Project ID 393

Competitive Research Grant

Sub-Project Completion Report

on

Cultivation, Marketing and Processing of Medicinal and Aromatic Plants (MAPs) in Bangladesh

Project Duration

June 2017 to September 2018

Department of Agribusiness and Marketing
Bangladesh Agricultural University
Mymensingh - 2202

Submitted to
Project Implementation Unit-BARC, NATP 2
Bangladesh Agricultural Research Council
Farmgate, Dhaka-1215

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Acronyms

AP	Aromatic Plant
APs	Aromatic Plants
BAMEA	Bangladesh *Agar*&*Atar* Manufacturers and Exporters Association
BARC	Bangladesh Agricultural Research Council
BARI	Bangladesh Agricultural Research Institute
BBS	Bangladesh Bureau of Statistics
BCR	Benefit Cost Ratio
BDT	Bangladeshi Taka
BGB	Border Guard Bangladesh
BINA	Bangladesh Institute of Nuclear Agriculture
CITES	The convention of International Trade in Endangered Species of Wild Fauna and Flora.
DAE	Department of Agricultural Extension
DAM	Department Agricultural Marketing
FGD	Focus Group Discussion
FO	Forest Office
HYV	High Yielding Varieties
IRR	Internal Rate Return
Kg	Kilogram
KII	Key Informant Interview
MAP	Medicinal and Aromatic Plant
MAPs	Medicinal and Aromatic Plants
MP	Medicinal Plant
MP	Muriate of Potash
MPs	Medicinal Plants
NGO	Non-Government Organization
NOC	No Objection Certificate
NPV	Net Present Value
SME	Small and Medium Enterprise
Tk	Taka
TP	Transport Permit
TSP	Triple Super Phosphate
UAO	Upazila Agriculture Office

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Executive Summary

Realization of the present health hazards and toxicity caused by the synthetic chemicals, Bangladesh, like other countries, feels the importance of medicinal and aromatic plants (MAPs) for their contribution in the national economy and international trade. In Bangladesh, the MP is surpassing various challenges that threaten the success of the sector. Therefore, strong and committed endeavors are essential for the integrated development of this sector for the purposes of increasing volume of the MAP production and its product markets both in the country and in the foreign market. The specific objectives of the study were: identifying different entrepreneurs/actors, their activities, problems and promotion activities in supply chain of MAP enterprises; determining value addition to MAP products and measuring the profitability of the selected MAP enterprises. Both primary and secondary data were used in this study. Ten commercially medicinal plant (MP) cultivating villages under Natore district and six commercially aromatic plant (AP) cultivating unions of Moulvibazar district were selected as the study areas. Purposive sampling technique method was followed for selecting the sample units. Nine types of supply chain actors, such as seed supplier, seedling grower, plant producer, wholesale-cum-retailer, processor, hoarder, hawker/faria, *Hakim*/*Kobiraj* and *Ghritokumari* supplier were selected for MPs study. Ten MPs i.e. *Amrul*, *Basok*, *Ghritokumari*, *Hostipolas*, *Kalomegh*, *Misridana*, *Oshwagandha*, *Shotomul*, *Shimulmul* and *Tulsi* were studied, whereas for AP enterprise only *Agar* plant was considered for investigation.

All MP traders were involved in purchasing and selling of MP products, but only the processors, hoarders and *Hakim*/*kobiraj*were involved in processing, hoarding and treatment practice of MP products, respectively. On the other hand, AP processors were involved in processing and selling of all types of *Agar* products, and exporters were involved in exporting the *Agar* products. Usually MP products were sold in green, dry and dust forms, while *Agar* oil was sold as white, black, natural and mix forms. Color, scent, etc. were used for judging quality of *Agar* oil and wood. Prices of all MPs and AP products were fixed mainly in open bargaining and payment was also made generally in cash. Export markets of *Agar* products were mainly situated in Dubai, Saudi Arabia, Q*atar*, Kuwait, Oman, Yemen, Bahrain, India, China, Hong Kong, UK, Japan and Thailand.

All the MAP enterprises were found profitable, employment generating and income earning source with foreign exchange (only the aromatic plant). Several major problems of MAP sector were identified by entrepreneurs were: non-availability of HYV and improved method and technology; unknown and uncontrolled pests and diseases; insufficient extension services; imparting no training to MAP entrepreneurs; scarcity of contact and linkage with markets and buyers; limited availability of bank loan, absence of certification for the hawker/*faria* business and *Hakim*/*Kobiraj* practice; absence of effective association of all MAP entrepreneur groups; scarcity of skilled laborers and workers; advance sale of immature *Agar* plants at lower prices; harassment in collecting NOC, TP and CITES, and harvesting and transporting *Agar* plants; charging gas and electricity bills at commercial rate for processing factory, and adulteration of exported products, etc. The findings of this study will lead to make appropriate measures and policies for promotion of the sector and also to establish a base and support for conducting the future research and development programs of MAP sector in the rural areas as well as national level in the country.

CRG Sub-Project Completion Report (PCR)

A. Sub-project Description:

1.Title of the CRG sub-project: Cultivation, Marketing and Processing of Medicinal and Aromatic Plants (MAPs) in Bangladesh

2. Implementing organization:Department of Agribusiness and Marketing, Bangladesh Agricultural University, Mymensingh.

3.Name and full address with phone, cell and E-mail of PI/Co-PI (s)

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4.Sub-project budget (Tk)

1.1 Total: BDT 2498810.00

1.2 Revised (if any): N/A

5.Duration of the sub-project

1.3 Start date (based on LoA signed): 13 June 2017

1.4 End date: 30 September 2018

6.Justification of undertaking the sub-project

Realization of the present health hazards and toxicity caused by the synthetic chemicals, Bangladesh, like other countries, feels the importance of medicinal and aromatic plants (MAPs) for their contribution in the national economy and international trade. The history of Medicinal and aromatic plants is very old. Probably it was started in 3500 BC. Bangladesh as a tropical

country is very rich in diverse natural MAPs and are scattered throughout the forests, plain lands, crop fields, roadsides, gardens and wetlands. MAPs are an important part of our natural and cultural wealth.

In early 80's, Ayurvedic and Unani companies procured 80% of medicinal plants (MPs) from natural forests and the rest from import. Now the scenario has changed: 80% are imported and 20% are procured from domestic production (Merry and Shahjahan, 2014). In spite of this inverse situation, Bangladesh is still now blessed with innumerable genetic diversity of medicinal plants. Bangladesh Agricultural Research Institute (BARI) recorded 722 plant species, growing or available in Bangladesh, have medicinal values (Mohiuddin, 2014). The author also mentioned that more than 8000 plant species are used as medicinal plants in world. Moreover, four thousand plant species are used as medicinal plants in India while in Bangladesh only 700 plants are used whereas currently about 255 MPs are used for preparation in ayurvedic and unani medicine (Mohiuddin, 2014).

Cultivation of MAPs contributes significantly to the economy of Bangladesh. The advantages of MAP cultivation are as follows:

- Higher productivity in small land and can be cultivated year-round.
- Income can be obtained round the year.
- Land of Bangladesh is fertile and suitable for MAPs cultivation.
- MAPs production is very easy.
- Lower production cost because of cheap labour compared to other countries.

MPs played a significant role in providing primary health care service as doorstep natural pharmacy to rural and tribal people. It also used for the treatment of domestic animals and culture fishes. But in the advancement of synthetic drug and paucity of MPs in nature, the practice of using herbal drug dropped significantly (Merry and Shahjahan 2014). Most of the MPs of Bangladesh are extensively used in the preparation of Unani, Ayurvedic and Homeopathic medicines (Haider and Alam 2014). At preset these herbal medicines are getting importance day by day and are being replaced by chemical and synthetic medicines as the later ones become costly and health hazardous (Mohiuddin, 2014).

Although cultivation of medicinal plants is becoming both more profitable and environment friendly, only few farmers are involved in cultivating them due to non-access of improved technologies and knowledge gap of improved marketing and processing systems. The commercial cultivation of MPs started in early 1990s mainly in the Natore district (Rashid et al. 2014). But their cultivation is yet in rudimentary stage. No prescribed cultivation methods are practiced in Bangladesh. Farmers cultivate in their own way using indiscriminate harvesting and storage. Both farmers and different NGOs are cultivating and promoting medicinal plants, but it exists in a very small-scale level.

The MAP sector demonstrates strengths but this sector has inherent weaknesses and also faces some challenges e.g. scarcity of *Agar* wood, low prices in the domestic market compared to world market, non-recognition as an industry by government, scarcity of standard testing tools, high import duties imposed by importing countries, complexity in delivering transit permit and CITES certificate etc. These strengths and weaknesses need to be identified in order to provide appropriate directions for the promotion of this sector. In Bangladesh, the MAP is surpassing various challenges that threaten the success of the sector. Necessary supports are absented for the utilization of the existing opportunities to gear up the sectors. Therefore, strong and committed endeavors are essential for the integrated development of this sector for the purposes of increasing volume of the MAP production and its product markets both in the country and in the foreign market. The study will provide specific findings for the sector in terms of activities, value addition and problems; status of supply chain and value chain; financial and economic profitability and agribusiness environment in domestic and export markets. The findings of this study will lead to make appropriate measures and policies for promotion of the sector and also to establish a base and support for conducting the future research and development programs of MAP sector in the rural areas as well as national level in the country.

7. Sub-project goal

The overall goal of this study is to promote medicinal and aromatic plants as an agribusiness enterprise in Bangladesh.

8.Sub-project objective (s)

The specific objectives are:

1) To analyse thebusiness profitability of medicinal and aromatic plants cultivation in Bangladesh;

2) To map the value chain and estimate the value addition in each of the nodes in the value chain;

3) To identify the constraints in production, marketing, and processing of MAPs.

9.Implementing location (s)

NatoreSadarupazila in Natore district
Barlekhaupazila in Moulvibazar district
Sadarupazila of Bogra district

10.Methodology in brief

10.1 Selection of the study areas

For medicinal plant, Laxmipur-Kholabaria union of NatoreSadarupazila in Natore district and Sadarupazila of Bogra district and for aromatic plant, Barlekhaupazila in Moulvibazar district were selected purposively as study areas. It was found that backward linkage actors and forward linkage actors of MP and AP enterprises have mainly and perfectly been developed in the Sadarupazila of Natore, Sadarupazila of Bogra and the Barlekhaupazila, respectively in country. Some basic information regarding the MAPs enterprises was collected through implementation of Focus Group Discussion (FGD)

with the participation of different MAPs entrepreneurs/actors and representatives of local upazila agricultural offices.

10.2 Target populationand sampling

Different types of activities involved in MAPs production, marketing and processing. Moreover, different channels are followed to transfer the produced MAPs from the production point to consumption point. The main actors who performed the marketing activities (packaging, transportation, pricing, grading, storage and warehousing etc.) are commercial producers, seed and seedling suppliers, stockiest, wholesaler-cum-retailers, processors, pharmaceutical companies, agents of foreign buyers, and exporters. Based on the concentration of production, area coverage, and value addition activities of MAPs, a total of 750 respondents, of which 350 (220 producers and 130 value chain actors) for medicinal plants and 400 (220 producers and 180 value chain actors) for aromatic plant enterprises, were interviewed. To make the research work representative and get a clear picture of MAPs sector, samples were finalized after key informant interview. Details category-wise sample size is described in Table 1.

Figure 1: Study Areas of the project (red-circled area)

Table1. Category-wise sample size of the study

Target population	Category of sample groups (sub-population)	Size of sample (MAPs)
Medicinal plant enterprise	**Bogra**	
	Producer	30
	Wholesaler-cum-retailer	5
	Pharmaceutical companies	1
	FGD with stakeholders	1
	KII with UAO and lead producer	3
	Natore	
	Producer	190
	Seed supplier	15
	Seedling supplier	10
	Gritokumari agent supplier	10
	Product processor	5
	Stockiest	20
	Wholesaler-cum-retailer	20
	Faria/Hawker	30
	Kobiraj/*Hakim*	10
	Pharmaceutical companies	4
	FGD with stakeholders	1
	KII with UAO, lead producer and traders	5
	Sub-total	**350**
Aromatic plant enterprise	**Moulvibazar**	
	Producer	220
	Seedling supplier	10

Target population	Category of sample groups (sub-population)	Size of sample (MAPs)
	Processor	145
	Exporter	15
	Agents of foreign buyers	10
	Sub-total	**400**
	Grand total	**750**

10.3 Selection of medicinal and aromatic plants

About 109 types of medicinal plants are grown both in the homestead garden and in the field area. Among different types of the medicinal plants, 10 types, such as *Amrul*,*Basok*, *Ghritokumari*, *Hostipolas*, *Kalomegh*, *Misridana*, *Oshwagandha*, *Shotomul*, *Shimulmul* and *Tulsi* are commercially produced at field level, which is considered as samples for the study. Photos of selected medicinal plants are given below:

Table 2. Illustration of selected medicinal plants

Name of MP	Illustration	Name of MP	Illustration	Name of MP	Illustration
Amrul		*Hostipolas*		*Oshwagandha*	
Basok		*Kalomegh*		*Shotomul*	
Ghritokumari		*Misridana*		*Shimulmul*	
				Tulsi	

Table 3. Local, English, Scientific and Family Name of MAPs under Study

Local name	English name	Scientific name	Family
Medicinal plants			
Amrul	Creeping wood-sorrel	*Oxalis comiculata*	*Oxalidaceae*
Basok	Malabar nut	*Adhatodavasica*	*Acanthaceae*
Ghritokumari	Aloevera	*Aloe vera*	*Liliaceae*
Hostipolas	Creeping butea	*Butea superba*	*Papillinaceae*
Kalomegh	The creat/Bhui-neem	*Andrographis paniculata*	*Acanthaceae*
Misridana	Scoparia-weed	*Scopariadulcis*	*Scrophulariacae*
Oshwagandha	Winter chery	*Withaniasomnifera*	*Solanaceae*
Shotomul	Asparagus	*Asparagus racemosus*	*Liliaceae*
Shimulmul	Silk cotton/kopok tree	*Bombax ceiba*	*Bombacaceae*
Tulsi	Holy basil	*Ocimum sanctum*	*Labiatae*
Aromatic plant			
Agar	*Agar*, Agru	*Aquilaria malaccensis*	*Thymeliaceae*

Source: Shahidullah and Haque (2010), SAARC (2012), Haider and Alam (2014), Rashid et. al. (2014)

Different types of aromatic plants are also available in different parts of Bangladesh but only one aromatic plant is commercially cultivated, namely *Agar* plant, since last centuries in Sylhet regions of Bangladesh.

10.4 Data sources

For successful completion of the survey, two sources of data, primary and secondary, were required. The main source of primary data, as shown below, was the sample survey, focus group discussion (FGD) and key informant interviews (KII). The main sources of secondary data were BARC, DAE, BBS, websites searching and other agencies that deal with MAPs and related reports and literatures of the project.

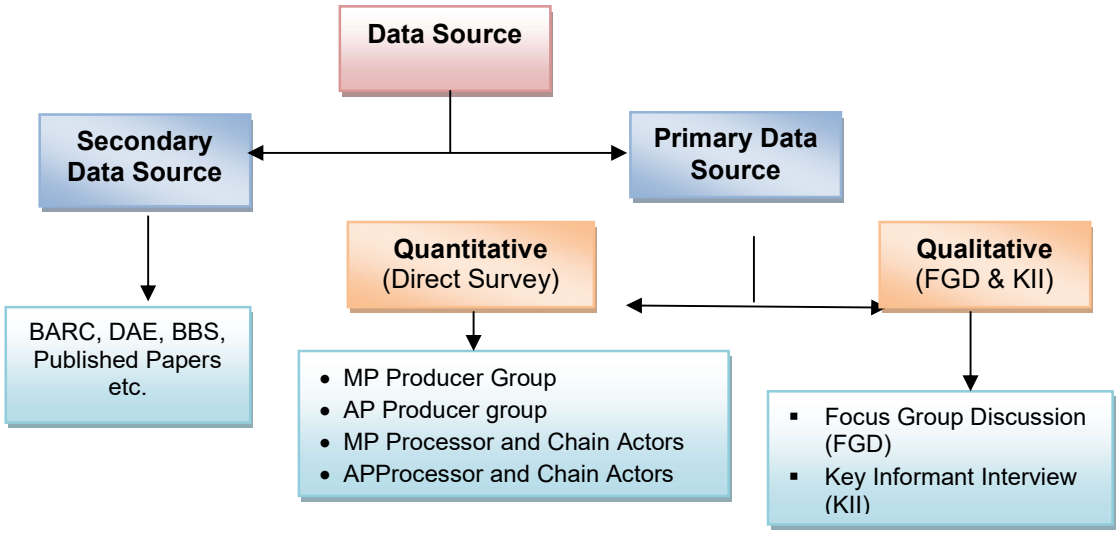


Figure 2: Flow diagram of data sources

Table 4. Location and target group wise list of FGD and KII

Target population	**Location wise category**	**No.**
Medicinal plant enterprise	**Bogra**	
	FGD with stakeholders	1
	KII with UAO and lead producer	3
	Natore	
	FGD with stakeholders	1
	KII with UAO, lead producer and traders	5
Aromatic plant enterprise	**Moulvibazar**	
	FGD with producer and exporters	1

Target population	Location wise category	No.
	KII with lead producer and exporter	2

10.5 Surveytools development

In conformity with the objectives of the study, preliminary survey schedules were designed for collecting data from the actors. The schedules were pre-tested and after making necessary correction, modification and adjustment, final schedules were developed. Several sets of survey schedules were prepared for *Agar* and medicinal products actors for collecting necessary data. The questionnaire covered different aspects of actors involved in *Agar* production, processing and marketing such as, general information, socio-economic variables, production, access to the market & credit, status of technology transfer & adoption, and their impact etc. To validate the collected primary data, FGDs were conducted with *Agar* producer, processor and exporter.

10.6 Recruitment and training of field staffs

For field level data collection, five enumerators were recruited along with scientific assistant. The minimum qualification was bachelor's degree in agricultural science having relevant field experiences. After recruitment, training was conducted to the scientific assistant and enumerators. They were trained to undertake the survey and imparted training on how to build rapport with the respondents, fill-in the questionnaires and other tools.

10.7 Field-testing, finalization and printing of survey questionnaires

At this stage, the draft questionnaires were pre-tested in one of the non-sample areas. In pre-test, special attention was paid to the following issues:

- To find out the strength and weakness of the instruments
- To determine whether the respondents/participants understand questions
- To determine the time required for completing an interview
- To observe the ability of the field staff to administer the questionnaires

After pre-testing, the instruments were then updated, modified and finalized after incorporating the feedbacks obtained from field test for finalization. Thereafter, adequate number of questionnaires was printed for administration in the field.

10.8 Data managementand analysis

Data were scrutinized and carefully edited to eliminate possible errors and inconsistencies contain in the schedules while recording them. The first step was to look into the data of each and every interview schedule to ensure consistency and reliability with the aims and objectives of the study. After completing the pre-tabulation task, it was transferred to an Excel sheet from the interview schedules. In this study, descriptive technique was followed to illustrate the whole scenarios of MAP cultivation,

marketing, and processing. The sum, mean, averages, percentages, gross costs and margins etc. were used to examine the value chain analysis of different MAPs.

10.9Analyticalmethods

10.9.1 Profitability analysis

Both types of primary and secondary data were used to measure the profitability of the MAP enterprises. Based on the collected data, profitability of the identified actors' enterprises was measured by analysis of gross margin and net margin. The profitability analysis was done to examine the costs, returns and BCRs of different MAPs production systems.

10.9.2Value chain analysis

After identification of the supply chain of each selected MAPs the value chain analysis was conducted. For MAPs marketing, actors involved in marketing channel were identified and marketing costs and margins, and profits of marketing intermediaries were determined by using tabular forms and flow diagrams. Value chain analysis of the selected MAPs and overall market promotion of MAPs products were also addressed using same analytical technique. The value addition at each stage wasanalyzed through measuring as:

Gross marketing margin = Sale price - Purchase price of the value-added product and

Net marketing margin = Gross marketing margin - Marketing cost

10.9.3SWOT analysis

The SWOT (Strength, Weakness, Opportunity and Threat) analysis was used to find out the business potentiality of MAPs. The tool allows the assessing of the current environment and potential changes. A deep review was performed for screening opportunities and threats in the market development process that hinder the market performance and export. Finally, policy guidelines were drawn based on the identified factors.

10.9.4Constraint matrix

A 'constraint matrix'was prepared to document the constraints in production, marketing and processing of MAPs. For doing so, FGDs, and KIIs were conducted with appropriate stakeholders of MAPs.

11. Results and discussion:

11.1 Profile of different stakeholders of MP

11.1.1 Seed suppliers

Local medicinal seed suppliers act as backward linkage actors in the supply chain. Some local persons and several wholesaler-cum-retailers operate seed business as the seed suppliers. They are involved only in purchasing and selling of seeds locally.

11.1.2 Seedling growers

Local medicinal seedling growers are also backward linkage actors in supply chain. They are involved both in growing and selling of the seedlings. Several functions like seed and seedling (immature) collection, seed sowing, seedling planting, input use, intercultural operations, seedling selling, etc. are performed by them.

11.1.3 Producers

MP producers are the major actors in the supply chain of MP enterprise. The producers are mainly involved in cultivation of MPs and marketing of MP products locally. Their activities are seed and seedling collection, tillage of land, input use, intercultural operations, plant harvest, product processing and selling.

11.1.4 Wholesaler-cum-Retailer

Local wholesaler-cum-retailers are associated with forward linkage of the supply chain as value adding actors. They are also considered as a major actor group of all the medicinal traders. They operate their business in their own or hired permanent shops in local markets. Almost all the activities related to purchasing and selling of the products are performed in the shops. They deal with the products of all forms - green, dry and dust. Although they are professionally not involved in processing, but low quality and unsold products are generally converted by them into dry or dust products for increasing sale and adding value to the products.

11.1.5 Processors

Local medicinal product processors are also value adding actors in forward linkage in the supply chain. The processors are only the actors who are professionally involved in processing of the products. All activities of processing are conducted in processors' residence houses.

11.1.6 Hoarders

Local medicinal product hoarders are also value adding actors in forward linkage of supply chain. They are mainly involved in storage business of dry products. Sometimes, they purchase green products and dry for storing. The products are usually stored in separate storehouses or rooms of the hoarders' residence houses. Only the hoarders of all the traders are associated with wholesale business of medicinal products.

11.1.7 Hawkers/*Farias*

Local hawkers/*Farias* act as a forward linkage in the supply chain as value adding actors of medicinal products. They always operate their business in outside areas and stay in selected business spots (areas)

ordinarily for the period of 2 to 5 days in a week or 15 to 25 days in a month. They collect products locally and usually one time in a week or month before the time of travelling to business place. They are never involved in processing and always sell products in the form of purchase.

11.1.8 *Hakim*/*Kobiraj*

Local medicinal product *Hakim*/*Kobiraj* are value-adding actors in forward linkage of supply chain. They do mainly herbal treatment as general village practitioners at their own residence and at local hat/bazars in surrounding areas. Generally, they have no institutional or trained knowledge about herbal treatment. They gained the knowledge from their ancestors, who involved in this profession and learning by doing.

11.2 Production system of MP

In the study area, different types of activities are performed for cultivation of the selected medicinal plants. Various categories of seeds and seedlings are used for growing the medicinal plants. *Kalomegh*, *Shimulmul* and *Tulsi* grow from seed whereas both seed and seedling are used for growing *Hostipolas*, *Oshwagandha* and *Shotomul*. Residuals (attached rootgrown underground) of *Amrul* and *Misridana* harvested in previous season are used for growing *Amrul* and *Misridana* for next season. Only seedling and stem are used for growing *Gritokumari* and *Basok*, respectively. In the study area, all types of medicinal plants are cultivated at homestead garden and in the field. In this study, medicinal plants cultivated at field level were considered.

For the cultivation of the medicinal plants, chemical fertilizers (urea, TSP, MP), irrigation and weeding are generally applied as per necessity. Manures (cow dung, compost- family produced) are generally applied one time during land tillage. Any prescribed or research developed methods, technologies and doses for fertilizers and pesticides application, pests and diseases control, irrigation, tillage and inter-cultured operations are not provided to them through any government or non-government organization. All the methods, technologies and doses practiced by their own knowledge and experiences. Some basic information regarding the selected medicinal plants is shown in the Table 5.

Table 5: Some basic information regarding selected medicinal plants

Selected Medicinal Plants	Duration of Life	Sowing/Planting Period of seed/seedling	Harvesting Period	Used Seed and Seedling
Amrul	10 - 11 months	Middle April – Middle June	The whole year	Residual (*Motha*)
Basok	3-5 years	The whole year	The whole year	Stem
Gritokumar	1 year	Middle October - Middle November	Middle January – Middle December	Seedling

Kalomegh	6-8 months	Middle March – Middle June	Middle September – Middle November	Seed and seedling
Hostipolas	3-5 years	The whole year	The whole year	Seed
Misridana	7 – 12 months	Middle March– Middle June	Middle March – Middle May	Residual (*Motha*)
Oshwagandha	1 year	The whole year	The whole year	Seed and seedling
Shotomul	1 – 3 years	The whole year	The whole year	Seed and seedling
Shimulmul	1 years	Middle March - Middle June	Middle November – Middle March	Seed
Tulsi	6-8 months	Middle March – Middle June	Middle March – Middle May	Seed

Source: Field survey 2017

Table 6: Yieldsofmedicinal plants

Selected Medicinal Plants	Yield/decimalin the Period of Life Duration					
	Duration of Life	Times of Harvest	Green Form		Dry Form	
			Range (kg)	Average (kg)	Range of yield (kg)	Average yield (kg)
Amrul	10 – 12 months	One time	50 – 120	70	-	-
Basok	3-5 years	Several times	-	-	60 – 120	80
Gritokumari	1 year	Several times	85 – 120	110	-	-
Hostipolas	3-5 years	Several times	20 – 40	30	-	-
Kalomegh	6-8 months	One time	-	-	5 – 10	8
Misridana	07 – 12	One time	12 – 24	20	-	-

	months					
Oshwagandha	1 year	One time	-	-	9 – 12	10
Shotomul	1 – 3 years	One time	20 – 160	80	-	-
Shimulmul	1 years	One time	36 – 100	70	-	-
Tulsi	6-8 months	One time	-	-	10 – 30	22

Source: Field survey 2017

11.3 Cost and return of different stakeholders of MP

Different types of costs are incurred for cultivation of the medicinal plants. Cost items such as seed or seedling, land preparation and manure are common. Other cost items are: chemical fertilizer, pesticide, irrigation, weeding, harvesting, processing, packaging and transportation. Moreover, chemical fertilizer, pesticide, irrigation, and weeding costs are the recurring cost of *Gritokumari* cultivation. In the producers' level, *Gritokumari*, *Shimulmul*, *Amrul* and *Shotomul* are generally sold in green form, whereas *Basok*, *Kalomegh*, *Oshwagandha* and *Tulsi* are always sold in dry form. Therefore, the costs are different for different plants.

11.3.1 Seed supplier

Cost and return of medicinal seed supplier were estimated to find out the benefits of seed business. Among all selected medicinal plants, *Kalomegh*, *Oshwagandha*, *Shotomul*, *Shimulmul* and *Tulsi* seed business are existing in the study areas.

It was observed that all the respondents dealt with seed product with other items jointly in same shop under the same business ownership. So, it required to separate seed business cost from costs of other items. After rigorous consultation with respondents and on the basis of personal observation and experience, the share of seed business cost was determined at 10 percent of total cost of whole business. On the other hand, total operating capital was the summation of the total seed purchase, seed procurement & processing and sales supporter service costs. Opportunity cost of operating capital was calculated at the rate of 6 percent for half of a year. Refreshment, cell phone and local movement cost were considered as other cost.

Table 7: Cost and return of medicinal seed business (Tk/Kg)

Items	*Kalomegh*	*Oshwagandha*	*Shotomul*	*Shimulmul*	*Tulsi*
Cost items					

Seed purchase	1189	1083	1230	187	1767
Procurement and primary processing	17.86	0.00	0.00	3.92	0.00
Shop rent	0.05	0.05	0.05	0.05	0.05
Electricity bill	0.04	0.04	0.04	0.04	0.04
Salary of staff	3.24	3.24	3.24	3.24	3.24
Market service charge	0.03	0.03	0.03	0.03	0.03
Other cost	2.27	2.27	2.27	2.27	2.27
Interest on operating capital	1.82	1.82	1.82	1.82	1.82
Total cost	1214	1090	1237	198	1774
Return					
Selling product (seed)	1928	1939	2340	255	3208
Net return	**714**	**849**	**1103**	**57**	**1434**

It is found from table 7that seed purchase cost is maximum for *Tulsi* and minimum for *Shimulmul* that was Tk 1767 and Tk 187 (per kg), respectively. As, seeds were collected from outside sources, *Kalomegh* and *Shimulmul* seed was required for further procurement and primary processing. It involved a per kg cost of Tk. 17.86 for *Kalomegh* and Tk. 3.92 for *Shimulmul* seeds; while other seeds were ready to use. In Medicinal Seed Business, there was also a cost of shop rent, electricity bill, salary of staff, market service charge, some miscellaneous cost. For every types of seeds, these variable costs were Tk. 0.05, 0.04, 3.24, 0.03 and 2.27 per kg respectively. Also, in every case, the cost of operating capital bearded an interest of Tk. 1.82 per kg.

Total cost refers to the aggregation of all costs that incurs in the enterprise. Table 7 indicates that total per kg cost of *Kalomegh, Oshwagandha, Shotomul*was Tk. 1214, Tk.1090, and Tk 1237. The cost of *Tulsi* seed business was maximum and that of *Shimulmul*was minimum which were Tk. 1774 and Tk. 198 per kg respectively. Finally, the net returnswerepositive for all plants,of which *Tulsi*had maximum net benefit and *Shimulmul*had minimum net benefit.

11.3.2 Seedling grower

Business profitability of the medicinal seedling grower were determined through analysis of net return. Net return was estimated from the gross return by deducting gross cost.

Table 8: Cost and return of Medicinal Seedling Grower (Tk/Decimal)

Items	*Basok*	*Ghritokumari*	*Hostipolas*	*Kalomegh*	*Oshwagandha*	*Shotomul*	*Tulsi*
Cost items							
Seed /seedling	1386	1421	392	664	400	339	194
Fertilizer & manure	153	88	66	136	92	26	71
Pest &disease	41	10	0	0	0	0	70
Irrigation	143	90	87	98	100	100	65
Polythene bag	255	0	0	0	0	0	0
Land tillage	260	105	151	219	183	195	209
Intercultural operation	1347	418	229	150	382	156	258
Opportunity cost of land	650	650	650	650	650	650	650
Interest on OC	215	128	55	76	69	49	52
Total cost	4450	2909	1630	1994	1877	1515	1568
Gross return	7710	7334	7008	3486	3847	6018	4435
Net return	3260	4425	5378	1492	1970	4503	2867
BCR (Full cost basis)	**1.73**	**2.52**	**4.3**	**1.75**	**2.05**	**3.97**	**2.83**

Table 8 reveals thatexcept seed/seedling and pest & disease cost, seedling grower faced the highest cost for *Basok* seedling growing although the net return was the highest for *Hostipolas* seedling growing.

Considering total cost expense, *Basok* experienced the highest per decimal cost of Tk. 4450 and *Shotomul* had a total cost of Tk. 1515 per decimal which is lower compared to others. In spite of lower total cost, *Shotomul* yielded the second highest profit, Tk. 4503 per decimal in the study area while *Hostipolas* had the highest net return of Tk. 5378 (per decimal) and *Kalomegh* provided lower net return of Tk. 1492 per decimal. Finally, Full cost basis BCR analysis indicated, higher BCR of 4.3 for *Hostipolas* and lower BCR of 1.73 for *Basok*. Seedling producer got higher prices for *Hostipolas* compared to other medicinal plants which increased the BCR of that medicinal plant.

Though, all types of medicinal seedling growing enterprise was profitable, the most profitable medicinal plant was *Hostipolas* followed by *Shotomul*, *Tulsi*, *Gritokumari* etc. Results revealed that *Gritokumari* and *Basok* cultivation was less profitable compared to others, but the demand of these two medicinal plants was high in the market.

11.3.3 Producer

Several inputs are used for medicinal plant production, among them seed and seedling cost was the highest and pest and disease control cost was the lowest irrespective of plant types. Subsequently, under input cost structure, among the plant categories, *Ghritokumari*had the highest cost for almost all types of inputs while *Tulsi*had the lowest cost respectively.

Table 9: Cost and return of Medicinal Producer (Tk/Decimal)

Items	*Amrul*	*Basok*	*Ghritokumari*	*Hostipolas*	*Kalomegh*	*Misridana*	*Oshwagandha*	*Shotomul*	*Shimulmul*	*Tulsi*
Cost items										
Land tillage	67	64	25	64	77	54	46	89	27	93
Seed & seedling	303	789	3990	207	164	385	158	337	123	46
Fertilizer & manure	206	61	182	94	47	56	63	26	72	28
Pest & disease control	1	2	32		2	6	12	1	1	
Irrigation	6	56	207	22	21	12	49	80	19	49
Intercultural operation	228	342	754	191	200	139	177	237	164	142
Harvest & post-harvest	204	329	650	165	145	148	107	239		103
Opportunity cost of land	251	753	251	753	251	251	251	502	251	251
Interest on operation capital	61	296	350	134	39	48	37	121	24	28
Total cost	1327	2691	6442	1631	945	1100	899	1632	683	739
Gross return	2358	5449	14955	5068	1470	2112	1642	3730	1603	1064
Net return	1031	2758	8513	3437	525	1012	743	2098	920	325
BCR (Full cost basis)	**1.78**	**2.02**	**2.32**	**3.11**	**1.56**	**1.92**	**1.83**	**2.28**	**2.35**	**1.44**

In Table 9, it is shown that *Ghritokumari* enterprise experiencedthe largest gross cost of production of Tk. 6442 per decimal which was followed by *Basok*, *Shotomul*, *Hostipolas*, *Amrul*, *Misridana*, *Kalomegh*,*Oshwagandha* and *Tulsi* with respective cost of Tk. 2691, 1632, 1631, 1327, 1100, 945, 899, 739. The minimum gross cost per decimal was estimated for *Shimulmul* being Tk. 683. So, *Ghritokumari*

was the costliest and*Shimulmul* was the cheapest MP in terms of gross cost is the areas under investigation.

The highest per decimal gross return was obtained by *Ghritokumari* (Tk 14955) and the same was done the lowest by *Tulsi* (Tk 1064). So, gross earning capacity of *Ghritokumari* was the highest and it was the lowest for *Tulsi*. The MPs subsequent to *Ghritokumari* were *Basok*, *Hostipolas*, *Shotomul* and *Amrul* in term of gross earning capacity.

Net return per decimalstands the highest for *Ghritokumari* (Tk 8513) and the lowest for *Tulsi* (Tk 325). But BCR (undiscounted) stands the highest for *Hostipolas* (3.11) and it is the lowest for *Tulsi* (1.44). So, BCR clears that all the MPs under investigation are profitable but profitability of *Hostipolas* is the highest followed by *Shimulmul*, *Ghritokumari*, *Shotomul* and *Basok* being the lowest for *Tulsi*.

11.3.4 Wholesaler-cum-Retailer

Wholesaler cum retailer has to go through some purchasing cost and this is one of the major costs for them. In the Table 10 it is depicted that, *Hostipolas* requiredthe highest purchasing cost of Tk. 360.67 per kg and *Tulsi* requires Tk. 57 per kg which is loweramong all types of plants. *Hostipolas* is a special type of medicinal plant which is used for a special type of disease. There are some costs in wholesaler-sum-retailing business which is incurred jointly, therefore we divide the those cost equally to each medicinal plants such cost wereprocurement and primary processing, drying, crushing, shop rent, electricity bill, andinterest on operating capital whichwereTk. 0.05, 0.01, 0.01, 0.03, 0.43, and 0.38 per kg respectively. Only for *Amrul* and *Shimulmul*medicinal plant, costs wereincurred for salary of staff of Tk. 0.12 and 0.69respectively, while *Basok*, *Hostipolas*, *Kalomegh*, *Misridana*, *Oshwagandha*, *Shotomul* and *Tulsi*had no cost associated with staff.

Table 10: Cost and return of Wholesaler cum Retailer (Tk/Kg)

Items	*Amrul*	*Basok*	*Hostipolas*	*Kalomegh*	*Misridana*	*Oshwagandha*	*Shotomul*	*Shimulmul*	*Tulsi*
Cost items									
Product purchasing cost	90.00	84.00	360.67	81.00	146.00	326.50	199.00	73.50	57.00
Procurement and primary processing	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Drying	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01

Crushing	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Shop rent	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Electricity bill	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43
Salary of staff	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.69	0.00
Market service charge	0.42	0.11	0.30	0.44	11.60	9.86	108.20	2.51	2.00
Other cost	2.14	0.00	6.00	0.00	10.50	0.00	0.00	7.00	0.00
Interest on operating capital	0.38	0.38	0.38	0.38	0.38	0.38	0.38	0.38	0.38
Total cost	94	85	368	82	169	337	308	85	60
Gross return	154	133	486	128	203	375	453	148	96
Net return	**60.8**	**48.0**	**118.1**	**45.7**	**34.3**	**37.2**	**145.2**	**63.4**	**36.1**

The total cost was found the highest of Tk. 368 per kg for *Hostipolas*,followed by Tk. 337 for *Oshwagandha*, while *Tulsi*had the lowestof Tk. 60 per kg. On the other hand, the highest gross return comes from *Hostipolas* (Tk. 486 per kg) followed by *Shotomul* (Tk. 453 per kg) and *Tulsi* yieldslower return of Tk. 96 per kg. Finally, to conclude with net return, from above table, every plant produced a positive net return for wholesaler-cum-retailers, but*Shotomul* had a net return of Tk. 145.2 per kg which wasthe highest and the second highest was*Hostipolas*(Tk. 118.1 per kg) medicinal business.

11.3.5 Processor

Different medicinal products incurred different types of processing cost (Table 11). The highest purchasing cost of processor occurred for *Hostipolas*, Tk. 222.5 per kg. *Shotomul*hadthe highest procurement & primary processing cost and drying cost (TK 63.61 and Tk. 258.24 Kg). The crushing cost is almost equal for every plant but *Amrul*'sprocessing costswasthe highest (Tk. 14.86 per kg) and followed by *Hostipolas*, *Misridana*, *Oshwagandha*'swhichwereTk. 13, Tk.12 andTk.12 respectively, but *Basok*, *Kalomegh*, *Shotomul*, *Tulsi* has no crushing cost.

Table 11: Cost and return of Processor (Tk/Kg)

Items	*Amrul*	*Basok*	*Hostipolas*	*Kalomegh*	*Misridana*	*Oshwagandha*	*Shotomul*	*Shimulmul*	*Tulsi*

Cost items									
Product purchase value	53.5	23	222.5	43	93	104.5	180	68	15
Procurement and primary processing	9.05	0.09	0.80	2.34	3.93	8.25	63.61	11.15	0.00
Drying	14.06	0.11	63.80	0.44	9.00	9.86	258.24	19.88	2.00
Crushing	14.86	0.00	13.00	0.00	12.00	12.00	0.00	7.00	0.00
Interest on OC	0.72	0.00	0.01	0.00	0.01	0.02	0.00	0.18	0.00
Total cost	92.18	23.19	300.11	45.79	117.93	134.63	501.86	106.22	17.00
Gross return	195	53	455	118	187	298	572	150	125
Net return	**102.8**	**29.8**	**154.6**	**72.2**	**69.1**	**163.4**	**69.8**	**44.1**	**108.0**

By aggregating all cost, Table 11 illustrates per kg total cost for *Shotomul*of Tk. 501.86 which is the highest, followed by Tk. 300.11 of *Hostipolas*, Tk. 134.63 of *Oshwagandha*, Tk. 117.93 of *Misridana*, Tk. 106.22 of *Shimulmul*, Tk. 92.18 of *Amrul*, Tk. 45.79 of *Kalomegh* and Tk. 23.19 of *Basok* and Tk. 17.0 of *Tulsi* which is also the lower cost. *Shotomul* yielded the highest gross return of Tk. 572 per kg,followed by *Hostipolas* Tk. 455 per kg and *Basok* hadlower gross return of Tk. 53 per kg. After calculating net return, *Oshwagandha*was found as most profitable one and *Basok* is least profitable among all plants.

11.3.6 Hoarder

In the case of Hoarder, table 12 indicates the per kg cost and return of Hoarder of medicinal products. From following table, it is found that, *Oshwagandha* hadthe highest purchasing cost which was Tk. 217 per kg. The procurement & primary processing cost, drying cost washigher for *Amrul*. *Shimulmul* while *Basok*, *Kalomegh*, *Misridana*, *Oshwagandha* had no drying costs. Packaging cost was almost similar except*Misridana*(Tk. 1.88 per kg) and *Shimulmul* (Tk. 1.78 per kg). *Shimulmul* experiencedhigher delivery cost of Tk. 2.10 per kg. Beside above costs, the depreciation cost, other cost and interest on capital stood at Tk. 0.33, Tk.0.63 and Tk.1.59 per kg for medicinal plants which were hoarded.

Table 12: Cost and return of Hoarder (Tk/Kg)

Items	*Amrul*	*Basok*	*Kalomegh*	*Misridana*	*Oshwagandha*	*Shimulmul*
Cost items						

Productpurchase cost	83	78	105	139	217	92
Procurement and primary processing	4.72	2.14	2.99	2.63	2.28	3.34
Drying	3.73	0.00	0.00	0.00	0.00	1.65
Packaging	1.41	1.45	1.49	1.88	1.56	1.78
Delivery cost	1.75	1.55	1.99	2.00	1.94	2.10
Depreciation cost	0.33	0.33	0.33	0.33	0.33	0.33
Other cost	0.63	0.63	0.63	0.63	0.63	0.63
Interest on OC	1.59	1.59	1.59	1.59	1.59	1.59
Total cost	97.16	85.68	114.01	148.06	225.32	103.42
Gross return	219	160	177	209	277	211
Net return	**121.8**	**74.3**	**63.0**	**60.9**	**51.7**	**107.6**

In case of gross cost and return, *Oshwagandha*'s costs and returns washigher of Tk. 225.32 and Tk. 277 per kg compared to other medicinal plants. But, in terms of per kg net return, although *Oshwagandha* yieldedthe highest gross return, it hadlower net return among all the remaining plants because of large share of gross return required during the hoarding process of *Oshwagandha*.

11.3.7 Hawker/Faria

For determining profitability of hawker/*faria* enterprise, all the gross return, gross cost and net profit were calculated in table 13 and it is found that, purchasing cost of *Hostipolas*was Tk. 343 per kg that wasthe highest and *Ghritokumari* hadthe lowest purchasing cost of Tk. 16 per kg. Since all types of medicinal plant were carried together, therefore business operationand interest on operating capital cost were same for all products.

Table 13: Cost and return of Hawker/*Faria* (Tk/Kg)

Items	*Amrul*	*Basok*	*Gritokumari*	*Hostipolas*	*Kalomegh*	*Misridana*	*Oshwagandha*	*Shotomul*	*Shimulmul*	*Tulsi*

Cost items										
Product purchase cost	116	77	16	343	104	203	312	62	157	113
Business operation	2.05	2.05	2.05	2.05	2.05	2.05	2.05	2.05	2.05	2.05
Interest on OC	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54
Total business cost	119	80	19	346	107	206	315	65	160	116
Gross return	277	212	41	546	226	494	676	193	300	240
Net return	**158**	**132**	**22**	**200**	**119**	**289**	**361**	**128**	**140**	**124**

In the case of total business cost and return, *Hostipolas* hadthe highest business cost that was Tk. 346 per kg and *Oshwagandha* providedthe highest return of Tk. 676 per kg. Besides, *Ghritokumari*hadlower amount of business costs and return, Tk. 19 and Tk. 41 per kg respectively. Moreover, *Oshwagandha* yielded the highest net return of Tk. 361 per kg, followed by *Hostipolas* and *Misridana* of Tk. 546 and Tk. 494 per kg respectively.

11.3.8 *Hakim/Kobiraj*

There were some variations in purchasing price among all the medicinal products indicated in Table 14. It wasfound that, like Hawker/*Faria*, the highest purchasing price per kg was of Tk. 284 for *Hostipolas.Hakim*/*Kobiraj* used medicinal plants for the treatment of different diseases in urban and semi urban areas of Bangladesh. When they moved to one place to another places, they carried all products with them, therefore treatment practicecost for each plant wassame of Tk. 0.26 per kg and their interest on operating capital, Tk. 0.55 wassame as well.

Table 14: Cost and return of *Hakim*/*Kobiraj* (Tk/Kg)

Items	*Amrul*	*Basok*	*Ghritokumari*	*Hostipolas*	*Kalomegh*	*Misridana*	*Oshwagandha*	*Shotomul*	*Shimulmul*	*Tulsi*
Cost items										
Product purchase price	33	83	16	284	84.7	187	239	69	137	67
Crushing	7	1.57	0.00	1.40	3.25	12.00	1.03	0.00	5.43	7
Treatment practice operation	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26
Interest on OC	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55
Total business cost	40.8	85.4	16.8	285.7	88.7	199.8	241.2	69.8	143.2	74.8
Gross return	378	509	57	569	267	328	679	288	342	356
Net return	**337**	**423**	**40**	**283**	**178**	**128**	**438**	**218**	**198**	**281**

The aggregated business cost incurred by *Hostipolas*wasthe highest (Tk. 285.7) and the lowest for*Ghritokumari*. The result was like other business enterprises. Moreover, *Oshwagandha*came with a higher gross return of Tk. 679 per kg. In terms of net return,*Oshwagandha*got the first position in return earning from *Hakim*/*Kobiraj* business enterprise.

11.3.9 *Ghritokumari* (Aloe Vera) Supplier

It is a special type of business enterprise who only deals with *Ghritokumari*. In the study area, few people were only engaged with this business. Cost and return analysis of *Ghritokumari* (Aloe Vera) supplier was illustrated in table 15 which shows *Ghritokumari* (Aloe Vera) supplier had a gross cost of Tk. 17.7 per kg and a gross return of Tk. 20 which produced a net return of Tk. 2.3 per kg.

Table 15: Cost and return of *Ghritokumari* (Aloe vera) Supplier (Tk/Kg)

Items	Amount (BDT)
Cost items	
Product purchase price	13
Selling cost	3.6
Other (local movement, entertainment, cell phone etc)	0.1
Interest on OC	1.0
Total business cost	17.7
Gross return	20
Net return	**2.3**

The total cost is aggregated by purchasing cost, selling cost, other costs that includes local movement cost, entertainment cost, cellphone cost etc. and also the interest on capital. The costs were Tk. 13, Tk. 3.6, Tk. 0.1, and Tk. 1.0 per kg respectively.

11.4 Marketing system, value chain mapping and value addition of different actors of MP

Marketing system includes all activities involved in the flow of goods from the point of initial producers to the consumers. It includes exchange activities associated with transferring property right to commodities, physically purchasing and allocating resources, handling products, disseminating information to participants and making institutional arrangement for facilitating these activities. In countries where agriculture is the principal economic activity, the marketing system becomes more important. It plays two important roles. Firstly, the role of physical distribution which is concerned with the physical handling and transfer of products from producers to consumers, and secondly, it adds value to farm commodities and facilitates the exchange process between buyers and sellers (Kohls and Uhl, 2005).

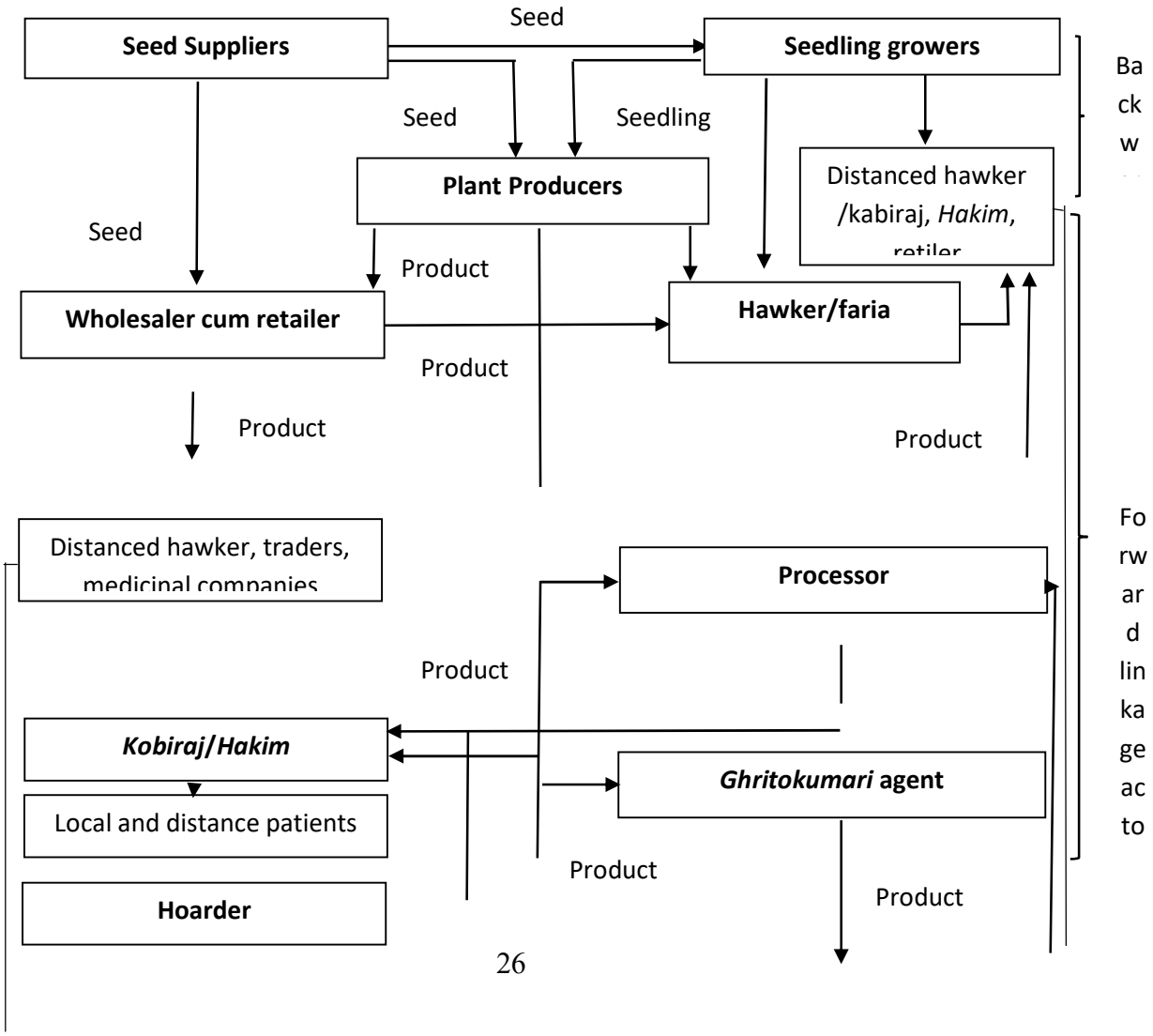
A marketing system is comprised of a number of elements: the particular products and their characteristics being transferred from producer to consumer; the characteristics of participants (e.g. the producers, the processors, the exporters and the users); the functions or roles that each participant performs in the market; and the locations, stages, timetable and physical infrastructures involved (FAO, 1995).

11.4.1 Value chain of medicinal plant and products

A value chain is the people, organizations, and activities necessary to transfer the ownership of goods from the point of production to the point of consumption. It is the way products and services get to the end-user, the consumer; and is also known as a distribution channel. A value chain is a useful tool

for management and is crucial to creating an effective and well-planned marketing strategy. Value chains are the routes through which agricultural products move from the producers to the consumers (Acharya and Agarwal, 2000).A marketing channel involves all the middlemen in the process such as producers, retailers, wholesalers, customers or end users. The value chains of medicinal plant and products as found in the study area are shown in figure 3.

In the study area a strong supply/value chain was found to be promoted and associated with nine types of entrepreneurs/actors of nine sub-enterprises under MP enterprise. These entrepreneur/actor groups were plant producers, seed suppliers, seedling growers, wholesaler-cum-retailers, processors, hoarders, hawkers/*Farias*, *Hakims*/*kobirajs* and *Ghritokumari* suppliers, where MP producers were the principal (key) entrepreneurs/actors. Apart from the producers, other eight entrepreneurs/actors were involved in backward and forward linkage of the supply chain. Seed suppliers and seedling growers were associated with the backward linkage, whereas wholesaler-cum-retailers, processors, hoarders, hawkers/*Farias*, *Hakim*/*kobirajs* and *Ghritokumari* suppliers acted in the forward linkage. Several wholesaler-cum-retailers were also involved in the backward linkage of the supply chain as seed suppliers.



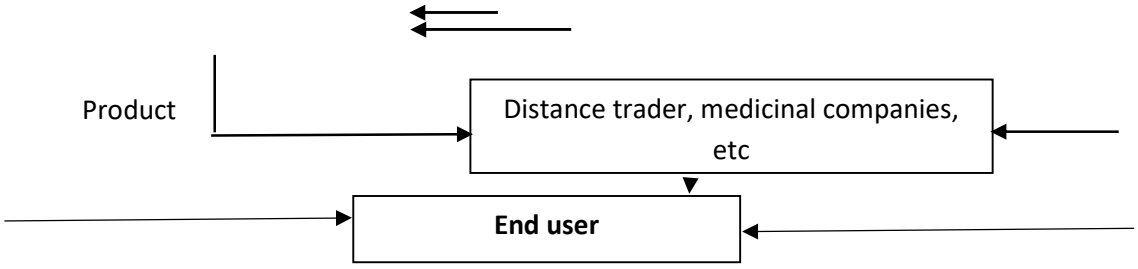


Figure3: Supply chain of medicinal plant

11.4.2 Functions performed in medicinal product marketing

11.4.2.1 Buying and Selling

In Medicinal Plant business enterprise, seed suppliers purchase and store seed till the time of selling. Medicinal seed selling is a seasonal business and the producers purchase seeds just before sowing. Except home-based supplier, everyone sells their seeds from shops. In the study area*Hostipolas*, *Shotomul*, *Kalomegh*, *Shimulmul*, *Oshwagandha*, *Tulsi* seeds were produced from the seeds purchased from seed suppliers. *Basok* and *Ghritokumari* stems and immature seedlings were purchased from the cultivable land locally. Also, outside sources like local mature *Shimul* plant owners, local cotton collector, miller/processor, trader and general shoppers soldseeds to the buyers (local seed suppliers) of Laxmipur-kholabaria union as per advance orders or current orders. Seedling growers soldtheir seedlings seasonally from nurseries to several local and outside buyers including local and outside producers, hawkers/*Farias*, *Hakims*/*kobirajs*, medicinal companies, NGOs, visitors. Normally buyers liked to buy seedlings after visiting the nursery physically.

Therefore, major portion of produced product was sold to local wholesaler-cum-retailers and rest to processors, hoarders, hawkers/*Farias*, and *Hakims*/*kobirajs*. Wholesaler-cum-retailers always purchased green, dry and dust products of MPs locally from local producers, local processors and local hoarders. Minimum 100 gm of dust and dry products and 1 kg of green product were sold as retail sale. Wholesaler-cum-retailers always sold products from their shops as permanent sales points in local markets. Products were sold to several local and outside buyers including local and outside hawkers/*Farias*, *Hakims*/*kobirajs*, wholesaler-cum-retailers, national and regional pharmaceutical and herbal medicinal companies (e.g. Navana Pharmaceuticals, Square Pharmaceuticals, Acmi Pharmaceuticals, Hamdard Labouratory Limited, Taiwan Company, etc.). Companies purchased products on their own responsibilities once or twice in a month and products were delivered to the companies on non-written verbal agreements. After wholesaler-cum-retailers it comes to the actor, processors who purchased and collected harvested and non-harvested green products mainly from local producers. Processors added value to products through primary, secondary and tertiary processing. Moreover, all the hoarders purchased mainly dry products and a small amount of green products from local producers and processors from their residence, but large-scale purchase came from producers. Generally, hoarders sold the stored products in off season when supply became scarce in the markets. Storage products were always sold and delivered from warehouse by hoarders to wholesale traders

coming from outside of Natore, local wholesale-cum-retailer and regional and national medicinal companies.

The hawkers/*Farias* always purchased/collected the products from the local wholesaler-cum-retailer, producers, processors and from own household supply. But, major portion of products were collected from local wholesaler-cum-retailers' shops. All the hawkers/*Farias* conducted their business in and outside areas through a several sales points by travelling these areas several times in a week or month. Outside Natore, they bought and sold from Tangail, Nawbabganj, Sirajganj, Mymensingh, Pabna, Naogaon, Bogra, Barisal, chattogram, Natore, Rajshahi, and Dhaka district. They sold products to local users/ general patients, other hawkers/*Farias*, *Hakim*s/*kobirajs*, retail traders.The *Hakim*/*kobirajs*were the last actors before end users and always involved in small-scale collection and distribution of products for treatment practice. They purchased from local producers, wholesale-cum-retailers, processors or collects from own household supplies.

11.4.2.2 Pricing

In case of MP business, prices were determined based on either a price fixed by sellers or an open bargaining method without any artificial pressure by any business association or any government/non-government organization or any other party. Due to short supply in selling season, seed priceswerefixed prior by suppliers. Also, due to quality variation of the product, the products were sold in difference prices within a season and this leads to price fluctuation and quality variation in the market. Also, it is observed that the prices of locally collected seeds wereusually lower. Besides, the *Hakim*s/*kobirajs* usually set treatment fee based on medicine type, quantity, quality, purchase price, cost and category of patient(poor/rich) and treatment service.

11.4.2.3 Processing

Producers sold their green and dry products after primary and secondary processing performed in harvested plot, home yard or temporary yard prepared on roadside. Where primary processing involves separating saleable product parts from the plants, unnecessary parts from saleable and washing saleable parts in pot water; secondary processing emerges with the cutting of saleable product parts into small pieces and drying in sunlight as per requirement. Root of *Amrul*, *Hostipolas*, *Shotomul*, *Shimulmul*, leaf of *Ghritokumari*, corn(dana) of *Misridana*were processed as green form while leaf and stem of *Basok*, root of *Oshwagandha*, full plant of *Kalomegh*, and full plant of *Tulsi* without root were processed as dry form. Again, wholesaler-cum-retailers were not professional processor, but sometimes they process some portion of the purchased products into dry and dust forms for increasing sales and promotion of purchased products and adding value to low quality rejected and unsold products. After the purchase, they sort products with non-uniform size & shape, spot and injury. Then, green products were converted into dry products through sun drying keeping on open *katcha* yard or *pacca* platform while Dry products were converted into dust product through crushing by hired crushing machine.On the other hand, processors add value to products through primary, secondary and tertiary processing.

Table 16: Processing methods and processed medicinal products

Product category	Processing stage	Processing method	Processed/ saleable form
Green product	Primary	Cleaning and sorting	Green
	Secondary	Drying	Dry
	Tertiary	Crushing	Dust
Dry product	Tertiary	Crushing	Dust

Source: Field Survey (2017)

In primary stage of processing, the activities include separation of saleable/useable parts from harvested plants, separation of unnecessary parts from saleable parts, cleaning and dry washing products with water and sunlight, packaging saleable parts with bags/basket/mat and storing it for future sale. In secondary stage of processing, saleable/unsaleable parts (such as root, corn, plant) were cut into small pieces and later dried, cleaned, packaged and stored for sale. In tertiary stage of processing, dry products were transported for crushing and converting it into dust products, their processing methods are mostly developed based on their experience, knowledge and heredity and have no standard procedure. Usually, their methods were always comparatively the cheapest, easiest and most effective for processing the products. Also, sometimes due to non-availability of quality dry and dust products, *Hakim*/*kobirajs* convert the collected green products into both dry and dust or any form according to the requirement; while the dry products were converted into the dust form.

During processing stage, while drying, huge weight loss occurs in green product. Moreover, during crushing weight loss also occurs in dry product through flying of dust and separation of bran (husk) from dust. This weight loss is shown in Table 17

Table 17: Weight loss for drying and crushing of medicinal products

Medicinal product	Processing method	Percent of weight loss
Amrul root	Drying	76
	Crushing	7
*Basok*leaf (with stem)	Drying	71
Hostipolas root	Drying	72
	Crushing	11
*Kalomegh*h – full plant	Drying	76
Misridana corn (dana)	Drying	73
	Crushing	7
Oshwagandha root	Drying	70
	Crushing	15
Shotomul root	Drying	85
	Crushing	7
Shimulmul root	Drying	73
	Crushing	10
Tulsi-full plant (without root)	Drying	75

Source: Field Survey (2017)

It shows in Table 17 that in the case of drying, average weight loss occurred the highest for green product of *Shotomul* (85 percent) and the lowest for *Oshwagandha* (70 percent). While considering crushing, these figures came to be 15 percent for *Oshwagandha* and 7 percent for *Amrul*, *Misridana* and *Shotomul*. Again, variation in weight loss due to drying was the highest for green product of *Shotomul* (19 percent) and the lowest for that of *Tulsi* (4 percent). Variation in weight loss due to crushing of dry product was the highest of 17 percent for *Oshwagandha* and the lowest was found in both *Misridana* and *Shotomul* (3 percent each). So, the products lost their weight more in drying than that of crushing.

11.4.2.4 Transportation

The outside seed suppliers supply seeds to the buyers (local seed suppliers) of Laxmipur-kholabaria union ordinarily through two methods – supply through physical visit in the study area and courier

supply through mobile contract. Motor operating van (including electric charging battery) or head-loading was used by the producers for carrying the plants from field to processing place. The processed products (green and dry) were sold by producers either at their own residence or in local markets. In the case of selling in local markets, hired motor operating van and own bicycle werethe most used transport.

Besides, wholesaler-cum-retailers generally collect and store products in their shops. So, they used hired motor operating van to carry products only for processing activities. Also, processors used local hired motor operating van for transporting products from purchase place to processing yard. Selling products were delivered to buyers always from storage places. Also, in this case, motor operating van is usually used for local transportation of sale products; while bus/truck is used for transporting the products to outside areas of Natore district. Hawkers/*Farias* performed their product deliverythrough train or bus by carrying large sized handbags containing products.

12.4.2.5 Grading

Most of the time, no standard and grade were maintained by the seed suppliers for purchasing, selling and storing their seeds in the study area. Also, no standardization and grading were maintained by wholesaler-cum-retailers in any stage of storage, packaging, transportation and selling of products. Most of the time, processors graded all types of products in green form, dry form and dust form. Besides, rejected and low-quality green products (non-uniform shape and size, spot and injured and discolored) were converted into dry and dust products through processing. Also, no standard and grade were followed by the hoarders.

12.4.2.6 Packaging

Seed suppliers use polythene bag for seed selling. Ordinarily for *Hostipolas*, *Kalomegh*, *Oshwagandha*, *Shotomul*, and *Tulsi* seeds, small packet was used but for *Shimulmul* seed large packet was used. While selling seedlings to the outside buyers, seedlings were usually delivered in cartoon box. Again, for wholesale, the products were supplied in plastic and polythene bags. But for retail sale, no packet was generally supplied for green and dry products, only small size thin polythene bags were supplied for dust products. In all 3 forms of products, pack size ranged from 1 to 200 kg. Processors used only jute bag and plastic bag usually for both green and dry product, whereas only polythene bags were used for dust product. Specific sizes of bags as per product quantity are not followed for storing and selling at processors' level. In this case, the size of bags ranges between 40 – 70 kg for green products, 20 – 40 kg for dry products, 1 – 5 kg for dust products. On the other hand, packing quantity varies among products and normally remains 20 to 50 kg for hoarders.

In the study area, Hawkers/*Farias* used big size (10 kg or 20 kg) plastic handbags (like gunny bags) for collecting and keeping the products till selling. Hawkers/*Farias*sold product in different quantities to the buyers but only for dust products, small size thin polythene bags were supplied to the buyers. Also, *Hakim*/*kobirajs* used small size thin polythene bag and plastic pot as packets for supplying medicines to the patients.

11.4.2.6 Storage

Different types of seed require different storage period ranging from 1 to 8 months. The suppliers store seeds in both residence and shops using several packet materials like polythene bag. To avoid pest attacks and covering the open side, they use neem leaves. *Basok*, *Kalomegh*, *Oshwagandha* and *Tulsi*were stored in dry form in producers' house in plastic bags within a bamboo container or in open form for a week to 3 months. While storing in open form, products are placed on polythene sheet or bamboo mat; or only on floor directly. Different sizes of packets (ranging from 1-80 kg) were used for storing. Besides, wholesaler-cum-retailers usually store both dry and dust products for a period of 7 to 30 days in residence houses or local market shops by using plastic and polythene bags, mats, bamboo baskets, plastic tray boxes, pots and plastic drams too. Processors usually stored products from 1 week to 1 month in residence house, own or hired processing yard, or land of product purchase and they don't have separate specialized warehouse for this. Like others, plastic mat, jute bag, plastic bag, polythene bag, plastic dram, bamboo basket, plastic pot, etc. were utilized for storing products. On the other hand, always dry products were hoarded by hoarders and among all actors in supply chain, only hoarders adopt improved system for storing products. Storage duration of medicinal products under study by hoarders ranged from minimum 1 month to maximum 12 months being the highest average of 9 months for dry product of *Amrul* and the lowest of 6 months for *Misridana*. They always use separate semi-*pacca*/*katcha* rooms as warehouse in their houses. Also, they use better quality packet than that of others. Spot free plastic bag, polythene bag, jute bag, plastic box/tray, plastic dram and plastic pot are generally utilized for storing products while this is no standard storing methodand all the methods were own developed or traditional based on personal preference, usefulness and cost effectiveness.

11.4.2.7 Marketing information

All the actors have no knowledge about market information and sales promotion regarding their products. They gather information on quality and prices from other MP producers, local suppliers and wholesaler-cum-retailers, hawkers/*Farias*, *Hakim*s/*kobirajs* at residence, local market or refreshment gathering in tea shop. Besides, they also exchange the same with buyers over cell phone. They also inform quality and price of the plants and the products to other actors (producers, processors, hoarder and wholesaler-cum –retailers) locally in the same way. Sometimes, the they buy and sell the seeds and products without collecting any market information.

11.4.3 Value addition to medicinal plant business

Value is added to the medicinal plant by the MP actors through buying and selling. Therefore, added value to the medicinal plants was expressed through the difference between selling price and purchasing price of the plants.

Table 18: Value addition mapping(Tk/kg)

Category of seed	Value Addition					
	Seed Supplier	Wholesaler-Cum-Retailer	Processor	Hoarder	Hawker/*Farias*	*Hakim*s/*Kobirajs*

Amrul	-	105.16	165.6	88	-	133
Basok	-	49	30	82	-	425.5
Ghritokumari	-	-	-	-	-	41
Hostipolas	650	349	315.8	-	-	285.5
Kalomegh	739	47	75	72	-	182
Misridana	-	143.33	125.4	70	-	98
Oshwaganda	856	130.33	183.5	60	-	439.67
Shotomul	1110	346.4	517.6		-	219
Shimulmul	68	102	113.8	67	-	208.5
Tulsi	1441	39	110	-	-	258

From Table 18, value addition of medicinal seeds can be found for different actors performing in the market. For *Amrul*, processor added the highest value of average Tk. 165.6 per kg followed by *Hakim*s/*kobirajs* (Tk. 133/kg), wholesale-cum-retailer (Tk. 105.167/kg) and Hoarder (Tk. 88 /kg)who added the lowest value. While seed supplier and hawker/*Farias* did not add any value. For *Basok* products, seed suppliers and hawkers/*Farias* did not have direct value addition but *Hakim*/*kobiraj* hadthe highest value addition of Tk. 425.5 per kg and processors added minimum of Tk. 30 per kg; whereas hoarder and wholesaler-cum-retailer added average of Tk. 82 and Tk. 49 per kg respectively. In case of *Ghritokumari* product, only *Hakim*/*kobirajs* added value of Tk. 41 per kg. Again, for *Hostipolas* product, seed suppliers addedthe highest value of Tk. 650 per kg, *Hakim*s/*kobirajs* added Tk. 285.5 per kg which was also the lowest and wholesaler-cum-retailer, processor added value of Tk. 349, Tk. 315.8 respectively. Moreover, for *Kalomegh*, seed supplier addedthe highest value and hoarder addedlower value of Tk. 739 and Tk. 72 per kg while wholesaler-cum-retailer, processor, *Hakim*/*kobiraj* added Tk. 47, Tk. 75, Tk. 182 per kg respectively. In case of *Oshwagandha*, *Shotomul* and *Tulsi*, seed suppliers hadthe highest value addition of Tk. 856, Tk. 1110, Tk. 1441 per kg, respectively while Hoarder contributedrespectively minimum of Tk. 70, Tk. Tk. 60, Tk. 67 per kg for *Misridana*, *Oshwagandha* and *Shimulmul* products. Wholesaler-cum-retailer contributed maximum to the value addition to *Misridana* (Tk. 143.33 per kg) and minimum to *Tulsi* seed (Tk. 39 per kg). *Hakim*s/*kobirajs* had value addition of Tk. 98, Tk. 439.67, Tk. 219, Tk. 208.5, Tk. 258 per kg for *Misridana*, *Oshwagandha*, *Shotomul*, *Shimulmul*, *Tulsi* products respectively. In above table, hawker/*Farias* contribution in value addition in MP business appears to be zero but generally the hawkers/*Farias* add value to medicinal products through transportation. Thus, they work hard in value addition process by performing frequent complex travelling with product carrying, operating business in outside areas being separated from the family, sacrificing comfort in life due to uncertain accommodation and entertainmentfacilities in the business areas.

11.5 Problems and constraints at different levels for MP

All the entrepreneurs/actors of MP enterprise faced several problems and constraints for operating their enterprises. The major problems faced by MP actors in the research area areshown in Table 19.

Table 19: Problem and constraint matrix of medicinal product production, processing and marketing

Problem and constraint	Producer and seedling grower	Wholesaler-Cum-Retailer	Processor	Hoarder	Hawker/ *Farias*	*Hakims*/ *Kobirajs*
1. Lack of HYV of medicinal plants	■					
2. Lack of modern cultivation and business practices	■	■	■	■	■	
3. Lack of credit	■	■	■	■	■	■
4. Lack proper extension services	■		■	■		
5. Lack of training facilities	■		■			
6. Unstable market supply, demand and prices	■	■	■	■	■	■
7. Attack of pest, diseases and rodents	■	■	■	■	■	■
8. Poor quality of medicinal seed	■					
9. Lack of bargaining association	■					
10. Problem of drying in winter and rainy season			■	■		
11. Lack of marketing information		■	■	■	■	■
12. Excess moisture deteriorates the quality		■	■	■	■	■
13. Lack of labour	■		■			
14. Lack of government supports					■	■

All the entrepreneurs/actors of MP enterprise are facing several problems and constraints for operating their enterprises. These problems along with their proposed solutions are discussed below.

11.5.1 Lack of HYV of medicinal plants

MP Producer, Seedling Growing and Seed Supply Enterprise mentioned that there was a lack of HYV medicinal plant seeds for MP producers. So, this was difficult for producers to make the supply of medicinal plant seeds, seedlings stable over the time.

11.5.2 Lack of modern cultivation and business practices

There was no modern standard method and technology for activities related to production of medicinal plant, its seedling and seed. On the other hand, tradershadlack ofknowledge about contact, market linkage, market information, sales promotion, processing, storage, packaging, transportation, etc. of the products. This leads loss to the business of medicinal plants and destroys MP product markets.

11.5.3 Lack of credit

As there exists no bank loan opportunity for MP cultivation, seedling and seed growers and producers mostly encounter problems related to availability ofcredit. Also, scarcity of capital and bank loan frustrates the trading business a lot in the study area. Traders don't feel safe to take risky venture regarding MP enterprises with own in-hand capital.

11.5.4 Lack of proper extension services

The services provided by local agriculture office regarding MP was insufficient and inappropriate. Therefore, there was no training support to the producers about cultivation, processing, storage and marketing of medicinal plants and products. Even no practical and effective suggestions and supportswere provided either from local agriculture office or from NGO's regarding medicinal product trading to the traders.

11.5.5 Lack of training facilities

No training support was available for the MP producers, seedling growers and seed suppliers about MP cultivation, seedling growing, and processing, storage, packaging, selling and transportation of medicinal products, seedlings and seeds. Also, all tradershad little knowledge about contact, market linkage, market information, sales promotion, processing, storage, packaging, transportation, etc. of the products. They did notreceive any form of training regarding this issue.

11.5.6 Unstable market supply, demand and prices

Due to low quality of seeds, sometimes germination rate of the seed was low and there was a scarcity of trained personnel for dealing MPs, seedlings and seeds. This created instability in the market supply of medicinal products. There also exists uncertainty in demand. Sometimes mature seedlings were not sold timely due to scarcity of potential buyers. This uncertain demand, supply and price sometimes makes the business heavily risky leaving very poor profit to the MP producers, seedling growers and seed suppliers. Regular buyers were not available around the year. Also, due to instability in market demand, supply and price traders feel less interested to go with MP enterprise.

11.5.7 Attack of pest, diseases and rodents

Often it appears unknown and non-controlled pests and diseases attack and damage to the MPs and seedlings in producer's residence or storage. On the other hand, product quality diminishes seriously due to attack by rats in storage of traders. This creates unexpected loses in MP business both to producers and traders.

11.5.8 Poor quality of medicinal seed

Due to low quality of seeds, sometimes germination rate of the seed was low. Because of this low quality and germination rate, unsold seeds were difficult to carry over in the next sowing seasons. Also, identification of seed quality was very difficult, and quality of seeds was very sensitive to high cold or high hot temperature. As producers and traders usually stored products in houses under normal condition, maintaining quality round the year becomes difficult.

11.5.9 Lack of bargaining association

There exists a lack of contact among the producers and outside buyers and scarcity of trained personnel for dealing with plants, seedlings and seeds. Moreover, there was no effective association for dealing with the problems and issues relating to medicinal sector effectively. This turned MP enterprise producing actors to a position where they can't bargain for their rights.

11.5.10 Problem of drying in winter and rainy season

Drying of medicinal products was seriously hampered by dense fogs in winter season and heavy rains in rainy season. Processors, wholesaler-cum-retailers had no option but waiting for sunlight for drying before further processing. This issue turns problematic for traders mostly.

11.5.11 Lack of marketing information

Traders' lack ofknowledge about contact, market linkage, market information, sales promotion, processing, storage, packaging, transportation, etc. of the products made them incapable of performing trading operations efficiently.

11.5.12 Excess moisture deteriorate the quality

As moisture of dry product is tested through organ test, standard moisture level of the products is not maintained properly. It causes quality deterioration. There was no standard technology available to the traders for controlling moisture deterioration. While selling these products ultimately causes loss to traders.

11.5.13 Lack of labour

While processing green products into dry form huge labourwas required as green products are cut and washed manually. Labour scarcity is prominent in MP sector.

11.5.14 Lack of government supports

No government organization issues trade license to hawkers/*Farias* and village herbal treatment practitioners. They were seriously harassed by mobile court and police during selling the products and treatment practice. In some cases, illegal fee was paid by hawker/*Farias* in excess of market fee/toll to the local pressure groups. Government supports in terms of training, guidebook, license, instruments, etc. were absent for hawkers/*Farias* and *Hakim*/*kobiraj*.

11.6 Suggestions for promoting MP enterprises at different levels

To strengthen the MPs sector, a holistic approach is necessary**.** DAE, DAM and NGOs can work together to improve the bottleneck situation. MP producers and traders were suggesting the following suggestions for promoting MP enterprises at different levels.

11.6.1 Developing HYV varieties

Research organizations like BARI, BFRI etc. should undertake research programs on varietal development of plants, seedlings, and processing techniques of MPs in the country. This would be very beneficial for producers if they get HYV of medicinal plant seeds and with an appropriate field demonstration of HYV. Standard method and technology of MP cultivation and seedling growing can be arranged by local agriculture office for making MP cultivation and seedling growing popular in major producing areas.

11.6.2 Offering training facilities by GO and NGO

Different GOs (like DAE) and NGOs should come forward with effective training on MP cultivation and seedling growing, and processing for MP producers in the country. Also, these GOs and NGOs should arrange appropriate training on processing, storage, packaging, leveling and transportation of the products of MPs. A short-term and long-term training with updated instruments, books, guideline, etc. should be given to the *Hakims*/*kobirajs* dealing with medicinal treatment in the study area. Finally, herbal treatment education and training institute may be established in all the districts of the country.

Table 20: Solution matrix of medicinal product production, processing and marketing

Solution	Producer and seedling grower	Wholesaler-Cum-Retailer	Processor	Hoarder	Hawker/ *Farias*	*Hakims*/ *Kobirajs*
1. Developing HYV varieties	■					
2. Offering training facilities by GO and NGO	■	■	■	■	■	■
3. Needing proper extension services	■	■	■	■	■	■
4. Offering SME loan	■	■	■	■	■	■
5. Monitoring the quality of seeds	■					
6. Developing policy guidelines for boosting up the sector	■	■	■	■	■	■
7. Developing proper drying technology			■			
8. Testing herbal medicine in the lab						■
9. Securing demand established by medicinal company	■					
10. Developing bargaining association	■				■	
11. Managing license and recognition of herbal treatment					■	■

11.6.3 Needing proper extension services

Different GOs and NGOs should try to motivate the medicinal companies to increase their purchase volume from the MP producers. Beside them, DAE, DAM and NGOs should help to formulate and run effective MP entrepreneurs' association in the MP areas of the country. For effective MP cultivation and seedling growing, a strong linkage between DAE and producers is ofutmost importance**.** DAE personnel may visit farmers' plots and growers' nurseries for providing necessary suggestions to solve their problems. Gathering and dissemination of information on production and marketing of medicinal plants and products, seedlings and seeds should be done by opening an information center or booth in the study area under local agriculture office or DAM office.

11.6.4 Offering SME loan

Banks and NGOs should develop, and practice special loan keeping consistency with production and return cycles of plants and seedling for the MP producers and seedling growers. For trader, adequate financial supports should be arranged by banks and NGOs.

11.6.5 Monitoring the quality of seeds

Strong monitoring by concerned authority (like DAE) is essential for maintaining quality of fertilizer, pesticides and other inputs used for MP cultivation and seedling growing. To maintain the quality of seeds both in short and long terms, standard method and packet should be developed and disseminated for storing by GOs and NGOs in the traders' level. Cost effective and easy technology may be developed by research organizations to test the quality of seed easily. Also, warehouse should be built in such a way that it is free from attack by rats completely.

11.6.6 Developing policy guidelines for boosting up the sector

MP entrepreneurs' (producer and trader groups) association should be formed and made effective to deal with fair price issue successfully. Necessary support should be ensured by government and non-government organizations for creating potential markets in home and abroad. This will support both producing and trading enterprises of medicinal products.

11.6.7 Developing proper drying technology

Acost-effective mechanical method for drying especially in winter and rainy seasons needs to be developed by concerned research institutes. This technology will ensure drying quickly at a lower cost.

11.6.8 Testing herbal medicine in the lab

For increasing acceptance of medicinal products both in home and abroad, medicinal value of the products should be identified in laboratory and disseminated among common people by different GOs and NGOs. This effort will be beneficial specially traders in the long run.

11.6.9 Securing demand established by medicinal company

Medicinal companies should practice large purchase utilizing full capacity of the companies. Also, a strong forward linkage and contract sale are essential to maintain stable price of the products. This will help in securing an establishment of demand by medicinal company.

11.6.10 Developing bargaining association

DAE, DAM and NGOs should help to formulate and run effective MP entrepreneurs' association in the MP areas of the country. Also, DAE should develop appropriate manual and government should formulate appropriate policy for supporting and promoting MP sector. DAM or DAE or NGOs should specially help to establish and operate effective hawkers/*Farias* associations in MP areas.

11.6.11 Managing license and recognition of herbal treatment

Government should issue trade license to the hawkers/*Farias* and *Hakim*s/*kobirajs* to run their business and treatment legally and smoothly. Government should give recognition and status to the herbal treatment practitioners like doctors in both village and town levels. A specific point or place should be fixed in the local market area for dealing with medicinal product business by the hawkers/*Farias*.

11.7 SWOT analysis for MP

SWOT stands for a strength, weakness, opportunities and threats. It is a matrix which consists of influencing factors of a business institution or enterprise. All relevant factors are considered under these four major factors. Strength and weakness are internal, also considered as favorable factors, control factors, while opportunity and threat are external and favorable, uncontrolled factors. Moreover, strength and weakness are present and influencing factors of an enterprise to be found out during selection, initiating and starting a business, while opportunity and threat are future and possible factors that may be occurred after starting and conducting the enterprise. SWOT analysis is one of the systemic tools to analyze the situation and condition of a business institution or enterprise.

Based on review of secondary documents, expert opinions and field reconnaissance, a SWOT matrix has been prepared and presented in Table21.

Table 21: SWOT analysis of medicinal plant production, processing and marketing

Strengths	Weakness
➢ Suitable land for production of MPs ➢ Diversified scope of MP business/ enterprise as different sub-enterprises ➢ Domestically/locally available inputs are used in production and processing. ➢ Supply of non-side effect and effective material of medicines ➢ Conservation of biodiversity ➢ Local knowledge of preparation for herbal and indigenous medicines ➢ Medicinal plants are resistant and strong in physiological aspects ➢ Salespersons are travelling nationwide for selling the herbal medicine ➢ History of traditional medicine and indigenous knowledge of therapeutic use of plants	➢ Any authorized body does not certify medicinal value of the herbal medicine ➢ Lack of research and development of high-yielding varieties, domestication, etc. ➢ Lack of organized efforts to collect and conserve germplasm of medicinal plants ➢ Low productivity and quality of output ➢ Lack of appropriate cultivation, processing, storage and packaging system. ➢ General people do not believe the effectiveness of the medicine that produces from an unauthorized group of people ➢ Un-organized market, and access to market information ➢ Limited research and development activities in medicinal sector of Bangladesh ➢ Lack of developmental, extension and advisory service
Opportunities	**Threats**
➢ Potential demand of medicinal products both in domestic and foreign markets ➢ Appropriate climate of producing diversified medicinal products ➢ Creationof entrepreneurship ➢ No need to import raw herbal medicine from foreign countries. ➢ Large number users use *Aloe Vera* in different forms ➢ Helping the development of medical production and processing industries ➢ Creation of employment ➢ Natural resources used for human welfare and society ➢ Abundant possibility for saving foreign exchange through substituting local ingredients of medicinal products for imported ones	➢ Skewed governmental policies and management in medicinal sector ➢ GO and NGOs has no separate credit program for the development of this sector ➢ Wastage of products due to poor marketing management ➢ Having no scientific approach in production and processing of medicinal plants ➢ Drought, climate change and disease hamper the production process

11.8 Profile of different stakeholders of *Agar*

Agar plant producer is the major actor of the supply chain. The sapling grower works as backward linkage actors, while processors and exporters involve as forward linkage actors. Again, sapling grower involves in input supply of *Agar* saplings, but the processors and the exporters are adding value to *Agar* products. Moreover, several local and foreign support groups like seed and sapling collectors, plant suppliers, product suppliers, sales agents and foreign buyers provide necessary supports to the actors for smooth operation of *Agar* business. The activities performed by different stakeholders involved in *Agar*supply chain are discussed below.

11.8.1 Seed and Sapling Collectors

Some local boys and girls seasonally collected seeds and immature saplings from local *Agar* gardens and then sold to the local sapling growers and producers.

11.8.2 Sapling Growers

Sapling grower involved in several activities like seed and sapling (immature) collection and growing, bed preparation, immature sapling planting, intercultural operations (fertilizer and pesticide application, irrigation, weeding, sapling replacement in beds), sapling selling, nursery management, etc. The sapling wassold mainly to the local *Agar* plant producers, but very few of them are sold to the outside producers of surrounding areas of Barlekhaupazila.

11.8.3 Producers

Agar plant producer performs all production activities and some related marketing activities. These activities werecollection and growing of *Agar* seeds and saplings, sowing and planting *Agar* seeds and saplings, land preparation, intercultural operations (fertilizer and pesticide application, irrigation, weeding, nail setting, etc.), and selling of plants. They collected the seeds and saplings from local collectors, local suppliers, local sapling growers and home supplied sources. The producers sold their plants only to the local processors always from their plant gardens.

11.8.4 Processors

Agar processorare engaged in changing the form of *Agar* plant through different processing activities. These activities were plant purchase, harvest and procurement of purchased plants, converting plants into *Agar* wood and chips, *Agar* oil production from the processed chips, processing of *Agar* products (*Agar* oil, wood and chips- boiled) packaging, storing, selling etc. The processors purchased plants only from the local producers and sell their products only to the local exporters and suppliers.

11.8.5 *Agar* Product Suppliers

Agar product supplier purchasedthe *Agar* products (*Agar* oil, wood and chips) from local processors and then sold to the local exporters. It was observed that activities of the suppliers are usually confined in purchase and sale of products.

11.8.6 Exporters

Agar product exporter adds value through processing and exporting the finished product. The necessary activities werepurchase and collection, processing, packaging and storage, transportation, selling and

delivering, CITES certificate collection, travelling, making contact and contracts, etc. The exporters purchased products always from local processors and suppliers. The exported *Agar* oil, wood and chip are sold to foreign suppliers, medicine/cosmetics companies and ultimate users.

11.9 Production system of AP

11.9.1 Land area of *Agar* producers

Table 22 shows that the average cultivable land was153.6 decimal and area under *Agar* cultivation was86.7 decimal which was67 percent of total cultivable land. It is also depicted that *Agar* production occupied 64 percent of own cultivable land and 3 percent of leased, mortgaged, and shared land in the study area. Thus, a major portion of cultivable land of the respondents is utilized for *Agar* production.

Table22: Average land area of *Agar* producers

Category	**Area (dec)**
Homestead area	22.0
Cultivable land	153.6
Own ownership	141.8
Leased, mortgaged and shared in	11.8
Agar plant garden (own land)	77.6
Agar plant garden (Lease land)	9.1

Source: Field Survey (2017)

11.9.2 Collection of seed and sapling for *Agar* plant production

Both seeds and immature saplings (aged 12 – 35 days) wereused for growing saplings in the nurseries. It wasfound that 16.7 and 83.3 percent nursery owners used seeds and immature saplings respectively for growing saplings.

Table 23: Information about collected *Agar* seeds and immature saplings

Item	Unit	Information
Price of seeds	Tk/kg	70
Price of immature saplings	Tk/kg	0.11
Age of saplings at the time of planting	Day	22
Size (length) of saplings during planting	Inch	1 - 1.5

Duration of seed sowing after falling down of plant in garden	Day	1 – 7

Source: Field Survey (2017)

It is shown in above table that the purchase price per kg seeds and immature sapling wereTk 70 and Tk 0.11 respectively. Moreover, age of the collected immature saplings was22 days, whereas the size was1-1.5 inches. The actors deal with immature saplings of very short size and age, and seeds for very short period.

The *Agar*producer used only saplings. Both naturally and nursery grown saplings were used by the growers. Saplings were collected mainly from three sources as follows:

i) **Producers' own nursery and collection:** Some producers collect seeds, immature saplings from their own, and others' plant gardens and grow saplings from the collected seeds and saplings in their own nurseries. Sometimes, naturally grown saplings were also used without transplanting. The peak periods of the seed and sapling collection were middle March - middle April and middle April – Middle June respectively.

ii) **Seed and sapling collector:** Some local collectors procured seeds and saplings from the local gardens and then sold them to the local plant producers.

iii) **Sapling growers:** Some local people grew saplings commercially in their own nurseries. Generally, price of mature saplings was higher than that of immature saplings. The average price of sapling wasTk 2.75.

11.9.3 Land preparation and sapling planting

As a forest plant, *Agar* is usually cultivated under local traditional method. No intensive care or special prescribed method was practiced for producing the plant. *Agar* plant is seriously water sensitive, so the plants are always cultivated in sloped high land where no water logging exists. Saplings are ordinarily planted round the year, but middle April – middle July is the peak period of planting. On the other hand, due to natural calamity like storm, heavy drought, heavy rain, theft, pest and disease attack; a considerable number of plants were damaged and lost in the garden.Many activities like tillage, cleaning and leveling of land, making pit (hole), mixing fertilizer with soil, collection of saplings, planting saplings, etc. are sequentially performed by the producers (Table 24).

Table24: Information about cultivation of *Agar* plant

Item	Unit	Amount
Area per plant garden	Deci	86.71
Produced plant per garden	No.	4112
Produced plant per hectare	No.	11713
Damage & loss rate of plant	%	27

Pit depth for sapling planting	Inch	11.88
Pit diameter for sapling planting	Inch	11.05
Distance- line to line for sapling planting	Feet	2.81
Distance- sapling to sapling for plating	Feet	2.55

Source: Field Survey (2017)

Table 24 shows that average area under plant garden, plant per garden and damage & loss rate of plant were86.71 decimal, 4112 and 27 % respectively. Moreover, average pit depth, diameter, line-to-line distance and sapling-to-sapling distance were2 inch, 16 inch, 5 feet and 5 feet respectively.

11.9.4 Intercultural operation for producing *Agar* plant

Some producers perform intercultural activities like weeding, fertilizer and pesticides application and irrigation in minor level as per necessary within the period of 1 to 5 years after planting sapling in gardens. However, for natural plant gardening, no intercultural operation is needed. Saplings were mainly planted in rainy season. Both chemical fertilizer and manure were applied in the pits. In rare case, some unknown pests (locally named *ulupoka*, *bisapoka*) attack and damage the stems and leave.

Table 25: Information on intercultural operation

Activity		**No. of application**	**Producers involved in Activity (%)**
Weeding		2	66.2
Fertilizer application	cow dung	1	30
	compost	1	5
	urea	1	48.8
	TSP	1	28.8
	MP	1	17.6
Pesticides application		1	7.6
Irrigation application		1	7.6

Source: Field Survey (2017)

It is found in table 25 that all the producers were not involved in intercultural operation and input application. The maximum of 66.2 percent producers didweed on average 2 times, whereas the minimum of 5 percent apply compost on average one time. Among the producer, 48.8, 30, 28.8, and

17.6 percent of producers applied urea, cow dung, TSP, and MP respectively. Only 7.6 percent wereinvolved in both pesticides application and irrigation in *Agar* plant garden.

11.9.5 Nail Setting in *Agar* plants

In the case of artificial infection in the plants, nails were set in the *Agar* plants. Mainly two factors, age and growth of plant, were significantly considered for setting nails in plants. Beforehand, the nails were sorted and rectified through boiling in water or heating in sunlight or burning in fire. Nail setting activities were performed in two ways: for advance selling, purchasers (local processors) always set it and for normal selling; it was always set by the producers. In some places, *Agar* wood was growing up naturally and no need of nail setting in the plants. Nails were usually set in the plants by local skilled hired labours before 2 to 5 years of plant harvest. In the study area,age of nail setting, quantity of nail and number of required labourdiffer from plant to plant.

11.9.6 Establishment of processing plants

Agar product processing plants are fully operated manually as well as manual operating instruments. Several infrastructures of the plants were as follows:

i) Factory shed: For setting boiling deg (large cooking pot) and water tank.
ii) Warehouse shed: For storing the procured *Agar* plants.
iii) Worker shed: For working factory workers.
iv) Boiling deg (big size steel pot): For boiling *Agar* chips to extract *Agar* oil from the chips.
v) Water tank (house): For keeping *Agar* chips before boiling.

Table 26: Establishment of processing plants

Category of infrastructure	Type			Usable period (year)
	***Katcha* tin shed (%)**	***Pacca* tin shed (%)**	***Pacca* building shed (%)**	
Factory shed	4	88	8	36
Warehouse	17	41	4	22
Worker shed	14	40	-	17
Boiling deg				34
Water house				39

Source: Field Survey (2017)

It is indicated from the Table 26 that most of factory shed (88%), warehouse (41%) and working shed (40%) weremade of *pacca* tin shed. There is no *pacca*building for plant workers but very few (about 8%) of factory shed and warehouse (about 4%)were*pacca* building.

11.9.7 Processing of *Agar* products

Processing is very important for any product to make it marketable. This section is designed to describe the processing technology used by the *Agar* processors in the study area. There are several ways to extract *Agar* oil from *Agar* wood. To extract *Agar* oil from *Agar* wood distillation processes were used. There were three types of distillation process practiced for *Agar* wood processing. They were:

- Water or hydro distillation
- Water- steam distillation
- Steam distillation

In Bangladesh, most of the factories extract *Agar* oil from *Agar* wood by water distillation process. In the study area, all processors used water or hydro distillation process to extract *Agar* oil from *Agar* wood. For hydro distillation method, firstly, the wood is chopped up into small pieces for distillation, and the dust produced from polishing and finishing the incense grade chips is also collected. The wood is commonly soaked in barrels of water for some time to make it easier for the oil to come out when heated. After the soaking process is over, the wood is placed in large stills and must be cooked at just the right temperature/pressure. Most distillers, in order to save money, cook the wood at very high temperatures and pressures. This is done in the hope of sucking out as much of the *Agar* wood oil in the shortest period of time possible, to cut down labour, fuel, water, and electricity costs. After the oil has been distilled, it is filtered, cured, and aged for a while. The better the oil has been aged, the better it will smell.

A long-term and complex processing method is followed for produced *Agar* products from the *Agar* plants. The processing methods are as follows:

11.9.7.1 Collection of Agar plant

The first step of processing technology is the collection of *Agar* plant from the owner of *Agar* garden by the processors. Matured trees are cut down by the labourer from the *Agar* garden after purchasing. After cutting, the trees are brought to processing factory.

Agar plant garden

11.9.7.2 Slitting and unplugging nail

After bringing the trees into factory, first work is to slit the trees with crowbar for unplugging the nail from them. The average days required to slitting and unplugging nail from an *Agar* plant was 15.

11.9.7.3 Chopping

Slitting and unplugging nail

The plants are manually converted into several types of small pieces of 2 to 3 inch by manual cutter. These pieces are named as *Agar* wood, white chips, black chips and natural/original chips. Sometimes all types of chips are converted into mix chips through mixing. *Agar* wood and chips are discussed below.

(i) *Agar* wood: *Agar* wood is generally a black part of *Agar* plant. *Agar* wood is generally two types which are- natural/original *Agar* wood and *lohar*/nail *Agar* wood.

(ii) Natural/original *Agar* wood:This wood is a black part of *Agar* plant, which is created inside of *Agar* plant due to attack by natural pests in the plant.

(iii)*Lohar*/nail *Agar* wood: This wood is also black part of *Agar* plant, which is created inside of the plant due to setting nail in the plants. It is mentioned that no classification of *Agar* wood is followed for selling.

(iv) White chips: White chips are made through converting the white part (all general part) of *Agar* plant into small pieces. White *Agar* oil (*boyeratar*) is collected from the white chips through boiling it in the deg. White chips are processed for 7-10 days for 2-3 tola white oil from 40 kg white chips.

Chopping agar wood

(v) Black Chips: Black chips are the black parts (attached parts of set nails) of *Agar* plants, which are created in the plants by setting nails. Black *Agar* oil (*Chosatar*) is collected from the black chips through boiling it in the deg. Every 4-5 tola black oil is processed from 40 kg black chips for a period of 20-30 days.

(vi) Natural/original chips: Natural/original chips are the outside parts of the natural/original wood, which are created inside of *Agar* plants by natural *Agar* pests. Natural/original*Agar* oil (*surunatar*) is collected from the natural/original chips through boiling it in the deg. Natural/original chips (40 kg) took 30-60 days for 10-12 tola natural/original oil.

(vii) Mix chips. Mix chips are made through mixing of white, black and natural chips. Mix *Agar* oil (mix *atar*) is collecting from the mix chips through boiling it in the deg.

11.9.7.4 Fermentation

Chopped wood are collected and drowned in water in a drum. The level of water is kept just 3 inches more than the wood layer on the drum. Woods are drowned and saturated under water for 10-15 days. After fermentation, the woods are turned into black color. The pieces of wood become almost soft and bad smell comes from the woods. The fermented water also is preserved for the next steps of the work.

Fermentation

11.9.7.5 Construction and Setting of Instrument and materials

The pan is filled by fermented wood pieces and with fermented water. The water height kept about 3 inches more from the wood level. The open part of the pan is closed with a metallic lid. A hole on the upper part of the chamber is made for passing the steam from the chamber. Upper portion of the lid is connected to the metallic funnel, which is used to path of the water. When water is lost in the pan, the extra water is needed. At last, the pan is fitted above the gas burner.

11.9.7.6 Heating

Heating on chamber is done by the help of the Gas burner. The fermented woods are kept on the heating chamber and heated continuously. Some water also added in the pan during heating time. Due to high evaporation of water, deficiency of water occurs in the pan and again the heating procedure continues.

11.9.7.7 Condensation

The upper of the lid is connected to the pipe of stainless steel, called condenser. The condenser goes out through the water tank. As a result, the steam is produced and goes through the tank. Steam turns into water due to fall of temperature and it create liquid oil. The last portion of the stainless-steel pipe is connected in a pot, where the oil is freezing.

Setting of instruments

Condensation

Collection of agar oil

11.9.7.8 Collection of Agar oil

After apply heating some oily substances observed in the water of the pot. After some days, oil observed clearly in the water. At last the oil is separated from water and collected smoothly by a spoon and with the help of plastic syringe and preserved in a glass bottle.

11.10 Cost and return of different stakeholders of AP

11.10.1 *Agar*Sapling Grower

For the purpose of profitability analysis, net return analysis was performed for a period of 2 years of the sapling growing enterprise in the study area. Seed and sapling cost were Tk. 13843 per acre per year and 4.8% of total cost. Also, Polythene bag and soil in polythene bag incurred a cost of Tk. 26157 and Tk. 7106 per acre per year which is 9% and 2.5% of total cost respectively. Seed sowing and sapling planting was the highest cost experiencing item with a per year cost of Tk. 66847 per acre (23.1% of total) and nursery caretaker's service charge was just after that with a cost of Tk. 58300 per year (20.1% of total). Therefore, land use cost contributed 15.7%, intercultural activities 10.7%, opportunity cost of operating capital was 9%, irrigation 2.4%, fertilizer 2.2% and pesticide 0.5% of total cost. Finally, with a total cost of Tk. 289599/acre and gross return of Tk. 410261/acre there exist a positive net return of Tk. 120662 per acre per year for sapling grower.

Table 27: Estimating cost and return of *Agar* sapling grower

Items	**Total cost (Tk/acre/year)**	**% of total cost**
Cost items		
Seed	13843	4.8
Polythene bag	26157	9.0
Soil in polythene bag	7106	2.5
Fertilizer cost		
Cow dung	132	0.0
Urea	1554	0.5
TSP	4521	1.6
MP	374	0.1
Pesticide	1404	0.5
Irrigation	6813	2.4
Seed sowing and sapling planting	66847	23.1
Intercultural activities	30999	10.7
Nursery caretaker's service charge	58300	20.1
Interest on operation capital	26166	9.0

Land use cost	45385	15.7
Total cost	289599	-
Gross return	410261	-
Net return	120662	-
BCR (Full cost basis)	**1.4**	**-**

BCR was estimated to be 1.4 which is positive meaning that sapling grower received Tk. 1.4 by investing Tk. 1. So, it gave a message that *Agar* sapling growing enterprise was a profitable business in the study area.

11.10.2 *Agar*plant producer

Producers in the study area did not maintain any written records of costs and returns of cultivation. However, labour cost involves the cost of human labour (family and hired).The cost of family labour was determined by applying principle of opportunity cost. The cost of hired labour was calculated based on the actual wage paid by the producers with meal or without meal. Labour was measured in terms of man-days (8 hours of work). Table 28 shows that 12.77 man-days family labour and 53.12 man-days hired labour wereused. Thus, in total of 65.89 man-days human labour per acre wereused with a wage rate of Tk. 423 per man-days. Per acre total labour cost wasTk. 33,615.81which contributes only 2.32 percent of total cost (Table 30). Operation wise distribution of human labour shows that nail setting on mature plant accounts for the largest amount of human labour, which was29.16 percent, followed by preparation of land (17%) and hole preparation (16%) (Table 28).

Table 28: Operation wise distribution of human labour cost for *Agar* producer

Name of the operation	Human labour (man-days)			Wage rate (Tk.)	Total cost (Tk./acre)	Percent of total cost
	Family	Hired	Total			
Collection of saplings	2.60	3.99	6.59	423	2787.57	8.29
Preparation of land	1.85	11.56	13.41	423	5672.43	16.87
Hole/pit preparation	1.62	11.04	12.66	423	5355.18	15.93
Planting, thinning and gap filling of seedling	2.31	7.17	9.48	423	4010.04	11.93
Weeding, fertilizer, insecticide, and water management	2.37	6.01	8.38	423	3544.74	10.55
Earthing up, drain out and	1.79	3.99	5.78	423	2444.94	7.27

pruning						
Nail setting on mature plant	0.23	22.94	23.17	423	9800.91	29.16
Total	12.77	53.12	65.89	423	33615.81	100.00

Source: Field survey, 2017

In the study area, on an average, the quantity of *Agar*saplings used by the producers was2497.11/acre, with a unit price of Tk. 9.23/piece. The per acre total seedling costs wasTk. 23,048.33, which shares 2.80 percent of the total material cost (Table 29) and 1.59 percent of the total cost (Table 30).Almost all the producers use fertilizer and all kinds of fertilizer are bought from the market at the prevailing market price. It appears total used amount of Urea was127.17 kg, TSP was 57.23 kg, MoPwas 11.56 kg per acre which costs Tk. 2,177.15, Tk.1,341.36 and Tk. 187.86 respectively (Table 29). The cost of all fertilizer stood at Tk. 3,706.37 which was 0.25 percent of the total cost (Table 30). The used amount of compost and cow dung as manure were117.34 kg and 90.17 kg that costs Tk.1,611.09 and Tk.180.35 respectively (Table 29).

Table 29: Material cost of *Agar* producer

Sl. No.	**Items of cost**		**Unit**	**Average cost of material input requirement**			
				Quantity	**Unit price (Tk.)**	**Cost (Tk./acre)**	**Percent of total**
1.	*Agar*sapling		No.	2497.11	9.23	23048.33	2.80
2.	Fertilizer	Urea	Kg	127.17	17.12	2177.15	0.27
		TSP	Kg	57.23	23.44	1341.36	0.17
		MoP	Kg	11.56	16.25	187.86	0.02
		All	Kg	195.96	56.81	3706.37	0.46
3.	Compost		Kg	117.34	13.73	1611.09	0.20
4.	Cow dung		Kg	90.17	2.00	180.35	0.02
5.	Nailing		Kg	13237	58	767746	96.20
6.	Insecticide		Kg	1.79	435.22	779.05	0.09
7.	Irrigation					920	0.12
	Total					797991.19	100.00

Source: Field survey, 2017

Agar producers in the study area follow artificial defeat of *Agar* trees by iron pegging when trees are of 6-7 years of age. The length of iron peg varies between 5 and 15 cm depending on the diameter of the tree. It required 13237 kg of nail per acre that costs Tk. 767746 per acre and Tk. 853.05 per tree which contributed 96.20 percent of the total material cost and 52.93 percent of the total cost (Table 27 and 28). Moreover, there exist a cost of insecticides which wasTk.779.05 per acre.

Table 30: Total cost of production of *Agar* producer

Sl. No.	Items of cost		Unit	Total cost of production				
				Quantity	Unit price (Tk.)	Cost (Tk./acre)	Cost (Tk./ tree)	Percent of total cost
1.	Human labour		Man-days	65.89	423	33615.81	37.35	2.32
2.	*Agar*saplings		No.	2497.11	9.23	23048.33	25.61	1.59
3.	Fertilizer	Urea	Kg	127.17	17.12	2177.15	2.41	0.15
		TSP	Kg	57.23	23.44	1341.36	1.49	0.09
		MoP	Kg	11.56	16.25	187.86	0.21	0.01
		All	Kg	195.96	56.81	3706.37	4.11	0.25
4.	Compost		Kg	117.34	13.73	1611.09	1.79	0.11
5.	Cow dung		Kg	90.17	2.00	180.35	0.20	0.01
6.	Nailing		Kg	13237	58	767746	853.05	52.93
7.	Insecticide		Kg	1.79	435.22	779.05	0.87	0.05
8.	Irrigation					920	1.02	0.06
9.	Interest on operating cost					498964.2	554.40	34.39
10.	Land use cost					120000	133.33	8.27
	Total					1450571.2	1611.73	100

Source: Field survey, 2017

Most of the producers (60%) did not apply any irrigation because of the fact that*Agar*saplings used to plant in rainy season, only 20% producer used irrigation and this cost wasTk. 920 per acre. As regards the production of *Agar*, the interest on operating capital wasestimated at Tk. 4,98,964.2 per acre and Tk. 554.40 per tree which shares 34.39 percent of the total costs (Table 30). In the study area, based on the rental value the land use costs of *Agar*werecalculated at Tk. 1,20,000 per acre and Tk. 133.33 per tree in twelve years period which constitutes 8.27 percent of the total cost of production (Table 30) and also a fixed cost. The yield of *Agar*wasestimated at 900 tree per acre with an average price of Tk. 3715 per tree which yielded a gross return of Tk. 3343500 per acre (Table 31). Producer planted on average 2497 sapling per acre but after twelve years yielded only 900 matured trees because they periodically removed damaged, weak, and immature tree from the garden.

Table 31: Summary of cost and return of *Agar* producer

Items	**Cost and return**
Yield (Tree/acre)	900
Gross return (Tk./acre)	3343500
Gross return (Tk./tree)	3715
Total cost (Tk./acre)	1450571.2
Total cost (Tk./tree)	1611.73
Net return (Tk./acre)	1892928.8
Net return (Tk./tree)	2103.27
BCR	2.30

To evaluate the business performance/ financial solvency of any kind of agribusiness net return is calculated. In this study, the net return wasestimated at Tk. 18,92,928.8 per acre and Tk. 2103.27 per tree (Table 31). Finally, table 31 shows that the BCR of *Agar* producer is 2.30 meaning that the producers are getting Tk. 2.30 by investing Tk. 1. Cash inflow, cash outflow and incremental net benefit (INB) with their present values for a duration of 12 years are shown in Table 32. Most of the cost items of *Agar* production incurred in the first year of operation but because of nailing cost, gross cost was highest in

seventh year. The net present value calculated at 10% discount rate wasBDT 552326.54 (Table 33). Similarly, discounted benefit cost ratio was 2.07 which means that BDT 100 of initial investment yields a net benefit of BDT 207. The internal rate of return was23.70% which wasvery high as compared to required rate of return (i.e. 10%). Since, IRR was greater than the required rate of return representing the opportunity cost of capital, investment on *Agar* production wasfinancially viable.

Table 32: Cash flows in *Agar*-wood production for one acre of land in the study area

Year	Gross cost (GC)	Gross benefit (GB)	Incremental net benefit (INB)	Dis. factor @ 10%	Present value of GC	Present value of GB	Present value of INB
0	50836.10	0	-50836.10	1	50836.10	0	-50836.10
1	10000	0	-10000	0.91	9100	0	-9100
2	10000	0	-10000	0.83	8300	0	-8300
3	11612	0	-11612	0.75	8709	0	-8709
4	10000	0	-10000	0.68	6800	0	-6800
5	11612	0	-11612	0.62	7199.44	0	-7199.44
6	10000	0	-10000	0.56	5600	0	-5600
7	787546.91	0	-787546.91	0.51	401648.92	0	-401648.92
8	10000	0	-10000	0.46	4600	0	-4600
9	10000	0	-10000	0.42	4200	0	-4200
10	10000	0	-10000	0.39	3900	0	-3900
11	10000	0	-10000	0.35	3500	0	-3500
12	10000	3343500	3333500	0.32	3200	1069920	1066720

Table33: Financial viability of *Agar*-wood production for 1 acre of land in the study area.

Sl. No.	**Particulars**	**Value**
1.	Net present value (BDT)	552326.54

2.	Benefit cost ratio	2.07
3.	Internal rate of return	23.70

From above financial analysis, it is proved that *Agar*-wood production is a source of great profit. At first, sensitivity analysis was conducted on the assumption that, what would happen if only cost of nails increased by 10 percent while all other costs of the project would remain the same. In second case, it was assumed that labour cost increased by 10 percent while all other costs remain the same and in third case, gross cost increased by 10 percent. In last case, it was assumed that, if *Agar* tree price decreased by 10 percent than what would happen to project NPV, BCR and IRR. The Table 34shows the results of sensitivity analysis for *Agar*-wood production units. The benefit cost ratio was more than 1.88 even with 10 per cent increases in the cost of nails, cost of labour and gross cost. Also, even if the *Agar* tree price falls by 10 per cent, the benefit cost ratio would still be above 1.86.

Table 34: Sensitivity analysis of *Agar* production

Sl. No.	Situation	NPV (BDT)	BCR	IRR
1.	10 per cent increase in the cost of nails	513171.50	1.92	22.40
2.	10 per cent increase in labour cost	550189.54	2.05	23.56
3.	10 per cent increase in gross cost	500567.19	1.88	21.67
4.	10 per cent decrease in *Agar* tree price	445334.54	1.86	21.42

11.10.3 *Agar*Product Processor

In the study area, *Agar* plant waspurchased from *Agar* plant producers from Sreemangal, Moulvibazar, Kulaura and Barlekha. Table 35 shows that the average price of a tree wasTk. 3,623 and to produce a kg of *Agar* oil/*atar*, 30 pieces of plants wereneeded, and the total cost wascalculated at Tk. 1,08,690 which is 38.63 percent of the total cost (Table 35). Again, every processor has to bear some repairing cost of factory every year and for a kg *Agar* product it was estimated at Tk. 3567.96 (27% of total cost). Beside this, the repairing cost of equipment for per kg *Agar* product stood at Tk. 3,703.70 (1.32% of total cost). In a working day of 8 hours, a hired labour gets a wage of Tk. 280 per man-days in the study area depending on the season and availability of labour. This wage rate was lower than the hired labour for *agar* plant production (which was Tk 423/day) because the terms of reference were different for the hired labour of *agar* processing activities. Hired labour had a contract with agar processor for working man-days in a month and no food was provided to the hired labour. For per kg of *Agar* product the requirement was 197 man-days which had a total cost of Tk. 55,160 and it constituted 19.60 percent of the total cost (Table 35). Electricity bill and Gas bill costs was calculated at Tk. 971.50 (0.34% of total) and Tk. 59,685.86 (21.21% of total) per kg *Agar* product respectively. Cost of procurement (including

expenses on transportation, loading, unloading of purchased trees, collection of market information etc.) for producing a kg *Agar* product wasTk. 4,353.31 (1.55% of total cost).

Fixed costs are those costs which do not change with the change in production. These costs are incurred even when production is not undertaken. Depreciation cost of factory building, equipment is a major fixed cost. According to the straight-line method, for life span of 20 years (according to field survey) the depreciation cost of factory building stood at Tk. 3,839.44 (1.36% of total cost) and equipment wasTk. 1,991 (0.71% of total cost). In the study area, 4 man-days of permanent labour wereused to produce a kg of *Agar* product and per kg cost wasTk. 26,308.56 which contributed 9.35 percent of the total cost. In the study area, every processor had their own land where they established their factory and land use cost for a kg of *Agar* product wascalculated at Tk. 1,279.81 (0.45% of total cost). Interest on operating capital wascomputed by taking all variable costs and calculated as Tk. 11,806.62 per kg, which is 4.19 percent of the total cost.

With a total fixed cost of Tk. 45225.43 (16.06%) and variable cost of Tk. 236132.33 (83.92%) the gross cost of *Agar* products per kg was Tk. 281357.76.Therefore, the main product wasknown as *Agar* oil/*atar*, that is divided into three categories such as, white *atar*, black *atar*, and original *atar*. In these three categories, production of black *atar* was high than white *atar* and original *atar*. Among these three combinations of *Agar* oil the total return wasestimated at Tk. 6,37,000 per kg (Table 35). The by-products were*Agar* wood and *Agar* chips and the selling price of these products wereTk.1,32,383.16 and Tk. 3451.09, respectively (Table 35). Also, the return from nail wasestimated Tk. 20,250. So, the total gross return was calculated at Tk. 7,93,084.25.Net return on total cost wasderived by deducting all the costs from the gross return. Table 35 shows that the net return per kg of *Agar* oil and *Agar* wood production in the study area wasTk. 5,11,726.49.

Table 35: Cost and return of *Agar* products (Tk. / Kg)

Sl. No.	Items of cost		Unit	No./ Quantity	Price (Tk./ unit)	Total Value (Tk.)	% of total cost
A.	**Variable Cost**						
	1.	Cost of *Agar* plant	Tk.	30	3623	108690	38.63
	2.	Repairing cost of factory	Tk.	-	-	3567.96	1.27
	3.	Repairing cost of equipment	Tk.	-	-	3703.70	1.32
	4.	Hired labour cost	Man-days	197	280	55160	19.60
	5.	Electricity bill	Tk.	-	-	971.50	0.34

	6.	Gas bill	Tk.	-	-	59685.86	21.21
	7.	Procurement cost (Transportation, loading and unloading)	Tk.	-	-	4353.31	1.55
	Total variable cost					236132.33	83.92
B.	**Fixed Cost**						
	1.	Depreciation cost factory building	Tk.	-	-	388339.44	1.36
	2.	Depreciation cost of equipment	Tk.	-	-	1991	0.71
	3.	Permanent labour cost	Man-days	4	6577.14	26308.56	9.35
	4.	Land use cost	Tk.	-	-	1279.81	0.45
	5.	Interest on operating capital	Tk.	-	-	11806.62	4.19
	Total fixed cost		Tk.	-	-	45225.43	16.06
C.	Total Cost (A+B)		Tk.	-	-	281357.76	100
D.	Gross return		Tk.	-	-		-
	i	*Agar* oil	ml	1000	637	637000	-
	ii	*Agar* wood	kg	1.84	71947.37	132383.16	-
	iii	*Agar* chips	kg	29.72	116.12	3451.09	-
	iv	Return from nail	kg	450	45	20250	-
E.	Total Gross return		Tk.	-	-	793084.25	-
F.	Net return		Tk.	-	-	511726.49	-
	BCR		-	-	-	2.82	-

Benefit cost ratio (BCR) is calculated as a ratio of gross return and gross cost and here it was estimated at 2.82 meaning that processors received Tk. 2.82 by investing Tk. 1. From the previous study on the development of low-cost*Agar* wood essential oil extraction system from *Agar* tree growers, BCR was

found 2.33 (Islam et al. 2014) which was quite close to the present study where BCR (undiscounted) was 2.82.

11.10.4 *Agar*Product Exporter

Profitability of the export enterprise was determined for analysis of net return. All items of gross return and gross cost were calculated on the basis of yearly average values. Based on the information, field experience and observation, rent of sales point in foreign country, electricity bill in that sales point, exporters' travelling cost to foreign country in every year was calculated as Tk. 3.3, Tk. 0.4, Tk. 7.4 per kg. Beside this, sales agents service charge wasestimated at Tk. 3.8 per kg per year and opportunity cost of operating capital turns to be Tk. 8.1 per kg per year. In this case, opportunity cost of operating capital was determined on basis of 12% interest rate for half of a year. There are other operating costs involved in *Agar* products exporting. Freight and courier cost, depreciation cost, rent of storage and work shade, procurement, processing & packaging cost, transportation cost and most importantly purchase cost of *Agar* oil, *Agar* wood and chips take place and in every year it was Tk. 1.6, Tk. 0.4, Tk. 1.9, Tk. 93.9, Tk. 24.0, Tk. 464505, Tk. 162827 per kg, respectively. Cost of purchasing *Agar* oil was the highest cost incurred for the business. Total cost of the export business wasestimated as Tk. 627477 from the summation of all individual cost items.

Table36: Cost and return of *Agar* products exporting

Cost items	**Total cost (Tk/Kg/Year)**
Rent of sales point in foreign country	3.3
Electricity bill of sales point in foreign country	0.4
Exporters' travelling cost to foreign country	7.4
Sales agent's service charge	3.8
Interest on operating capital	8.1
Freight and courier cost	1.6
Depreciation cost	0.4
Rent of storage and work shade	1.9
Procurement, processing and packaging	93.9
Transportation cost	24.0
Purchase cost of *Agar* oil	464505
Agar wood and chips	162827

Total cost	**627477**
Return	603598
Agar oil	
Agar wood	95170
Agar chips	156
Gross return	**698924**
Net margin	**71448**

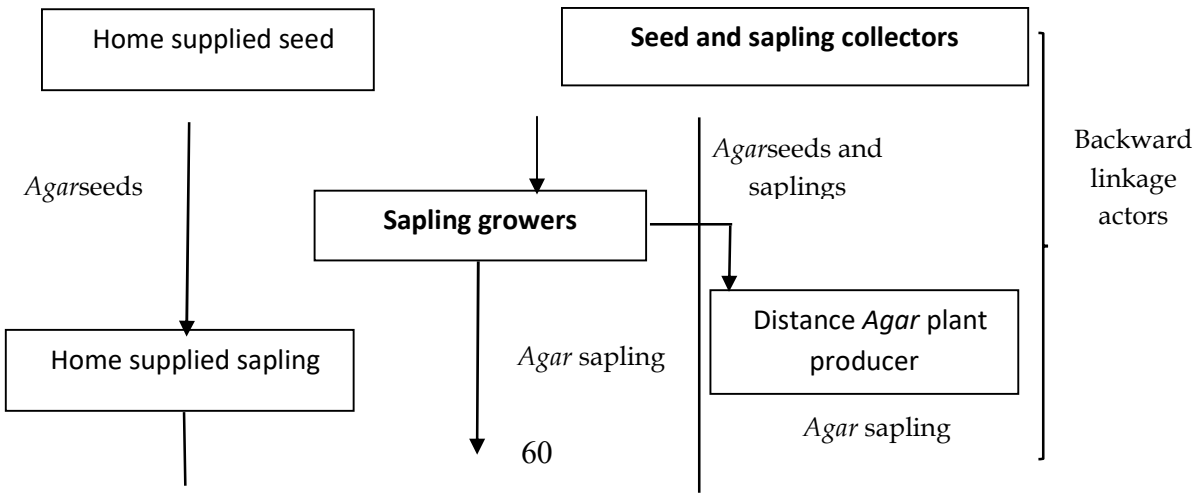
On the other hand, in a year a return of Tk. 603598 per kg was produced. In addition to this, *Agar* wood and *Agar* chips added up additional Tk. 95170 and Tk. 156 per kg respectively in each year. This led to a gross return of Tk. 698924 per kg which provided a positive net return of Tk. 71448 per kg in a year.

11.11 Marketing system and value addition of different actors of AP

Marketing of any product is essential to transfer it to the final consumers from widely, scattered production points. Marketing may be thought of as the connecting link- the bridge between specialized producers and consumers (Khols and Uhl, 2005). Agricultural marketing can be defined as comprising of all activities involved in supply of farm inputs to the farmers and movement of agricultural products from the farmers to the consumers (Acharya and Agarwal, 2000).

11.11.1 Value chain of *Agar* plant and products

In marketing terminology, a chain refers to a way of making a product available to distribute to the end consumers. A marketing channel/chain helps by getting the right products to the right consumer in time for purchase. Marketing channels/value chains are alternative routes of product flows from producer to consumers (Kohls and Uhl, 2005). The marketing chain may be short or long for a particular commodity depending on the marketed quantity of the products, nature and size of the consumers and producers, marketing services needed and the prevailing social and physical environments. The value chains of *Agar* products found in the study area are shown in figure 4.



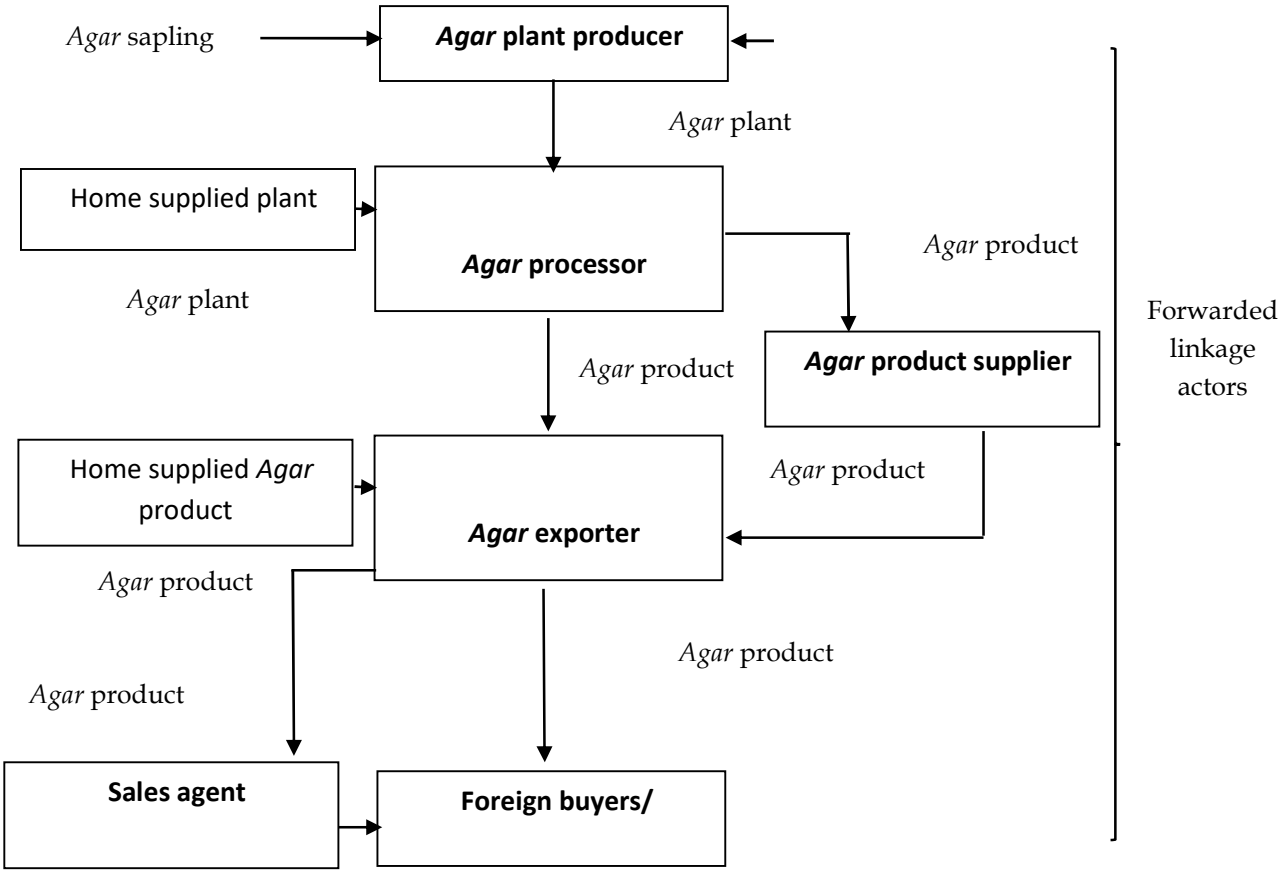


Figure 4: Supply/Value Chain of *Agar* Plant

Under the AP enterprise in study area it appears that there exist eight types of actor groups. These actor groups were seed and sapling collector, sapling grower, plant producer, product processor, product supplier, product exporter, sales agent. While AP producers were the key actor, other seven actors are involved in backward and forward linkage of the supply chain. Local seed and sapling collector, sapling growers act as backward linkage actor whereas product processor, product supplier, product exporter, sales agent are forward linkage actor.

11.11.2 Functions performed in *Agar* product marketing

Marketing function may be defined as major specialized activities performed in accomplishing the marketing process (Kohls and Uhl, 2005). It is a major part of a products marketing system. Any single activity performed in carrying a product from the point of its production to the ultimate consumer may be termed as marketing function (Acharya and Agarwal, 2000). Marketing functions of *Agar* products in the study area has been broken down into various activities, like buying and selling, transportation, storing, grading, pricing, packaging and market information.

11.11.2.1 Buying and Selling

Buying and selling are the functions of exchange. Both have primary objects of negotiating terms of exchange. The buying function is largely one of seeking out of sources of supply, assembling of products and the activities associated with purchase (Kohls and Uhl, 2005). It involves the problems of what to buy, when to buy, from where to buy, how to buy and how to settle the price and the terms of purchase. The selling function is more than merely passively accepting the price offered. Selling is the personal or impersonal process of assisting and persuading services to dispose of a product.

In this study, local *Agar* seed and sapling collector soldseeds and saplings to local *Agar* sapling growers or directly to local producers (Barlekhaupazila). Local and outside producers both purchased majority of seeds and saplings from sapling growers and a minor portion of seed wassupplied by the grower itself. Local *Agar* product processors purchased from the local plant producers only. *Agar* plant producers sold their plants at the garden in standing position, either before maturity or after maturity. In normal selling of *Agar* plants, plants were harvested by purchasers during or just after selling, or as per non-written mutual and verbal contract between the producers and the purchasers. But for advance selling, all conditions were written on government non-judicial revenue stamp.

Table37: Information on Sale of *Agar* Plants

Particular		Information
	Unit	Average
Selling plant per acre	No.	900
Age of plant during normal selling	Year	12
Length of plant during harvesting	Feet	29
Diameter of plant during harvesting	Inch	22
Price per plant for selling	Tk.	3623
Producer involved in advance selling	%	77
Producer involved in normal selling	%	23

Source: Field Survey (2017)

It is depicted in table 37that, average selling of *Agar* plants per acre was900 with an age of 12 years in case of normal selling. The plants wereharvested with an average length of 29 feet, diameter of 22 inch. Seventy-seven percent of producers wereinvolved in advanced selling and the remaining 23% didnormal selling. Per plant price for selling wasTk. 3623. *Agar* saplings (with polythene bags) were always sold from the nurseries to local and outside producers of Barlekhaupazila. Middle April - middle July was the peak period of sapling planting and the highest number of the saplings was sold during this period.

Table 38: Selling of *Agar* saplings

Particular		Information
	Unit	Ave
Selling saplings per acre	No.	149186
Selling price per sapling	Tk	2.75
Age of saplings during selling	Month	10-12
Length of saplings in 6 – 12 months	Inch	8 - 10

Source: Field Survey (2017)

From table 38, we found that average selling of saplings per acre, price per sapling and age of sapling for selling were149186, Tk. 2.75 and 10-12 months respectively. All the *Agar* products were exported to different Middle east countries and other Asia countries which are shown in the table 39.

Table 39: Countries of export of *Agar* products

Product category	Exporting country
Agar oil and wood	Dubai (United State of Arab Emirates), Saudi Arabia, Q*atar*, Kuwait, Oman, Yemen, Bahrain, India, China, Hongkong (China), London (UK), Japan and Thailand.
Agar Chips	Dubai, China, Hongkong, Thailand.

Source: Field Survey (2017)

It is informed that major portions of *Agar* oil and wood were exported to the Q*atar*, Saudi Arabia, Kuwait and Dubai (United State of Arab Emirates). Earlier, almost all the *Agar* chips wereexported to Dubai; but some of them are exported to China, Hongkong, India and Thailand. Basically, Dubai was the established wholesale market for all the products and different buyers of different Middle eastern countries and other countries like China, Hongkong (China), London (UK) and Singapore also purchased the products from this wholesale market. In India, Bombay was mainly the export market of *Agar* oil and wood. It is also informed that several buyers of Middle eastern countries, India, China and Singapore visited study area several times; but they never purchased *Agar* products locally, rather collected from export markets of Middle East and India. It is revealed that average quantity sold of black oil wasthe highest (about 330 tola), followed by white oil (269 tola) being the lowest of only 51 tola for natural/natural oil; the average quantity of *Agar* wood and *Agar* chips were11.18 kg and 30000 kg, respectively.

Agar product processors sold100 percent *Agar* oil and *Agar* wood to the exporters. Some local *Agar* product supplier sold to *Agar* products exporter. The exported *Agar* oil and wood were regularly soldand deliver to different users and buyers from the sales points. Besides, the sales agents and the exporters regularly made personal contact with different buyers through physically visiting them. As the sales agents stay outside for mainly other purposes, they provided part time services for selling the products. The *Agar* chips were always exported on advance order basis at prefixed price. Moreover, two forms of dust chips exist, these were powder chips and microfiber chips. In fact, all sizes and all forms were sold at the same price in the market.Sales point, sales agents of outside country purchased from local exporters and sold to foreign traders/buyer or to the ultimate consumers. All transactions tookplace on cash.

11.11.2.2 Pricing

Pricing is the important marketing function for producers and processors. The prices of the products basically depend on the supply of and demand for the product in the market. All producers and processors are involved in buying and selling of *Agar* plant and *Agar* products. The price of *Agar* plant depends on its height, diameter and hole by pests in plants. Sometimes variation in pricing happens due to variation in quality of the products. In the study area, in every stage of product transfer, (e.g. seed & sapling collector to sapling grower to plant producer to product processor to local supplier to exporter to foreign trader or consumer to ultimate buyer) the price of *Agar* plants or products was always fixed by bargaining method without having any artificial pressure. In plant selling, for advance and normal selling, the smallest price per plant wasTk 400 and 1000 and the same wasthe largest of Tk 6500 and 8000 yielding average Tk 6500 and 80000 respectively. In export level price was prefixed from the negotiation between trader and local exporters. The pricing of oil, wood and chips were done on the basis of kg. Per kg of white oil was Tk. 307533, black oil was Tk. 582743, natural oil was Tk. 887018, mix oil was Tk. 637099. The price of *Agar* wood was Tk. 95170 per kg and the price of *Agar* chips (dust) wasTk. 191 per kg. The maximum average price wasfound for natural oil (Tk. 887018 per kg) while the minimum for white oil (Tk. 307533 per kg). On the other hand, the average price of *Agar* wood wasTk. 59225 per kg and Tk. 2.24 for *Agar* chips. Highly price variation wasfound for both *Agar* oil and wood; the variations wereTk. 1500, 3500, 5000 and 1800 for white, black, natural and mix oil. While for *Agar* wood the variation became Tk. 80000. It is found that this variation wasdue to variation in quality of the products.

11.11.2.3 Processing

Agar oil and wood were always exported by the exporters in the same form of purchase. But the chips were dealt on processed by the exporters as advance delivery orders of the foreign buyers. After purchasing, chips were converted into pieces and in dust forms by the exporters. The rejected parts were converted into dust through crushing. At first, the collected un-processed piece chips were kept in worker shade then the waste and unnecessary materials are removed. The un-processed chips of uniform size and shape were separated by worker manually as per the demand of the foreign buyers. Then washed uniform and non-uniform chips separately with water as per requirement. Chips were dried in sunlight for a period of 3 or 4 days (30-40 hours). After drying, the rejected non-uniform chips were converted into dust through crushing @ Tk 10/- per kg. After the processing, the piece and dust

chips were stored in warehouse in plastic bag. There was no specification piece size although the small size wasremained within 0.25 – 0.50 inch, medium size (standard/master size) within 0.50 – 1.00 inch, and large size within 1.00 – 1.25 inch. The processing of chips is highly labour intensive and expensive. Generally, the chips were dried on open yard. Manual testing method was always applied for determining the standard drying level on basis of hardness and moisture freeness.

11.11.2.4 Transportation

Transportation enables the movement of products between places, which creates place utility and facilitates availability of goods at the right time, in right condition and at the right place. Adequate and efficient transportation system is a corner stone of modern marketing system (Kohls, 2005). In the study area, no specialized transport was used for carrying the *Agar* plant. As producers sell *Agar* plants always from the garden, they need no transport for carrying plants. Processors and local exporters generally used truck and van for carrying plants from producers' garden to processors plant. As processors sell *Agar* oil and wood from their residences and chips from the processing plants, they did not need any transport for selling their products. The chips businessman used truck pick up and van for bringing the chips from the processor's plants to their processing points. They sold some chips to the exporters and the rest were sold to the local consumers. As the *Agar* oil and wood were light in weight and small in volume but highly valuable, they were always exported by airplane either by carrying physically by the exporters while travelling to foreign countries or by sales agent when he leavesthe home country. Also,productsweresent to foreign countries either by airplane or through courier service companies like DHL, FeDex, AeroMax, etc. On the other hand, as *Agar* chips were large size in volume and exported in huge quantity at a time, local transports like pick-up and truck were used for the transportation to seaport (Chittagong). Then the chips were fully transported through cargo (steamer) from the seaport to country of destination (e.g. Dubai, USAE). Usually a separate chamber of cargo was fully reserved for carrying the chips. All activities and formalities regarding the chips export both in domestic and foreign countries were maintained by 'Export-Import Service Providing Company/Enterprise' (legal private service organization in seaport) on condition of a prefix payment. It was mentioned that the exported chips werealways delivered to foreign buyers (contracted advance) from the cargo in the seaport of the foreign country.

Table 40: Percentage of *Agar* products exported using different modes/methods

Particular	Average (%)
Agar oil by airplane	91
Agar oil by courier service	9
Agar wood by airline	92
Agar wood by courier service	8

Agar chips by cargo	100

Source: Field Survey (2017)

It is revealed in the table 40 that most of the exported *Agar* oil (about 91 percent), *Agar* wood (about 92 percent) weretransported by airline and the rest by courier service. But only cargo (steamer) wasused for exporting all the quantity of the chips.

11.11.2.5 Grading

Grading refers to the sorting of products into various established or accepted standards quality. It is a marketing function which facilitates the movement of produce. Several specific standards such as colour, scent, and density are followed for grading or classifying *Agar* oil. But level, scale or degree of these standards are not tested by any scientific method or machine. *Agar* oil is always classified into four classes, such as white oil, black oil, natural oil and mix oil. Several criteria (standard) like color, scent and density are applied for identifying the quality level of the oil. Again, no classification is maintained for the wood, but several standards like color, scent, weight and substance are followed for determining the quality. On the other hand, *Agar* chips were identified as major two classes e.g. piece chips and dust chips. Any specific standard was not maintained for quality of the both chips. The exporting size of the chips was always fixed in accordance with demand and order of foreign buyers. There wasno scientific method for testing quality of *Agar* products. All activities were done on the basis of practical knowledge, experience and observation. In this way, standards and grades were followed for the *Agar* products are presented in table 41.

Table 41: Standardization and grading of *Agar* products

Product category	Type of class	Standard measuring quality
Agar oil	White oil Black oil Original /natural oil Mix oil	Color Scent Density Freezing in cold (white oil)
Agar wood	No grade	Color Scent Weight Substance

Unprocessed *Agar* chips	No grade	No standard
Processed *Agar* chips	Piece	Small size: 0.25 – 0.50 inch Medium size: 0.50 – 1.00 inch Large size:1.00– 1.25 inch
	Dust	Powder dust Microfiber dust

Source: Field Survey (2017)

Local *Agar* seed and sapling collector make some informal grading by manual testing (touch, observe etc.). On the other hand, producers soldthe plants to processor from garden before cutting, so it was difficult to make any grading before maturity. Although no strict grading was done, while setting prices producers asked prices based on assumed length, height and diameter which was also kind of hypothetical grading. There was prescribed grade for *Agar* oil or *atar* in the study area. Grading wasroughly done according to Black *atar* and White *atar.* Black *atar*wasextracted from black part of the infected *Agar* plant and white*atar*wasextracted from white part of *Agar* plant. *Agar* wood was evaluated based on color and differentiation is made based on quality. No standard was followed for grading the *Agar* chips.

11.11.2.6 Storage

Storage is an important marketing function, which involves holding and preserving goods from the time they are produced until they are needed for consumption. It creates time utility. Proper storage facilities are essential in order to minimize losses in agricultural commodities.Local seed collectors stored the seeds and sapling either with plastic bags or in an open place. Sapling grower and producers need not to store as it was sold from the land. In the study area, the processors stocked the *Agar* plant in their processing plant. As *Agar* oil and *Agar* wood were highly valuable products, maximum security was maintained for these products both in home and abroad. The processors and exporters kept *Agar* oil in a bottle made of glass and keptthe bottle in a shelf or almirah for couple of months for improving the smell of *Agar* oil. During long-term storage, sometimes *Agar* oil was heated in sunlight opening the mouth of container for increasing quality and scent. These products were stored in the exporters' residence with packing in glass jar, glass bottle, aluminum bottle etc. It was observed that *Agar* chips (boiled) were usually considered as rejected or waste products in processors' level and no special care was taken for storing them. After processing, this product was stored on open place inside or outside the plants and it was sold to local exporters and suppliers without further processing. Sometimes plastic bags of size 40-50kg were used as packet for selling the chips. But during exporting, the products were stored in hired sales points, sales agents' residence and exporters' staying hotels. Moreover, in country the processed chips were stored in exporters' storage sheds and in exporting the chips are always delivered to advanced contract buyers through cargo in seaport. Sales agent used to store the products in handbags with their original storage.

11.11.2.7 Packaging

Some common types of bags and containers were used for keeping *Agar* products. Polythene bags are used for *Agar* sapling. In the country, for keeping *Agar* oil, glass jar and glass bottle were used as container and their size ranged from 50 gm-10 kg. But for carrying the oil during exporting and in the exporting countries, aluminum and plastic bottle were used to avoid risk of breaking.

Table 42: Packet material and size used for *Agar* products

Product category	In domestic country		In foreign country (during and after export)	
	Packet material	**Packet size**	**Packet material**	**Packet size**
Agar oil	Glass jar Glass bottle	50gm – 10 kg	Aluminum bottle Plastic bottle Hand briefcase Bold paper box	250 gm – 2 kg
Agar wood	Polythene bag Carton box	1 – 2 kg 2 – 20 kg	Polythene bag Carton box	1 – 2 kg 2 – 10 kg
Agar chips (processed)	Plastic bag Bamboo basket	20 – 30 kg 20 – 60 kg	Plastic bag	20 – 30 kg

Source: Field Survey (2017)

For export, the size of aluminum and plastic bottle was 250 gm–2 kg. Processors and exporters usedsmall size thin polythene bag and bold paper carton box as packet for keeping *Agar* wood both in home and abroad. Thin polythene bag size was usually 1-2 kg, while the carton box size was 1 to 10 kg. The packet or container size for *Agar* chips ranged from 40 – 50 kg. Finally, for physical carrying, several oil bottles and wood packets were kept in hand briefcase, but carrying through airplane and courier service, carton boxes were used for the same purpose. For saving the chips in the country, both bamboo basket and plastic bag were used; while for exporting, only plastic bag was used. In both cases, 20 to 30 kg packet size was followed for plastic bag; but for the bamboo basket the size was 20 - 60 kg.

11.11.2.8 Market information

Market information is one of the facilitative marketing functions required for efficientoperation of a marketing system. Market information includes all facts, estimates, opinions and other information used inmarketing decisions that affect the marketing of goods. Market information is necessary tobe used for smooth operation of marketing activities. It also helps the buyers and sellers totake proper decision about their business.

Information about purchasing and selling of *Agar* plants and products was delivered between the *Agar* plant producers (seller) and the *Agar* product processors (purchasers), product processor (seller) to product exporter/product supplier (buyer), product exporters (seller) to sales agents(buyers), sales agents (seller) to trader/retail consumers (buyer) through several ways. For example, for the purpose of purchase, the processors always communicated directly with the producers at the producers' residences. Besides, information was also exchanged between the producers and the sellers through refreshment gathering at tea shops in local markets and over cell phones. Sometimes, the saplings were sold without exchanging any information. Also, other communication media acted as supporting. Therefore, in the initial stage of the export business a huge number of personal contact and contract with the foreign buyers have to be done for convincing them for selling the products. But after establishing the contacts, the buyers regularly purchase the products from their contract exporters.

11.11.3 Value addition at different levels of AP

All the *Agar* products were fully exported by the exporters. The exporters purchased the products from the processors directly or indirectly both in processed and un-processed form. Then they added value to the products through processing, transportation and selling to foreign countries. In fact, *Agar* oil and wood were exported in the same form of purchase while *Agar* chips were processed into piece and dust chips before export. So, value was added only through transporting and selling in foreign countries and ultimately 'form utility' and 'place utility' was created for their works. For exported *Agar* products, it appears maximum value was created in *Agar* chips, 1810 percent and 1110 percent for processed piece and dust chips respectively. On the other hand, except chips,*Agar* wood has a maximum 69.30% of value addition while natural oil adds minimum of only 10.01% to purchase price (Table 43).

Table 43: Value addition to Exported Agar Products

(1 tola = 11.66 gm)

Product category	Price of product (Tk/unit)				Value addition to purchase price (%)
	Unit	Sale price	Purchase price	Added value	
White oil	Tola	3587	2608	979	37.54
Black oil	Tola	6797	5917	880	14.87
Natural oil	Tola	10346	9405	941	10.01
Mix oil	Tola	7431	6063	1368	22.56

Agar wood	Kg	95170	56213	38957	69.30
Piece chips (processed)	Kg	191	10	181	1810
Dust chips (processed)	Kg	121	10	111	1110

Source: Field Survey (2017)

Table 44: Mapping of value addition of different actors

Actor	Unit	Value addition (BDT)	% of purchase price
Sapling grower	BDT/Tree	1.53	41.69
Plant producer	BDT/Tree	2563	340.37
Processor	BDT/Plant	8322	149.97
Exporter	BDT/Tola	1042	17.34

Again, if we consider value addition by different actors in *Agar* enterprise, we can conclude from table 44 that plant producer's added maximum 340.37% value of their purchase price which was Tk. 2563 per tree and exporter added a minimum of 17.34% value to their purchase price. Moreover, Sapling grower added 41.69%, processor added 149.97% value in addition to purchase price which were Tk. 1.53 and Tk. 8322 per plant respectively.

11.12 Problems and constraints at different levels of AP

In this section, an attempt has been made to identify the major problems related to production, processing and marketing of *Agar* plant and *Agar* products. It may be noted here that the problems of *Agar* production, processing and marketing are identified based on opinion of the sapling growers, producers, processors and exporters.

Table 45: Problem and constraint matrix of *Agar* producing and marketing actors

Problems	**Sapling grower**	**Producer**	***Agar* Processor**	**Exporter**
1. Attack of different insects	■	■		
2. Force selling of immature *Agar* plants		■		
3. Lack of knowledge and information	■	■		
4. Lack of extension services	■	■		
5. Unavailable of government support services		■		
6. Problem of getting documents from authority		■	■	■
7. Low market price of plant	■	■		
8. Lack of manpower	■	■	■	
9. High gas and electricity bill			■	
10. Lack of theft protection		■	■	

11. Lack of credit			■	
12. Non-availability of modern technology			■	
13. Adulteration in finished products				■
14. Clumsy export procedure				■
15. Lack of bargaining associations		■		
16. Lack of encouragement		■		
17. Lack of government initiative to formalize the sector				■

11.12.1 Attack of different insects

Different types of unknown and un-identified pests (local name- *ulu poka, bisapoka, joiyapoka*etc.) attack *Agar* plant, make injury both outside and inside and damage leaf and underground part of the plant.This hampered growth and quality of plant even plant died after drying. That caused damage of yield. Mostly, sapling growers and producers faced this problem.

11.12.2 Force Selling of immature plants

Due to poverty, immediate needs and long maturity of *Agar* plants, the producers were compelled to sell immature *Agar* plants in advance at lower prices. This discouraged producers to continue AP enterprise.

11.12.3 Low market price of plants

The market price of *Agar* plants was low at every level. Sapling growers soldwith minimum marginal profit to plant producers and because of uncertainty of sales, plant producers soldtheir plants most of time at a lower price.

11.12.4 Lack of knowledge and information

As the *Agar* plant producers had no proper knowledge and experience, no appropriate method, instrument and machinery are known to the producers for protecting plants from pest attack. Also, due to lack of knowledge and information sapling growers and producers incurred a loss in selling products and purchasing raw inputs. Moreover, proper business information played a crucial role in *Agar* products (*Agar* oil, *Agar* wood, *Agar* chips etc.) trading. Without appropriate information of the market price setting was difficult. However, this problem wasnot very serious in the study area.

11.12.5 Problem with electricity and gas bill

Regular irrigation is very essential for proper growth of *Agar*saplings but interrupted electric supply hampers irrigation a lot. During drought, this problem was more acute for *Agar* plant production. Again, the production of *Agar* oil depends on the proper heating system. As the gas bill rate washigh, the processors had to bear the higher cost of gas bill for producing *Agar* oil. This wasthe major problem for *Agar* processing in the study area.

11.12.6 Lack of Credit

Lack of adequate capital was one of the major problems faced by processor. Without capital, it was almost impossible for the processors to run their factory in the study area. The processing cost of *Agar* product washigh since input requirement washigh. As*Agar* processors neededhuge capital to buy necessary inputs, it became difficult for them to run the business without sufficient capital.

11.12.7 Lack of extension services

Almost all types of support service (counseling, visit, modern input and technology, etc.) were nearly absent from local government and non-government offices. Producers faced the problem of being in the middle of nowhere while they faced something new in production phase and they got no support from relevant government and non-government sectors.

11.12.8 Non-availability of modern technology

In the study area, most of the processors used traditional technology to process *Agar* product. It reduced the product quality (compared to other country) and increased production cost. One half of processors faced the problem of non-availability of modern technology.

11.12.9 Labour scarcity

Another problem of the processors was scarcity of labour. In the study area, labours werenot available in rainy season. Also, the cost of labour washigh. For that reason, sapling growers, producers and processors faced scarcity of labour during these periods.

11.12.10 Lack of plant theft protection

Most of the gardens were usually situated at long distance from producers' residence; even some gardens were situated in hilly remote areas which are completely inaccessible to any government and non-government official. As a result, many mature plants were stolen both in day and night.

11.12.11 Lack of encouragement

As most of the producers, processors and traders were poor and due to their land scarcity, low land fertility, financial insolvency, increasing production cost, and decreasing yield, quality and price; the producers' encouragement to *Agar* plant production was decreasing day by day.

11.12.12 Lack of bargaining association

Although selling price was determined through open bargaining, but in absence of producers' association, the market always is dominated by the purchasers (processors). Producers often did not earn enough money to support their family.

11.12.13 Problem with access to documents from government offices

Sometimes producers were seriously harassed in collecting of NOC (No Objection Certificate) and TP (Transport Permit) for harvesting and transporting *Agar* plants from local union council and forest office. The producers had to be pay illegal extra money for collecting these documents. Not only producers but also processors and exporters faced this problem.

11.12.14 Absence of policy support from the government

Till now, *Agar*wasnot recognized as an industrial sector in any government policies like Industrial Policy, Import Policy, Export Policy, Investment policy, SME Loan Policy etc. As a result, entrepreneurs were not getting any policy support including bank loan at concessional rate, cash incentives for export of an agro-processed product, payment of electricity, gas and other utilities bill as an industrial line etc.

11.12.15 Lack of government initiative to formalize the sector

Agar oil, *Agar* wood, *Agar* chips were exporting by the entrepreneurs from Barlekha to different Middle East Countries. But all of these transactions were occurring in informal channel due to lack of official arrangement for formal export of *Agar* product. As a result, government was not getting revenue as well as the entrepreneurs are not getting government supports as exporter (Abdin 2014).

11.12.16 Export related issues

It is revealed that, exporters often find the finished products were adulterated and the exporting policy is clumsy. Getting CITES was a difficult process for exporters. So, they were avoiding formal procedure for product exporting. This decreasedexporters' credibility to foreign buyers.

11.13 Suggestions at different levels of AP

Agar product enterprise is one of the less renowned kinds to the consumers and even most of the producers. Above this issue, the actors who currently involve with existing production and marketing process go through significant constraints and following could be possible remedial solutions for supporting both producer and traders.

Table 46: Solution matrix of *Agar* production and marketing

Suggestions	Sapling grower	Producer	*Agar* Processor	Exporter
Proper extension services	■	■		
Establishment of producer's bargaining association		■		
Offering proper training and information disseminating	■	■		

activities				
Providing prompt services by government offices		■	■	■
Ensured gas and electricity bills at subsidized rate			■	
Developing policy guidelines for boosting up the sector			■	■

11.13.1 Proper extension services

Local agriculture and forest offices and their representatives should come up with an appropriate and necessary supports and suggestions. These extension support should be provided timely and regularly to *Agar* sapling growers and plant producers for ensuring proper growing and marketing of saplings and plants.

11.13.2 Establishment of producer's bargaining association

A strong bargaining association of producers which will ensure the availability of seeds, saplings, other raw inputs and machineries need to be established. To avoid issues with procurement this association will provide protection to the producers. To ensure higher and reasonable price of outputs, bargaining power and financial solvency of the producers should be augmented through creating effective '*Agar* Plant ProducersAssociation'. Relevant Go's and NGO's should come forward in this direction.

11.13.3 Offering proper training and information disseminating activities(Research and extension)

Concern government and non-government organizations should come forward for developing and disseminating hybrid seeds, improved methods, instruments/machineries and inputs including pesticides for promoting *Agar* sapling growing sector. Obviously, training, workshop, seminar, meeting, publicity, etc. should be done to build awareness about importance of *Agar* plants in the *Agar* producing areas of the country.

11.13.4 Providing prompt services by government offices

Government should introduce single desk service for all the services (CITES, license, etc.) related to *Agar* product export in *Agar* growing area.It should determine separate bar code and take recognition for smooth export of *Agar* products in countries abroad. Moreover, monitoring by administration, police, BGB, forest office, union council and BAME (Bangladesh *Agar-Atar* Manufacturers and Exporters Association) should be strengthened for eliminating the procurement harassment and the stolen of the purchased plants. Also strong monitoring by local administration is essential to reduce harassment in delivery of NOC and TP, harvesting and transportation of *Agar* plants, and combating stealing of plants in the gardens, etc.

11.13.5 Ensured gas and electricity bills at subsidized rate

Government should take measures to ensure regular supply of electricity in *Agar* sapling nursery area. Concerned government authority should take necessary steps to ensure uninterrupted supply of gas and electricity in the processing area. Special permission needs to be given for new gas connection in processing plant areas. Instead of commercial rate, gas and electricity should be supplied at the rate of crop and tea industry of the country.

11.13.6 Developing policy guidelines for boosting up the sector

Strong monitoring, supervision, check, etc. should be done to stop any illegal activity relating to adulteration of export products. Finally, a comprehensive policy should be developed and implemented by the government for improvement of *Agar* sector and export of its products to foreign countries.

11.14 SWOT analysis of *Agar* plant enterprise

All the factors influencing present and future operations of all the sub-enterprises of *Agar* plant positively and negatively are displayed in Table 47. The strengths are existing favourable factors for beginning and running the enterprise; while opportunities are the future favourable factors influencing the enterprise. On the other hand, weaknesses are currently hindering factors, which should be overcome by the entrepreneurs for smooth operation of the enterprise. Besides, threats are risk factors, which need to be minimized for protecting failure of their enterprise. So, the entrepreneurs could achieve success and profit of their enterprises by exploiting favourable factors (strengths and opportunities) and overcoming unfavorable factors (weaknesses and threats).

Table47: SWOT Analysis of *Agar* enterprise

Strengths (S)	Weaknesses (W)
➢ Suitable sloped high land for production of *Agar* plants. ➢ Locally available inputs like seed, seedlings, fertilizer, pesticide, nail, etc. ➢ Inland procurement facility of instruments, tools, etc. ➢ Local processing and storage facilities are available. ➢ Scope of value addition to products through processing and exporting. ➢ Existence of 'Bangladesh *Agar-Atar* Exporters Manufacturers Association' (BAEMA). ➢ Advantage of family members staying in Middle eastern countries.	➢ Non-availabilityof entrepreneurs' education and training knowledge on improved method of processing and exporting of *Agar* products. ➢ Deficiency in establishing market linkage and sales promotion in foreign countries. ➢ Non-availability of access to credit. ➢ Financial insolvency in *Agar* plant producers results in selling of immature plants in advance at lower prices. ➢ Non-existence of bargaining association in plant producers' and sapling growers' levels.

Opportunities (O)	Threats (T)
➢ Huge scope of investment for both GOs and NGOs. ➢ Chance of promoting backward and forward linkages in home and abroad. ➢ High prospects for production and processing due to export opportunities. ➢ Labour-intensive operation with potentiality of employment generation. ➢ Favorable business environment in export markets of foreign countries. ➢ Goodwill in foreign export markets for natural quality of *Agar* products. ➢ Adequate opportunities for earning foreign exchange through increasing export.	➢ Use of traditional variety and technology for growing *Agar* plant and sapling. ➢ Increasing production and manufacturing cost of plant, sapling and product. ➢ Attack and damage by unknown and uncontrolled pests and diseases. ➢ Stealing mature *Agar* plants from gardens. ➢ Same gas bill both in running and off periods of processing plant. ➢ Time consuming and complex procedure for getting CITES certificate, export license, etc. ➢ Unstable demand for products in foreign markets. ➢ Deterioration of product quality by dishonest exporters through mixing chemicals. ➢ Absence of proper policy guidelines for the development this sector. ➢ Cultivable land is decreasing day by day

12. Research highlight/findings:

- All the MAP enterprises were found profitable, employment generating and income earning source with foreign exchange.
- Benefit cost ratios of AP indicated the urgency of declaration of *Agar* enterprise as thrust sector by the government.
- Prices of all MPs and AP products were fixed mainly in open bargaining and payment is made generally in cash.
- Due to poverty and urgent cash need, the AP producers were compelled to sell immature *Agar* plants to the processors in advance at cheaper price.
- Due to scarcity of suitable land, higher cost, lower price etc., *Agar* plant production was decreasing day by day.
- The MAP sector was surpassing various challenges that threaten the success of the sector.
- Attestation of medicinal processor, hawker/*faria* and *Hakim*/*kobiraj*was necessary to scale up the medicinal sector.
- Almost all types of support services for cultivation and marketing of *Agar* plants from local government offices and non- government organizations were absent.

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B. Implementation Position

1. Procurement:

Description of equipment and capital items	PP Target		Achievement		Remarks
	Phy (#)	Fin (Tk)	Phy (#)	Fin (Tk)	
(a) Office equipment					Required items were successfully procured
UPS	1	10000	1	9850	
Laptop	1	60000	1	60000	
Printer	1	20000	1	19800	
Desktop	1	60000	1	59900	
Scanner	1	5000	1	5000	
File cabinet	1	20000	1	19990	
Secretariat Table	1	22888	1	22700	
Computer chair	1	3500	1	3600	
Computer table	1	5000	1	4950	
(b) Lab &field equipment	-	-	-	-	-
(c) Other capital items	-	-	-	-	-

2. Establishment/renovation facilities (Not Applicable)

Description of facilities	Newly established		Upgraded/refurbished		Remarks
	PP Target	Achievement	PP Target	Achievement	

2. Training/study tour/ seminar/workshop/conference organized

Description	Number of participants			Duration (Days/weeks/ months)	Remarks
	Male	Female	Total		
(a) Training					
(b) Workshop					

C. Financial and physical progress

Fig in Tk

Items of expenditure/activities	Total approved budget	Fund received	Actual expenditure	Balance / unspent	Physical progress (%)	Reasons for deviation
A. Contractual staff salary	588922	550794	535502	15292	97.2	
B. Field research/lab expenses and supplies	1132500	1132500	1132500	0	100.0	
C. Operating expenses	258000	280698	280698	0	100.0	Needed extra moneythan proposed for operating expenses
D. Vehicle hire and fuel, oil & maintenance	198000	198000	198000	0	100.0	
E. Training/workshop/seminar etc.	0	0	0	0	0.0	

F. Publications and printing	100000	0	0	0	0.0	
G. Miscellaneous	15000	15000	15000	0	100.0	
H. Capital expenses	206388	205700	205700	0	100.0	

D. Achievement of Sub-project by objectives: (Tangible form)

Specific objectives of the sub-project	**Major technical activities performed in respect of the set objectives**	**Output (i.e. product obtained, visible, measurable)**	**Outcome (short term effect of the research)**
To understand the existing production systems, costs and return, and key social, institutional, environmental and other factors that govern the present status of MAPs	• Personal Observation • FGD • Key Informant Interview • Survey Research • Reviewing Previous Works	• Research Report • MS Thesis • Research Papers in Peer Reviewed Journal	• Updated knowledge of MAPs production systems, cost and return
To map the value chain and estimate the value addition in each of the nodes in the value chain and assess the efficiency of the value chains	• Personal Observation • FGD • Key Informant Interview • Survey Research	• Research Report • MS Thesis • Research Papers in Peer Reviewed Journal	• Updated knowledge of value chain and value addition of MAPs
To identify the constraints in production, marketing and processing	• Personal Observation • FGD • Key Informant Interview • Survey Research	• Research Report • MS Thesis • Research Papers in Peer Reviewed Journal	• Updated knowledge about MAPs production, marketing and processing

E. Materials Development/Publication made under the Sub-project:

Publication	**Number of publications**	**Remarks (e.g. paper title, name of journal,**

	Under preparation	Completed and published	conference name, etc.)
Technology bulletin/ booklet/leaflet/flyer etc.			
Journal publication	1	1	- An Economic Analysis of *Agar*-Wood Production in North-Eastern Bangladesh - Processing and Marketing of *Agar* Products in Bangladesh: A Case Study from North-Eastern Bangladesh
Information development			
Other publications, if any - PCR	1		
MS Thesis		1	An Agribusiness Study of *Agar* Products in Some Selected Areas of Moulvibazar District

F. Technology/Knowledge generation/Policy Support:

i. Generation of technology (Commodity & Non-commodity)

N/A

ii. **Generation of new knowledge that help in developing more technology in future**

An updated knowledge of identifying different entrepreneurs/actors and their activities, problems and promotion activities in supply chain of MAP enterprises; determining value addition to MAP products and measuring the profitability of the selected MAP enterprises

iii. Technology transferred that help increased agricultural productivity and farmers' income

N/A

iv. Policy Support

- Knew strengths, weakness, opportunities and threats of MAPs
- Identified key drivers of change in the strategies or business environment of MAPs
- Knew a full constraint matrix of MAPs production and marketing

i) Desk Monitoring[description & output of consultation meeting, monitoring workshops/seminars etc.):

A workshop on "Progress Review of CRG Sub-projects, PIU-BARC, NATP-2 Project under AERS Division, BARC"was held on 05 March 2018 at the Conference room-1 of Bangladesh Agricultural Research Council (BARC), Farmgate, Dhaka. Dr. Paresh Chandra Golder, Member Director (P&E), BARC and Dr. MianSyeed Hassan, Director (PIU-BARC), NATP-2 project waspresent as Chief Guest and Special Guest, respectively in the inaugural session of the workshop. Dr. A.S. M. Anwarul Huq, Member-Director (AERS), BARC presided over the inaugural session. A total of 75participants including principal & co-principal investigators (PI & Co-PI) of 10 sub-projects, research management expert of PIU-BARC, scientists, professors, agriculture experts and delegates attended the workshop from different research organizations, universities and private sectors. Activities wise progress under the objectives of the respective sub-projects along with limitations was presented by PIs/Co-PIs in the technical sessions of the workshop. Two technical sessions were presided over by Professor Dr. Rezaul Karim Talukder, Advisor, MUCH, FAO/MoFood and Dr. Jahangir Alam Khan, Former Director General, BLRI, Dhaka. In discussion sessions the learned participants were participated actively by giving valuable comments/suggestions for further improvement. However, sub-project wise comments/suggestions made in the workshop by the distinguished participants are given below:

Comments:

i. The presentation should be made by legible font size and the readable document distributed among the participants.

ii. The variety or name of medicinal and aromatic plant should be identified.

iii. Production system of medicinal and aromatic plant should be well explained.

iv. Focus group discussion (FGD) and Key informants of medicinal plant cultivation and marketing should also be properly undertaken.

v. Difference between land of normal tree plantation and land for medicinal tree plantation should be investigated.

vi. To identify the problem of overseas marketing of medicinal plant grown in Bangladesh, it was suggested to consult with the experts who are working in this connection.

ii) Field Monitoring (time& No. of visit, Team visit and output):

Monitoring team	Date(s) of visit	Total visit till date (No.)	Remarks
Technical Division/ Unit, BARC	13th February 2018	1	Technical progress is good but need more attention in data collection
PIU-BARC, NATP-2	March 2018	Meeting at BARC complex	Comments added in the section G

H. Lesson Learned/Challenges (if any)

i) The project enhanced the capacity of research team to deal with filed level producers and actors as well as increased the capacity of collecting necessary from the respondents
ii) Collecting data from the filed level is always a tough job. Data collection and research team employed their best level to finish the job successfully.
iii) It is difficult to implement a government funded research in Bangladesh because of bureaucracy problem.

I. Challenges (if any)

Signature of the Principal Investigator

Date …….

Seal

Counter signature of the Head of the organization/authorized representative

Date ……..

Seal