

RESEARCH ARTICLE

PRESENT STATUS, PROSPECTS AND PROBLEMS OF CASHEW CULTIVATION IN BANGLADESH

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ABSTRACT

Cashew (*Anacardium occidentale* L.) remained underexploited in Bangladesh, though it is a vital crop in many countries. This study was conducted to reveal the present scenario, explore the prospects, and identify the problems of cashew cultivation in Bangladesh. Data were collected from randomly selected 63 cashew-producing farmers from three hilly districts, Rangamati, Bandarban and Khagrachhari, under the Chittagong division of Bangladesh, using a structured interview schedule from February to April 2019. The majority of the farmers (65.1%) owned medium-size farms (1.01-3ha) and about half of them (46.0%) belonged to the higher annual income (>1,50,000 BDT; equivalent to 1,750.55 USD) group. The cashew yield was medium (1.40 to 1.80t ha⁻¹) and an individual tree yield ranged from 3 to 8 kg with an average of 6.24 kg. More than two-thirds (68.3%) of the farmers earned 1,20,001-1,80,000 BDT ha⁻¹ from cashew cultivation with an average of 1,68,000 BDT (equivalent to 1,960.62 USD). An average of 0.89 ha of land could still be taken under cashew cultivation. The net profit potential of 8,34,242 BDT ha⁻¹ (equivalent to 9,706.69 USD) is possible from cashew cultivation which is much higher than other crops. The farmers confronted low (79.4%) to medium (20.6%) problems and among the 16 identified problems, 'lack of processing for nut and apple' was the most serious severe problem, followed by 'lack of quality seeds or seedlings'. The findings suggest that the government should take initiatives to overcome the prevailing problems regarding cashew cultivation.

KEYWORDS

Anacardium occidentale L.; Cashew; Prospects; Problems.

1. INTRODUCTION

The cashew tree (*Anacardium occidentale* L.) belongs to the Anacardiaceae family. It is indigenous to South and Central America and was discovered by Portuguese missionaries in the 15th century (Nakasone and Paull, 1998). It has become naturalized in many tropical countries, particularly in coastal areas (Kapinga et al., 2017). Thus, it is assumed that cashew could be cultivated in the southwest coastal region of Bangladesh. It was introduced in Bangladesh by the Chittagong Hill Tracts Development Board (C.D.B.) and the Department of Agricultural Extension (D.A.E.) 45-50 years ago in the hill areas of the southeast region of Bangladesh (D.A.E., 2020). All parts of the cashew tree are essential for medicinal and food values. Raw nut, cashew kernels and cashew nut-shell liquids are the three main cashew products, while the fourth product, the cashew apple, is generally processed and consumed locally. The nut's skin contains high tannin, which can be recovered and used to tan hides. The Cashew nut tree provides food, employment, and income and the wood is used for carpentry, mainly in the construction of boats and ferries, while other products from it include firewood and charcoal (Akinwale, 2000). Cashew resins are also used to manufacture insect repellents and natural insecticides, while different tree parts have medicinal value as they are used to cure various diseases (Cavalcante et al., 2003).

Cashew kernel is known for its delicious, pleasant taste and balanced nutritive profile. A hundred grams of cashew kernel contains about 553 Kcal energy. The nutritive values present in cashew kernels are protein (21%), fats (47%), carbohydrates (22%) and have all the fat-soluble

vitamins (A, D, E and K), which are helpful in the assimilation of fats and improving immunity in human body (Ware, 2018). About 82% of the total fat available in cashew is an unsaturated fatty acid and helps lower the cholesterol level in the blood (Lakshmana et al., 2018). It is also a source of minerals like calcium, magnesium, phosphorous, potassium, sodium, iron and other minerals. In addition, cashews are a good source of antioxidants as other nuts and alkyl-phenols are especially abundant. Cashew kernel is widely used in the confectionery industry for flavoring cakes, sweetmeats, vegetable dishes and chocolates. The kernel contains 40% oil, resembling almonds (Guledgudda, 2005).

Cashew is a fast-growing evergreen tree and is salt and drought tolerant, suitable for growing in the coastal saline areas of Bangladesh (Subasinghe, 2004). Cashew can be cultivated in almost all soils ranging from coastal sandy and red lateritic soils to red sandy loam soils in plains and soils with good fertility status. It was believed and now scientifically proved that cashew is a wasteland crop and does not need much care, and can protect soil from water and wind erosion, proving the potentiality and suitability of cashew for growing in the southwest coastal areas Bangladesh.

Cashew is an important cash crop and foreign exchange earner for many countries in Asia and America. There is a growing market for cashew in Europe and the U.S.A., with a new market opening up in the other parts of the world, such as Russia and Japan (Guledgudda, 2005). There is a growing demand on the world market for cashew kernels and their by-products. Cashew might be one of the agricultural products with tremendous potential for increasing foreign exchange and employment in

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Bangladesh. Despite the favorable agro-climatic condition, internal demand and export opportunities, there is still a lack of initiatives to popularize cashew cultivation in Bangladesh. Krishi Gobesona Foundation (K.G.F.) [a Bangladesh government-sponsored research organization under the umbrella of BARC (Bangladesh Agricultural Research Council)] indicated that Bangladesh has a tremendous possibility of cashew cultivation (Banerjee, 2016). Among all nuts, cashew imports increase faster than almonds in Bangladesh (Mahmud and Myers, 2019). The cashew nut production in Bangladesh was 1,323 tons in 2019-'20, which was 32.3% higher than a year earlier, and the raw nut export earning was 3,57,000 USD in the 2019-'20 fiscal year (Milad, 2020).

Cashew is a highly nutritious and profitable fruit crop gaining popularity in Bangladesh. However, the possibility of cashew cultivation in the southwest coastal region of Bangladesh has not yet assessed with formal research approaches. It requires an in-depth investigation for making decision on cashew cultivation here. The annual demand for cashew in Bangladesh is around 50,000 tons and we mainly depend on the imports to fulfill the current requirements (Irani, 2020). Therefore, we need to expand cashew cultivation in Bangladesh. Bangladesh's southwest coastal areas could be a growing hub soon as cashew withstands and can grow in salinity-stricken soils. Agrotechnology Discipline of Khulna University, Bangladesh, which is the largest public university in the southwest region, has developed a germplasm pool of cashew nut trees by this time to foster the future production possibility in this region. However, the ins and outs of cashew cultivation status in other parts of Bangladesh are needed to be known in this regard.

Thus the present piece of the study was conducted with the following specific objectives:

- i. To reveal the present scenario of cashew cultivation in the southeast region of Bangladesh.
- ii. To explore the prospects of cashew cultivation.
- iii. To identify the problems faced in cashew cultivation.
- iv. To describe the socio-economic characteristics of the farmers involved in cashew cultivation.
- v. To ascertain the relationships between cashew's monetary earnings and the farmers' socio-economic characteristics.

2. METHODOLOGY

2.1 Study Area and Research Design

The survey was conducted in three districts (Rangamati, Bandarban and Khagrachhari) under the Chittagong division, the southeast region of Bangladesh (Map 1). The survey was conducted using a "Diagnostic and descriptive research design," focusing on quantitative and qualitative data collection approaches from target respondents.

2.2 Data Collection

Data were collected from randomly selected 63 (8.43% of 747 persons) cashew-producing farmers of the study area using a pretested structured interview schedule through a face-to-face interview from February 2 to April 28, 2019. Data were collected on 15 issues (Table 1) to assess the present scenario. These were: land under cashew cultivation (ha), land suitable for cashew cultivation (ha), age of the tree (years), the height of the tree (m), flowering time (month), apple color, apple taste, apple yield (kg per tree), nut color, nut taste, nut yield (kg per tree), whole fruit (kg per tree), fruit size (fruit per kg), cashew production ($t\ ha^{-1}$) and income (B.D.T. ha^{-1}). Data were collected to explore the prospects of cashew cultivation. Data were also collected from secondary sources to explore the prospects of cashew cultivation. Eight issues were considered in this regard: land could be brought under cashew cultivation (ha), cultivated varieties, Number of trees (owned per farm), intercropping possibilities, income potential (profit ha^{-1}), profit comparison with other crops (profit ha^{-1}), import compromise (tons per year) and the possibility of growing in the southwest coastal regions.

Sixteen problems (Table 4) were identified through F.G.D. (Focus Group Discussion) and then those problems were ranked for severity intensity, and the farmers were categorized based on obtained personal problem scores. Socio-economic characteristics; (Table 6) viz. age, educational qualification, family size, farm size, experience in farming, experience in cashew farming, annual income, organizational participation, extension media contact and attitude towards cashew cultivation; of the respondents were treated as independent issues and were described for understanding the cashew farmers' status. This study considered income from cashew production regarding the economic benefit of cashew production as the focus issue to ascertain the statistical relationship.

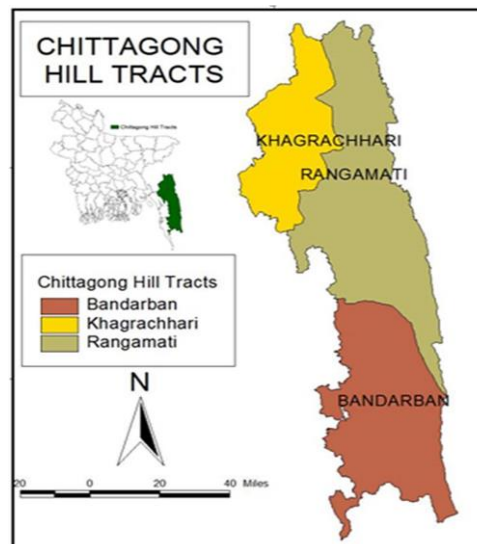


Figure 1: Map of the study area of Rangamati, Bandarban and Khagrachhari

2.3 Data Analysis

After completing the collection, all the data were compiled, coded and then tabulated for processing. Local units were converted into standard units. Collected data were analyzed using SPSS and Microsoft Excel software for different statistical techniques and for obtaining results and subsequent interpretation to satisfy the study's mentioned purpose. For categorizing the findings, the mean (\bar{x}) and standard deviation (sd or S.D.) were calculated and categorized as follows: (i) low " $< (\bar{x} - sd)$ ", (ii) medium " $(\bar{x} - sd) \leftrightarrow (\bar{x} + sd)$ " and (iii) high/large " $> (\bar{x} + sd)$ ". Statistical treatments such as Number, percent, rank order, range, mean and standard deviation were used to describe and interpret the data. In addition, Pearson's Product Moment Correlation Coefficient 'r' was employed to explore relationships between any two variables. Finally, measurement of the different independent issues, such as socio-economic information of the cashew-producing farmers, socio-psychological, cashew-farm management related information and cashew-tree related information, were measured following standard procedures and units (Islam et al., 2019).

The sixty-three respondents were asked about the problem they faced during cashew cultivation with their severity magnitude. A four-point rating scale such as highly severe, severe, less severe and not at all was assigned against each of the problems to indicate the severity. A score of 3, 2, 1 and 0 was assigned against each of the scales, respectively. The problem confrontation score of a respondent was determined by summing up all the scores obtained against all problems. The problem confrontation score of respondents could range from '0' to '48', where '0' indicated no problem confrontation while '48' indicated the highest problem confrontation. To determine the severity of a problem 'Problem Confrontation Index (PCI)' was calculated by using the following formula:

$$PCI = Nh \times 3 + Ns \times 2 + Nl \times 1 + Nn \times 0;$$

Where PCI = Problem Confrontation Index; Nh = Number of respondents rated the problem as highly severe; Ns = Number of respondents rated the problem as severe; Nl = Number of respondents rated the problem as less severe; Nn = Number of respondents rated the problem as not at all a problem.

The PCI score of the respondents could range from '0' to '189', where '0' indicated not at all a problem and '189' indicated the most severe problem.

3. RESULTS AND DISCUSSION

3.1 The Present Status of Cashew Cultivation

The present status of cashew cultivation was studied on some parameters, viz. land under cashew cultivation (ha), land suitable for cashew cultivation (ha), age of the tree (years), tree height (m), flowering time (month), apple color, taste of apple, apple yield (kg tree⁻¹), nut color, taste of nut, nut yield (kg tree⁻¹), total fruit (nut & apple) production (kg tree⁻¹), fruit size (Number of fruits kg⁻¹), cashew nut production ($t\ ha^{-1}$) and income from cashew (B.D.T. ha^{-1}).

3.2 Land Area Under Cashew Cultivation

In the study, it was found that land under cashew cultivation ranged from

3.92 to 0.01 ha, with an average of 0.47 ± 1.01 . Around half (46%) of the respondents had 0.02 to 0.20 ha (marginal) land and only 1.6% had a large (>3 ha) area under cashew cultivation (Table 1 and Figure 1).

3.3 Land Suitable Cashew Cultivation

The respondents had an average of 0.91 ± 0.83 ha of land still could be taken under cashew cultivation (i.e., suitable for cashew cultivation, however, not yet brought under practical cultivation). 61.9% of the respondents had 0.21 to 1.00 ha (small) land area suitable for cashew cultivation (Figure 1).

3.4 Age of The Trees

The age of the trees ranged from 3 to 15 years with an average of 9.82 ± 2.6 . More than half of the trees belonged to the middle age (8-11 years) category, i.e., they are in a full bearing stage of reproductive growth (Table 1).

3.5 Tree Height

The height of the cashew trees ranged from 2.74 to 7.62 m with an average of 5.89 ± 1.45 m. The majority (79.4%) of the trees were in the tall (>4 m) category, followed by semi-tall (2.5 to 4 m, 20.6%) and none of the trees was dwarf (Table 1).

3.6 Flowering Time

Majority (65.1%) of the cashew trees produce flowers during February, followed by January (28.6%), i.e., cashew is a winter flowering tree that starts to form fruit when the daily average temperature starts to increase from March and onward (Table 1).

3.7 Apple Color, Taste and Yield

Around half (44.4%) of the cashew apples were reddish yellow-colored, followed by yellow (34.9%) and red (19%) (Table 1). Besides, the majority (77.8%) of the fruits tasted sweet, followed by sweet-sour (17.5%). Negligible quantities (4.8%) were tested as less sweet. Apple yield ranged from 18 to 48 kg tree⁻¹, with an average of 37.43 and a standard deviation of 10.65. The majority (79.7%) of the trees produced medium yield (26.78-48.08 kg), followed by low yield (<26.78 kg).

3.8 Nut Color, Taste and Yield

It is observed in Table 1 that the majority (66.7%) of the cashew nuts were ash-colored, followed by brown (23.8%), blackish (6.3%) and whitish (3.2%). The majority (57.1%) of the nuts were tasty, followed by delicious (42.9%), and none was less tasty. Nut yield ranged from 3 to 8 kg tree⁻¹, with an average of 6.24 ± 1.77 kg. The majority (79.7%) of the trees produced medium yield (4.47-8.01 kg), followed by low yield (<4.47 kg).

Table 1: Present Scenario of Cashew Cultivation.

Characteristics	Category	Score/Code	Percentages	Mean \pm SD	Range	
					Min.	Max.
Land under cashew cultivation (ha)	Landless	<0.02	20.6	0.47 \pm 1.01	0.01	3.92
	Marginal	0.02-0.20	46.0			
	Small	0.21-1.00	17.5			
	Medium	1.01-3.00	14.3			
	Large	>3.00	1.6			
Land suitable for cashew cultivation (ha)	Landless	<0.02	0	0.91 \pm 0.83	0.05	4.00
	Marginal	0.02-0.20	11.1			
	Small	0.21-1.00	61.9			
	Medium	1.01-3.00	25.4			
	Large	>3.00	1.6			
Age of the trees (Years)	Early age	≤ 7	15.9	9.82 \pm 2.60	3	15
	Middle age	8-11	57.1			
	Old age	≥ 12	27.0			
Tree height (m)	Dwarf	<2.5	0	5.89 \pm 1.45	2.74	7.62
	Semi-tall	2.5-4	20.6			
	Tall	>4	79.4			
Flowering time (Month)	January	1	28.6	-	-	-
	February	2	65.1			
	March	3	6.3			
Apple color	Red	1	19.0	-	-	-
	Reddish yellow	2	44.4			
	Yellow	3	34.9			
	Light yellow	4	1.60			
Taste of apple	Less sweet	1	4.8	-	-	-
	Sweet	2	77.8			
	Sweet-sour	3	17.5			
Apple yield (kg per tree)	Low	<26.78	18.8	37.43 \pm 10.65	18	48
	Medium	26.78-48.08	79.7			
	High	>48.08	0			
Nut color	Ash	1	66.7	-	-	-
	Brown	2	23.8			
	Blackish	3	6.3			
	Whitish	4	3.2			
Taste of nut	Less tasty	1	0	-	-	-
	Tasty	2	57.1			
	Delicious	3	42.9			
Nut yield (kg per tree)	Low	<4.47	18.8	6.24 \pm 1.77	3	8
	Medium	4.47-8.01	79.7			
	High	>8.01	0			
Total fruit (nut & apple) production (kg per tree)	Low	<31.24	18.8	43.67 \pm 12.43	21	56
	Medium	31.24-56.1	79.7			
	High	>56.1	0			
Fruit size (Number of fruits per kg)	Low	<21.19	18	21.98 \pm 0.79	20	23
	Medium	21.19-22.77	64			
	High	>22.77	18			
Cashew nut production (t ha ⁻¹)	Low	<0.89	19	1.24 \pm 0.35	0.60	1.60
	Medium	0.89-1.59	81			
	High	>1.59	0			
Income from cashew ('000'BDT ha ⁻¹)	Low	≤ 120	31.7	168 \pm 47	60	160
	Medium	120.001-180	68.3			
	High	>180	0			

Source: Field survey, 2019

3.9 Total Fruit Production and Fruit Size

In this study total fruit (apple + nut) production was ranged from 21 to 56 kg per tree. The average was 43.67 kg with a standard deviation of 12.43 kg. The majority of the trees (79.7%) produced medium yield (31.24-56.1 kg). Fruit size (Number of fruitskg⁻¹) ranged from 20 to 23. The majority (64%) of the fruits were medium-sized (21.19-22.77 per kg) (Table 1).

3.10 Cashew Nut Production and Income From Cashew

The cashew production ranged from 0.6 to 1.6 t ha⁻¹. The average production was 1.24 t ha⁻¹, with a standard deviation of 0.35. The majority of the respondents (81%) obtained medium production (0.89-1.59 t ha⁻¹) followed by low production (19%, <0.89 t ha⁻¹). More than two-thirds (68.3%) of the respondents had medium income (120,001-180 thousand B.D.T.) with an average of 168 thousand and a standard deviation of 47 thousand. The recorded highest income was 160 thousand B.D.T. and the

lowest was 60 thousand B.D.T. (Table 1).

3.11 The Prospects of Cashew Cultivation

3.11.1 Land Utilization Prospect

The average farm size of the respondents was 2.19 ha, land under cashew cultivation was 0.47 ha and land suitable for cashew cultivation was 0.91 ha, which could be taken under cashew cultivation (Figure 1). This result indicated a great scope of cashew cultivation in the study area. Moreover, according to the Ministry of Agriculture, at least 5,00,000ha of land in the three hilly districts, namely Rangamati, and Khagrachhari, were lying uncultivated (Ali, 2021). Therefore, cashew cultivation was available on at least 22% of the land in the three hilly districts. Besides, the soil in other hilly areas of the country was also conducive to cashew cultivation (Awal and Uddin, 2021). So there is an excellent scope of cashew cultivation in Bangladesh.

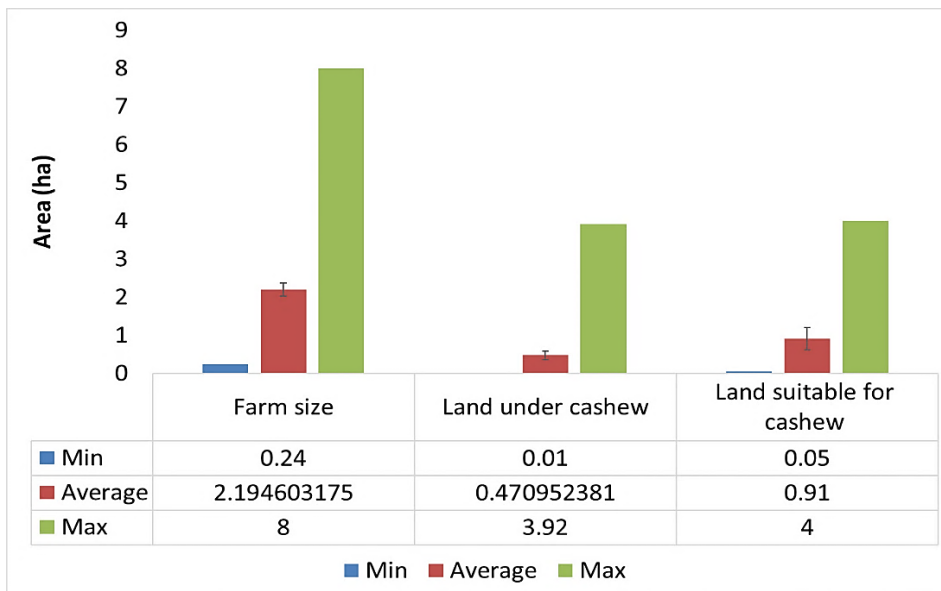


Figure 1: Prospect of Cashew cultivation in Bangladesh with particular attention in the southwest coastal area. Source: Field survey, 2019

3.11.2 Cultivated Varieties

Most cashew nut varieties were found local (88.9 %) and few were locally improved (11.1%). So there is a great scope to introduce a high-yielding variety of cashew. For example, at Regional Agricultural Research Station (RARS), Hathazari, Chittagong, among eight cashew nut germplasms, 'A.O. Hat 004' had maximum fruit yield (35.93 kg per plant), nut yield (4.16 kg

per plant), edible kernel weight (1.77 kg per plant) and individual nut weight (7.0g) (Ona et al., 2017). The most common six commercial types of cashew nuts were w-180,w-210, w-240, w-320,w-450 and scorched wholes (<http://cashewindia.org/cashew-kernels>). These types might be perfect for commercial introduction in Bangladesh. Thus, there is a great scope to introduce these types of cashew in our country for commercial purposes.

Table 2: Types of cultivated cashew varieties.

Characteristics	Category	Score/Code	Percentages
Cultivated varieties	Local	1	88.90
	Local Improved	2	11.10
	Improved	3	0

Source: Field survey, 2019

3.11.3 The Number of Trees

In the study area, it was found that 57.1% of respondents had few cashew trees at home (<10), and 22.2% had a small (10-50) to medium (51-200) number of cashew trees. Only 20.7% of respondents had a large (>200) number of cashew trees (Table 3).The lowest Number of trees was one and the highest was 1200. In India, cashew cultivation is taken up in small and marginal holdings and as more than 70% of the cashew area is under this category, cashew plays an essential role in developing small and marginal

farmers. A spacing of 7.5m×7.5m (175 plants ha⁻¹) or 8m×8m (156 plants ha⁻¹) was recommended. High-density planting of cashew at a closer spacing of 4m×4m (625 plantsha⁻¹) in the beginning and thinning out in stages to maintain a final spacing of 8m×8m in the tenth year is also recommended. This practice enables higher returns during the initial years. In the first year, when planted at a spacing of 7.5m×7.5m (175 plants ha⁻¹), the crop utilizes minimal land area (Adiga and Kalaivanan, 2017). Thus, there is an excellent scope for large-scale commercial cashew cultivation.

Table 3: The Number of Trees Grown in The Study Area.

Characteristics	Category	Score/Code	Percentages	Mean±SD	Range	
					Min.	Max.
Number of Cashew Trees	Few at Home	<10	57.1	130.73±241.5	1	1200
	Small	10-50	9.5			
	Medium	51-200	12.7			
	Large	>200	20.7			

Source: Field survey, 2019

3.11.4 Intercropping Possibilities

In China, in young orchards, cashew is intercropped with green manure cover crops and short-term annual crops. Main cover crops include pasture grasses and inter-crops such as peanut, sweet potato and beans. In recent years, cashew has been inter-cropped in some areas with melons (watermelon and sweet melon) and vegetables such as hot pepper (Kangde et al., 1998). In Myanmar, several inter-crops are taken by some farmers, predominantly annual crops such as sweet potato, sesame, peanut, maize, cassava and pigeon pea. In some areas, other tree crops such as jackfruit, mango and fuelwood trees are associated with cashew

(Lay, 1998). In Sri Lanka, creeping cover crops such as *Pueraria phaseoloides*, *Centrosema pubescens* and bush cover crops such as *Gliricidia maculata*, *Leucaena leucocephala* and nitrogen-fixing trees such as *Acacia mangium* are the principal cover crops used in cashew growing areas. Due to frequent fire hazards, most large-scale plantations have fire gaps laid down when cover crops are grown. Banana is a popular inter-crop in many cashew plantations. Pineapple, papaya, pomegranate and coconut are also used as semi-perennial and perennial inter-crops. The common annuals grown in cashew plantations are Legumes (cowpea, black gram, and green gram), oil crops (sesame, groundnut) and condiments such as hot pepper and onion (Surendra, 1998).

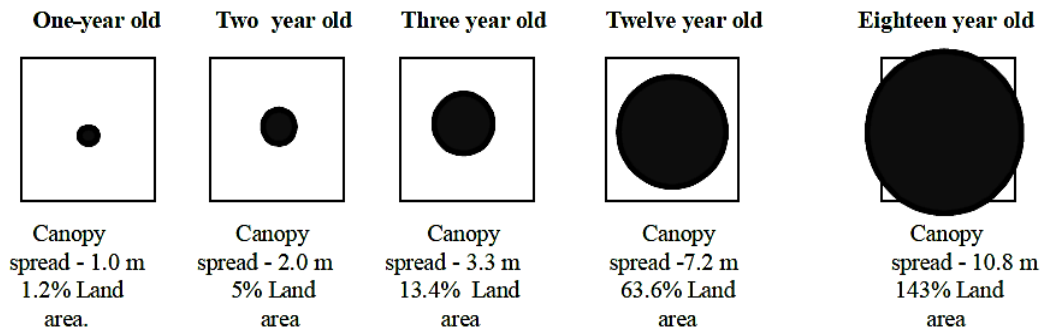


Figure 2: A canopy development pattern about age. (Source: Adiga and Kalaivanan, 2017)

A systematic intercropping system involving compatible crops with varying morphological and rooting habits will enable better resource use and more returns. Biennial horticultural crops like pineapple, banana and papaya and annual food crops like cowpea and tapioca are suitable inter-crops in cashew. In addition, pepper and pomegranate also come up nicely, along with cashew. Cashew grafts are generally planted at a spacing of 7.0m×7.0m to 10.0m×10.0m. In the first year, when planted at a spacing of 7.5m×7.5m (177 plants ha⁻¹), the crop utilizes minimal land area. The canopy development pattern of cashew about age is illustrated in Figure 3 (spacing of 7.5m×7.5m). During the first year, cashew uses hardly 1.2% of the land area provided for the crop. The canopy coverage is only 5% and 13.4% during the second and third years. This pattern of canopy development offers tremendous scope for intercropping in cashew during the early years.

3.12 Income Potential

In fiscal 2019-'20, about 1,323 tons of cashews were produced, up 32.3% from a year earlier, according to data from the agriculture ministry. A kg of cashew nut sells between BDT 800 (9.34 USD) and BDT 1,700 (19.84 USD), depending on the quality in the local market. So, around 2,000 farmers are currently engaged in commercial cultivation of cashew, especially in the hill tract areas, tempted by the high nut price in the local market Green Grain Cashew (Irani, 2020). The processing industry was the country's first cashew nut processing industry to get an order to supply 16 tons of processed cashew nuts to Dubai. Bangladeshi cashew nuts are tastier than the Indian or Vietnam varieties. A Bengal businessperson ordered the 500 kg of cashew nuts for his departmental shops in England.

3.13 Comparison with Other Crops

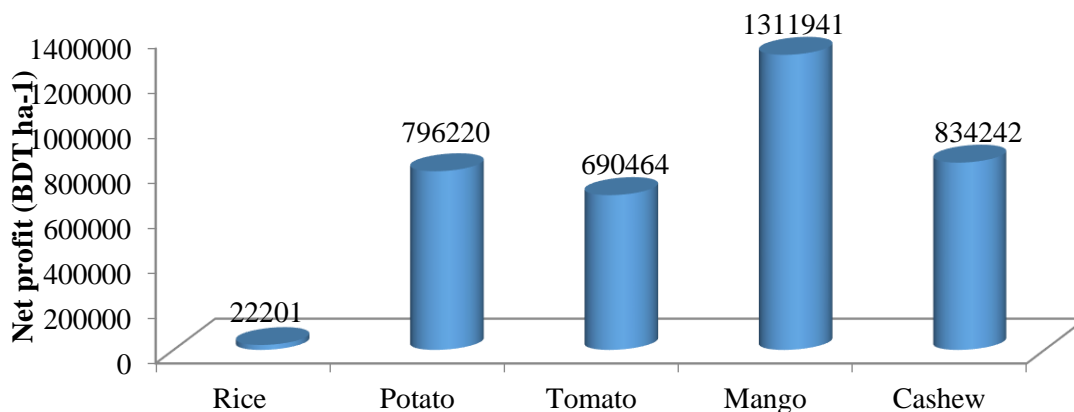


Figure 3: Comparison of profit among different types of crops. [Source: Rice, Potato, Tomato, Mango, Cashew] (Akter et al., 2019; Mukul et al., 2013; Zaman et al., 2006; Rahman et al., 2019; Verma et al., 2014)

Jackpot Cashew Nuts Industries started producing an assortment of cashew-nut-based foods earlier this year to cash in on the growing demand for heart-healthy snacks.

They received orders from Spain and Germany to export 30 tons each month for USD 7.5 per kg. The jackpot industries started producing fresh cashews in June 2016 and now have opted to introduce these new items, where 90% of the workforce was female. If we can develop these industrial crops and its processing sector, Bangladesh can also earn much foreign currency by exporting processed cashew nut products, as we have a tremendous amount of workforce to utilize in this sector at a lower wage than Vietnam and India. So cashew nuts are the new hope for earning foreign currency (Asaduzzaman and Shabuj, 2020). Bangladesh Steel Re-Rolling Mills (BSRM) will invest BDT 5,00,000,00(583,487 USD) to set up a cashew nut processing plant at the Bangabandhu Sheikh Mujib Shilpa Nagar (BSMSN), a move that will boost the local economy and encourage farmers (Chakma, 2020). Cashew is a high-value cash crop that can contribute significantly to farm household incomes.

In Ghana, cashew is expected to play the role of money-spinner or the 'new cocoa' and is considered an important crop to broaden and diversify the current export base (Ajayi and Place, 2012). However, the vast majority of raw cashew nuts are currently exported to India, where they are processed as Ghana only has 12 small processing companies with a capacity of merely 2,137 tons per year (whereas total production equaled 26,454 tons) (Heinrich, 2012). Addressing these issues can result in higher margins for cashew farmers and a higher overall contribution of cashew to our economy as a whole.

The Figure 3 represents that from 1 ha of rice, which is our main field crop, we get 22,201 BDT; from 1 ha of potato, which is the most giant cultivated tuber in our country, we get 7,96,220 BDT (Akter et al., 2019; Mukul et al., 2013). Again, summer tomato is a high-value crop in our country, from which we get 6,90,464 BDT ha⁻¹. (Zaman et al., 2006). Mango is the most popular fruit crop in our country which needs intensive care, and from 1 ha of 6-7 years old orchards, we get 13,11,941 BDT; and from 1ha of 6-7 years old cashew orchards, we get 8,34,242 BDT, which can be grown in fallow lands and needs not much care like other crops, is found here the 2nd highest in terms of monetary return (Rahman et al., 2019; Verma et al., 2014). So, we can suggest commercial cashew cultivation in Bangladesh.

3.14 Import Compromise

The cashew nut production in Bangladesh was 1,323 tons in the fiscal year 2019-'20, which was 32.3% higher than a year earlier, and the raw nut export earning was 3,57,000 USD in the 2019-'20 fiscal year (Milad, 2020). The annual demand for cashew in Bangladesh is around 50,000 tons, and we mainly depend on imports to fulfill the current requirements (Irani, 2020). The requirement gap is 48,677 tons (Figure 4). This gap should be fulfilled to reduce the dependency on the import of cashew nuts.

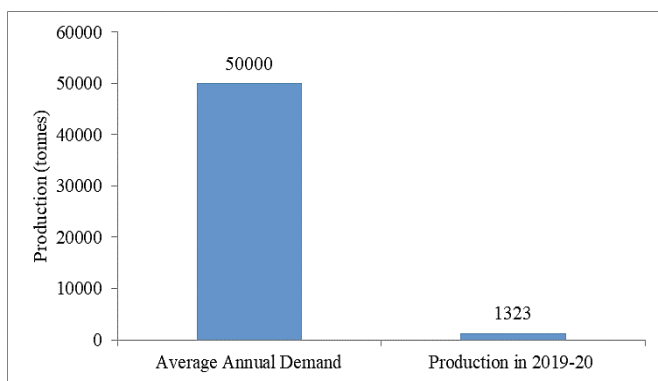


Figure 4: Comparison between cashew production and demand.

3.15 Possibility of Growing in Southwest Coastal Areas

Cashew is a fast-growing evergreen tree and is salt and drought tolerant (Subasinghe, 2004). Thus, cashew is suitable for growing in the coastal saline areas of Bangladesh. Cashew might be one of the agricultural products with tremendous potential for increasing foreign exchange and employment in Bangladesh. Despite favorable agro-climatic conditions, internal demand and export opportunities, there are still no initiatives to popularize cashew cultivation in Bangladesh. Bangladesh's southwest coastal areas could be a growing hub soon as cashew withstands and can grow in salinity-stricken soils. Agriculture is a dominant activity in the coastal economy of India, but it is poorly performed. Cashew has been traditionally grown in India's western and eastern coastal regions. However, non-traditional areas, such as the coastal region of some states viz., Karnataka, Gujarat, Maharashtra, Chhattisgarh, and Jharkhand and north-eastern states, are presently making headway in cashew cultivation as a horticultural crop. In the Bastar region of Chhattisgarh, cashew cultivation has gained importance as the main crop in recent years (Verma et al., 2014). Again most of the coastal areas in 46 countries across Africa, Asia, Latin America and the Caribbean are major production regions of cashew nut (UNCTAD, 2021).

In the study area, farmers previously cultivated many crop varieties (> 35 different annual crops) with minimal inputs in traditional practices. They only cultivate 3-to 4 annual crops and perennial fruit varieties for subsistence needs and increase their cash income. Trends in these changes were observed during the scoping study. In recent decades, the cultivation of cash crops, fruits and monoculture tree plantations has increased in Chittagong Hill Tracts (C.H.T.). People cultivate a single crop or a mixture of crops (two to three types) and fruit trees. Trees and paddy land – a standard agroforestry system and fruit- and tree-based intensive agroforestry system in Khagrachhari are prevalent (Ahammad and Stacey, 2016). Forest and agrarian changes in the C.H.T. region of Bangladesh are occurring gradually. The annual crop cover includes spices (turmeric and ginger) with rice paddy, cotton, maize, vegetables, beans and seasonal fruits (mainly lemon, mango, jackfruit and cashew apple).

The Krishi Gobesona Foundation (K.G.F.) of Dhaka (a Bangladesh government-sponsored research funding agency) indicated in a paper (2011) that the production of cashew crops has a significant growth possibility in Bangladesh. In contrast, when one looks at neighboring India, it is impressive to find the level of development of the cashew industry. Portuguese colonials brought cashew plantations to India more than two hundred years ago. Indians consume cashews in nuts and liquor and have exported cashew nuts for decades. On the other hand, cashew as an agricultural crop has not been established in Bangladesh. Similar soil and weather conditions in the Indian states of Andhra Pradesh and Odisha have been growing cashews for at least a century. Vietnam started its production of cashews in 1988 and has emerged as one of the world's leading nut producers. In 2013, it ranked as the most prominent producer globally, with more than 25% of the total world production of approximately 4.5 million metric tons.

3.16 Problem Confrontation

3.16.1 The Rank Order of The Problems as Confronted by Cashew Producers

The farmers of the study area confronted 16 problems to a different extent. The Problem Confrontation Index (PCI) score and percent data were also arranged in rank order presented in Table 4, indicating that the lack of processing for nuts and apples was the most significant severe problem. This problem ranked first might be due to the lack of cashew processing centers/industries in Bangladesh. Lack of quality seed/seedlings/grafts and proper training on cashew cultivation is second and third-ranked problems for the farmers, which directly influence production. Similarly, the non-availability of quality planting material was the fifth and sixth-ranked problem in Tamil Nadu and Andhra Pradesh, whereas it was ranked fourth in Kerala (Venkattakumar et al., 2004). Training on general management practices of cashew, viz., fertilizer application, irrigation management, and soil and water conservation measures, was the second-ranked need in Maharashtra and Tamil Nadu and the third-ranked need in Kerala Andhra Pradesh (Venkattakumar et al., 2009). Therefore, the Ministry Of Agriculture can take necessary action to ensure quality seed/seedlings/grafts and training for the cashew farmers.

Less market price of cashew nut get by the farmers was another most common severe problem (4th) due to the intermediaries and lack of proper marketing channel or linkage. In India, low price for raw nuts due to intermediaries' involvement was the third and eight ranked problem in Tamil Nadu and Andhra Pradesh, respectively (Venkattakumar et al., 2009). Wide price fluctuation in the market for raw cashew nut as the significant constant (rank first) was found in Dakshina Kannada, Karnataka (Sajeev and Saroj, 2015). On the other hand, the farmers had low problem confrontation regarding the problem insect in fruit (15th) and the high price of organic/chemical fertilizer (16th). These findings indicate that the production cost of cashew will be minimum for the producer and if the government takes the necessary step to ensure the correct market price of cashew through the processing center/industry along with the proper marketing channel, then cashew will be an essential cash crop for Bangladesh.

A study was done in 1965, titled Reconnaissance Soil and Land Use Survey, the Chittagong Hill Tracts by the Soil Resources Development Institute, Ministry of Agriculture, provides an instrumental and fascinating historical perspective on the livelihoods of the hill tracts area (SRDI, 1986). During this period, incomes are so low that neither savings nor investment can take place on any significant scale within the agricultural industry, thus restraining growth within the sector. The level of dependence on own-farm production is exceptionally high. The use of the land is extensive rather than intensive, and farmers are not making the most effective use of the land available to them. As a result, yields per acre, output per worker, and volume of business are low. This situation discouraged the development of processing industries." Land Management Practices in the Chittagong Hill Tracts and Sustainable Alternatives also provide exciting background and perspectives. Another research in 2017 is very much aligned with those described above. The 1965's study says that the problems most commonly mentioned by farmers include: "inadequate assistance in the form of fertilizer, seedlings and extension advice, difficulties of access to market centers, and inadequacies in credit and marketing arrangements." Again, it is difficult to conclude anything other than these fifty years.

Table 4: The Rank Order of Problems is Based on The Problem Confrontation Index

Sl. No.	Problems	Magnitude of Problems				PCI			
		Severe (3)	Moderately Severe (2)	Negligible (1)	Not at All (0)	Total	Score	Percent	Rank
1.	Lack of Cultivable Land	0	0	9	54	63	9	4.761	14 th
2.	Lack of Quality Seed or Seedling	17	45	1	0	63	142	75.132	2 nd
3.	High Price of Seed or Seedling	3	18	4	38	63	49	25.925	6 th
4.	Lack of Proper Training	17	40	6	0	63	137	72.486	3 rd
5.	High Price of Organic or Chemical Fertilizer	0	0	7	56	63	7	3.703	16 th
6.	Lack of Quality Pesticide	0	3	8	52	63	14	7.407	11 th
7.	High Price of Pesticide	0	6	3	54	63	15	7.936	10 th
8.	Cashew Tree Is More Susceptible to Pest	0	1	8	54	63	10	5.291	13 th
9.	Insect in Fruit	0	1	6	56	63	8	4.232	15 th
10.	Less Production	2	4	18	39	63	32	16.93	7 th
11.	Fruit Dropping		4	9	50	63	17	8.994	9 th
12.	Less Market Price	16	43	3	1	63	132	69.841	4 th
13.	Thief		1	9	53	63	11	5.820	12 th
14.	Lack of Storage	9	11	10	33	63	59	31.217	5 th
15.	Lack of Processing Industry	52	6	2	3	63	170	89.947	1 st
16.	Natural Calamities or Disaster	3	8	5	47	63	30	15.873	8 th

Source: Field Survey, 2019

3.16.2 Problem Confrontation Categories

The problem confrontation scores of the cashew farmers ranged from 7 to 29, with a mean and standard deviation of 13.17 and 5.07, respectively.

Based on possible problem confrontation scores, the 63 cashew farmers have been classified into three categories, as shown in Table 5. Most of the farmers (79.4%) had low problem confrontation, while 20.6% of the farmers had medium problem confrontation. None of the farmers had high problem confrontation.

Table 5: Distribution of The Respondents According to Their Problem Confrontation Score.

Categories	Score	Distribution of Respondents (N=63)		Mean	SD	Range	
		Number	Percentages			Min.	Max.
Low Problem confrontation	1-16	50	79.4	13.17	5.07	7	29
Medium Problem confrontation	17-32	13	20.6				
High Problem confrontation	>32	0	0				

Source: Field survey, 2019

Many unsolved issues regarding cashew nut production are the outcomes of the prevalence of existing problems. Therefore, good government policy and extension measures should be undertaken to help the cashew farmers to overcome those problems so that cashew nut production gets popular and higher production could be obtained in terms of both quality and quantity for export.

3.17 Personal Socio-Economic Characteristics

In the stud area, different groups of tribal people considered 'jhum' cultivation as a part of their means of living and culture. However, as population pressure increases with time, the increasing demand for food and other necessary amenities for modern life cannot be met by outdated 'jhum' cultivation. Therefore, many farmers have started using a modern system of crop cultivation. To increase income by decreasing soil nutrition and water availability, they are cultivating high-value horticulture crops; Fruit species are familiar sources of household foods and cash incomes in the region. The principal fruit crops are banana, pineapple, papaya, jackfruit, guava, lemon, litchi, mango, cashew apple, and orange.

It was found that the majority of the respondents (66.7%) were middle-aged as compared to (6.3%) young aged and (27 %) old aged. It might be said that middle-aged people are more engaged in cashew cultivation (Table 6). Cashew farming requires laborers, which is also gender-sensitive. The entire respondent in the study was male. (Uwagboe et al., 2010) also found that most of the cashew farmers were male in a case study of Oriri L.G.A of O.Y.O. state, Nigeria. Male domain cashew farming activities were also observed in the study area because women can cultivate arable crops on their husbands' plots, while access to permanent crop production is usually restricted to men (Abubakar, 2013).

About one-fifth (23.8%) of the respondents had primary and secondary levels of education, followed by illiterate (22.2%) and (19%) can sign only. Only 3.21% of the respondents had above higher secondary level and 8% had a higher secondary level of education. It has been clear from the study that all the respondents involved in cashew production had not been highly educated (Table 6). It reveals that farmers' level of education would enhance their farming activities and level of awareness.

More than half (52.38%) of the respondents' families belonged to a medium-sized family, followed by a small family (41.27%), while only 6.35% belonged to a large family. It can be suggested that there is a great scope for using family labor for cultivating cashew as horticultural crops; many of the operations can be done by women and some by household children along with the other family members. In the Gambia, cashew nut production is men's domain activity while women are engaged in nut picking and collection (Saikou and Ebrima, 2018). In Kogi State, Nigeria, the same result was observed (Jacob et al., 2019). The majority (65.1%) of the respondents had medium farm sizes equally to small and large (17.5%). None of the respondents belongs to the landless and marginal farm categories. This result represents the study area's great scope for commercial cashew cultivation. Banerjee also suggested that the Chittagong Division in southeast Bangladesh is an area where an integrated cashew plantation project should be initiated (Banerjee, 2016). The area already has a few cashew plantations.

Most of the respondents (98%) had medium to high experience in farming, with an average experience of 27.16 years in agriculture. Moreover, 60.3% had medium and 31.8% of respondents had high experience in cashew farming, followed by low experience (7.9%) (Table 6). Agriculture farming is an already established enterprise in hill tracks, but commercial cashew

farming is a comparatively new approach for ensuring the utilization of the fallow hilly areas. These findings are in line with that of (Shivaramu et al., 2004; Veerker et al., 2006; Venkattakumar, 2006, 2008, 2009). On the other hand, the majority (41%) had low experience in cashew farming with an average experience of 10.5 years only.

These findings align with Venkattakumar but contrast with studies conducted in the same region (Venkattakumar, 2006; Veerker et al., 2006). The majority (46.0%) of the respondents belonged to the higher income group as compared to the medium (33.3%) income group and low income

(20.6%). Most (100%) of the respondents had low organizational participation. The majority of the respondents (54.8%) had medium-scale extension media contact, followed by low scale extension media contact (45.2%). None of the respondents belongs to the high contact categories (Table 6). Extension media contact was insufficient, which caused difficulty in overcoming agriculture and cashew production problems. The majority (96.8%) of the respondents expressed a favorable attitude, while 3.20% were moderately favorable and there were no respondents with a less favorable attitude. This finding also indicates prospects for cashew cultivation.

Table 6: Distribution of The Respondents Based on Selected Socio-Economic Characteristics.

Characteristics	Categories	Score	Respondents (N= 63)		Min.	Max.	Mean±SD
			Number	Percent			
Age (Year)	Young	≤35	4	6.3	32	68	46.66±7.87
	Middle	36-50	42	66.7			
	Old	>50	17	27			
Educational qualification (Schooling year)	Illiterate	0	14	22.2	0	14	4.45±4.42
	Can sign only	0.5	12	19			
	Primary	1-5	15	23.80			
	Secondary	6-10	15	23.80			
	Higher Secondary > Higher Secondary	11-12 >12	5 2	8 3.20			
Family size (Number)	Small	≤4	26	41.27	2	12	4.94±1.44
	Medium	5-6	33	52.38			
	High	>6	4	6.35			
Farm size (ha)	Landless	<0.02	0	0	0.24	7.00	2.19±1.35
	Marginal	0.02-0.20	0	0			
	Small	0.21-1.00	11	17.5			
	Medium	1.01-3.00	41	65.1			
	Large	>3.00	11	17.5			
Experience in agriculture (Year)	Low	≤10	1	1.59	5	45	27.16±7.58
	Medium	11-20	14	22.22			
	High	>20	48	76.19			
Experience in cashew cultivation (Year)	Low	≤5	5	7.9	4	20	9.83±3.36
	Medium	6-10	38	60.30			
	High	>10	20	31.80			
Annual income ('000'BDT)	Low	≤120	13	20.60	100	626	221.777±122.434
	Medium	120.001-150	21	33.30			
	High	≥150	29	46.00			
Organizational participation (Score)	Low	≤7			0	5.00	1.06±1.50
	Medium	8-14	63	100			
	High	>14					
Extension Contact (Score)	Low	≤13	53	84.12	1	3	1.31±0.53
	Medium	14-26	10	15.87			
	High	>26	0	0			
Attitude towards cashew cultivation (Score)	Less favorable	≤7	0	0	12	25	19.85±2.16
	Moderate	8-14	2	3.20			
	Favorable	>14	61	96.80			
	Favorable						

Source: Field survey, 2019

3.18 Relationship and Contribution of Variables Towards Income From Cashew

The findings related to the relationship of selected characteristics and their contribution toward farmers' earned money from cashew and the problem score appear in Table 7. Among 19 selected characteristics, farmers' education, annual income, income from agriculture, farm size, land suitable for cashew, land under cashew, Number of the cashew tree, Number of the fruiting cashew tree, total production(t), sold cashew (kg) attitude and income from cashew (B.D.T.ha⁻¹) had a significant positive contribution towards earned money from cashew. Sajeev also found cultivable land available, the Number of yielding cashew trees, net income

from agriculture, and significant relationship with the socio-economic impact of cashew cultivation (Sajeev, 2015). Land under fruit at home had a significant negative relation with income from cashew. This result implies that land under the home is already occupied by different fruit trees in the study area. The Number of fruit per kg showed a negative Correlation with earned money from cashew indicates the quality of fruits, which means less Number of fruits in a kg get more prices in the market. The problem score had only a significant negative Correlation with land suitable for cashew cultivation (ha) which indicates that as suitable land is available for cashew cultivation, the problem score is less and there is an excellent scope for cashew cultivation.

Table 7: Relationship and Contribution of Selected Characteristics Towards Farmers' Income from Cashew and Problems (Pearson's Product Moment Coefficient of Correlation).

Personal Socio-economic Characteristics and Cashew Tree Characteristics (Independent Issues)	Correlation Coefficient (r) of Earned Money from Cashew	Correlation Coefficient (r) of Problem Score
Education (Years)	0.473**	-.152 NS
Annual Income (BDT)	0.696**	.118 NS
Income From Agriculture (BDT)	0.824**	.104 NS
Farm Size (Ha)	0.415**	-.177 NS
Land Suitable for Cashew Cultivation (Ha)	0.854**	-.263*
Land Under Cashew Cultivation (Ha)	0.982**	-.155 NS
Land Under Fruit at Home (Ha)	-0.291*	-.017 NS
Number of Cashew Tree	0.800**	-.209 N.S.
Number of Fruiting Trees	0.982**	-.155 NS
Age of Tree (Years)	0.103NS	-.039 NS
Yield Tree ⁻¹ kg	0.216NS	.010 NS
Fruit Number Kg ⁻¹	-0.287*	-.204 NS
Total Production(T)	1.000**	-.140 NS
Sold Cashew (Kg)	1.000**	-.140 NS
Attitude (Score)	0.377**	-.045 NS
Earned Money from Cashew (BDT)	1	-.140NS
Problem Confrontation (Score)	-0.140NS	1
Yield (Tha ⁻¹)	0.216NS	-.028 NS
Income from Cashew (BDT Ha ⁻¹)	.281*	-.119 NS

NS=Non-significant.*Correlation is significant at the 0.05 level (2tailed).**Correlation is significant at the 0.01 level (2tailed).

4. CONCLUSIONS AND RECOMMENDATIONS

Cashew cultivation status was found 'not up to the mark' in the study area. Most of the farmers (65%) owned medium-size farms, and cultivated cashew varieties were local (89%) in origin. The cashew yield was medium (1.40 to 1.80 t ha⁻¹), with an individual tree yield ranging from 3 to 8 kg. More than two-thirds (68.3%) of the farmers earned BDT 1,20,001-1,80,000 ha⁻¹ from cashew cultivation. An average of 0.89 ha of land could still be taken under cashew cultivation. The net profit potential of 8,34,242 BDT ha⁻¹ (equivalent to 9,706.69 USD) is possible from cashew cultivation which is much higher than other crops. This proves that the prospect of cashew cultivation is of high economic potential. Farmers confronted problems medium. Lack of processing for nuts and apples was the highly severe problem, followed by lack of quality seed or seedlings. Among 19 selected characteristics of the respondents, education, annual income, income from agriculture, farm size, land suitable for cashew, land under cashew, cashew variety, number of the cashew tree, fruiting tree, total production per tree and attitude had a significant positive relationship and home under fruit showed a significant negative relationship with income from cashew. So there is an excellent scope for cashew cultivation in Bangladesh. If the government takes the necessary step to ensure the correct market price of cashew through the processing center or industry and the proper marketing channel, then cashew will be an essential cash crop for Bangladesh. Furthermore, the findings suggest that the government should improve knowledge, adoption and attitude towards cashew cultivation and increase cashew yield in Bangladesh.

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