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Cardamom Farming Status in Bangladesh

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Abstract: Cardamom, both small cardamom (*Elettaria cardamomum*) and large cardamom (*Amomum subulatum*) known as the "Queen of spices", is widely utilized for a variety of applications worldwide and has the potential to be an understory high-value crop for the Bangladesh. A first exploratory survey in nine districts of Bangladesh was carried out to identify cardamom farming systems, prospects and constraints in the existing environment. Data were gathered through key informant interviews during February 2020 to January 2021 using questionnaire. About 4,600 small and 980 large cardamom plants have been growing successfully at nine upazila under agroforestry system in Bangladesh for last few years, so far. *Azadirecta indica*, *Artocarpus heterophyllus* and *Albizia lebbeck* were reported as shade tree for maintaining 60-70% shade for quality production. Time of flowering and fruiting were reported February to March and April to mid-June, respectively. Yield of cardamom was reported about 0.4 to 0.5 kg plant^{-1}. Estimated benefit cost ratio (BCR) was 4.14. Lack of proper information (97%) and quality planting materials (90%) marked as major problems faced by the farmers. Knowledge of cardamon cultivation (0.74) and annual income from cardamon farm (0.94) were showed a significant relationship with number of plants. Enhancing cardamom production on underutilized land could help marginalized people, especially women's empowerment through income generation, as well as provide various ecosystem services that are closely related to SDGs 1, 2 and 13.

Keywords: *Amomum subulatum*; *Elettaria cardamomum*; Queen of spices; Calendar; BCR, Bangladesh.

INTRODUCTION

A spice is any part of a plant that is mainly used to flavor or color food, including seeds, fruits, roots, bark, and other plant materials. Cardamom is called the "Queen of spices" (Nair, 2006), and is a major spices crop worldwide, under the Zingiberaceae family. This royal spice is recognized by its two main forms in the world. One is small cardamom (*Elettaria cardamomum)*, and the other one is large cardamom (*Amomum subulatum)*.

Cardamom is the world's second most significant spice crop, after black pepper (*Piper nigrum*), which known as the "King of spices" (Cobb, 2018). Some Asian countries and Guatemala are the major cardamom-producing country in the world. Among Asian countries, Indonesia and India accounted for 29.44% and 28.51% of the total production in 2020, followed by Guatemala accounted for 26.84% and 26.8% of the total production of small cardamom (Tridge, 2020). On the other hand, Nepal is the largest large cardamom-producing country, with 52%, followed by India and Bhutan, which accounted for 37% and 11% of the total production (Pothula and Singh, 2013).

It grows in a cool environment at high elevations, as an under-storey crop, in the shade, and next to forest plants. For cardamom cultivation, the required soil pH is 4.5-6.0 (Anitha and Hore, 2018). Cardamom is grown well in homesteads and shady areas (Korikanthimath, 2002). The basic problem is seed germination failure of the growers and higher cost of production (Pandey, 2017). Though cardamom propagation is done by both sexual and asexual (vegetative) means (Parthasarathy & Prasath,

2012), farmers have no basic technical knowledge about successful cardamom seedling production.

The major diseases for both small and large cardamom are chirkey, phurkey, cigatoka, and leaf blight (Paudel *et al.*, 2018; Pandey, 2001). With these diseases, cardamom leaf can be affected by burning from the leaf margin and also a bushy appearance. Another challenge for cardamom is insect attack. There is no report of severe insects before cardamom farming in Bangladesh. But there is a leaf feeder insect; that may cause severe damage to the cardamom plant growth and development. Research is going on besides this thesis work about the damaging nature and percentage of the insect throughout their life cycle at the Agroforestry and Environmental Science Research field and Laboratory in Sylhet Agricultural University, Sylhet.

As it grows well in rain-fed and hilly areas, Bangladesh may become one of the most suitable cardamom-growing countries in the world. In addition, cardamom growing potentiality is enormous in the vast 11,22,700 hectares of homestead area in Bangladesh (BBS, 2021). So, there is enough opportunity to expand cardamom production to the hilly region and homestead area of Bangladesh to get a greater amount of revenue. Bangladesh has a hilly area in the eastern part, including Sylhet and Chattogram, which can grow cardamom. An adequate supply of good-quality seedlings can increase the farming scenario of cardamom in Bangladesh. The domestic demand for this royal spice is about 4,000-5,000 tons per year in Bangladesh (TBS, 2019). There are no specific studies on cardamom cultivation status in Bangladesh, so far. In that case, this research was conducted to ascertain the status of cardamom farming in Bangladesh.

MATERIALS AND METHODS

Study area

The survey was conducted in nine upazilas of Bangladesh such as Sharsha upazila in Jessore, Roumari upazila in Kurigram, Gazipur sadar upazila in Gazipur, Ruma upazila in Bandarban, Shibganj Spice Centre at Shibganj upazila in Bogura, Sreemangal in Moulvibazar, Mirsharai in Chottogram, Sapahar in Naogaon, and Sreebardi in Sherpur (Figure 1).

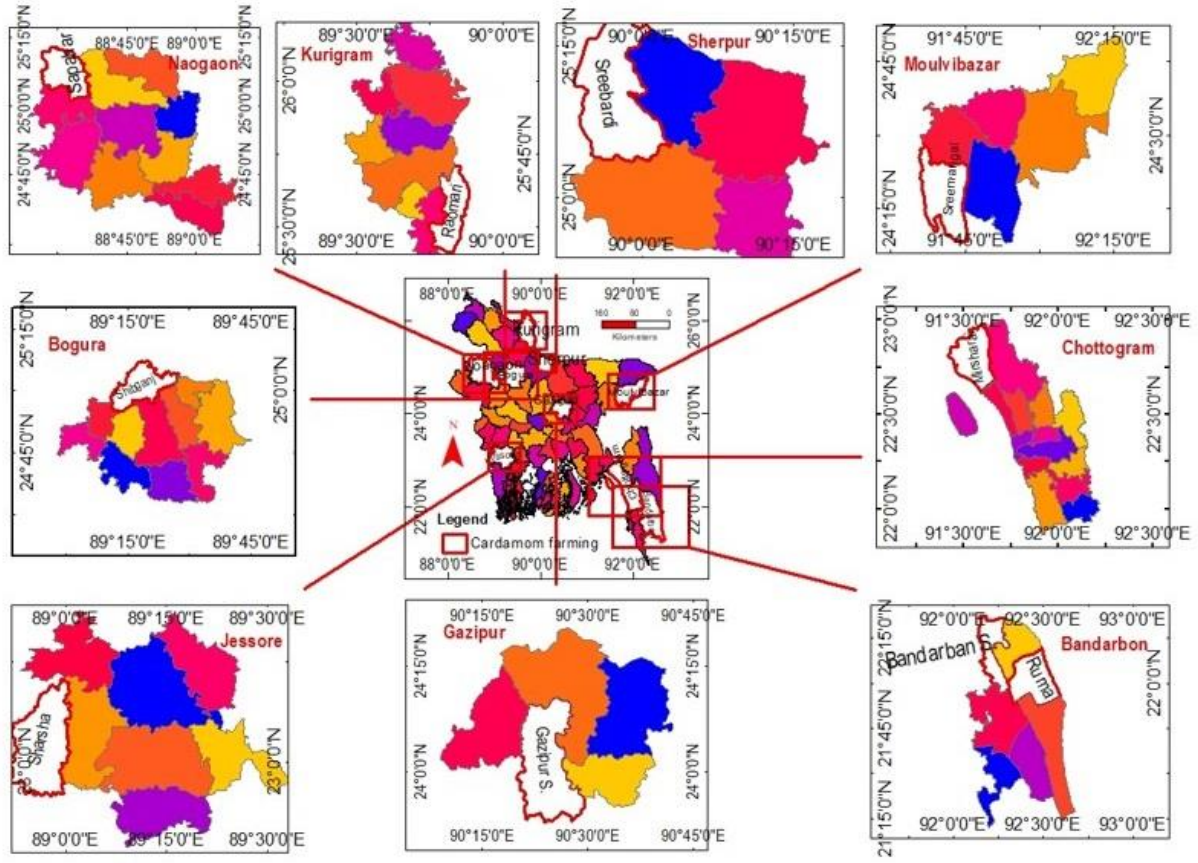

Figure 1. Study area

Survey planning and sampling procedures

In order to achieve the goal of this study, on-the-spot interviews were scheduled because the farmers typically do not keep documents and accounts of their farm activities. The procedures used in the current research were the area selection, detailed records of the pertinent variables, sampling method, inquiry period, scheduling of the interview, reporting to respondents, gathering of data,

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processing of data, as well as data analysis. The questionnaire was meticulously designed with the goal of the research in mind in order to collect pertinent data. Both open-ended and closed-ended topics were included in the survey sheet. A selection of respondents from different regions were interviewed as a pre-test for the questionnaire. As a result, certain portions of the draft questionnaire were enhanced, reorganized, and changed in light of the researcher's real and practical experience from the pretesting. In light of the study supervisor's sound advice, rational progressions, and remarks, the final questionnaire was developed.

Period and method of data collection

The study was conducted in nine locations in nine upazilas in Bangladesh from February 2020 to January 2021. Data were collected utilizing the individual form.

Variables of the study area

The selection and assessment of variables, such as an independent (age, education, occupation, farm size, annual income from cardamom farm, knowledge of cardamom farming and socio-economic conditions of the respondents) and dependent variables (yield and number of cardamom plants) are significant components in this scientific study.

Data processing and analysis

After the end of data collection from all interview dates, the data were coded, collected, tabulated, and evaluated in accordance with the study's goals. Each answer to the interview plan was assigned a number-coded value during this procedure. Whenever feasible, descriptive analyses including range, number, proportion, mean, standard deviation, and rank order were used. For data processing and graph preparation, Microsoft Excel and SPSS (version 25) were used.

RESULTS AND DISCUSSION

Socio-economic profile of the respondents

The respondents' ages varied from 33 to 50 years old, with a standard deviation of 5.18 and an average age of 43. Begum et al. (2012) discovered results that were similar to the average age of 41.69 reported by the interviewees in Gopalpur upazila, Tangail district, and Danner (2019) reported an average age of 43.66. 25% of respondents in classes XI–XII had a lower degree of education than the 75% of respondents in this survey. As a result, all study areas had a 100% literacy rate. It exceeded the 73.20% national average literacy rate (BBS 2020). The professions of the respondents from the study regions are listed in the following table, with NGOs and farmers ranking highest at 33%, followed by GO, business, and others at 11%. According to Table 1's data, the majority of respondents 56% were in the very small category, while the marginal and large categories had proportions of 33% and 11%, respectively. According to Rashid et al. (2007), small farms accounted for 53% of the 100 respondents' average farm size, marginal farms for 17%, landless farms for 23%, and large farms for 7%. At an average of 0.70 lakh taka and a standard deviation of 0.98, the majority of respondents (50%) in the study areas fell into the low-income category, while 38% of respondents had a medium-annual income and 12% had a high income. Additionally, focusing on the yearly revenue from cardamom farms, Kattel et al. (2020) found 489386 takas ha^{-1} $year^{-1}$.

The respondent's computed scores for knowledge of cardamom cultivation varied from 0 to 5, with a mean of 2.78 and a standard deviation of 1.39. According to Sharma et al. (2009), Indian cardamom growers lack adequate expertise of the crop. The data in Table 2 shows that while 22% of respondents had low socioeconomic conditions, with an average score of 8.33 and a standard deviation of 4.04 for 8 respondents, the majority of respondents (34%) are in moderate and moderately high socioeconomic conditions. Similar findings about the benefits of commercial flower cultivation for farmers' socioeconomic circumstances are also found by Shaibur et al. (2020).

Cardamom plant status in Bangladesh

The Bangladeshi study area contains 5,580 cardamom plants in total. There are 980 large cardamoms and 4,600 small cardamoms among them (Table 3). Jessore's farm is at the top with the most cardamom plants. Mandal et al. (2018) discovered a similarity in India, where 85% of the nation's supply is produced in the northeastern state of Sikkim.

Respondents reported that they maintain about 60-70% shade for maximum cardamom cultivation during the survey. Neem (*Azadirecta Indica*), Jackfruit (*Artocarpus heterophyllus*), White Shiris (*Albizia lebbeck*), Ipil Ipil (*Leucaena leucocephala*) or any other tree species were reported which have dense foliage to use as a shade tree. But they opined not to use the Eucalyptus tree as it consumes much water from the soil. Plants that have a long trunk and dense foliage are highly recommended. Nitrogen Fixing Trees (NFT) are also effective for cardamom farms.

Yield of cardamom in Bangladesh

Small cardamom was found in only Jessore and Chattogram districts, whereas large cardamom was found in Kurigram and Gazipur districts. 55 small cardamom plants were observed in two districts, and 32 large cardamom plants were observed in another two districts (Table 4). Estimated Benefit Cost Ratio (BCR) was 4.14. (Table 5). According to Govindarajan et al. (1983), the larger plantations had optimal inputs for plant protection, irrigation, and fertilizer, and produced high yields of 100 to 150 kg ha^{-1}.

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Table 1. Socio-economic profile of the respondents

Age	Related percentage	Education	Related percentage	Occupation	Related percentage	Farm size	Related percentage	Annual income	Related percentage
31-40	38	Class XI-XII	25	Farmer	33	Small (<0.20 ha)	56	Low (<0.50 lakh)	50
≥40	62	Hons./Masters	75	GO	11	Marginal (0.20-0.50 ha)	33	Medium (0.50-1.50 lakh)	38
				Business	11	Large (>0.50 ha)	11	High (>1.50 lakh)	12
				NGO	33				
				Others	12				
Mean	43					0.28 ha		0.70 lakh taka farm^{-1}	
SD (±)	5.18					0.25		0.98	

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Table 2. Cardamom farming knowledge and socio-economic conditions of the respondents

Knowledge of cardamom farming	Related percentage	Socio-economic conditions	Related percentage
Low (0-1)	11.00	Very low	00.00
Medium (2-3)	67.00	Low	22.00
High (4-5)	22.00	Medium	34.00
		Moderately high	34.00
		High	00.00
Mean	2.78		8.33
SD (±)	1.39		4.04

Table 3. Cardamom plant status in Bangladesh

SL. No.	Location	District	Cardamom Type	Number of Plants	Percentage (%)
1.	Sharsha	Jessore	Small	3000	53.76
2.	Ruma	Bandarban	Small	1200	21.51
3.	Gazipur	Gazipur	Large	500	8.96
4.	Roumari	Kurigram	Large	300	5.38
5.	Mirsorai	Chattagram	Small	200	3.58
6.	Shibganj	Bogura	Small and Large	200	3.58
7.	Sreemangal	Moulvibazar	Small	100	1.79
8.	Sapahar	Naogaon	Large	50	0.90
9.	Shreebordi	Sherpur	Large	30	0.54
		Total		5580	100

Table 4. Annual yields at the study areas during the survey

Location	Small cardamom		Large cardamom	
	No. of plants under production	Avg. yield plant^{-1} (Kg)	No. of plants under production	Avg. yield plant^{-1} (Kg)
Jessore	10	0.4	-	-
Chattogram	45	0.5	-	-
Kurigram	-	-	20	0.4
Gazipur	-	-	12	0.3
Total	55		32	

Table 5. Yield and price of cardamom hectare^{-1}

Year of Planting	Average Yield (Kg ha^{-1})	Price (Tk.)
1st Year	Null	Null
2nd Year	Null	Null
3rd Year	210	525000
4th Year	360	900000
Total	570	1425000
Gross Income		1147800
BCR		**4.14**

Source: Survey 2021

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Relationship between the selected characteristics of the respondents with yield plant^{-1} and number of plants

The relationship between age, education, farm size, annual income from cardamom farm, and socio-economic conditions of the respondents with yield plant^{-1} was non-significant except for knowledge of cardamom cultivation (0.736) (Table 6). Rejuan et al. (2011) discovered a statistically negligible correlation between the age of the respondents and varied tree species, with a correlation coefficient of 0.054. The relationship between age, education, farm size, knowledge of cardamom cultivation, and socio-economic conditions of the respondents with the number of plants was non-significant except for annual income from cardamom farms (0.939). Rashid et al. (2007) discovered a statistically significant positive correlation (r = 0.475) between respondents' educational attainment and a variety of tree species.

Table 6. Pearson's co-efficient of correlation between the dependent and independent variable

Independent variable	Dependent variable	
	Yield plant^{-1}	Number of Plants
Age	0.362^{NS}	0.650^{NS}
Education	0.628^{NS}	0.369^{NS}
Farm size	0.131^{NS}	0.414^{NS}
Farm income (Lakh)	0.419^{NS}	0.939**
Knowledge of cardamom cultivation	0.736*	0.637^{NS}
Socio-economic condition	0.576^{NS}	0.430^{NS}

* Correlation is significant at the 0.05 level (2-tailed); ** Correlation is significant at the 0.01 level (2-tailed)

Cardamom farm distribution in Bangladesh

There are two centers of distribution in Bangladesh; one is the Primary Cultivation Centre, and the other is the Secondary Cultivation Centre. The primary center is Jessore, Kurigram, Chattogram, and Naogaon. The secondary cultivation centre covers Gazipur, Sherpur, Moulvibazar, Bandarban, and some other locations (Figure 2).

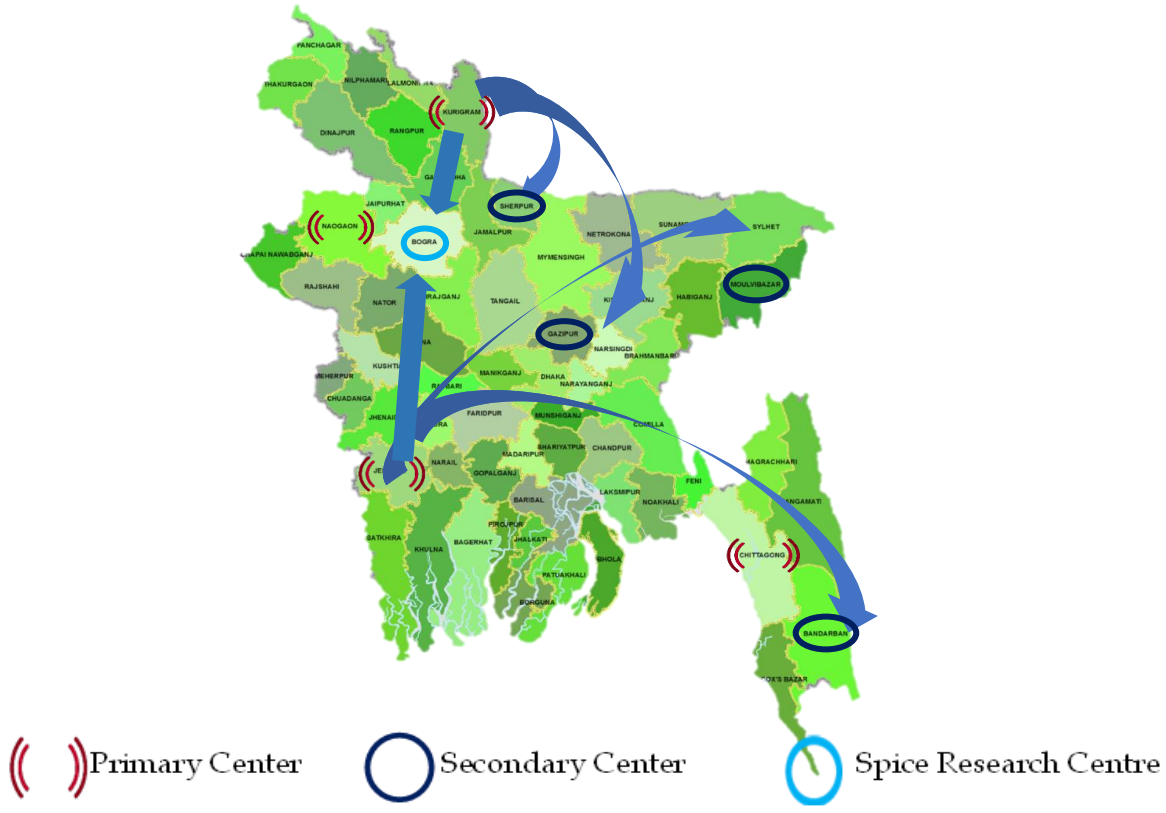

Figure 2. Cardamom farm distribution in Bangladesh

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Cultivation calendar in Bangladesh

Cardamom is a perennial plant. Based on survey data and field observation cardamom cultivation calendar is prepared (Table 7). In Bangladesh, both small and large cardamom seeds start to germinate from December to February (winter) and lasts up to six months in the seed bed. After that, it is transplanted to the main field. From February to March, new spikes start to head. Flowering starts in February-March, and fruit setting ends in mid-June. Fruit maturation occurs up to September, and harvesting ends before November. During germination, new spike heading, and flowering, the average temperature (19.910C) and the average rainfall (34.82 mm) remain low compared to the other months.

Table 7. Cardamom cultivation calendar in Bangladesh

Month	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
Germination												
New Spike												
Flowering & Fruiting												
Maturation & Harvesting												
Temp (^{0}C)	19.91			27.25			28.49			26.50		
Precipitation (mm)	34.82			412.09			1253.13			514.81		

Major constraints

Problems in cardamom farming in Bangladesh reported by the farmers were presented in the Table 8. They were lack of information (97%), quality planting materials (90%), government support (80%), improved production technology (78%), capital etc. Interested growers were facing problem for identifying true cultivar and wild cultivar.

Table 8. Problems faced by the respondents

Rank	Problems	Percentage
1	Lack of proper information	97%
2	Lack of quality planting materials	90%
3	Lack of government support	80%
4	Lack of improved production technology	78%
5	Lack of capital for investment	76%
6	Insect	60%
7	Shade management knowledge	52%
8	Diseases	43%
9	Inadequate land	30%
10	Flood problem (Sidr, Flash flood)	25%

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CONCLUSION

There were very few cardamom farms marked in the studied area. Small cardamom was found to be more popular for cultivation than large cardamom because of its high demand and market price. The hilly region was observed to be more preferable for high yields compared to the plain area in Bangladesh. Cardamom plants took four years to produce cardamom in Bangladesh. Estimated BCR was 4.14. Annual cardamom farm income showed a significant relationship with the number of plants and knowledge of cardamom cultivation showed a significant relationship with yield plant^{-1}. The major problem with cardamom cultivation was the lack of proper information and planting materials. It is observed that there is a notable disparity between respondents' knowledge and perception of cardamom farming. Increasing cardamom farming on underutilized land might help marginal people, especially women's empowerment through income production, as well as provide various ecosystem services that are closely related to SDG 1 (no poverty), SDG 2 (zero hunger), and SDG 13 (climate action). Various efforts should be made to provide training, incentive campaigns, and effective technologies to increase the cardamom farming and its production.

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Conflict of Interest

There are no conflicts of interest declared by the authors.

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