support creates obstacles to reach to the market and corporate buyers like pharmaceutical industries. Big pharmaceutical companies are ready to procure priority plants (Table 4) in a bulk quantity if the quality standards are strictly maintained. This needs an extensive capacity building and training support. On the other hand, the *Baiddyas* are facing competition from the modern treatment system due to lack of modern facilities for the processing of medicinal preparations as well as lack of awareness among new generation. Developing skills concerning cultivation, management and primary processing needs appropriate training and capacity building. A comprehensive action plan supported by the policy can play a significant role in this regard. The forest policy must reflect these issues and need to integrate it with agricultural policy and action plan, so that it can be treated as cash crop like rice, sugarcane, potato etc. and attract more attention from the policy maker.

Nursery raising of commercially and ecologically viable medicinal plants, plantation management, primary processing, drying and grading demands on farm and institutional training. The respondents from farmers and traditional healers' community expressed their continued demand for quality planting material. Research institutions like the BFRI and the Bangladesh Forest Department can ensure quality-planting material at the doorsteps of farmer. Otherwise, the sustainability of MP sector will continuously be threatened and confined to the local community only. Local organizations can play a significant role in undertaking such intervention to skill the growers with technical and commercial know how if the government provide substantial support to those organizations in the form of training and capacity building.

The village Panchayat in India arranged training on value addition like grading, storage and packaging with the help of skilled professional from research institution and pharmaceuticals companies as mentioned by Bhattacharya & Hayat 2004) In Bangladesh the traditional healers were given training by BFRI on plantation management aspect so that they can improve their own MP garden in their homestead (Dixie *et al.* 2003)..

Infrastructural constraints

The respondents of the Natore study site wanted to have a storage facility in order to preserve their produce, especially the *Aloe vera* leaves, during the rainy season when excessive monsoon rain causes damages to the leaves as well as during the winter when the demand is dropping considerably and greatly affects the price. Provision of a regional storage facility can help farmers to preserve their produce for a certain period until they manage to get a

reasonable price. On the other hand, the *Baidhyas* demanded a constant supply of quality planting material to sustain their profession with quality treatments. Ten of the respondents mentioned adulteration as a major threat to their entire profession. They suggested the establishment of a central nursery that could act as a source for planting material as well as deliver raw materials. Raising nurseries to ensure a sustained supply of quality and commercially viable medicinal plant seedlings is a big challenge. A significant number of farmers were interested in changing to MP cultivation realizing its possible economic and social benefits as livelihood support, but they had a limited knowledge on how to start. As a result, many of the local initiatives end up with poor quality and a small volume of products. The needs for a collective effort for providing institutional support have been reiterated (Hamilton 2004 & Bhattacharya & Hayat 2004).

Transportation is another problematic issue since most of the farmers in developing countries live in the remote village where the road network needs to be improved. During our survey, farmers also mentioned the uncertainties in arranging a transport to deliver their harvested products to the capital market (Fig. 13). The prices of transportation also fluctuate significantly, which ultimately affect the local traders and the farmers. The *Beparis* demanded transport facility at their doorsteps to market their products that will ultimately benefits the farmers.



Fig. 13 Trucks loaded with medicinal plants are heading towards the capital

Credit and cooperative

Micro financing with affordable interest rates can aid the farmers to cover the input cost during the time of plantation until harvesting. However, there is a mixed opinion regarding the micro credit support in both study areas. Marginal and poor farmers in the study areas needed the credit badly since they often lacked running capital for buying inputs like seedlings, fertilizer etc., while the medium and large farmers were more concerned about high interest rates of the available credits that might be detrimental instead of being beneficial. The

Baidhyas demanded financial support to establish practice chamber or for buying handy tools for medicine preparation. Government can play a decisive role in mitigating the high interest rate and the prevailing bureaucratic barrier that make farmer disinterested to go for micro-credit. There should be a pro-farmer loan disbursement policy strictly monitored by respective government authority.

According to different studies micro financing can help eradicating the influences of intermediaries by strengthening their position to bargain with the traders to get maximum price of their produce and help conserving biodiversity as it is linked with enhancement of income and improved life status (Bhattacharya & Hayat 2004; Mahapatra & Mitchell 1997). The same scenario can be depicted from the respondents' view in the Natore study area as most of the farmers stand for livelihood first which will ensure sustainable conservation and utilization for the shake of their own subsistence.

Dynamic cooperative system can provide all-round protection to the members who will find confidence towards further expansion and better management of their plants. In the present study, the respondents' views on cooperatives are not fully satisfactory because of its weak functioning attributes. 54 percent of the respondents expressed satisfaction while 32 percent raised issues of conflicts and misuse of power by their representatives, which created mistrust among the members. The representatives were found biased towards some of the more influential farmers and hence tended to provide unfair services in marketing their produce. Such irregularities can probably be solved if the community organization with support from the state agencies provides technical and administrative support to the cooperatives to strengthen their capacities. Ultra poor farmers are always in need of a formal cooperative or platform to ensure a rationale price of their produce (APFD 2002 & Silori & Badola 2000).

Cultivation and management issues

As commercial cultivation is getting momentum, there is, however, also a growing concern about the quality of the products assuring safety and efficacy in order to enter the competitive global market. Emergence of disease and biotic interference further limits and brings uncertainty to the sector. The farmers in the study areas had noticed (though sporadic yet) the emergence of several diseases like root rot and leaf spots in *Aloe vera*, root rots in *Adhatoda vasica* and scale insects on *Withania somnifera*, which affects the quality and consequently the price. While discussing this issue with the leading pharmaceutical companies they also raised questions concerning the quality of *trifolia* (a medicinal combination of fruits from *Embllica officinalis*, *Terminalia chebula* and *T. belerica*). Despite of availability on the local markets they have

chosen to import from neighbouring countries due to poor size and grading of the locally produced *trifolia*.

Availability of quality planting material is important aspects, which need to be addressed properly to make this sector viable. From the study, it revealed that 46 percent farmers depends both on other farmers and market source for procuring desired planting materials, while the majority group mainly depends on neighbouring farmers. Since farmers are not sure about the quality of the procured seed and seedling there remains every chance of havoc, which may lead to total destruction of the crops. Forest department in collaboration with research institutes should take the lead role in ensuring the quality of the planting material. Grassroots organizations can be used further to disseminate the technology of growing quality materials by giving proper training and technical inputs. Ensuring a regular supply of quality planting material with affordable price would probably boost the sector with quality as well as quantity. Even the *Baidhyas* will be able to regain their reputation, which is at the edge of demolition due to massive adulteration.

As the available resource base is a minimum compared to the population size of Bangladesh, we can apply similar approaches like Taungya, to expand the cultivation of MP in the forest area too. Over harvesting, degradation of natural stock and loss of traditional knowledge in the use of herbal medicines are commonly faced problems all over southern Asia, which might have a greater impact in the end (Dhar *et al.* 2002; Caniogo & Siebert 1997). In this regard, commercial cultivation could be a better alternative, which will meet current and future demand apart from relieving pressure on the wild stock and hence be described as a conservation approach for threatened species (Schippmann *et al.* 2002; Silori & Badola 2000). Dold & Cocks (2002) urged for commercial cultivation and genetic improvement to prevent an eroding natural resource base.

Institutional support

Ensuring institutional support for the medicinal plant farmers is a big step ahead to gain sustainability, which is strikingly limited in Bangladesh. There seems to be a big gap between different governmental organizations and research institutions on one side and NGOs and the farmers' community on the other. The Forestry Master Plan also mentioned the lack of coordination between different organizations an issue that was also reflected on other studies too.. The respondents also informed that role conflicts among the organizations often led to a poor outcome. Various institutional support programmes, like resource inventory, ex situ-conservation, market promotion and capacity building, can be taken into consideration (Kala *et al.* 2006). Separate policy for NTFP was demanded by farmers as well as by the NGOs and other professional during the survey and this can be performed with a

collaborative action plan as done in India described by Dhar *et al.* (2002). Neither the policy nor the institutional mechanisms are in favour of supporting the interested stakeholders. Some efforts are underway to link the MP production sector to potential buyers through an agreement initiated by some NGOs. This needs rigorous institutional support in the form of capacity building, technology, and infrastructure and finally yet importantly, the policy supports in order to be compatible with the value addition and formal requirements of the potential buyers.

The present study also revealed such limitations whereby the interviewed farmers complained about the absence of training in cultivation and management techniques, credits, and capacity building on primary processing for value addition. Farmers from both study sites demanded a legitimate support from respective authority. Nine out of eleven respondents from Bandarban study site mentioned that there is no governmental intervention to facilitate the profession through providing quality planting material, training and legal protection. On the other hand, misinterpretation and abuse of the existing policy and working guidelines by the field level government (mainly forestry) officials may lead to a general mistrust and conflicts among the farmers. If it should be possible to engage community organizations or grass root platforms for such intervention, transparency and highest level of efficiency must be demonstrated (Shukla & Gardner 2006).

Very recently, the Government of Bangladesh formulated development strategies recognizing the potential role of the traditional healers (*Baidhyas* and *Kabiraj*) in rural health care and suggested necessary directives in a draft national health policy 2008. This is now being processed by the parliament. Apart from this initiative, the government already created positions for 45 medical officers termed as alternative medicines (AMC) in 45 Thana health complexes to mainstream this branch with modern health care system. A demonstration plot with important and widely used medicinal plants has already been established in many Thana Health Complexes to aware people about the importance of MP in traditional health care system. These state interventions are scattered and do not necessarily reflect the actual demands of the field practitioners strictly, since there is virtually no controlling body or mechanism to monitor the whole process. Weak linkages between research organizations and state forest agency are also responsible for the poor performance in this sector.

Extension mechanism

From the field study, it is apparent that the extension mechanism to deliver technological support to the farmers is absent or strikingly limited. BFRI recently started some extension activities to transfer their developed technologies. However, due to the budget and logistic limitations this effort

has not yet been a success. The faulty selection of target clients is also a vibrant factor behind the poor achievements so far. The Bangladesh Forest Department is not playing any substantial role in providing support at the field level due to lack of personnel and since they mostly are engaged in conventional protection activities. Different NGOs are working with community people, but they need strengthening of their capacity in terms of skilled manpower, transparency in expenditure and trust building with government organizations. During the survey, the respondents urged the need for establishing separate extension department with all necessary support to reach to the farmers. The existing extension mechanism of agriculture department can be used by imparting training on MP and related issues. However, for this purpose it needs integration of programme action plan through policy directives.

During the institutional survey, all respondents mentioned the need of some kind of extension mechanism to deliver and promote their message and products. However, the farmers and traditional healers urged for institutional and policy support, governmental intervention, and legal protection as well as demanded an extensive research on the socio-economic aspects of MP. Several studies have resulted in the same conclusion suggesting more research and appropriate technology transfer mechanisms (Kala *et al.* 2006; Rao *et al.* 2004; Ghimire *et al.* 2004b).

Research and policy issues on medicinal plants

Conservation through commercial cultivation is rather a new dimension for the farmers as well as for the policy makers in Bangladesh. The current forest policy hardly reflects the issues of NTFP. On the other hand, this policy is formulated without any consultation with major stakeholders, like farmers. While conducting a survey with other professionals only the respondents from the state agencies denoted the current policy as pro-farmer whilst the other respondents expressed their dissatisfaction with the existing policy describing it as a top-down approach. So in order to create awareness and to support sustainable commercial cultivation the policy planners and researchers need to work together to address the issue through consultation with farmers and community organizations. Khan (2009) clearly pointed out the impractical and irrational assumptions, conditionality and targets included in the forest policies of Bangladesh, which in the end proved to be inefficient to address the reality in the field. The interaction between forest and local communities is hardly ever reflected on in the policy agenda like (Gopalakrishnan *et al.* 2005; Tripathy *et al.* 2003).

However, addressing the needs of small-scale cultivation by the marginal farmer by giving inputs on policy imperatives on local setting could bring a positive outcome as observed by Larsen *et al.* (2000). Community based

approach applied by local NGOs gave positive results like arranging *Baidyas* workshop, village biologist (also called bare foot botanist) as mentioned by Shukla & Gardner (2006).

Formulating a farmer's friendly policy is a challenging task as it often entangled the interests of many different stakeholders and thus it is hard to avoid being influenced by demands from powerful interest groups (Muhammed *et al.* 2008). Careful consideration of the socio-political attributes of the locality could bring success in the stay of sustainability as discussed by Hoareau & DaSilva (1999). Developing a sustainable management strategy for the MP sector must consider commercial aspect as well as the conservation issue since imposing ban for conservation is not an apprehended approach where people suffering for sustaining livelihood (Larsen & Smith 2004). Special interest groups like indigenous communities should also be taken into consideration since a majority of them rely directly on MP for their day-to-day health care (Khan & Rashid 2006; Bhattacharya & Hayat 2004).

A comprehensive survey was conducted in our study to get the views from different quarters of *other professionals*. The respondents mentioned several challenges in conducting research out of which insufficient funding and its delayed allocation were important factor, followed by poor institutional coordination and overlapping activities. Shortages of manpower and logistics are a common scenario in a country like Bangladesh, which is mainly caused by budget limitation along with poor planning by policy makers. Political influence at local level and frequent changes of government and its political views also influenced greatly the smooth implementation of any project, but the policy maker to avoid unnecessary pressure and harassment seldom mentions it in problem identification exercises. However, during this survey the respondents urged the government agencies to take a leading role in this regard.

While discussing research support with farmers they complained on the poor feed back from different research institutions, e.g. BFRI, who for instance did not provide any effective solution on disease surveillance of MP viz. leaf spot, root rots and scale insect in *Aloe vera*, *Withania somnifera* and *Adhatoda vasica*, respectively. Even from our analysis, the research activities of BFRI it is apparent that NTFP sector is not in the core of their action programme. The technology development of BFRI also support this argument since they from the establishment in 1957 until 2000, so far have developed 44 technologies, but only one is related to the propagation and conservation of MP. A review of the research documents published by scientists at BFRI during period 1958–2000 revealed that out of 800 scientific papers and field documents, 96 were related to NTFP and 16 were related to MP. The same scenario was observed in the case of BCSIR. So far, they have developed 25 industrial processes related to medicinal and aromatic plants (MAP). However, inadequate and

delayed allocation of research funding and frequent changes of researcher is a common scenario in the research institutions of Bangladesh.

Such limitations were also mentioned in the Forestry Master Plan and put provision for gradual development. The absence of extension mechanisms by the research institutions is also responsible for the results not being able to reach the farmers. Studies from India and Nepal have also shown these drawbacks (Kala *et al.* 2006; Larsen & Smith 2004).

Due to the top-down institutional policy approach farmers demand is hardly been taken into consideration while designing and selecting priority in research programmes. The academicians, NGOs and community workers apart from the personnel of the research institutions also mention this rigorously during the survey. While conducting this survey the top-down characteristics of the Bangladesian policy formulation was widely spoke about. Research institutions formulated their annual research plan without the participation of the farmers' communities or other forest user groups. The annual research plan of BFRI was finalized through consultation with pre-selected stakeholders, excluding representative from farmers' or community organizations, and hence the research plan often fails to reflect real scenario of the field. Such problems have also been highlighted in other studies of the situation in Nepal and India, respectively (Ghimire *et al.* 2004a; Dhar *et al.* 2002). The respondents from the universities as well as from the national and international NGOs strongly demand more action research to an address the socio-economic and market attributes of MP to enable the policy planners to get through the challenges of MP sector of Bangladesh.

Resource scarcity is obviously a limiting factor. However, a careful formulation of programme plan with active participation of all stakeholders can bring a synergy in the MP sector leading to economical and ecological sustainability. Irregular supplies of quality seeds and seedlings, raw materials, disorganized marketing system were described as limiting factors in stabilizing or expanding NTFP sector in Bangladesh. An absence of a database to provide information on market potential, technology, research activities etc. and reliable resource inventory were pointed out as major limitations in the planning of as well as the formulation of a good NTFP policy that could bring economical as well as ecological success.

While analyzing the current national forest policy and its salient features no concrete statement on NTFP were found. The only reference was made arbitrary and statement number 24 declared that NTFP production would be encouraged under the afforestation programme. Keeping this in mind the action programme stated by Forestry Master Plan where they planned to raise 1 500 ha of MP cultivation in different land category like forestland, farmers land

etc. through community participation. Compared to the plan of raising 1 500 ha plantation of medicinal plants with an expenditure of US\$ 2.2 million within 20 years time span, the achievement is negligible. In the Natore study area farmers started their cultivation totally on their own initiative inspired by a local *Kabiraj* named Afaz Uddin popularly called Afaz Pagla (Fig.14) and until now there is hardly any effort from the government sector to cater the needs of the farmer.



Fig. 14 The pioneer of medicinal plants cultivation in Natore study area

Based on the discussion above it is clear that we need to create a platform where the farmers and the other professional group will work together in favour of MP sector of Bangladesh.

Conservation and cultivation issues

Excessive extraction of MP for commercial use resulted in ruthless destruction of natural population in most cases in south Asia (Dhar *et al.* 2002). Under this backdrop, small scale or commercial cultivation both can meet current and future demand apart from relieving harvest pressure on the wild populations. Especially for threatened species, it could be a better option for conservation. The *Baiddyas* of the Bandarban study area strongly demanded to study the feasibility of commercial cultivation of MP, which will meet their professional demand apart from enduring economic gain. Small-scale cultivation can be effective as a response to a declining stock as well as to generate income and to supply the regional market as mentioned by Schippmann *et al.* (2002). However, on the contrary they concluded that a large-scale commercial

cultivation mostly would benefit the elite influential. Such research experience can be useful also in the context of Bangladesh while formulating a new forest policy to enhance the growth of NTFP sector especially the MP.

The fragmentation of landownership has a significant detrimental effect on productivity and efficiency as stated by Rahman & Rahman (2008) in case of rice cultivation where due to the 1 percent increase of fragmentation reduced the output by 0.05 percent. Therefore, landownership by farmers can induce positive result in case of large-scale plantation of MP. As the MP cultivation is expanding over agricultural land so there is an ample scope to integrate this venture with agriculture. Our agricultural policy supported by land policy can help significantly in this regard. Furthermore, using the network of agricultural department of Bangladesh we can reach the farmers quite successfully without any delay. In every Thana, there exists one Agricultural Extension Officer who can be successfully utilised to meet the requirement of the farmers through a collective effort.

Development of infrastructure and capacity building both at farmers' and at institutional level was strongly requested among the *farmers* and *other professionals* in their respective field. So policy planning should address these issues through investing adequate fund. In this case, support from regional and international organization can be sought. The concept of conservation and sustainability issue are directly related with livelihood. *Farmers* and *others professionals* both have important roles to play to create a win-win situation. Since resource is scarce we must integrate our existing resource under one umbrella for its maximum utilization by avoiding duplication in project implementation and research activities, which is prominent in context of Bangladesh.

Most of the present research is conducted in isolation without any sharing of knowledge between different players. In order to overcome this problem action research strategy should be introduced which is a team effort of problem solving consist of multi disciplinary people to address diversified requirements of the stakeholder.

Conclusion

Challenges ahead

From our study, it is revealed that one of the biggest challenge in the sustainable management of medicinal plants (MP) lies within the integration of farmers need in line with available knowledge and technology support. Making synergy between economic and ecological perspective is the need of time. Furthermore, since our natural forest is eroding fast measures in regards to the protection of the remaining forest is also urgent. The conventional approach of the forest management by the Forest Department of Bangladesh is not appropriate in the present context to tackle the problems rather it has induced the issue. Participatory approach like community based natural resource management can be a good way, which has been shown in many countries. It is therefore important to take the livelihood of farmers and the interests of other stakeholders into stern consideration in the development of any coordinated conservation plans.

A comprehensive policy planning needs to include ecology and economy as mentioned hereafter as the livelihood of poor farmers to tackle the dilemma of sustainability in MP cultivation and management which previously has been shown (Kala *et al.* 2006; Rao *et al.* 2004). Long-term management policy that brings all interest groups together is a necessary way to obtain sustainability, since rapid changes could bring negative drift into this sector. The driving forces of political economy must be taken into consideration in the formulation of new policies and action plans since the influence of the political elites is a dilemma in local conservation. Several studies have described the urgency for such mechanisms through analyzing the policy discourse on regular basis (Khan 2009; Muhammed *et al.* 2008; Shukla & Gardner 2006).

Community organizations could play a decisive role in the policy formulation since they often are the only ones in direct contact with the grass root farmers as we observed in the Natore study area. However, the role of community organization should be reflected in decision making process which is a limiting factor in Bangladesh and neighbouring countries like India, Nepal as mentioned by Gopalakrishnan *et al.* (2005). In some cases the policy process found more inclined to the interest of local political elites instead of the actual needs of farmers as described by Bhattacharya & Hayat 2004; Kala *et al.* 2004.

Institutional capacity building is another limiting factor to uphold the growing trend in terms of cultivation and conservation, which was mentioned by all of the respondents. All parties including farmers, traditional healers, researchers, and community organizations demanded intensive training and capacity

building to make this sector viable in terms of their respective demand like livelihood and conservation. Detailed guidelines for harvesting, storage, drying, grading and primary processing are necessary tools needed for adding value to the produce. Farmers of the Natore and traditional healers of the Bandarban urged for primary processing technology as well handy tools for the purposes. Partnerships between various stakeholders, mainly farmers, community organization, industries and research & development institutions, have been pointed out as the way to go (Shinwari & Khan 2000; APFD 2002).

From our study, it revealed that the existing database is poor. A regular resource inventory survey (to determine the current stock in quantity as well as in number of species) is demanded to design plans concerning MP and their management. As the medicinal plant sector has shown and constantly is showing a promising development, both nationally and internationally, it is important for governments to coordinate their efforts with various international agencies to be able to tackle future challenges to bring equilibrium between conservation and sustainable utilization (Alam *et al.* 1993; Larsen & Smith 2004).

Clues for future development

Considering the responses of the *farmers* and *other professionals* and comparing relevant cases of neighbouring countries, we can conclude with following attributes those can direct us towards economical and ecological sustainability of MP.

1. Medicinal plant cultivation in the homestead can support livelihood as showed by the farmers of Natore
2. Disease management needs amid attention by the research institution immediately.
3. Transportation, storage facilities and other infrastructures needed to further develop the MP cultivation
4. Mixed cropping technique can help reducing disease infestation and maximum utilization of our scarce land resources as observed in the study.
5. Micro-credit support with minimum interest rate for the marginal farmers and small traders should be ensured through NGOs like BRAC, Grameen Bank, ASA etc.
6. Creation of a reliable database on status, habitat requirements, extent of exploitation and the market of different plant species with the active participation of local user groups in collaboration with researcher, policymaker, NGOs.
7. Strict law enforcement and supervision is vital to protect the resource as well as the related knowledge from erosion and misappropriation.
8. Ex-situ and in-situ conservation efforts for the sustained supply of planting material for traditional healers and cultivators.

- 9 Institutionalization of farmers' cooperatives and arranging capacity building of all stakeholders in cultivation, management, value addition and marketing approach through coordinated effort of NGOs, R&D institutes.
- 10 More studies, especially on socio-economic aspect through action research projects, are needed to highlight role of MP when it comes to local economy and biodiversity conservation and hence help policy makers in decision-making.
- 11 Finally, since MP is now being cultivated in agricultural field along with other crops, there is a need for an intensive coordination between forestry and agricultural sector through policy directives.

If we can ensure the required support and infrastructure in place, the MP sector in Bangladesh will certainly flourish as per the hopes and aspirations of *farmers* and *other professionals* who are working to make it worthwhile despite of having many limitations.

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Appendix- I Questionnaire for survey at the farmers level (Natore study site)

1. Name of the village:

2. Name of the respondent:

3. Age and sex of the respondent:

4. Religion:

5. Occupation:

6. House hold size by Age

Age class	Male	Female	Earning members	Occupation Primary	Occupation Secondary
0-15					
15-30					
30-45					
>45					

7. Educational Status

Status	Respondent	Wife/Husband	Son	Daughter	Others

8. Land ownership Category

Land Types	Self Owned	Leased	Others
Homestead			
Agriculture			
Others			

9. Available livelihood activities in the locality

MP cultivation		
agriculture		
Rickshaw pulling		
Saw milling		

10. From when you are practicing MP cultivation?

11. What influenced you into undertaking this MP cultivation?

a.

- b.
12. What is the land coverage for the current cultivation?
 13. What species do you cultivate?
 - a.
 14. What are the sources for the seed / planting material source?
 15. What are the market potential of your product?
 16. How do you market your MP?
 17. Do you sell the raw products or process them to some extent?
 18. Do you think further processing could bring better price to your product? If so what are the limitations you have encountered?
 19. Are there any cooperatives among the farmers? In that case, are you a member?
 20. Does a cooperative provide positive support in your case? If not why?
 21. What is the current market value of your product in TAKA/kg
 22. What is your approximate annual income from the MP cultivation?
 23. What sort of help do you get from the government agencies viz. FD
 - a. Technical
 - b. Financial
 - c. Others
 24. Is there any other organization (i.e. NGO) that provides or can provide you with support? How?
 25. Do you think micro-finance can help your endeavour? How?
 26. What problems do you encounter in regards to the cultivation, management and marketing of MP?
 - a.
 - b.
 27. What support or help do you need and want for a better cultivation and management of your MP cultivation?
 - a.
 - b.
 28. What are the future prospects of selecting/introducing new species?

29. Do you think biodiversity conservation is necessary for sustainable development? If so, how you will address this issue in your practice?
30. How issue of land fragmentation will affect the future cultivation and sustainability? What is your planning to address this upcoming situation?
31. Do you think MP cultivation can be a source of sustainable livelihood in your locality as well as in Bangladesh? Please give your justification
32. What is your suggestion for the improvement of the NTFP sector in Bangladesh especially concerning MP?

Appendix- II Questionnaire for survey of the Baiddyas at the Bandarban study site

1. Name of the respondent
2. Age and Sex of the respondent
3. Education
4. Household (Family) size
5. Land holding size
 - a. Total
 - b. Land use category
6. Your profession as *Baidhya*
 - a. Primary:
 - b. Secondary:
 - c. Others:
7. From when you are practicing *Kabiraji / Baidhya*?
8. What are the common plants used for *Kabiraji/ Baidhya* for your health ailment?
 - a.
 - b.
9. From where you collect these plants/ plants products?
 - a. Forest
 - b. Local Market
 - c. Local *Bepari*
 - d. City wholesaler
10. Is it easily available in forest or locality? If not why?
11. How do you address the issue of conservation considering your current practices and use of natural resources?
12. Do you have some medicinal plants cultivated at your homestead?
 - a.
 - b.
13. What are the problems in regards to the traditional healing practices?

14. Have you got or do you need any support for your profession?
Mention
 - a. .
 - b. .
15. What is your income from this profession
16. Is it possible to make livelihood out of this profession? If not why?
17. What is your suggestion to develop this profession /sector?

Appendix- III Questionnaire for survey at the institutional level

1. Name of the Institution:
2. Name of the department/unit:
3. Name and designation of the person:
4. Major activities of the department:
 - a.
 - b.
5. What are the ongoing research activities in relation to MP?
 - a.
 - b.
6. How do you formulate the research program to be implemented?
7. How do you address the issues of local people/farmers and their needs in regards to NTFP especially MP cultivation?
8. What are the major challenges in conducting research activities in this field?
 - a.
 - b.
9. Do you have any knowledge and technology transfer mechanisms to bring the results from your research outcome to the local farmers?
 - a.
 - b.
10. What is the current research gaps prevailing in MP Sector?
 - a.
 - b.
11. Do you think current forest policy and government intervention is considering conservation and farmers need in regards to NTFP? - Give your views please
12. How do policy issues influences the management and conservation of NTFP in Bangladesh? - Give your views

13. Is the need of local people/farmers properly addressed in the current research and policy formulation – justify please

14. What are your suggestions for the future development of NTFP sector in Bangladesh?

a.

Appendix- IV List of commonly cultivated and available MP at Natore study area

Local Name	Scientific Name	Family
Ulatkambal	<i>Abroma augusta</i> L.	Sterculiaceae
Apang	<i>Achyranthes aspera</i> L.	Amaranthaceae
Grhitokumari	<i>Aloe vera</i> L.	Liliaceae
Kalomegh	<i>Andrographis paniculata</i> Nees.	Acanthaceae
Ishwarmul	<i>Aristolochia indica</i> L.	Aristolochiaceae
Shotomuli	<i>Asparagus racemosus</i> L.	Liliaceae
Shimul	<i>Bombax ceiba</i> L.	Bombacaceae
Hastipolash	<i>Butea superba</i> Roxb.	Papillinaeae
Dadmardan	<i>Cassia alata</i> L.	Fabaceae
Talmul	<i>Curculigo orchioides</i> Gaertn.	Amaryllidaceae
Anantamul	<i>Hemidesmus indicus</i> R. Br.	Asclepiadaceae
Bhuikumra	<i>Ipomoea digitata</i> L.	Convolvulaceae
Alkusi	<i>Mucuna pruriens</i> (L.) DC.	Fabaceae
Ghandabadali	<i>Paederia foetida</i> L.	Rubiaceae
Kayamul	<i>Pandanus odoratissimus</i> L. f.	Pandanaceae
Peepul	<i>Piper longum</i> L.	Piperaceae
Sarpagandha	<i>Rauwolfia serpentina</i> Benth.	Apocynaceae
Misridana	<i>Scoparia dulcis</i> L.	Scrophulariaceae
Arshawgandha	<i>Withania somnifera</i> Dunal.	Solanaceae
Nishinda	<i>Vitex negundo</i> L.	Verbenaceae

Appendix-V List of MP frequently used by the Baiddyas of Bandarban along with their uses

Local Name	Scientific Name	Family	Uses
Apang	<i>Achyranthes aspera</i> L.	Amaranthaceae	Dog and Fox bite, Jaundice
Penchi	<i>Annona muricata</i> L.	Annonaceae	Pain relief
Sapangeye	<i>Antidesma ghaesembilla</i> Gaertn.	Euphorbiaceae	Madness
Kamranga	<i>Averrhoa carambola</i> L.	Oxalidaceae	Cough, fever
Pathorkuchi	<i>Bryophyllum calycinum</i> Salisb.	Crassulaceae	Insect bite, cough and cold, infection in wounds
Dadmardan	<i>Cassia alata</i> L.	Leguminosae	
Moragphul	<i>Celosia cristata</i> L.	Amaranthaceae	Body swelling(dropsy)
Menmuni	<i>Centella asiatica</i> L.	Hydrocotylaceae	Blood dysentery
Veg	<i>Clerodendrum viscosum</i> L.	Verbenaceae	Roundworms with indigestion, pain and vomiting
Bon Holud	<i>Curcuma aromatica</i> Roxb.	Zingiberaceae	Tonic, carminative, blood purifier, snakebite
Langio	<i>Cynoglossum lanceolatum</i> Forssk.	Boraginaceae	Belly inflation
Mainsingh	<i>Gelonium multiflorum</i>	Euphorbiaceae	Boils
Simakrankhi	<i>Helminthostachys zeylanica</i> L.	Ophioglossaceae	Jaundice
Kala Holud	<i>Kaempferia parviflora</i> Wall ex. Baker	Zingiberaceae	Diarrhoea with vomiting
Baggach	<i>Leea Macrophylla</i> Roxb.	Leeaceae	Boils, arthritis
Golmorich	<i>Piper nigrum</i> L.	Piperaceae	Cough and cold, carminative, dyspepsia, fever, piles and gastritis
Agnichita	<i>Plumbago indica</i> L.	Plumbaginaceae	Anaemia, irregular menstruation, leucorrhoea, skin diseases
Rakta Chita	<i>Plumbago rosea</i> L.	Plumbaginaceae	Eye infection, skin diseases, abortion, leprosy, paralysis, indigestion
Chita	<i>Plumbago zeylanica</i> L.	Plumbaginaceae	Jaundice, leucorrhoea, menstrual problem
Bombarja	<i>Rauwolfia serpentina</i> Benth.	Apocynaceae	Snakebite, headache
Misridana	<i>Scoparia dulcis</i> L.	Scrophulariaceae	Stomach-ache
Bon Methi	<i>Sida acuta</i> Burm.	Malvaceae	Fever, intestinal worm, chronic dysentery, gonorrhoea
Harjora	<i>Vitis quadrangularis</i> Wall	Vitaceae	Orthopedic disorder

Appendix-VI List of commonly planted /available MP in the homesteads of Baiddya

Local name	Scientific Name	Family	Uses
Boch	<i>Acorus calamus</i> L.	Araceae	Diarrhoea, dysentery, weakness, cough, indigestion
Basak	<i>Adhatoda vasica</i> Necs.	Acanthaceae	Expectorant, cough, asthma
Gritokumari	<i>Aloe indica</i> Rosc.	Liliaceae	Purgative, cooling agent, stomach diseases
Shatamuli	<i>Asparagus racemosus</i> L.	Liliaceae	Diuretic, measles, pox and diarrhoea
Neem	<i>Azadirachta indica</i> A.Juss.	Meliaceae	Antispasmodic, insecticide, tonic
Lebugandhi ghas	<i>Cymbopogon citratus</i> Stapf.	Poaceae	Stomach disorder, laxative, bronchitis, leprosy, gastritis, cholera
Dhutra	<i>Datura metel</i> L.	Solanaceae	Fever, mental disorder, arthritis, hydrophobia
Amloki	<i>Emblica officinalis</i> Gaertn.	Euphorbiaceae	Stomach diseases, indigestion,
Tulsi	<i>Ocimum sanctum</i> L.	Lamiaceae	Cough, fever, stomach diseases, mosquito repellent
Pipul	<i>Piper longum</i> L.	Piperaceae	Expectorant, stimulant, cough and cold, fever, headache
Bahera	<i>Terminalia bellerica</i> Roxb.	Combretaceae	Constipation, stomach diseases, weakness, fever, diarrhoea
Haritaki	<i>Terminalia chebula</i> Retz.	Combretaceae	Stomach diseases
Nishinda	<i>Vitex negundo</i> L.	Verbenaceae	Intestinal worms, ulcer treatment, expectorant and diuretic
Daiful	<i>Woodfordia floribunda</i> (L.) Kurz.	Lythraceae	Female diseases, for dying
Ada	<i>Zingiber officinale</i> Rosc.	Zingiberaceae	Stimulant, cough, as spice

Appendix- VII Whole sale price of the major MP and products available in the Natore study area

Name of the MP and products	Whole sale price (Taka/kg)
Powder of <i>Terminalia arjuna</i> bark	100
<i>Aloe vera</i> (green leaf)	350/ bundle (55 kg)
Trifolia: Mixture of fruits from <i>Emblica officinalis</i> , <i>Terminalia chebula</i> and <i>T. belerica</i>	120
Root powder of <i>Scoparia dulcis</i>	400
Root powder of <i>Asparagus racemosus</i>	400
<i>Withania somnifera</i> (whole tree plus root)	300
Root powder of <i>Withania somnifera</i>	600
Powder of young <i>Aegle marmelos</i>	100
Root powder of <i>Bombax ceiba</i>	250
Seeds of <i>Withania somnifera</i>	3000
Seeds of <i>Mucuna pruriens</i>	150
Seed powder of <i>Mucuna pruriens</i>	300
<i>Butea superba</i> (whole plant dried)	600
<i>Butea superba</i> (whole plant green)	150
Mixed powder-consist of 8 species viz. <i>Emblica officinalis</i> , <i>Terminalia chebula</i> , <i>T. belerica</i> , <i>Withania somnifera</i> , (others were not mentioned due to business secret)	120