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Profitability of Litchi Cultivation in Some Selected Areas in Dinajpur District of Bangladesh

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Abstract: The present study was undertaken to examine the costs and returns of producing litchi by using both primary and secondary data. The primary data were collected in the production period of litchi during March to May through direct interviews. Considering the scope and potential of litchi production, this study was based on a sample survey and employed farm level cross section data of total 80 litchi growers. In the first stage, one litchi growing district (Dinajpur) with four Upazilas was selected randomly. In the second stage, two villages from each Upazila were selected randomly. Descriptive statistics were employed for analyzing the data and testing the hypotheses of the study. This study shows that litchi production has greatly influence on the socio-economic condition such as age, literacy rate, occupation, training received, household income and expenditure of litchi growers. The major findings of the present study revealed that litchi production was profitable to the litchi growers. The production of litchi largely depends on its age and climate during the four months of litchi production. Per acre total cost, gross revenue, gross margin and net revenue of litchi production were estimated at Tk.118245.72, TK. 241450, TK. 196816 and TK. 123204.28 per season i.e. per year production of litchi is profitable. But it is difficult to get the overall figures of cost and production of the whole life of litchi within one season of production. In the study area, litchi orchards were leased out by the owner for 1 to 6 years which is known as Deed. Because of primary data collected from respondent and reviewed by other agricultural personnel BCR was calculated 2.04Tk. It indicates that the litchi production project is acceptable and highly profitable. The study also identified some problems and constraints faced by the litchi growers which hindered the higher production and yield of litchi and suggested some recommendations to improve the present production situation. This study would be a guideline for further research about other fruit crops like mango or jackfruit and the result of this study would help the planners and policy makers to formulate suitable policy for increasing litchi production in Bangladesh.

Keywords: Household Income; Profit; BCR; Litchi production; Agriculture.

1. Introduction

Bangladesh is mainly an agricultural country with an area of 147570 sq. kilometer. The total population of this country is 163.61 million with an annual growth of 1.27 percent. The population density of this country is 1253 persons per sq. kilometer (BER, 2019). Agriculture is the main economic activity in Bangladesh. This sector has a large impact on employment generation, poverty reduction, food security and human resource development. It is known as the main source of food as it has crops, livestock and fisheries sector. We get from this sector: industrial raw materials, timbers used in construction and foreign exchange for the country by exporting agricultural commodities those may be raw or processed.

The cropping intensity of Bangladesh is now 193 percent (BBS, 2018). Bangladesh has about 14.943 million hectares of total cropped area. Out of total cropped areas, 2.23 million hectares are single cropped, 4.107 million hectares double cropped and 1.485-million-hectare triple cropped areas. Rice, wheat, pulses, oilseeds, vegetables, sugarcane and potato are the major crops grown in Bangladesh among which rice is the staple food grown in all the three seasons (BBS, 2018). In Bangladesh the major cereals are rice and wheat; the minor cereals include barley/jab, joar, bazra, cheena and kaon; of the oil seeds, rape and mustard are most important. Fiber crops include jute, cotton, hemp and kenaf. Jute dominates among fiber crops having about 737000 metric tons annual production (Banglapedia, 2019).

Being an agro-based country, different agricultural product provides economic return to Bangladesh. But all the agricultural products do not give higher returns. In every region production of agricultural commodities differs based on different agro-ecological zones. Based on soil criteria and temperature litchi grow well in Dinajpur district. Bangladesh is a country whose economy is largely based on agriculture which contributes about 13.35 percent to the Gross Domestic Product (GDP) at constant market prices. The growth rate of GDP in Bangladesh depends on the performance of crops, fruits and vegetables. In the year 2017-2018 the total area under litchi cultivation is about 40889 acres and total annual production is about 94160 metric tons (BBS, 2018) fruits such as mango, litchi and jackfruit etc. although its losses due to natural calamities like storm of April or May (known as kal boishakhi). A significant position of agriculture is also embedded in its role as provider of employment for rural labor forces. About 80 percent of the total population of the country live in rural areas and are directly or indirectly engaged in a wide range of agricultural activities. About 40.60 percent of the labor forces are employed in agriculture. High population growth with declining death rate together with low growth in agricultural productivity adversely affects the living standard in the country. Land is the basic resource of human society. Because of the rapid growth of population and indiscriminate destruction of forest, it is difficult to meet the huge demand for timber, fuel, food and fodder and maintaining ecological balance. Litchi cultivation is one of the most important income sources for small-scale farmers. This change in litchi cultivation endangers sustainable land use and accelerates soil erosion. To avert such developments, supportive measures to find upgrading possibilities within the value chain of litchi that put the upland in a more strategically advantaged position are required.

The present fruit production situation is not sufficient to meet domestic requirements. The long-term fruit production growth rate was less than the population growth rate, and the price of fruit increased in subsequent years due to rapid population growth, lower per capita arable land and less developed agricultural production system. In Bangladesh, arable cultivable land is limited and there is little scope to expand. So, to increase the litchi production, productivity of litchi should be increased through adoption of improved technology and integrated farming of litchi with other crops. The nutritional value of fruits places them on the crest of our edibles. Fruits contain vitamins and minerals in large quantities. Fruits are the oldest food of mankind. Taking fruits everyday strengthens our vitality. Nutrition scientists advise us to take at least 115 grams of fruit every day for a balanced diet. But at present our country has the capacity to provide each of us with only 38 grams of fruits every day (Chowdhury, 2019).

2. Justification of the Study

Litchi is decidedly a delicious, highly nutritious and popular fruit. It has also commercial fruit. In the context of Bangladesh, it is grown in limited areas for consumption and commercial purpose. But the demand of litchi exists all over the country. Adequate care is not taken for its cultivation and proper marketing. There is no special program of the government to develop its cultivation and marketing. Litchi is a highly perishable fruit that requires careful handling and quick marketing. No modern storage facilities for litchi have yet been developed in the country. As the fruit rotten soon and need time to reach the purchasers, therefore, becomes a compulsion. So, selling litchi at a reasonable price and at desirable times are the major problems. It is reported that litchi growers are not getting fair price due to the lack of proper marketing facilities and urgency of money required by growers immediately after its harvesting. A large portion of litchi produced is reported to be wasted. Moreover, due to continuous increase in the cost of carrying and freight charges, this small producer and the local traders are not getting fair returns by marketing litchi. In the past there was no adequate study on production of litchi as such it felt that a study on production of litchi could be of much importance. It is hoped that the findings and specific suggestion from the study will help the producers, trader, consumers, extension workers and researchers in their efforts for the improvement of production and marketing of litchi in Bangladesh.

3. Objectives of the study

The main aim of the study is to identify and explain possibilities for improving productivity and profitability of litchi by increasing the efficiency of litchi. The specific objectives of this study are as follows:

a) To assess the socio-economic characteristics of litchi growing farmers.
b) To calculate the profitability of Litchi cultivation.
c) To explore the problems and constraints faced by the litchi growing farmers.

We need fruits for economic reasons too. Most fruit trees live for years. Fruit farming is quite profitable although it may be a little expensive at the beginning. Fruits can be processed for preservation in many ways. For example, different kinds of healthy foods like jam, jelly, candy, etc. and drinks can be made from fruits. Some fruits can be dehydrated for marketing.

Orchard means a long-term establishment and maturity period investment and careful planning is essential to ensure economic success. Litchi orchard is no exception in this regard. Knowledge of investment costs to establish the orchard and

to analyze production and return analyses for this crop is needed to help growers assess profitability and evaluate future ventures.

4. Review of Literature

Hossain *et al*. (2011) made an extensive survey on the incidence and severity of nursery diseases of litchi in different locations of major fruit growing areas of Bangladesh. In addition, they were working on isolation and identification of disease causal organisms. Moreover, management of nursery diseases was their main target of research.

Coates *et al*. (2003) studied diseases of litchi, their distribution, importance and control of diseases of litchi (Litchi chinensis) with characteristics and production of the fruits. Saponins in litchi may be responsible for the paucity of major diseases in these crops. Root roots (*Annillariamellea* and *Annillariasodalis*) and diebacks (associated with *Hemicriconemoides mangiferae* and Xiphinemabrevicolle) tend to be exacerbated by water stress and leaf spots and flower blights do not tend to be serious. A wide range of fungi are reported to cause postharvest disease if fruit are not handled correctly, including *Alternaria*, *Aspergillus*, *Fusarium*, *Cladosporium* and *Penicilliumspecies*.

Ghosh (2000) revealed that, in India litchi is grown mainly in the states of Bihar, West Bengal and Uttar Pradesh. It is also grown in limited scale in Tripura, Orissa, Punjab, Himachal Pradesh, Assam and the Nilgiri hills in the south. Current production of litchi is about 429,000 tons from an area of about 56,200 hectares.

Aklimuzzaman (2011) revealed that, the fruit quality attributes of three commercially important litchi varieties of Bangladesh, namely 'Bombai', 'Bedana' and 'China 3'. Physico-chemical parameters such as peel color, pericarp browning, weight loss, dry matter content and pulp pH to increase with the duration of storage, whereas moisture content and vitamin C content decreased with the progress of storage. Among the varieties, changes in the above parameters were slower in 'Bedana' as compared with 'China 3' and 'Bombai'. On the other hand, pulp to peel ratio and TSS increased initially but declined afterwards in all varieties. The level of disease incidence and severity increased proportionally during the storage period. Fungal pathogens like Aspergillus spp, Rhizopus spp and Penicillium spp were identified from the infected fruits. Significant difference in respect of shelf life was also observed among the varieties. The longest shelf life was observed in 'Bedana' (3.75 days) as compared to those of 'China 3' (3.07 days) and 'Bombai' (2.08 days) varieties.

Ting *et al.* (2014) Publish Chemistry Central Journal which identified that Fruit was treated with pyrogallol at 1 mm and then stored at ambient temperature (25°C) or low temperature (4°C). Compared with control, pyrogallol significantly reduced pericarp browning and delayed the rotting of fruit day 4 at 25°C, and on day 30 at 4°C. The chemical treatment reduced respiration rate and the activities of peroxidase (POD) and polyphenol oxidase (PPO) and delayed the loss of membrane permeability. Pyrogallol increased the activity of phenylalanine ammonia-lyase (PAL), delayed the loss of anthocyanin and phenolics, and maintained high 2, 2-dipheny 1-1-pieri hydrazyl (DPPH) radical scavenging activity and reducing power.

Molla *et al.* (2010) investigated that the postharvest losses were reported mainly at harvesting (8.0%), handling from orchard to selling point by the growers and beparies involved in harvesting (4.61%) and after buying to consumption by the consumers (7.5%). Considering the channels involved in litchi marketing, the growers and beparies engaged in harvesting had the highest percentage of losses (16% in Dinajpur, 12% in Ishwardi, and 11 % in Natore) followed by the consumers (7.5%).

The above-mentioned discussion and review indicate that literature on production of litchi was considerably inadequate particularly in Bangladesh. Several attempts were made to investigate socio-economic aspects of litchi cultivation in other countries, but no systematic study was available in Bangladesh regarding litchi production. Therefore, the present study will generate valuable knowledge and information which would be highly useful both at micro and macro level. Government Organization and NGOs and policy makers for formulating appropriate policy for widespread cultivation of litchi in Bangladesh.

4. Methodology

4.1 Study Area and Population

Selection of the study area, which is an important step, largely depends on the objectives set for the study. Selection of the area depends on several factors like availability of data, purpose of the study, access to the area and the possible cooperation of the litchi growers. Before selecting the study area some preliminary visits were made by the researcher himself to a few villages to get acquainted with the respectable persons, Sub Assistant Agricultural Officer (SAAO) and the litchi growers. Based on preliminary information received, four villages namely, Masimpur, Nashipur, Madhobbati and Mongolpur from Dinajpur district were selected as the study areas to address the specific objectives. The reasons for selecting these areas were.

4.2 Study Design and Sampling Techniques

It was impossible to interview all the litchi growers in the sample areas due to the limitation of time and resources. For this reason, reasonable sizes of sample litchi growers were chosen which can at least satisfy the objectives set for the study. A simple random sampling procedure was followed to select litchi growing areas. In the first stage, one litchi growing district Dinajpur with two Upazilas (Dinajpur Sadar and Birol) was selected randomly. In the second stage, two villages from each Upazila were selected randomly. Finally, a total of 80 growers were selected from the collected lists by adopting simple random sampling methods from each village.

4.3 Selection of the Varieties

In the study area different varieties of litchi are produced such as Bombai, Bedana, Madrazi, Chaina-2, Chaina-3, and Mozaffari etc. But Bombai is popular among all the varieties because of its higher production and good taste. However, Bombai litchi 53 sample, Bedana litchi 17 sample, Madrazi litchi 5 sample, Chaina-2 litchi 3 sample, and Chaina-3 litchi 2 sample were selected for this study.

4.3 Period of Data Collection

To satisfy the objectives of the study, necessary data were collected by the researcher himself through personal interview with the sample litchi growers. The duration of data collection was March to May 2023. To obtain reliable data, the researcher visited the study area and introduced himself to the litchi growers.

4.4 Preparation of Interview Schedule

Preparations of interview schedule for collecting data are a crucial need in any socioeconomic survey. Before preparing the final interview schedule a draft interview schedule was developed keeping in view the objectives of the study. Then it was field-tested by interviewing a few respondents for necessary modifications before starting data collection. As a result of pretesting, some items irrelevant to local conditions were deleted and some more understandable points were included. Finally, this edited copy was duplicated, processed and printed for making interviews. The final interview schedule was developed in logical sequence so that the Litchi growers could answer systematically.

4.5 Methods of data collection and source of data

Both primary and secondary sources of data were collected for this study. Primary data were collected through direct interviews by making personal visits were made by the researcher to the selected litchi growers. Normally, the interviews were conducted in the early morning and in the evening because litchi growers were very busy with their work in the daytime. Before starting the interview, each respondent was given a brief idea about the nature and purpose of the survey, and they were convinced that this research was purely an academic one. The questions were asked by the researcher systematically with simple words and were recorded accordingly in the interview schedule. After each visit, the collected information was checked for accuracy and clarification. If there were any missed or overlooked items, the correspondent farmer was revisited.

Initially, data were recorded in local units, for example, locally used unit of land was bigha (1 bigha=50 decimals). Later they were converted into international units after editing. The data were collected from 80 sample litchi growers through personal interview. In addition to field level primary data and information having relevance with this study were also collected.

4.6 Data Entry and Analysis

The data and information collected from field surveys, interviews, discussion and communications were scrutinized, classified, edited and coded. The responses of the respondents were recorded in the interview schedule. Data entry was then done by the researcher himself and analysis was done using the concerned computer software packages Microsoft Excel. A list of tables with their meaningful interpretations were prepared based on the aims and objectives of the study.

5. Data Analysis and Findings

5.1 Socioeconomic Characteristics of the Litchi Growers

Table 1: Age distribution of the selected litchi growers

Age group (years)	Number of litchi growers	Percentage of total litchi growers
Below 30	8	10
31-40	30	37.50
41-50	22	27.50
Above 50	20	25.00
Total	80	100

Source: Field survey, 2023.

Table 1 indicates that the highest number of selected litchi growers was 37.50 percent belonged to the age group of 31-40 years. About 10 percent of the selected litchi growers were in the age group of 20-30 years and that 25 percent were in the group of above 50 years; 27.50 percent were in 41-50 years. So, maximum litchi growers belong to the age group of 31-40 years.

Table 2: Educational status of the selected litchi growers

Literacy level	Number of litchi growers	Percentage of litchi growers
Literate	15	11.67
Up to primary	18	20
Up to secondary	25	33.33
Up to Higher Secondary	22	26.67
Up to graduation and above	10	8.33
Total	80	100

Source: Field survey, 2023.

Table 2 indicates that 11.67 percent were illiterate, that means the majority of the were literate, among which 20 percent were educated up to primary level, 33.33 percent of the selected were educated up to secondary level, 26.67 percent of the selected growers were educated up to higher secondary level and 8.33 percent of selected up to graduation level. So most of the selected litchi growers were educated up to secondary level and they are in need of certain knowledge of farming and technology.

Table 3: Distribution of sample litchi growers according to their main occupations

Occupation	Number of litchi growers	Percentage of total
Agriculture	68	85
Business	8	10
Service	4	5
Total	80	100

Source: Field survey, 2023.

Engaged in other occupations like Vegetable cultivation business and other services (teacher, village doctor etc.). The occupations of selected litchi growers of different categories are presented in Table 3. Most of the litchi growers in the study area were involved in agriculture (85%). Generally, a rational farmer of the study area cultivates rice and is involved in litchi orchard farming. But besides their main occupation 10 percent litchi growers are businessman and 5 percent farmer earn their income from different services.

Table 4: Distribution of sampled litchi growers according to the training received

Location	Number of training receiver	Number of respondents not receiving training
Sadar Upazilla	27	7
Birol Upazilla	29	4
Total amount	56 (70%)	11 (13.75%)

Source: Field survey, 2023.

Training is the most important tool for acquiring knowledge about a technology. It will increase farmer's skill regarding production practices and related aspects. It may be observed from Table 4 that on an average sample litchi growers receiving 70 percent agricultural training. It is noted that 13.75 percent litchi growers had no any institutional training regarding agriculture. Litchi growers of Sadar Upazila received more training facilities than Birol Upazila. This is due to lack of training facilities of litchi cultivation and the distance of the field level workers from the litchi growers for training.

Table 5: Distribution of trees according to varieties

Name of the variety	Number of trees	Percent of the total varieties
Bombai	1810	62.69
Madrazi	721	24.97
Bedana	180	6.23
China-2	103	3.57
China-3	73	2.54
Total	2887	100

Source: Field survey, 2023.

Different varieties of litchi are grown in litchi orchard those are Bombai, Madrazi, China-2, China-3, Bedana etc. among these varieties Bombai is the highest in number of litchi trees are grown which gives comparatively highest yield than others. Madrazi gives lower production than Bombai and it is disease intensive. Bedana is highly demandable among all other varieties, chaina-2 and chaina-3 do not give production in every year. Table 5 shows that the share of Bombai is highest (62.69%) among the total variety.

Table: 6 Average annual heads of expenditures of farm households

Heads of Expenditure	Amount of money (Tk.)	Percent of the total expenditure (%)
Food	75800	25.44
Clothing	25000	8.39
Health care	12123	4.07
Education	50335	16.89
Housing and Furniture	40328	13.53
Housing and furniture	40328	13.53
Farming	87401	29.31
Electricity /fuel	2013	0.67
Miscellaneous	5000	1.68
Total	298000	100

Source: Field survey, 2023.

Table 6 shows annual expenditure of farm households. From the Table it can be seen that the highest expenditure spent on farming (29.31%). For the other sectors such as food, clothing, health care, education, housing and furniture, electricity and Miscellaneous The Percent Of Expenditure Is 25.44, 8.39, 4.07, 16.89, 13.53, 0.67 And 1.68 Percent Respectively.

5.2 Costs and Returns of Litchi Production

5.2.1 Estimation of Production Cost of Litchi

When the cost of inputs deducted from the value of output, then it expresses the profitability analysis. In calculating the production cost some components were considered. Those are human labor, fertilizers, irrigation, insecticides, safety and security operation, interest on operating capital and land rent cost. For the convenience of analysis, cost items were classified into two groups: (a) variable cost and (b) fixed cost.

5.2.2 Variable cost

Variable costs are the cost of using the variable inputs. These costs vary with the level of production and using various inputs such as labor, organic and inorganic fertilizer, irrigation, insecticides and vitamin etc. are considered as variable costs. Costs of using these inputs are discussed below:

5.2.2.1 Cost of labor

Labor required for almost all the operations of litchi production such as fertilizing, insecticide, harvesting, etc. and there were two sources of supply of human labor in the study areas, one was family labor and another was hired labor. Family labor included the farmer himself and his family members. Labor was measured in terms of man-day unit which consisted of 8 hours of work by an adult man. For child and women, man equivalent hours were estimated. The valuation of purchased labor was done as the nominal cash wages paid plus the monetary value of kind payments provided by the litchi growers. Average wages of the purchased labor was taken as the opportunity cost of home supplied labor. In the study area, the average wage rate was Tk. 220.00 per man-day. However, this rate varies from 150 to 250 per man-day basis of different operation of litchi production.

Table7: Operation wise cost of labor in litchi production per acre

Labor types	Cost of labor Tk./man day	No. of labor	Operation wise cost	Percent of total cost
Fertilizer application	300	3	900	6.67
Pesticide application	375	9	3375	25
Irrigation	270	5	1350	10
Harvesting	525	15	7875	58.33
Total		32	13500	100

Source: Field survey, 2023.

5.2.2.2 Cost of fertilizer

In litchi production, fertilizer was applied mainly after harvesting litchi. Sometimes small quantity of fertilizer applied before fruiting of litchi. Fertilizers have slight importance in litchi production. Litchi growers used different types of

fertilizers such as urea, TSP, MP, Boron, Zink and organic manure etc. The total cost of fertilizer was Tk. 2512 in case of litchi production.

Table 8: Per acre cost of applying fertilizer

SL. No.	Types of fertilizer	Quantity (kg)	(Tk./Kg)	Total
1	Organic Manure	11	3	33
2	Urea	9	16	144
3	TSP	7	25	225
4	MP	10	16	160
5	Other	13	150	1950
Total				2512

Source: Field survey, 2023.

5.2.2.3 Cost of Insecticides

Litchi growers used different kinds of pesticide to protect their litchi from the attack of pest and diseases. Name of some insecticides which are used in litchi production are rival, ripcord, nitro, companion, carbon dazing and alba etc. Cost of insecticides was calculated on the basis of actual amount of money paid by the litchi growers. On an average, per acre cost of insecticides was calculated at Tk. 8715 which constituted 7.37 percent of the average total cost of production (Table 9)

5.2.2.4 Cost of irrigation

Irrigation is an essential input for cultivating litchi. Most of the litchi growers had to pay mechanical irrigation water charges and they used manual labor for irrigation. In the study area most of the litchi growers used Shallow Tube Well (STW) for irrigating their litchi orchard. production period litchi orchard need 5 to 7 time irrigation. Considering all the sampled litchi growers, average irrigation cost per acre was estimated at Tk. 3392 which constituted 2.86 percent of total cost of production (Table 9).

5.2.2.5 Safety and security operation

Litchi is a fruit crop. It needs extra care than cereals and Vegetables. Watch man is must in a litchi orchard at the time of fruiting to harvesting to protect the litchi fruit against thief. Year wise extra cost also needed in litchi production such as pruning of branch, fence around the orchard (if the branch lies near to the soil), and covering the fruit for protecting from bird etc. on the basis of this safety and security operation, on an average Tk. 16515 is needed per acre. This is 13.96 percent of the total cost.

5.2.2.6 Total variable cost of production

Total variable cost included all cash expenses/ hired variable input costs and non-variable cost of litchi was Tk. 44634 per acre. However the cost incurred for cultural and management practices include human labor. Some variable cost was quite higher for those litchi growers who have not proper knowledge and training facilities about litchi cultivation.

5.2.3 Fixed cost

Fixed cost are those which do not change in magnitude as the amount of output changes and are incurred even when production not undertaken. The interest on operating capital and land use cost (with litchi tree) were considered as fixed cost for litchi production.

5.2.3.1 Rental value of land (with litchi tree)

Rent of the land (with litchi tree) varies from different period of time (Usually it varies from I to 6 years). Land use cost varies from one place to another depending on the location, soil fertility, topography of soil etc. In the study area rental value of land also varies depending on number of trees per acre and age of the litchi tree within the orchard. On the basis of the information from the sample litchi growers, the rental value of land varies from Tk. 80000 to Tk.125000 per acre. The average amount of rental value of land is Tk. 65332 per acre.

5.2.3.2 Interest on operating capital

Interest on operating capital (IOC) was calculated by taking into account the amounts spent for different operations such as cost for human labor, fertilizers, manure, insecticides, etc. Moreover, not all the operating costs were incurred at the period of litchi production. Interest on operating capital was calculated by taking into account the costs incurred on all field operations but excluding those items for which interest had already been calculated. Interest on operating capital was worked out on the basis of opportunity cost principle, that is, it was assumed that if the litchi growers borrowed the money from a bank, they had to pay the interest at the same rate. Therefore, the standard formula for calculation of operating capital is as follows (Miah, 1987):

Interest on operating capital (IOC) =AI x i x t Where, AI= average investment = (total investment/2)

i=interest rate which was 11 percent during the study period; and t=length of the period of litchi production (Falgun-Jaistha=4 months)

Table 9 shows that the estimated capital was Tk. 8279.52, which is 11.86 percent of their total cost of production.

5.2.3.3 Total fixed cost

Table 6.3 reveals that on an average, fixed cost of litchi cultivation was Tk. 73611.52 per acre. Land use cost shared 88.75% of fixed cost.

5.2.4 Total cost

The total cost was calculated by adding up total variable cost and fixed costs. Table 6.3 represents the gross cost of litchi production. In the present study per acre gross costs for producing litchi were estimated at Tk. 118245.72 for litchi growers.

Table 9: Per acre costs of litchi production per season

Sl. No.	Items	Amount (TK/acre)	Percent of total cost (%)
1.	Total Variable cost (a+b+c+d+e)	44634	-
a.	Labor	13500	11.41
b.	Fertilizer	2512	2.12
c.	Insecticide	8715	7.37
d.	Irrigation	3392	2.86
e.	Safety and security operation	16515	13.96
2.	Total Fixed cost (a+b)	73611.52	-
a.	Rental value of land	65332	55.25
b.	Interest on operating capital	8279.52	7.00
3.	Total cost	118245.72	99.97

Source: Field survey, 2023.

5.2.5 Gross Revenue

Gross revenue from litchi cultivation is the sum of the returns from different verities of litchi. Table10 shows the average gross return estimated for having 80 trees per acre. The production of litchi depends on the age of the tree. For the convenience of calculation, the age of litchi tree belongs the age bracket of 15 to 30 years was used to calculate the gross return from litchi production. Among all the verities cultivated in the study area Bombai gives the highest production and that of, Madrazi gives lower litchi production than Bombai but it gives early production of litchi and it also disease intensive. China-2 and Bedana have got the higher price. China-3 gives lower production in the study area.

Table 10: Per acre gross return earned from litchi orchard per season

Sl No.	Litchi varieties	Number of trees planted	Quantity(piece)	Price (Tk./ per litchi)	Return from different varieties (Tk.)
1.	Bombai	53	94000	1.9	171000
2.	Madrazi	17	27000	1.1	29700
3	Bedana	5	18000	1.5	27000
4.	Chaina 2	3	7500	1.3	9750
5.	China 3	2	4000	1	4000
Total revenue					241450

Source: Field survey, 2023.

5.2.6 Gross Margin

Gross margin is the difference between the gross return and total variable costs. The argument for using gross margin analysis is that the litchi growers of Bangladesh are more interested to know their return over variable costs. Per acre gross margin of litchi production amounted Tk. 196816 per season.

Table 11: Per acre cost and profitability of litchi per season (considering)

1.	Total variable costs	44634
2.	Total fixed costs	73611.52
3.	Total cost (1+2)	118245.72
4	Gross revenue	241450
5.	Gross margin (4-l)	196816
6.	Net revenue (4-3)	123204.28
7.	BCR (4/3)	2.04

Source: Field survey, 2023.

5.2.7 Net revenue

Net return is obtained by deducting all costs from gross return. Table 11 reveals that per acre net return of litchi considering' all varieties is Tk. 123204.28 which means litchi production is a profitable enterprise.

5.2.8 Benefit Cost Ratio (BCR)

Benefit cost ratio (BCR) is the ratio between gross return and total cost. From table 11 it seems that, gross revenue is TK. 241450 and total cost is TK. 118245.72. So Per acre BCR of litchi are 2.04. Now we can say that litchi production is profitable.

5.3 Factors Affecting Production of Litchi

Table 12: Coefficient and related statistics of Cobb-Douglas production function of Litchi

Explanatory Variables	Litchi			
	Estimated coefficient	Standard errors	t-value	P value
Constant	7.69	1.65	4.66	0.03
Human labor cost (X_1)	0.16***	0.10	1.60	0.08
Land rent cost (X_2)	0.03	0.25	0.13	0.90
Insecticide cost (X_3)	0.08*	0.06	1.83	0.03
Fertilizer and manure cost (X_4)	0.05**	0.27	2.34	0.02
Irrigation cost (X_5)	0.06*	0.04	1.19	0.03
Safety and Security Cost (X_7)	0.60*	0.09	-1.95	0.01
R^2	0.82			
Adjusted R^2	0.79			
F- value	15.42			
Return to scale ($\sum b_i$)	0.98			

Source: Author's calculation, 2023.

*=Significant at 10 percent level;

**=Significant at 5 percent level;

***=Significant at 1 percent level.

The coefficient of determination R^2 of the model was 0.82 for litchi which indicates that about 82 percent variation in the gross return from litchi has been explained by the explanatory variables, which were included in the model (Table 12).

The adjusted R^2 was at 0.79. It indicated that about 79 percent of the variation in the dependent variable was explained by the explanatory variables in the model (Table 12).

The F- values of the estimated production function were significant at one percent probability level for litchi farmers, (Table 12), which implies good fit of the models. That is, all explanatory variables included in the model were important for explaining the variation of litchi production

The summation of all the regression coefficients or production elasticity of the estimated model gives information about the returns to scale, that is, in response of output to a proportionate change in all inputs. The sum of all the production coefficients of the equations for litchi production was 0.98 (Table 12). These indicate that the production function exhibited decreasing returns to scale for the selected farming production was 0.98 (Table 12). These indicate that the production function exhibited decreasing returns to scale for the selected farming.

The overall performance of Cobb-Douglas production function model for Litchi productions was satisfactory as indicated by the estimated R^2. The estimated values of the model, however confirm that the selected variables had significant impacts on the gross return of litchi productions.

5.4 Problems and Constrains in Litchi Production

Table 13: Problems faced by the litchi growers

Name of the problem	Number of growers	Percentage of growers reporting the problem
Inadequate extension services	80	95
Natural calamities	60	92
Damaged caused by insect and diseases	58	97
Lack of technical knowledge of growing trees	55	92
Stealing	50	83
Inefficient marketing systems and low product price	31	52
Lack of loan facilities	29	48
Lack of storage facility	26	43
High price, imbalance use and spot of fertilizer	21	35
Lack of operating capital	19	32

Source: Field survey, 2023.

Most of the litchi growers had knowledge gap about new varieties, plant treatments, soil test, optimum sowing of litchi

plant recommended fertilizer management which were essential for yield increment. It may be mentioned that there have not enough opportunity of the 92 percent respondents received training on any aspect of litchi. Litchi production required considerable amount of investment due to land preparation, purchase of various inputs such as litchi plant, fertilizer, labor, pesticide etc. which the 32 percent small litchi growers cannot easily afford. Based on 35 percent litchi growers' opinion, the third ranking socioeconomic constraint was high price and scarcity of fertilizers. Such problem lead to apply fewer amount of fertilizers which further aggravated the unbalanced use of commercial fertilizer per acre is increasing over the years, still the used less than recommended and imbalance doses.

Bangladesh agriculture is dominated by very small (average farm size less than 2.49 acre), do not get the appropriate price of their products due to an unorganized marketing system. Price of any product is very important for marketing decision for the next time crop production. Inefficient marketing systems and the price of litchi was low when the litchi growers want to sell it to the market. But if they sell the whole garden before harvesting period they get the legal price from the syndicate and 52 percent growers faced this problem.

The 48 percent producers also faced problems in obtaining bank loans for different terms and conditions and sometimes they do not get loans in due time. Therefore, the litchi growers have to borrow money from other source such as money lender with high interest rate.

Most of the litchi growers complained that, extension officers or SAAO did not visit their areas regularly/timely and did not contract to the all because their lands are not close to the roped sides or nearby markets, they did not help them.

Due to lack of proper knowledge, the 43 percent of litchi growers could not store their produced litchi in proper place resulted storage loss. On the other hand, they could not keep it for selling later on when market price would go up. Trees take three to five years to come into production, and will not produce substantial crops until year seven or eight humidity less than 60%. Stealing of litchi is also a problem in litchi production and the guard needed to protect litchi from stealing create extra cost for litchi growers. The 83 percent of litchi growers faced this problem.

High temperatures, low humidity and soil moisture conditions during fruit development promote this disorder and 92 percent of litchi growers indicated this problem. Inadequate moisture during early period of fruit growth results in the skin becoming hard and sun-burnt. It may crack when it is subjected to increase internal pressure as a result of rapid aril growth following irrigation or rain.

Intermediaries get the chance and give the growers lower price. If growers could not sell their litchi, the litchi were deteriorates and above 50 percent litchi growers indicated this problem. They require regular chemical control measures for pests and suffer heavy losses to bees and fruit bats in some areas if not netted 97 percent respondent indicates it as their problem. There are some other constraints which gathered through observation and discussion with litchi growers, personnel of GO and NGOs. These constraints are to cut the litchi plant by the elite of the society, introduce alternative profitable crops, lack of specific enterprise wise training facilities, there is not proper marketing channel fixed by government for litchi, sun burn of litchi flowers, heavy wind, low temperature facilities, lack of knowledge about soil test, do not get fair price etc. in the study area under litchi production. Maximum respondent indicate lack of training facilities as their main managerial and technical problem.

6. Conclusions

Socioeconomic conditions of the litchi growers are relatively better compared to other enterprises produces by the farmers.

The cultural and management practices of litchi growers are poor. Due to lack of knowledge about proper cultural and management practices they cannot get better production of litchi. Considering the production period, litchi production is more profitable in the long-run compared to the short-run enterprises produced by the farmers. Litchi growers face many problems and constraints regarding cultural management and marketing from field to market or other place and distribution of litchi.

7. Recommendations

- Management as well as varieties selection is important for improving yield and economic return of litchi production. Accordingly DAE and other related organizations should come forward to help farmers to this end.
- Good variety of litchi plants supply should be increased.
- A requisite number of cold storage should be established for the well preservation of litchi.
- Establish linkage with banking institution for credit support.
- Management practices should be improved by providing training on litchi production and distribution. GO and NGOs should arrange multi-disciplinary training on litchi production to enrich litchi growers' knowledge and skill.

- The credit facilities should be available to the litchi growers through bank or financial institutions on easy terms and conditions to meet the cash requirements for litchi production.
- The scheme of litchi insurance may be introduced to cover the risk and uncertainty prevailed in litchi production.

8. Limitations of the Study

The present for conducting the research in a manageable way the researcher consider the following limitations on litchi production in the study area. These limitations are as follows:

a) The present study is mainly concerned with the production aspect of the litchi and was restricted to a particular area where litchi production was concentrated. Two Upazilas and four villages from these Upazilas were selected by simple random sampling. The study might provide more meaningful results if it covered a good number of Upazilas producing litchi.

b) Most of the litchi growers did not keep record of their farming business. Then the researcher had to depend on the memory of the litchi growers. To overcome this problem, several visits were made by the researcher herself to ensure the collection of reasonably accurate data from the field.

c) Age of litchi tree cannot consider in this research to identify the cost of production.

d) Different varieties of litchi are ignored in terms of cost and benefits from litchi tree.

e) In this study, only one important litchi growing area of Bangladesh was selected due to the practical situation. Covering all regions of Bangladesh would increase the accuracy and reliability of the study for comprehensive development policy.

f) Profitability of litchi production is certainly influenced by the degree of efficiency of the marketing of inputs and outputs. The result of the study would be more enriched, if the study would include marketing aspects of input and output.

g) Climate is gradually becoming more variable and also changing day by day. This has a greater impact on litchi production as well as production of other food crops and thereby on food security of farm households.

9. Scope for Further Study

A number of areas are identified where further economic study may be conducted to develop arid fine-tune policies dealing with the fruit as a whole or some of it. The weakness of lire present study, of course, opens avenues of further research which are given below:

a) A broad based study on the profitability of litchi production should be undertaken with and without intercropping of litchi.

b) A comparative study can also be undertaken to assess the relative profitability of different varieties of litchi and other fruit crops.

c) An aspect requiring further study is the variety of litchi currently being used by the litchi growers. It suggested that carrying out a detailed survey for the development of litchi Variety.

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