ZIBELINE INTERNATIONAL™ PUBLISHING
ISSN: 2785-9002 (Online)
CODEN: FAERCS

Food and Agri Economics Review (FAER)

DOI: http://doi.org/10.26480/faer.01.2022.01.06

RESEARCH ARTICLE

MANAGEMENT OF NURSERIES TO PRODUCE QUALITY PLANTING STOCKS: A CASE STUDY AT PHULTALA UPAZILA OF KHULNA DISTRICT, BANGLADESH

Bichitra Kumar Bachar[a,b], Tanmoy Dey[a,b*], Md. Akramul Islam[a,b], Md. Najmus Sayadat Pitol[a,b]

[a]Bangladesh Forest Research Institute; Ministry of Environment, Forest and Climate Change, Bangladesh.
[b]Forestry and Wood Technology Discipline, Khulna University, Khulna-9208, Bangladesh.
**Corresponding Author Email: tanmoyfwt100518@gmail.com*

ARTICLE DETAILS

Article History:

Received 13 August 2021
Accepted 08 October 2021
Available online 01 November 2021

ABSTRACT

A study was carried out at Phultala Upazilla of Khulna District in order to recognize the basis of selection criteria of planting materials and management techniques to produce better quality planting stocks in nurseries due to the dominance of nurseries in this area. This study was conducted by a survey of 88 sample nurseries using the snowball sampling technique. The majority of nursery owners (51.13%) are middle-aged (31-50), and 37.5% have a primary education. The maximum nursery owners (48.86%) had no training and their nursery size was small to medium size (73.86%). Maximum nurseries are permanent on both own and lease land (43.18%). Normally, greater numbers of fruit tree species are produced than timber species because of the higher demand for fruit tree species. Nursery owners consider quantity rather than improving the quality of seedlings. They collect seeds from the nearby home gardens (Rank-1), individual trees (Rank-2), private plantations (Rank-3), roadside plantations (Rank-4) and purchase them from the local market (Rank-5). They have little knowledge about the quality of seeds as well as their sources. Most nursery owners consider only a few characters for mother tree selection. They do not apply pre-sowing treatment, culling, grading, and conditioning properly, but they use pesticides and fertilizers (usually inorganic) regularly (36.77%). On the basis of this study, it is suggested that the nursery owners should be facilitated with training and other logistical support to achieve adequate knowledge of nursery management and to produce quality planting stocks in the study area.

KEYWORDS

Nursery, Quality planting stocks, Sources of planting materials, Mother tree, nursery techniques.

1. INTRODUCTION

Bangladesh is an extensively populated country with a limited land area and the population is increasing day by day (BBS, 2013). The high population growth rate is creating depression in all forms of daily life. An important portion of the necessary daily products come from tree species like different types of edible fruits, construction timber, fuel wood, etc. (Powell et al., 2013). So, demand for woody products is increasing but their supply or sources are limited, as Bangladesh has about 17% of forest land of the total land area, but actual tree cover is less than 7%, where a country needs 25% of forest for its total land area (Iftekhar, 2006). Therefore, the government of Bangladesh has provided special emphasis on the planting of different tree species throughout the country. Nurseries are the places that raise seedlings for the purpose of planting. Young seedlings are nurtured in the nursery from seeding to maturity in order to withstand the hard field conditions (Wilkinson et al., 2014). The main objective of nursery raising is to supply better quality planting stocks for plantation programs. The quality of seedlings has a profound effect on the success of tree farming. The quality of seedlings utilized has a significant impact on tree survival, growth performance, rotation period length, and the volume and grade of timber that can be harvested from a plantation (Islam, 2011; Duryea, 1964). A low quality seedling is not worth planting because it will always produce a low quality tree, even if it is provided with the appropriate silvicultural management and planted on an appropriate site. Further, the plantation maintenance cost of low quality seedlings can be high due to high mortality and more intensive management requirements (Haase and Davis, 2017). A high-quality seedling, on the other hand, has a low seedling death rate and requires less intense management, resulting in lower plantation costs. Moreover, the planting of high quality seedlings provides an early return on investment because they have more rapid growth, thus the rotation age is shortened (Duryea, 1964). As a result, nursery seedlings should be of good quality, and nursery owners should concentrate on developing high-quality seedlings rather than the quantity of seedlings produced. The quality of planting stocks largely depends on the selection of ideal sources of planting materials and proper management strategies of planting stocks adopting suitable nursery operations (ICRAF, 2013; Cortina et al., 2013). Few studies have been conducted in Bangladesh on nursery status, including status of owners and workers, species composition, socio-economic and marketing status of the nursery business in Bangladesh, especially in

Quick Response Code	Access this article online	
	Website: https://faer.com.my	DOI: 10.26480/faer.01.2022.01.06

Cite the Article: Bichitra Kumar Bachar, Tanmoy Dey, Md. Akramul Islam, Md. Najmus Sayadat Pitol (2022). Management of Nurseries to Produce Quality Planting Stocks: A Case Study at Phultala Upazila of Khulna District, Bangladesh. *Food and Agri Economics Review, 2(1): 01-06*.

urban areas (Ahmed et al., 2008; Haque et al., 2007). But there are no available research findings regarding the basis of selection of sources of planting materials and management techniques to produce better quality planting stocks in Bangladesh. Therefore, detailed information about nursery management strategies would help the nursery owners as well as researchers to improve the quality of planting stocks with a view to enhancing and promoting large scale plantation programs.

2. Research Method

2.1 Study Site

The study was conducted purposively in Phultala Upazilla of Khulna District, Bangladesh. People of this area are mainly agro-based. However, a number of people are engaged in raising nursery. The study area is located between 22°54 and 23°01 north latitudes and between 89°23 and 89°29 east longitudes in the south-western part of Khulna District (BBS, 2013). The total area of Phultala Upazila is 56.83 sq km and is bounded by Abhaynagar Upazila on the north and west, Dumuria Upazila and Khan Jahan Ali Thana on the south, and Dighalia and Abhaynagar Upazilas on the east (BBS, 2013). The maximum land area of Phultala Upazila is plane. Very little land is developed with undulating riverian silty, springtide, and marshy land of organic soil. The main sources of surface water for this upazilla are khal (canal), marshland rivers etc. The Bhairab River follows the north-east side of this upazilla. The climate of this area is sub-tropical, with three distinct seasons; the summer begins from the middle of April and continues till the middle of June, the winter starts from November and continues till February, and the monsoon exists from July to October. According to the Meteorological Department report of 2011, the monthly average maximum temperature rises to 31.1°C during the month of May. The monthly average minimum temperature falls to 21.8°C in the month of January. The level of humidity rises to 89 percent in the month of July, which commences from the middle of June and continues till the end of September. In the months of June to September, there is usually a lot of rain. The annual rainfall recorded in 2011 was 162.3 millimeters (BBS, 2013). Phultala Upazilla is connected with Khulna City and Zilla Town Jessore by road and railway. This Upazilla is also communicated with Khulna City by waterway through a river. Rail, bus, rickshaw, van, truck, easy bike, tempo, etc. are the prevailing vehicles of communication used by people inside and outside of the Upazilla.

2.2 Reconnaissance Survey

A reconnaissance survey of the study site was conducted to assess the prevailing conditions at the site and issues to be included in the study. This reconnaissance survey has been conducted in several nurseries to appraise the nature and categories of the nursery activities and to outline the questionnaires. During a reconnaissance survey, it was found that nursery practices are extensively being practiced, mainly at Phultala and Damodar Union. People have been traditionally practicing nursery activities.

2.3 Preparation of Survey Questionnaire

A semi-structured sample questionnaire was prepared to collect nursery information and data from primary sources by visiting and surveying the target area. The questionnaire was designed to cover the location of the nursery, socio-economic profiles, farm size and farming characteristics, selection and processing of planting materials, and management strategies of different nursery operations.

2.4 Sampling procedure

A snowball sampling technique was followed to get information about the management of planting stocks at different nurseries. In the first round, a few nurseries were selected purposively from different villages of the Upazilla to conduct with the nursery owners at Bagerdanda Bazer. Then, asking these nursery owners, more other nurseries were selected in the second round. This process was repeated in the third round respectively. A total of 88 nurseries were selected from the two unions where most of the nurseries are located.

2.5 Data collection

The survey was conducted between June and August 2017 in Phultala Upazilla, Khulna. Primary information regarding management of planting stocks at different nurseries was collected through a face-to-face semi-structured questionnaire survey. Owners and workers of the nurseries were interviewed to find out the adherent information required to do the survey. Secondary data like edaphic and climatic conditions, area, population, water sources, communication system, floristic composition etc. were collected from the Statistical Bureau of Bangladesh, government publications, other research papers on the same or similar issue, and the Agricultural Extension office at Phultala, Khulna.

2.6 Data analysis

The data was analyzed in percentage, frequency, and relative frequency. Socio-economic profiles (age, sex, education) of nursery owners were expressed in frequency and percentage. The farm and farming characteristics were also expressed in frequency and percentage. The three selection criteria and management techniques of planting stocks were expressed in frequency and relative frequency. Relative frequency was utilized to rank selected species and criteria, and nursery techniques/operations employed by nursery owners were also ranked using relative frequency.

3. Result

3.1 Socio-demographic profiles of the nursery owners

Of the 88 nursery owners interviewed, 51.12% were aged between 31 and 60 years, including 31.81% in the 31 to 40 year age class (Figure 01). Among the nursery owners, 27.27% had no formal education, 37.50% had completed primary education only, 19.32% had completed secondary education and the remaining 15.90% had higher academic or professional education (Figure 1). The average family size of the nursery owners was 6 and the adult male, female, and children constituted 38.63%, 32.95%, and 28.41% of total family members, respectively (data not shown). Most of the interviewed nursery owners were male (89.77%) and 78.41% of the respondents declared nursery practice as their primary activity. Others mentioned agriculture, aquaculture, local transport, grocery selling, poultry business and small business as their primary occupations and income from the nursery sale was a secondary objective (data not shown). Among the nursery owners, 48.86% had no training, 31.81% attended one training, 12.50% attended two training and 6.81% attended three training on nursery management techniques (Figure 1).

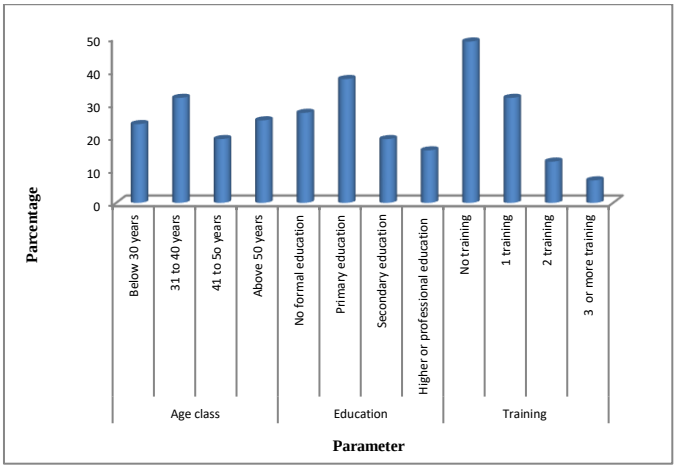

Figure 1: Age, education level and training attended on nursery techniques of respondents in the study area

3.2 Farm and farming characteristics

Only 23.86% of respondents implemented nursery activities on their own land and 32.95% of the nursery owners conducted nursery practices on leased land, whereas 43.18% adopted on both leased and own land (Figure 2). The nurseries were categorized into several sizes. While 35.23% of the respondents implemented a medium-sized nursery (51-100 decimal), 38.63% of the respondents had very small to small pieces of land (up to 50 decimal) for farming, and 26.14% of the respondents had a total area of above 100 decimal (Figure 2). The nursery owners mentioned that 15.90% of the nurseries' establishment age was up to 5 years, 35.23% of the establishment age was within 6-10 years and 48.86% of the establishment age was more than 10 years respectively (Figure 2).

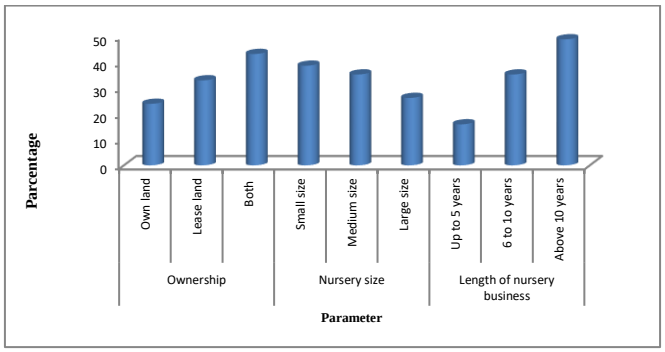

Figure 2: Ownership pattern of land, size of nursery and length of nursery business in the study area

The nursery owners were more concerned with species selection as 38.63% of the nursery owners preferred only fruit tree species/horticultural species, 17.05% of the nursery owners favored a combination of timber and multi-purpose tree species, and 44.32% of the owners desired a combination of timber, fruit tree, medicinal, and multi-purpose tree species (data not shown). Almost all nursery owners manage their nursery with family members.

3.3 Planting stocks at the nurseries of the study area

In the nursery survey, we identified and listed timber, fruit trees, medicinal and multi-purpose tree species. A total of 42 timber, fruit and multi-purpose tree species were observed at the nursery for propagation (Table 1). Most were identified in terms of their scientific names with family, whereas a few were identified by their local names only. The species were ranked according to relative frequency. *Mangifera indica, Swietenia mahagoni, Psidium guajava, Manilkara zopota, Zizyphus mauritiana, Artocarpus heterophyllus, Lichi chinensis, Citrus citrus, Spondia dulcis, Samanea saman, Cocos nucifera, Areca catechu, Citrus grandis*, and *Syzygium cumini* were the top 15 species according to Mostly fruit-bearing species were propagated at the nursery following a few timber and multi-purpose tree species.

Table 1: Seedling species/planting stocks raised at the nurseries of the study area

Scientific name	Local name	Family	Frequency	Relative frequency	Rank
Mangifera indica	Am	*Anacardiaceae*	84	7.92	1
Swietenia mahagoni	Mahagani	*Meliaceae*	75	7.08	2
Psidium guajava	Peara	*Myrtaceae*	73	6.89	3
Manilkara zopota	Safeda	*Sapotaceae*	69	6.51	4
Zizyphus mauritiana	Kul	*Rhamnaceae*	64	6.04	5
Artocarpus heterophyllus	Kanthal	*Moraceae*	61	5.75	6
Lichi chinensis	Lichu	*Sapindaceae*	59	5.57	7
Citrus citrus	Kagochi lebu	*Rutaceae*	56	5.28	8
Spondia dulcis	Amra	*Anacardiaceae*	52	4.91	9
Samanea saman	Raintree	*Fabaceae*	49	4.62	10
Cocos nucifera	Narical	*Arecacea/Palmae*	43	4.06	11
Areca catechu	Supari	*Arecaceae*	41	3.87	12
Citrus grandis	Jambura	*Rutaceae*	38	3.54	13
Khaya anthotheca	Lombu	*Meliaceae*	26	2.45	14
Syzygium cumini	Jam	*Myrtaceae*	23	2.17	15
Phyllanthus emblica	Amloki	*Euphorbiaceae*	21	1.98	16
Albizia lebeck	Sirish	*Fabaceae*	18	1.69	17
Feronia limonia	Katbell	*Rutaceae*	18	1.69	17
Citrus x sinensis	Malta	*Rutaceae*	17	1.60	18
Punica granatum	Dalim	*Punicaceae*	16	1.51	19
Albizia richardiana	Raj koroi	*Mimosaceae*	14	1.32	20
Mimusops elengi	Bokul	*Sapotaceae*	14	1.32	20
Syzygium samarangense	Jamrul	*Myrtaceae*	13	1.23	21
Averrhoa carabola	Kamranga	*Oxalidaceae*	12	1.13	22
Annona squamosa	Ata	*Annonaceae*	12	1.13	22
Melia azedarach	Nim	*Meliaceae*	11	1.04	23
Terminalia arjuna	Arjune	*Combretaceae*	10	0.94	24
Terminalia chebula	Hartoki	*Combretaceae*	8	0.75	25
Dulbergia sissoo	Sissoo	*Fabaceae*	8	0.75	25
Dimocarpus longan	Asfal	*Sapindaceae*	7	0.66	26
Albizia lucida	Silkaroi	*Leguminosae*	6	0.57	27
Citrus reticulate	Kamla	*Rutaceae*	6	0.57	27
Terminalia bellirica	Bohera	*Combretaceae*	6	0.57	27
Angle marmelos	Bel	*Rutaceae*	6	0.57	27
Baccaurea ramiflora	Latkan	*Euphorbiaceae*	5	0.47	28
Gmelina arborea	Gamar	*Verbenaceae*	4	0.38	29
Anthocephalus chinensis	Kadam	*Rubiaceae*	4	0.38	29
Delonix regia	Krishnachura	*Fabaceae*	3	0.28	30
Lagerstroemia speciosa	jarul	*Lythraceae*	3	0.28	30
Butea monosperma	Pallash	*Fabaceae*	2	0.19	31
Caesalpinia pulcherrima	Radhachura	*Fabaceae*	2	0.19	31
Saraca asoca	Asok	*Caesalpiniaceae*	1	0.09	32

3.4 Sources of planting materials

Table 2 lists the relative frequency of sources of planting materials in order of rank on the basis of the respondents' consideration. Home gardens as the sources of planting materials headed the list, followed by individual trees, private plantations and roadside plantations.

Table 2: Sources of planting materials preferred by the nursery owners in the study area

Sources of planting materials	Frequency	Relative frequency	Rank
Home garden	78	32.09	1
Individual tree	69	28.39	2
Private plantation	55	22.63	3
Roadside plantation	29	11.93	4
Purchase from the local market	12	4.94	5

3.5 Mother tree selection criteria

The nursery owners mentioned that they have considered different parameters as mother tree selection criteria for selection of timber, fruit trees, medicinal and multi-purpose tree species. Mother tree selection criteria for timber, fruit trees, medicinal and multi-purpose tree species are discussed below.

3.6 Mother tree selection criteria for timber species

Table 3 shows the relative frequency of 9 mother tree selection criteria for timber species in order to rank them based on the respondents' consideration. Good stem form as the criteria for mother tree selection of timber species headed the list, followed by fast growth and big diameter. Good branching habit as the criteria for mother tree selection of timber species was listed as rank 9. Pest and disease free, tall trees, mature trees, prolific seeders and root systems were also listed as mother trees of timber species selection criteria.

Table 3: Timber species mother tree selection criteria by the nursery in the study area

Mother tree selection criteria	Frequency	Relative frequency	Rank
Good stem form	46	21.57	1
Fast growth	38	17.84	2
Big diameter	31	14.55	3
Pest and disease free	28	13.15	4
Tall tree	22	10.33	5
Mature tree	17	7.98	6
Prolific seeder	13	6.10	7
Root system	11	5.16	8
Good branching habit	7	3.29	9

3.7 Mother tree selection criteria for fruit tree species

Table 4 illustrates the relative frequency of 7 mother tree selection criteria for fruit tree species in order to rank them based on the nursery owners' consideration. High quality varieties as the criteria for mother tree selection of fruit tree species headed the list, followed by healthy fruit of marketable size, fast growth, pest and disease free, large crown, mature tree and root system.

Table 4: Fruit tree species mother tree selection criteria by the nursery in the study area

Mother tree selection criteria	Frequency	Relative frequency	Rank
High quality varieties	76	31.40	1
Healthy fruit of marketable size	64	26.45	2
Fast growth	35	14.46	3
Pest and disease free	26	10.74	4
Large crown	21	8.68	5
Mature tree	14	5.78	6
Root system	6	2.48	7

3.8 Mother tree selection criteria for medicinal and multi-purpose tree species

Table 5 clarifies the relative frequency of 6 mother tree selection criteria for medicinal and multi-purpose tree species in order to rank them based on the respondents' consideration. Fast growth as the criteria for mother tree selection of multi-purpose tree species was listed at the top position and heavy branching habits, several trunks, pest and disease free, mature tree and root system were also listed as mother tree selection criteria.

Table 5: Medicinal and multi-purpose tree species mother tree selection criteria by the nursery in the study area

Mother tree selection criteria	Frequency	Relative frequency	Rank
Fast growth	62	32.63	1
Heavy branching habit	51	26.84	2
Several trunks	39	20.53	3
Pest and disease free	23	12.11	4
Mature tree	12	6.32	5
Root system	3	1.58	6

3.9 Nursery techniques

Table 6 illustrates the relative frequency (RF) of different nursery techniques adopted by the nursery owners in order to rank them on the basis of the respondents' consideration. Most of the respondents used both seeds and vegetative material for propagation (RF-69.32%), followed by only the vegetative part (RF-23.86%) and only seeds (RF-6.81%). In the case of vegetative propagation, the combination of grafting, air layering, branch cutting and budding secured the highest RF (45.45). On the other hand, most of the respondents used open beds as seed germinating media to produce planting materials. The Polybag size of 6×9" headed the list of RF in the case of seedling growing substrates. Most nursery owners adopted several types of water treatment as pre-sowing treatment for seed germination purposes.

Table 6: Nursery techniques adopted by the nursery owners in the study area

Items	category	Frequency	Relative frequency
Materials for propagation	Only seeds	6	6.81
	Vegetative propagation	21	23.86
	Both (seeds and VP)	61	69.32
Vegetative propagation methods	Grafting	14	15.90
	Air layering	6	6.81
	Grafting and air layering	28	31.81
	Grafting, air layering branch cutting and budding	40	45.45
Seed germinating media	Open bed	42	47.72
	Polybag	11	12.50
	Both (open bed and polybag)	26	29.54
	Open bed, polybag and tob	9	10.23
Polybag size	5"×7"	14	15.90
	6"×9"	30	34.09
	Both (5"×7" and 6"×9")	26	29.54
	5"×7", 6"×9" and 9"×12"	18	20.45
Pre-sowing treatment	Hot water, cold water and sun heated water treatment	43	48.86
	Water and acid treatment	17	19.32
	Water treatment and Scarification	13	14.77
	Water, acid and Scarification	15	17.05

3.10 Other nursery operations

Table 7 shows the relative frequency of several seedling management strategies as nursery operations in order of rank followed by the nursery owners. For this purpose, regular watering was listed as rank 1 and culling or grading was recorded as rank 6. application of pesticides, application of fertilizer, regular weeding, conditioning treatment, mulching and shoot pruning were also implemented by the nursery as key nursery operations. But few of these nursery operations, such as conditioning treatment, mulching, shoot pruning, etc., adopted by nursery owners depend on the type of species and its silvicultural requirements.

Table 7. Other nursery operations accepted by the nursery owners in the study area

Nursery operations	Frequency	Relative frequency	Rank
Regular watering	76	21.17	1
Application of pesticides	68	18.94	2
Application of fertilizer	64	17.83	3
Regular weeding	56	15.59	4
Conditioning treatment	49	13.65	5
Mulching	27	7.52	6
Shoot pruning	11	3.06	7
Culling or grading	8	2.23	8

4. Discussion

In this article, we studied socio-economic profiles of nursery owners, farm and farming characteristics, status of planting stocks, and species composition in the nursery, mother tree selection criteria, and nursery management techniques approved by small-scale nursery owners. The result illustrated that most of the owners practiced nursery activities on their own or leased land with small and medium pieces of land (up to 100 decimal) for a long time (6–10 years and above). But a remarkable number of nursery owners had above 100 decimal of land for nursery practices. It may be due to limited land property and inadequate capital for investment, being a member of an extensively populated developing country like Bangladesh. A study found the opposite results in Gazipur and Jessore districts in terms of ownership pattern of land and length of the nursery business. Fruit trees and first-growing timber were the most desired species, but some medicinal and multi-purpose tree species were also identified at the bottom of the list of species. Nursery owners mentioned 42 species, among them a considerable number were fruit-bearing species. Of the top-ranked 15 species according to the preference of the nursery owner, 12 were fruit species. The top-ranked forest tree species, **Swietenia mahagoni**, was listed in the second position and other forest species, medicinal and multi-purpose species were ranked at the bottom. The main factor that affected farmers to provide special concern about propagation of the fruit bearing species was the high local demand for such species. The other species were also selected on the basis of the extent of their local demands. Studied urban nurseries in Bangladesh and found similar results in the case of species composition (Ahmed et al., 2008). An estimated the revenue of each category (timber, fruit trees, medicinal and multi-purpose tree species) of seedling species in the Dhaka, Savar and Gazipur regions and found a similar ratio of species composition as in the study area (Mamun et al., 2018). The economic study of the plant nursery business in Gazipur and Jessore districts and also found similar results in the case of species category (Haque et al., 2007). A survey on the study of nursery business in the Harbin Region and found that a similar combination of forest and fruit tree species was preferred by the nursery owners (Saud et al., 2013).

In the case of the choice of seed sources, most of the nursery owners collected seeds from home gardens and individual trees. The farmers of Bangladesh collected planting materials from their home gardens, relatives and neighbors, markets, and occasionally from government nurseries (Leuchner and Khaleque, 1987). In the Patuakhali region, seeds or vegetative parts were collected from their own or other homesteads (neighbors and relatives) and the market (Islam, 2011). The dominant/co-dominant qualities in the timber species were in demand among the localities, such as good stem form, fast development, large diameter, pest and disease free, and so on. In the Patuakhali region, the nursery owners considered medium age, disease free, straight boles, and healthiness as the criteria for mother trees' selection of timber species (Islam, 2011). High quality varieties and healthy fruit of marketable size were preferable criteria adopted by the nursery owners for selection of fruit tree species. A study found a similar result as the mother tree selection criteria of timber and multi-purpose tree species (Azad et al., 2015). The majority of nursery owners used both seeds and vegetative parts for planting materials establishment. It may be due to most tree species producing a remarkable number of seeds every year, and most of the fruit tree species and some of the timber and multi-purpose tree species have the ability to produce new offspring from vegetative parts. Most of the respondents applied grafting and air layering methods for vegetative propagation, especially for fruit tree species. The majority of nursery owners use open beds as a growing medium for planting stocks because of their cost and time effectiveness. The nursery owners mentioned they had to use 5”×7”, 6” ×9” and 9” ×12” sizes polybags, however 6” ×9” was the dominant size. Based on the previous research, there illustrated that in case of mango grafts, polybags size had no effect on the sprouting and survival percentage but larger size bags had positive impact on vigor quality of grafted seedling (Haldankar et al., 2014). Then others show there was no significant difference in growth and physiological traits of rubber seedlings raised in reduced sizes of polybags as compared to standard sized polybags (Gayashan et al., 2018). Most nursery owners used water treatment (hot, cold and sun-heated water) as a pre-sowing treatment for seed germination to increase the rate of germination, break the seed dormancy and thereby increase the germination percentages. Literature supported water treatments for seed germination of *Albizia lebbeck*, *Terminalia arjuna*, *Gmelina aborea, Delonix regia*, *Tectona grandis*, *Terminalia chebula*, *Albizia procera*, *Xylia kerrii*, *Dalbergia sissoo*, *Albizia richardiana* and *Melia azedarach* (Kumar et al., 2018; Zazai et al., 2018; Adebisi et al., 2011; Imchen et al., 2015; Billah et al., 2015; Hossain et al., 2005; Ali et al., 1997; Azad et al., 2006; Matin et al., 2006; Azad et al., 2010a; Azad et al., 2010b). Several other nursery operations and cultural practices were also adopted by the nursery owners, such as regular watering, application of pesticides, application of fertilizer, regular weeding, conditioning treatment, mulching, culling, or grading etc. on the basis of the type of species and its silvicultural requirements. Some researchers found more or less similar results at the nurseries of Sylhet town and the Patuakhali region, respectively, in their investigations (Ahmed et al., 2008; Islam, 2011).

5. Conclusion

Quality planting materials are necessary as the planting of high quality seedlings provides an early return on investment because they have more rapid growth, thus rotation age is shortened. So, it is better to produce a few seedlings of high quality than to produce many seedlings of low quality. Unfortunately, in the study area, nursery owners have little knowledge of quality planting materials and nursery operations to produce quality seedlings. Most nursery owners are not aware and do not realize the importance of quality planting materials. Normally, they consider quantity rather than improving the quality of seedlings. Awareness should be raised through a campaign on the importance of the quality of planting stocks production. For most of the species, seed orchards and superior quality mother trees are not available in the study area. A seed orchard or seed production area should be established with improved varieties of tree species. Training should be provided to the nursery owners on quality sources of seeds and scions, seed quality testing, appropriate nursery operations, etc. to secure the quality of planting stocks. If the nursery owners of the study area had got the above mentioned support adequately, it could have played a positive role in the development of the forestry sector in Bangladesh.

References

Adebisi, M.A., Adekunle, M.F., Odebiyi, O.A., 2011. Effects of Fruit Maturity and Pre-Sowing Water Treatment on Germinative Performance of *Gmelina Aborea* Seeds. Journal of Tropical Forest Science 23(4): 371–378.

Ahmed, R., Hasan, M.S., Halim, M.A., Alam, M., 2008. State of urban nurseries in Bangladesh: a case study from the north-eastern region. Small-Scale Forestry. 7:275–283. DOI: 10.1007/s11842-008-9062-2.

Ali, M., Akhter, S., Kamaluddin, M., 1997. Study on the bearing of water

treatment on seed germination and seedling growth study of *Albizia Procera*. Indian Forester. 123(8): 764–8.

Azad, M. S., Matin, M. A., Islam, M. W., Musa, Z. A., 2006. Effect of pre-sowing treatment on seed germination of Lohakath (*Xylia Kerrii* Craib & Hutch.). Khulna University. Studies. 7(2): 33–6.

Azad, M.S., Paul, N. K., Matin, M. A., 2010a. Do pre-sowing treatments affect seed germination in *Albizia Richardiana* and *Lagerstroemia Speciosa*? Front Agri China. 4(2):181–4. DOI: 10.1007/s11703-010-0100-4.

Azad, M.S., Musa, Z.A., Matin, M. A., 2010b. Effect of pre-sowing treatments on seed germination of *Melia Azedarach*. J Forest Res. 21(2): 193–6. DOI: 10.1007/s11676-010-0031-1.

Azad, S., Manik, M.R., Hasan, S., 2011. Effect of different pre-sowing treatments on seed germination percentage and growth performance of *Acacia Auriculiformis*. Journal of Forestry Research 22, 183.

Azad, M. S., Sarker, B. K., Matin, M. A., 2015. Species Selection and Nursery Technique Adoption for Seedling Establishment in Bangladesh — Towards Enhancing Plantation Programme. Precious Forests - Precious Earth. https://doi.org/10.5772/60912.

BBS., 2013. District Statistics 2011: Khulna. Statistics and Informatics Division (SID), Ministry of Planning, Government of the People's Republic of Bangladesh.

BBS., 2013. Population and Housing Census 2011: Socio-Economic and Demographic Report National Series, Volume – 4, Ministry of Planning, Government of the People's Republic of Bangladesh.

Billah, M. A. S., Kawsar, M. H., Titu, A. P., Pavel, M. A. A., Masum, K. M., 2015. Effect of Pre-Sowing Treatments on Seed Germination of *Tectona grandis*. International Journal of Bioinformatics and Biomedical Engineering Vol. 1, No. 1, pp. 37-42.

Cortina, J., Vilagrosa, A., Trubat, R., 2013. The role of nutrients for improving seedling quality in drylands. New Forests, DOI 10.1007/s11056-013-9379-3.

Duryea, M. L., 1985. Proceedings: Evaluating seedling quality: principles, procedures, and predictive abilities of major tests. Workshop held October 16-18, 1984. Forest Research Laboratory, Oregon State University, Corvallis. ISBN 0-87437-000-0.

Gayashan, N. D. K., Nayanakantha, N. M. C., Seneviratne, P., Senavirathna, A.M. W. K., Jayasinghe, H. A. S. L., Panditharathna, B. M. S. S., 2018. Effect of Polybag Size on Growth and Physiological Attributes of Rubber (*Hevea brasiliensis*). Seedling Animal and Crop Production. Technology Proceeding of the 2. International Research Symposium, Uva Wellassa University, Badulla 90000, Sri Lanka, 1 8 t — 2 February 2018.

Gregorio, N. O., Herbohn, J. L., Harrison, S.R., 2010. Guide to Quality Seedling Production in Smallholder Nurseries, Visayas State University funded by the Australian Centre for International Agricultural Research, Q-Seedling Project, College of Forestry and Natural Resources, Visca, Baybay City, Leyte, Philippines.

Haase, D. L., Davis, A. S., 2017. Developing and supporting quality nursery facilities and staff are necessary to meet global forest and landscape restoration needs. Reforesta 4:69-93. DOI: https://dx.doi.org/10.21750/ REFOR.4.06.45.

Haldankar, P. M., Parulekar, Y. R., Kulkarni, M.M., Lawande, K. E., 2014. Effect of Size of Polybag on Survival and Growth of Mango Grafts. Journal of Plant Studies; Vol. 3, No. 1.

Haque, M. A., Miah, M. A. M., Rashid, M.A., 2007. An Economic Study of Plant Nursery Business in Gazipur and Jessore Districts of Bangladesh. ISSN 0258 – 7122. Bangladesh J. Agril. Res. 32(3): 375-385.

Hossain, M.A., Arefin, M. K., Khan, B. M., Rahman, M.A., 2005. Effects of Seed Treatments on Germination and Seedling Growth Attributes of Horitaki (*Terminalia chebula* Retz.) in the nursery. Research Journal of Agriculture and Biological Sciences 1(2): 135-141.

Iftekhar, M.S., 2006. Forestry in Bangladesh: An Overview Journal of Forestry; Apr/May 2006; 104, 3; Academic Research Library pg. 148.

Imchen, C., Sen, S., Kumar, H., Marak, J. K., 2015. Effect of Different Pretreatment Method on Seed Germination of Gulmohar (*Delonix regia*). Trends in Biosciences 8(19), Print : ISSN 0974-8431, 5105-5110.

Islam, M.S., 2011. Present Status of Homestead Nursery of Care-Lift Project-A Case Study in Patukhali, Bangladesh. Journal Of Agriculture & Social Sciences, ISSN Print: 1813–2235; ISSN Online: 1814–960X, 10–053/AWB/2011/7–1–7–12.

Kabir K.H., Kashem M. A., Miah M., 2013. The Level of Knowledge of Nursery Owners in The Production and Marketing of Saplings, European Scientific Journal, Vol.9, No. 30, Pp. 332-350.

Kumar, N., Handa, A. K., Dev, I., Ram, A., Uthappa, A.R., Shukla, A., Chand, L., 2018. Effect of pre-sowing treatments and growing media on seed germination and seedling growth of *Albizia lebbeck* (L.) Benth. Journal of Applied and Natural Science, 10(3): 860 – 863.

Leuschner, W.A., Khaleque, K., 1987. Homestead Agroforestry in Bangladesh. Agroforestry Systems, 5: 139–151.

Mamun, A., Rahman, A., Afrooz, N., 2018. A Socio-economic Analysis of Private Plant Nursery Business in Bangladesh. The Agriculturists 16(2): 102-114.

Matin, M.A., Islam, M.S., Azad, M.S., 2006. Seed germination, seedling growth and rooting of branch cuttings of *Dalbergia Sissoo* Roxb. Khulna University Studies (Special Issue 1st Research Cell Conference). 2006; 83–87.

Mozumder, S., Khan, B. M., Rahman, M. R., 2018. Pre-sowing Treatments for Improved Germination and Growth Performance of *Tamarindus Indica* L. in Bangladesh. Asian Journal of Biological Sciences, 11: 120-129.

Powell, B., Ickowitz, A., McMullin, S., Jamnadass, R., Padoch, C., Vasquez, M.P., Sunderland, T., 2013. The Role of Forests, Trees and Wild Biodiversity for Nutrition-Sensitive Food Systems and Landscapes.

Saud, S., Yajun, C., Fahad, S., Abdullah, M., Ajmal, M.M., Sadiq, A., 2013. Study of Nursery Business in Harbin Region, Journal of Biology, Agriculture and Healthcare, ISSN 2224-3208 (Paper) ISSN 2225-093X (Online), Vol.3, No.13, 2013.

Wilkinson K.M., Landis T.D., Haase D.L., Daley B.F., Dumroese, R.K., 2014. Tropical Nursery Manual: A Guide to Starting and Operating a Nursery for Native and Traditional Plants, U.S. Department of Agriculture, Forest Service, Agriculture Handbook 732.

World Agroforestry Centre (ICRAF)., 2013. Establishing a tree nursery in Kenya. Kenya. 7808.

Zazai, K. G., Raina, N.S., Sehgal, S., 2018. Effect of Pre-Sowing Treatments and Fruit Size on Germination of *Terminalia arjuna*. Int. J. Curr. Microbiol. App. Sci. 7(9): 1926-1933.