

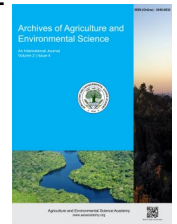


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ORIGINAL RESEARCH ARTICLE



The cost-benefit analysis and constraints of pineapple production in Bangladesh

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ABSTRACT

The main purpose of the study was to estimate the profitability of pineapple production in Sreemangal, Moulvibazar District. Structured questionnaires and face to face interviews were done to collect raw data from 100 pineapple farmers during harvesting season. These farmers were chosen using a multi-stage sampling approach. Net return analysis, Benefit-Cost Ratio, and Kruskal-Wallis One Way Analysis of Variance (ANOVA) were used to analyze the prepared data. Findings from net return analysis showed that pineapple production was a profitable activity in the study area. The total cost of production was Tk. 740,767 and the total return was also substantial, resulting in a net return of Tk. 501,445 for pineapple production. The Benefit-Cost Ratio (BCR) was 1.48, indicating that pineapple farming was profitable for the farmers. However, the study also discovered several constraints perceived by the farmers that hindered pineapple production. These constraints included issues like animal damage, lack of credit availability, natural calamities, labor supply shortages, expensive fertilizer, inadequate storage facilities, and poor seed quality. By mitigating these constraints, pineapple productivity may rise not just in the study area but also in other regions of Bangladesh where the fruit is grown intensively. Thus, this improvement could significantly contribute to the well-being of farmers and enhance their disposable income.

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INTRODUCTION

Bangladesh, a lower middle-income country with significant reliance on agriculture (FAO, 2023; Polas, 2013), has seen a recent decline in the agricultural sector's contribution to GDP. Nevertheless, a substantial portion of its population is engaged directly or indirectly in agricultural activities for sustenance. Historically, agriculture accounted for more than 50% of GDP, but as industrialization took hold, economic activities diversified across sectors. Consequently, the agriculture sector, encompassing crops, livestock, fisheries, and forestry, now contributes

about 11.66 % (FY 2021-22) to the total Gross Domestic Product (GDP) of the country. According to the provisional report of Quarterly Labor Force Survey 2022 this sector accommodates around 45.33% of total labor force (BBS, 2022). Notably, Bangladesh's GDP experienced a growth of 0.6 percentage points, reaching 7.1% in FY 2016 from 6.5% in FY 2015 (BBS, 2016). Despite this change, agriculture continues to be important in Bangladesh, contributing significantly to macroeconomic goals including creating jobs, reducing poverty, developing human resources, and ensuring food security. Recognizing this, the government has given agriculture first

priority in order to produce enough food grains on its own. Crop production predominates among agricultural operations, and a variety of crops, fruits, and vegetables add to the sector's diversity. Because of the country's mild climate, a variety of fruits and vegetables, including bananas, mangoes, jackfruits, and pineapples, as well as staples like rice, wheat, maize, jute, lentils, sugarcane, tea, and oil seeds, can be grown there (Sarker et al., 2017). Fruits are crucial for improving the nation's nutritional profile and food security (BBS, 2014). In recent years, there has been an increase in the area used for fruit growing. In 2016, fruits occupied 0.99% of the total cultivated land in Bangladesh (BBS, 2016).

Pineapple (*Ananas comosus*), the third most significant tropical fruit crop after bananas and citrus fruits, contributes to over 20% of global tropical fruit production (Hossain et al. 2015). Its cultivation is extensive across countries like Costa Rica, Brazil, the Philippines, Thailand, Indonesia, Nigeria, Mexico, Ghana, India, Sri Lanka, and Bangladesh. In Bangladesh, the pineapple holds a prominent spot among commercial fruit crops, often referred to as the "queen of fruits" due to its exquisite flavor (Baruwa, 2013). Among the three predominant varieties of pineapple grown in Bangladesh, Giant Kew, Honey Queen, and Ghurasal, Kew and Honey Queen are the most commercially significant. While Bangladesh offers an ideal environment for pineapple cultivation, it thrives particularly in districts like Tangail, Rangamati, Mymensingh, Gazipur, Chittagong, Khagrachari, Bandarban, Moulvibazar, Sylhet, and Dhaka (Hasan, 2011). The production of pineapples has gradually increased in Bangladesh, producing 197,518 thousand metric tons from 33,687 acres in 2014–15 and 200,701 thousand metric tons from 33,498 acres in 2015–16 (BBS, 2015; 2016). An increase in production is being accompanied by a decrease in the amount of land under cultivation. After Dhaka and Chattogram, the Sylhet division produces the third-most pineapples (BBS, 2016). The Sylhet division's Moulvibazar district, which has the most cultivated area and the highest yearly production of 4,901 MT from 917 acres, leads the region in pineapple production (BBS, 2016). In the Moulvibazar district, Sreemangal produced 6,300 MT of pineapples on 741 acres (DS, 2011), significantly contributing to the output of the area. Although pineapple farming can prove advantageous for farmers (Abbey, 2005; Asante and Kuwornu, 2014), challenges impede its economical feasibility and production levels, particularly in Sreemangal. Hence, production is very essential for Pineapple to reach from primary producers to ultimate consumers. Factors such as inadequate returns for produce and fruit damage due to constraints beyond farmers' control (Pandit and Basak, 2013) hinder expected production level. Among these constraints, a lack of access to credit is a common issue in developing countries (Kamal et al., 2015; Rahman, 2013; Mondal et al., 2012). Therefore, understanding these constraints is vital to increasing production and minimizing losses. The aim of the study was to assess the profitability of pineapple production and identify key constraints faced by pineapple farmers. By doing so, the study seeks to offer insights that can empower growers to make pineapple cultivation more rational.

In order to reduce the current research gap, this present work was undertaken.

MATERIALS AND METHODS

In this study, we randomly selected a total of 100 pineapple-growing farmers. The survey was conducted from March to April 2022 using the Paper and Pencil (PAP) method. We gathered primary data by directly interviewing pineapple farmers in the study area about their production. The collected data were analyzed using SPSS. To assess the profitability of different pineapple production methods, we applied net return analysis (Olson and Westra, 2022; Uddin et al., 2022) based on the equation:

$$\Pi = P_m * Y_m + P_b * Y_b - \sum (P_{X_i} * X_i) - TFC$$

Where,

Π = Net return,

P_m = Price of main product per piece,

Y_m = Total quantity of main product (piece),

P_b = Price of by-product per piece,

Y_b = Total Quantity of by-product (piece),

P_{X_i} = Price of i^{th} input per kg used for pineapple production

X_i = Quantity of the i^{th} input used for pineapple production,

TFC = Total fixed cost,

$I = 1, 2, 3, \dots, n$ (number of input).

We also used the Benefit-Cost Ratio (BCR) to determine the profitability of each farm (Asante and Kuwornu, 2014).

$$BCR = \frac{\text{Gross Return}}{\text{Gross Cost}}$$

For identifying the major constraints in pineapple production, we employed the Kruskal-Wallis ranking analysis. This technique helped us understand the challenges perceived by farmers in pineapple farming. To conduct this, we ranked the data from high to low and used the Kruskal-Wallis's formula:

$$H = \frac{12}{(N+1)} \sum_{i=1}^{ni} \frac{1}{ni} \frac{[R_i - ni(N+1)]^2}{2}$$

Where R_i is the sum of ranks for observations in the sample and $\frac{ni(N+1)}{2}$ is the expected sum of ranks for the treatment (Wayne, 1990).

RESULTS AND DISCUSSION

The profitability analysis of pineapple production

It's possible that pineapple farming is done for reasons other than supplying food for the home or for survival. As a result, the farmers will be interested in the farm business' prosperity, just like any other entrepreneur. Based on the current market rates, the expenses associated with the various types of inputs used and the sales revenues were estimated. The estimated total costs of pineapple production were deducted from the total revenues to get the per-hectare Net Return (Olson and Westra, 2022). The cost of inputs used for producing a crop plays an

important role in a farmer's decision-making. In the study area, farmers used both purchased and home-supplied inputs for cultivating Pineapple. Both inputs and outputs were valued at the farm gate price during the survey period. It was easier for a farmer to determine the cost of the purchased inputs like seedlings, lime, fertilizer, hormones, vitamins, etc. However, it was not so easy to determine the cost of home-supplied inputs like family labor, for which no payment was made. For solving this problem of such home-supplied inputs the principle of opportunity cost was employed. For the estimation purpose, the cost items were discussed under the following heads:

All the input costs mentioned above were taken into account in

- Cost of seedling
- Cost of lime
- Cost of urea
- Cost of TSP
- Cost of MoP
- Cost of hormone
- Cost of vitamin
- Cost of human labor
- Interest on operating capital
- Land use cost

calculating the per-hectare cost of Pineapple cultivation. In estimating total costs, both variable and fixed input costs were considered. All the above-mentioned costs are variable costs except land use costs.

Cost of seedling

Seedling is one of the most important material inputs for pineapple cultivation. Farmers used an average of 29010.62 seedlings/ha and the average price of seedlings was Tk. 2.33/piece in that area. Per hectare mean Seedling cost was Tk. 67595 (Table 1) represented 13.48 percent of total cost of production.

Cost of lime

Lime was used as an organic fertilizer in pineapple cultivation. In the study area, farmers applied on an average of 874.98 kg lime per ha and the average price of lime was Tk. 4.54/kg. The

average cost of lime used for pineapple production was Tk. 3972 per ha (Table 1) represented 0.79 percent of the total cost of production.

Cost of urea

The application of recommended doses of fertilizer is important for crop production. In the study area, farmers used mainly three types of fertilizer namely Urea, Triple super phosphate (TSP), and Muriate of potash (MoP). Among them, Urea is a fertilizer material used directly for crops or in the preparation of blended fertilizers for rapid leaf growth. On average, 835.50 kg of Urea was used by farmers per ha and the average price of Urea was Tk. 17.93/kg. In the study area, the average cost of Urea Tk. 14981 per hectare (Table 1) incurred 2.99 percent of the total cost of production.

Cost of TSP

As a fertilizer, TSP was more used by farmers in the study area because of rapid growth than other fertilizers for pineapple production. It is mainly used for quick development of roots, flowers, seeds, and fruit. Farmers applied on an average of 1044.38 kg TSP per ha and the average price of TSP was Tk. 24.54/kg. The average cost of TSP used for pineapple production was Tk. 25629/ha (Table 1) occupied 5.11 percent of the total cost of production.

Cost of MoP

In the study area, farmers applied an average of 762.53 kg of MoP (Muriate of Potash) for strong stem growth, movement of water in plants, and promotion of flowering, and fruiting. The average price of MoP used for pineapple production was Tk. 16.17/kg and the average cost was Tk. 12330/ha (Table 1) represented 2.46 percent of total cost of production.

Cost of hormone

Table 1. Per hectare average cost and return of pineapple cultivation.

Particulars	Quantity/ha	Price/unit (Tk./unit)	Cost/Returns (Tk./ha)
Variable cost			
Seedling (piece)	29010.62	2.33	67595
Lime (kg)	874.98	4.54	3972
Urea (kg)	835.50	17.93	14981
TSP (kg)	1044.38	24.54	25629
MoP (kg)	762.53	16.17	12330
Hormone (ml)	3023.26	2.70	8163
Vitamin (kg)	0.57	97800	55746
Human Labor (man-day)	698.91	292	204082
Interest on operating capital	-	-	29437
Total variable cost			421935
Fixed cost			
Land use cost			79510
Total fixed cost			79510
Total cost of production			501445
Total Return			
Main product (Pineapple) (piece)	26495.76	23	609402
By-product (Sucker) (piece)	81089.47	1.62	131365
Total return			740767
Net return			239322
Undiscounted BCR			1.48

Source: Author's estimation

Table 2. Summary of Kruskal-Wallis test for farmer's perception on major constraints.

Constraints	Mean	Rank
Non-availability of credit at the proper time	507.50	6
Supply shortage of labor in peak season	310.50	4
Low-quality of seed	66.50	1
The high price of fertilizer	278.50	3
Natural calamity	502.50	5
Damaged by animals	587.50	7
Lack of storage facility	200.50	2
Total		700
Chi-square		533.891
Degree of freedom		6
Assumption significant		0.00

1 – 7: Lowest to Highest; Source: Author's estimation.

Farmers used on average 3023.26 ml hormones like Ripen (100ml) and ethanol per ha for flowering and ripening of fruits, and the average price of that hormone was Tk. 2.70/ml. The average cost incurred for hormone Tk. 8163/ha (Table 1) occupied 1.63 percent of the total cost of production.

Cost of vitamin

Recently in Sreemangal, farmers used on an average 0.57 kg of vitamin per ha, namely BARONTO, as growth promoters, and here average price of vitamin was Tk. 97800/kg. The average cost of vitamins was Tk. 55746/ha (Table 1) obtained 11.12 percent of the total cost of production.

Cost of human labor

Human labor was the most important and one of the largest inputs used for pineapple production. There were broadly two different categories of human labor -family labor and hired labor. It is required for different farm operations like land preparation, planting, weeding, fertilizer application, hormone and vitamin spray, harvesting, carrying, etc. In the study area, on average, 698.91 men per day per ha were employed by farmers and the rate of human labor was TK 292 per man-day. The average cost per ha of labor used was Tk. 204082 (Table 1) acquired 40.70 percent of the total cost of production.

Interest on Operating Capital (IOC)

IOC included both labor and materials used in the production of Pineapple and were calculated for 18 months at the rate of 10 percent per annum. It was assumed that if the farmers borrowed money from banks and other financial and non-financial institutions, they had to pay interest at a specified rate. This rate was taken to calculate IOC. The average IOC of farmers was TK 29437 (Table 1) incurred 5.87 percent of total cost. The interest on operating capital was, therefore, computed using the following formula:

$$\text{Interest on operating capital} = \frac{\text{Operating capital}}{2} \times \text{rate of interest} \times \text{time considered}$$

Land use cost

Some of the sample farmers had to pay a specified amount per hectare of land they leased for a specific year. Pineapple was grown by other farmers on their property. They might have made money from renting out their land if they had done so. The

amount they may have been paid per hectare was regarded as the land usage cost or the opportunity cost of the land.

In the present study, in computing land use cost, the average leased value of land per hectare for the cropping period covering around 18 months was considered based on the reports of the farmers in the study area. The average land use cost incurred by farmers was Tk. 79510/ha (Table 1) represented 15.85 percent of total cost of production.

Total cost

The total cost was calculated by adding all the costs of variable and fixed inputs and was presented in Table 1. The average Gross cost of Pineapple cultivation was estimated at TK 501445 per hectare.

Total return and net return

Total return was estimated by adding the multiplication of the price and total quantity of the main product with the multiplication of the price and total quantity of by product. The total return from pineapple cultivation was Tk. 740767/ha (Table 1). Net return was obtained by deducting the total cost from the total return. The per hectare net return of pineapple cultivation was Tk.239322 in the study area (Table 1). Approximately Similar findings were found in the work of Uddin et al. (2022) and Suhaimi and Fatah (2019) who also worked on pineapple to analyze its significance financially.

Undiscounted Benefit-Cost Ratio (BCR)

An undiscounted benefit-cost ratio (BCR) is a relative measure, which is used to estimate benefit per unit of cost. The summary result is presented in Table 1. The average area under pineapple cultivation among the farmers was 0.987 ha. The average return from both the main product and by-product of the pineapple was Tk.740767/ha. According to Table 1, the benefit-cost ratio for growing pineapples was 1.48, meaning that an investment of one taka produced a net benefit of 0.48 taka. Thus, it is lucrative for farmers to engage in pineapple farming in the research area or to focus more on this farming to sustain such outcomes since the usage of inputs returns more to the farmer than the initial investment. This is because the BCR of pineapple production was more than one. The result is similar with Uddin et al. (2022) where the author declared that being a profitable business, pineapple production could contribute to livelihood improvement of farmers.

Major constraints for pineapple production

In Bangladesh, farming is the oldest and most widespread occupation. In this country, the vast majority of people live in villages and rely on agriculture for their livelihood. Agriculture, however, is subject to a variety of limitations. The production of pineapples in Sreemangal Upazila was also average. In this study, Kruskal-Wallis One Way Analysis of Variance (ANOVA) by ranks was used to examine the farmer's perception of the major constraints they encountered. On a scale of 1 to 7, pineapple producers were asked to rank the extent of the principal limitations. According to Table 2, the lowest and highest-rated constraints are represented by the numbers 1 and 7 respectively.

Most prevalent constraints to pineapple production

This test which assumed a null hypothesis that the distribution of rank was the same across different categories of constraints was strongly rejected at a 1% level of significance. So, the result showed that constraints in pineapple production were significantly different from one another. From the results, damage by animals had the highest rank (7) and this implied that it was the most significant constraint in the pineapple production in the study area. Every year, there is a bumper production of pineapple in the study area. But, in each season the extensive amount of yield (5-10% of total production) was spoiled in the harvesting period due to animals (Squirrel, Bat, and Monkey) attacking. No preventive measures are available to them for this problem. Non-availability of credit in proper time was ranked as the second highest constraint to pineapple production in the study area. This was also identified by Uddin *et al.* (2022) as a major problem for production. Farmers reported that they received loans from BKB with too much complexity such as not getting sufficient amounts at the proper time, collateral requirement, and high transportation costs for two/three times visited due to the unwillingness of that bank to provide agricultural loans. In addition, producers had to borrow money from NGOs (BRAC, Grameen Bank, etc.) at exorbitant/excessive interest rates when public banks were not available. Pineapple producers further reported that the production of pineapple needs proper doses of fertilizers, hormones, and special care concerning timely agronomic practices.

The production cost of pineapple was high since the input requirement was high. It was difficult to manage sufficient money on the part of producers. Lack of extension service for their financial solvency and social status and small farmers are almost deprived of this service. Natural calamity was the third highest constraint in pineapple production. Maximum farmers complained that precipitation and drought were the major natural calamities in the study area. Heavy rain causes water stagnation and hence, the roots of pineapple are damaged. Besides, the quality and color of matured fruits are affected by drought. Supply shortage of labor in peak season was ranked as the fourth-highest problem in pineapple production. Farmers argued that laborers were not available especially for weeding, mulching, and harvesting at as usual wage rate because most of the day

laborers are involved in non-agricultural activity. In this case, farmers had to pay double wages during peak season. This affected productivity badly. Farmers highlighted the high price of fertilizer as their fifth major constraint in the way of expansion of pineapple cultivation. They had to purchase fertilizers from the traders who claimed higher prices than the subsidized rate offered by the government. They said that production depends on adequate availability of inputs, if the cost of inputs increases and the price of the commodity remains constant, profit will decrease. In these circumstances, it will be difficult for them to maintain their existing production status in the study area. This point of view is also closely associated with the findings of Uddin *et al.* (2022). Growers claimed the lack of storage facilities as their sixth minor constraint. A huge amount of total production is damaged in the harvesting period and they do not get a fair price for their pineapple since there is no preservation facility. Sometimes, they have to sell products at lower prices due to product perishability. Uddin *et al.* (2022) also included lack of preservation and processing facilities as one of major limitations for pineapple production in Tangail. The low quality of the seed was ranked as the most minor constraint in the study area. Farmers reported that in the local market, pineapple seeds were not available. Most of the farmers purchased seeds but they claimed that in many cases, the seeds were not good quality and the price of seed was too high during the seedling period.

Conclusion

This study reveals that pineapple production is a profitable business based on the net return analysis of pineapple production. Despite the profitability of pineapple production, several problems were found to be impeding the industry's potential. These problems included the lack of credit and labor facilities, weather and diseases, lack of quality and market outlet of seed, lack of storage facilities, and high cost of fertilizer. Based on the findings, it is suggested that there is a need for the pineapple sub-sector to be intensified and expanded in terms of the provision of high-yielding, disease-free suckers or crowns, the involvement of public and private organizations in the timely availability of high-quality farm inputs, such as fertilizers, seeds, and vitamins at affordable prices. In addition, the Department of Agricultural Marketing (DAM) ought to establish the cold storages facilities to reduce fruit perishability and ensure the agricultural price support programs. Easier access to credit from formal sources by simplifying the lending terms, such as favorable interest rates and using guarantors instead of landed property for collateral security should be promoted along with the educational opportunities for farmers through the setting up of adult literacy classes, extensional activities and membership to cooperative societies. Finally, the Department of Agricultural Extension (DAE) should focus on the training of the producers about improved modern production management practices that will enable the use of available resources efficiently as well increase productivity.

Conflict of interest

No conflicts of interest exist, according to the authors, with the publishing of this paper.

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