

Opportunities of Dragon Fruit Cultivation in Bangladesh: An Analysis of Profitability and Employment Potential



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ABSTRACT: This study investigates the impact of dragon fruit cultivation on income generation, profitability, and employment among farm households in Bangladesh, focusing on Jhenaidah and Chuadanga districts. As a recently introduced high-value crop, dragon fruit offers significant economic potential due to its adaptability, nutritional value, and strong market demand. Utilizing a mixed-method approach, primary data were collected from 160 dragon fruit farmers through structured household surveys. The Cobb-Douglas production function was employed to assess input-output relationships, revealing that labor, land preparation, seedlings, and fertilizer significantly influence income, with labor showing the highest elasticity (0.772). The estimated R-squared (0.898) suggests that the model explains a substantial portion of income variability. Cost-benefit analysis indicates a high benefit-cost ratio (1.83), confirming strong profitability. Furthermore, dragon cultivation contributes to increased labor force participation and reduced dependency ratios. Average daily working hours rose by 2.13, and full-time employment increased by over 7 days per month, indicating a shift from seasonal to year-round employment. These findings highlight the socio-economic benefits of dragon fruit cultivation and suggest that it is a viable tool for rural development. The study recommends supportive policies, input optimization, infrastructure investment, and market linkage to further enhance the profitability and sustainability of dragon fruit farming in Bangladesh.

KEYWORDS: Dragon Cultivation, Farm Households, Income, Employment, Poverty Status.

JEL Classification Numbers: Q11, Q12, D31, E24, I32

1.0 INTRODUCTION

Most of the population in Bangladesh resides in rural areas, and their primary source of livelihood is agriculture and related activities. According to the estimation of [Bangladesh Economic Review \(2023\)](#), the overall contribution to the broad agriculture sector at the constant price was 11.20 percent of GDP in the financial year 2022-23. Moreover, around 45.33% of the country's overall labor power is in agriculture ([Labor Force Survey, 2022](#)). The study area, Jhenaidah and Chuadanga, is an agriculture-producing region situated in the country's South-Western portion. Most of the inhabitants of these districts live in rural areas, and they have been able to implement agricultural modernization practices. Apart from the usual agricultural products of Bangladesh, such as rice, wheat, potatoes, vegetables, sugarcane, battle leaf, lentils, garlic, onion, ginger, and fruits like mango, banana, jackfruits, guava, Dragon, plum, etc. are produced in the region. Among the agricultural products, fruits play a vital role in enhancing the economic status of farm households. The tropical fruit Dragon has become a new and attractive fruit to consumers and producers.

1.1 Background of the Study

Dragon is the recently introduced super fruit in Bangladesh. It is a nourishing and delightful exotic fruit grown in arid regions worldwide, particularly in Asian countries ([Aryal et al., 2020](#)). It has garnered immense popularity among growers and consumers due to its appealing colour, delectable pulp containing edible black seeds, nutritional benefits, and promising potential for export. The flower of the dragon is so beautiful that it is called 'Queen of the Night' ([Gunasena et al., 2006](#) & [Mori et al., 2023](#)). It offers substantial profitability, providing yields within 14-16 months of planting and continuing to bear fruit for up to 20 years, with a crop cycle spanning from May to December ([Perween et al., 2018](#) & [Khan et al., 2021](#)). Dragon fruit can be collected all year round, and it bears fruits after one year of planting ([Ahmad et al., 2019](#)). It is a promising crop because it can be grown in dry habitats ([Sosa et al., 2020](#)). The fruit springs in various kinds, such as red flesh with pink skin, white flesh with pink skin, white flesh with yellow skin, and violet red flesh with pink skin, etc. This fruit is grown commercially in Vietnam, Thailand, Malaysia, Taiwan, China, Sri Lanka, Israel, Australia, Nicaragua, and Central America ([Research & Markets, 2020](#)). Vietnam presently holds the title of the

Opportunities of Dragon Fruit Cultivation in Bangladesh: An Analysis of Profitability and Employment Potential

world's largest dragon fruit supplier, commanding the most significant share in Asia, Europe, and occasionally in the United States. Thailand and Israel are the second and third most prominent suppliers in the European market. The United States, Mexico, and Central and South America substantially oppose Asian dragon fruit suppliers, primarily due to their environmental advantages (Thanh et al., 2018).

The dragon fruit plant exhibits remarkable adaptability and grows in soils with a tiny, heavy texture. The plants are typically propagated using stem cuttings. Flower buds typically appear 15-18 months after planting and take approximately 28-30 days to bloom (Hossain et al., 2021). It starts bearing fruit in the second year after planting and attains production capacity within five years (Perween et al., 2018). They are good-looking in shape and colour and have good nutraceutical properties that attract growers worldwide. Red-flesh dragon fruit varieties are notably wide in antioxidants, making them increasingly sought after in the market for antioxidant products and natural food colorants (Wanitchang et al., 2010 & Khan et al., 2021). The fruits can be easily stored fresh at room temperature. Additionally, the pulp from the fruit can create various processed products. So, considering the above aspects, there are enormous prospects for Dragon fruit cultivation, especially in Bangladesh. However, a few research works have been done on this fruit crop. A research thrust must be given in all aspects covering importance, cultivation techniques, manuring, pollination, harvesting, pests, and diseases so everyone becomes familiar with Dragon fruit.

The proposed research study concentrates on Dragon fruit cultivation, based on available literature and practical knowledge from cultivating farmers. The study aims to measure the extent of dragon fruit cultivation in Bangladesh and analyze its productivity, efficiency, and profitability. The study used primary data collected through field investigation from the selected sample households engaged in Dragon fruit cultivation in the study area.

1.2 Problem of the Statement

Dragon fruit is one of the most mysterious fruits cultivated worldwide (Mori et al., 2023). In Bangladesh, dragon fruit was introduced by private entrepreneurs from various countries to cultivate them as ornamental plants (Chakraborty, 2020). Dragon fruit cultivation has been gradually gaining popularity in Bangladesh due to its adaptability to the local climate and its potential for high yields (Ghosh et al., 2023). This tropical fruit, known for its vibrant red colours and unique appearance (Das & Kossar, 2022), has captivated not only the visual senses but also the economic interests of farmers nationwide. Another study (Ghorai, 2023) stated that Dragon is a unique and captivating fruit known for its vibrant appearance, distinct taste, and potential health benefits. Recently, the cultivation of the Dragon has expanded significantly, driven by its promising prospects in domestic and global markets. The cultivation of dragon fruit in Bangladesh has witnessed outstanding growth in recent years, and its economic impact extends far beyond the lush orchards where these exotic fruits thrive. Jhenaidah is the Dragon fruit-producing hub as it produces 39% of the total production, while other districts, namely Chuadanga, Jashore, Natore, and Bandarban, have also become significant producers. In fiscal 2020-21, Bangladeshi farmers grew Dragon on 695 hectares of land to bag 8,660 tons of fruit, more than double the total yield of 3,463 tons the previous year (Hossain, 2023). In this article, we investigate the multifaceted effects of dragon fruit cultivation on income, and employment within Bangladesh's agricultural landscape. As dragon fruit emerges as a prominent cash crop, its influence on the socioeconomic fabric of the nation becomes increasingly significant.

As the dragon fruit industry in Bangladesh continues to flourish, evaluating the profit efficiency of dragon fruit cultivation becomes imperative. Understanding the economic aspects of this agricultural endeavor is crucial for farmers, policymakers, and investors alike. By shedding light on dragon fruit cultivation's profit efficiency, we intend to pay for valuable intuitions that can guide stakeholders in production conversant decisions and further promote the growth of this emerging agricultural sector. The fruit comes in various types, such as red flesh with pink skin, white flesh with pink skin, white flesh with yellow skin, and violet red flesh with pink skin, etc. (Kadam et al., 2023). Most farmers found inspiration in cultivating dragon fruit due to its exceptional resistance to pests and diseases, promotion of robust health, extended yielding period, and capacity for growth from seeds and cuttings. Moreover, dragon fruit boasts a superior profit margin compared to other crops grown in the field (Ghosh et al., 2023). It is resilient and robust and can thrive in various climatic conditions suitable for flowering and fruiting as long as the soil has good drainage. So, considering the above aspects, there is a prospect for Dragon fruit cultivation, especially in Bangladesh. This fruit crop requires comprehensive research across various dimensions, including cultivation techniques, processes, fertilization, harvesting, and management of pests and diseases. The aim is to ensure that dragon fruit becomes familiar to a widespread audience. In this current study, we will address the following theoretical questions and concepts that require clarification.

1.3 Objectives of the Study

The general objective of this study is to measure the present status of Dragon fruit cultivation in Bangladesh and its impact on the productivity, efficiency, and profitability of farm households. The specific objectives are as follows:

- To examine dragon fruit cultivation's effect on farm households' income levels.
- To identify dragon fruit cultivation's effect on farm households' profitability status.
- To measure the employment opportunities generated by dragon fruit cultivation.

1.4 Research Questions

This study addresses the following research questions:

- How does dragon fruit cultivation affect the income levels of farm households?
- What is the impact of dragon fruit cultivation on the profitability status of farm households?
- How does dragon fruit cultivation affect the employment status in farming communities?

1.5 Significance of the Study

Since 1971, there have been notable transformations in the quantity and variety of fruit production. These alterations have been manifested by a significant increase in the yield of various fruits and the introduction of numerous new fruit varieties. Dragon fruit, a newly introduced super fruit, is making significant inroads, particularly in South Asia. Its growing popularity among cultivators and consumers can be attributed to its appealing colour, delectable pulp, nutritional richness, substantial export prospects, and financially rewarding characteristics (Jalgaonkar et al., 2021). Its ornamental value is evident through the exquisite beauty of its large, night-blooming flowers. Recognized as a fruit crop with tremendous potential for the future, dragon fruit bears fruit within 12-15 months of planting and maintains a fruitful production cycle for up to two decades (Khan et al., 2021). Typically, plants propagate through stem cuttings. After about 15-18 months from planting, flower buds emerge, followed by a blooming period of approximately 28-30 days. This fruit has garnered popularity owing to its rich nutritional profile, serving as a valuable source of essential minerals, vitamins, glucose, fructose, and dietary fibre. It contributes to fortifying the human immune system and finds application in maintaining the conditions of diabetes and heart diseases and supporting healthy weight maintenance (Hossain et al., 2021). In a separate research endeavor (Singh et al., 2023), It is important to emphasize that dragon fruit is not only a nutritious fruit but also an economically viable one. The study highlights that dragon fruit has become a valuable asset for the economy and plays a central role in promoting the country's sustainable development. It is particularly evident in its support for the sustainable use of ecosystems and biodiversity. Notably, Dragon fruit requires minimal water for its growth and development. From a commercial perspective, Dragon fruit presents a multitude of advantages. Its appealing shape, vibrant colors, and impressive nutraceutical properties make it a magnet for growers worldwide. In particular, the red-fleshed varieties are rich in antioxidants, fulfilling the rising demand for natural food colorants and antioxidant products. These fruits also have the advantage of being easily stored under room temperature conditions. Moreover, the fruit pulp offers ample opportunities for various processed goods. Dragon fruit is a robust crop capable of thriving in any climatic conditions, ensuring consistent flowering and fruiting. Considering these factors, Bangladesh holds promising prospects for Dragon fruit cultivation. Nevertheless, it is essential to emphasize that there remains a substantial research gap related to Dragon fruit. Thus, there is a pressing need for comprehensive research to familiarize a broader audience with the potential of Dragon fruit.

Given these considerations, the proposed research study takes on significant importance. This research endeavor will provide insights into the scientifically justified cultivation of Dragon fruit, covering its characteristics, productivity, efficiency, and profitability. Ultimately, it aims to elevate the economic well-being of farm owners and promote the widespread adoption of Dragon fruit cultivation in Bangladesh.

1.6 Limitations of the study

This study examines the effects of dragon fruit cultivation on income, and employment. The research will be conducted in regions or communities where dragon fruit cultivation is prevalent, considering the unique contextual factors that may influence the outcomes. However, it is essential to acknowledge that the results may only be generalized to some regions due to variations in agricultural practices, market conditions, and socioeconomic factors. Additionally, the study relies on primary data collection methods, such as surveys, interviews, and case studies, which may be subject to limitations such as sampling bias and data accuracy. Despite these limitations, the study aims to provide valuable insights into the impacts of dragon fruit cultivation on income, and employment contributing to the existing knowledge base in this field.

1.7 Research Gap

Despite the rising popularity and economic potential of dragon fruit cultivation in Bangladesh, there remains a significant research gap concerning its comprehensive impact on farm households' income and employment generation. While existing studies emphasize its profitability, nutritional value, and adaptability to local climatic conditions (Aryal et al., 2020; Sosa et al., 2020; Ahmad et al., 2019), few empirical studies systematically assess its socioeconomic contributions within rural communities. The fruit's appeal—stemming from its vibrant appearance, nutraceutical properties, and promising export potential (Gunaseena et al., 2006; Mori et al., 2023; Khan et al., 2021)—has made it a popular choice among farmers. However, the current body of literature largely focuses on agronomic aspects and market potential, with limited attention to quantifying its effects on household income levels, labor force participation, and employment opportunities. While Bangladesh has seen substantial growth in dragon fruit production, increasing from 3,463 tons in 2019–20 to 8,660 tons in 2020–21 (Hossain, 2023), this expansion has not been matched by analytical studies that explore its socio-economic implications. Moreover, the crop's resilience, long productive life, and year-round yield capability (Perween et al., 2018; Ahmad et al., 2019) make it a strong candidate for rural development initiatives.

Opportunities of Dragon Fruit Cultivation in Bangladesh: An Analysis of Profitability and Employment Potential

Nevertheless, a comprehensive, data-driven investigation into its economic efficiency, employment potential, and sustainability is still lacking. This research aims to fill that void by empirically analyzing the productivity, profitability, and efficiency of dragon fruit cultivation, thus contributing to informed decision-making for policymakers, investors, and farmers. It also opens avenues for further research into environmental sustainability, regional comparative performance, and the broader impact of this emerging sector on rural livelihoods in Bangladesh.

2.0 METHODOLOGY OF THE STUDY

The methodology section of this research elucidates the chosen research design and approach employed to examine dragon fruit cultivation in Bangladesh. It provides a comprehensive framework for data collection, analysis, and interpretation.

2.1 Research Design

A mixed research approach is employed, with a primary emphasis on quantitative approaches, to understand dragon fruit cultivation in Bangladesh comprehensively. The research comprises the following key components:

2.2 Data and Its Nature

This study was constructed on primary data collected through the household survey using a structured questionnaire. The quantitative data has been collected for the study, emphasizing household income, and employment dynamics.

2.3 Data Collection Methods

Primary data were collected through a household survey using structured questionnaires. In-depth interviews have been conducted with dragon fruit farmers, agricultural experts, and extension officers to advance a reflective understanding of the challenges, the best practices, and innovation in dragon fruit cultivation.

2.4 Sample and Sampling Techniques

A multi-stage purposive sampling was utilized to select the sample farm owners for the survey. In the first stage, the study purposively selected the two districts, and the next, we purposively selected four Upazilla from the two districts, Moshespur and Courtchadpur from Jhenaidh District and Jibonagar and Damurhuda from the Chuadanga district. After selecting four Upazilla from two districts, we purposively selected eight villages, Gaurinathpur and Aloampur from Moshespur; Fulhori and Somajkolla from Courtchadpur; Kasipur and Khayerhuda from Jibonagar; and Perkrisnapur and Bastupur from Damurhuda Upazila. In the process of our study, we collected data from a total of 160 individuals who were engaged in Dragon fruit cultivation.

2.5 Household Survey

A comprehensive survey focusing on collecting quantitative data was conducted among a sample of households to assess the impact of Dragon fruit cultivation on farm owners' income, yield, and profitability. Economic indicators encompass landholding, output, input costs, income, occupation, employment, and expenditures.

2.6 Data Analysis Techniques

The study involved a detailed household survey to collect primary data, focusing on economic indicators such as income, the cost of production, profitability, occupation, and employment. In this study, the Cobb Douglas production function has been utilized to estimate the impacts of dragon cultivation on the income/productivity of the farm owners.

Cobb Douglas Production Function: The specification of the model is as follows:

$$Y_i = \beta_0 X_1^{\beta_1} X_2^{\beta_2} X_3^{\beta_3} X_4^{\beta_4} X_5^{\beta_5} X_6^{\beta_6} X_7^{\beta_7} e^{u_i}$$

The log linear form of the Cobb Douglas Production Function will be-

$$\ln Y_i = \beta_0 + \beta_1 \ln X_{1i} + \beta_2 \ln X_{2i} + \beta_3 \ln X_{3i} + \beta_4 \ln X_{4i} + \beta_5 \ln X_{5i} + \beta_6 \ln X_{6i} + \beta_7 \ln X_{7i} + u_i$$

Where,

\ln = Natural logarithm

Y_i = Gross income of the i th farm (Tk/Bigha/Year)

X_{1i} = Labour cost of the i -th farm (Tk/Bigha/Year)

X_{2i} = Land Preparation cost of the i -th farm (Tk/Bigha/Year)

X_{3i} = Cost of seed of the i -th farm (Tk/Bigha/Year)

X_{4i} = Irrigation cost of the i -th farm (Tk/Bigha/Year)

X_{5i} = Cost of pesticides of the i -th farm (Tk/Bigha/Year)

X_{6i} = Cost of fertilizer of the i -th farm (Tk/Bigha/Year)

X_{7i} = Cost of the Piller, rope and wire (Tk/Bigha/Year)

$\beta_1 = \beta_0$ to β_6 are unknown parameters and

u_i = the disturbance term

The methodology outlined in this study aims to provide a comprehensive analysis of dragon fruit cultivation in Bangladesh, focusing on production efficiency and profitability. By employing a mixed-method approach and economic modelling, the research offers

Opportunities of Dragon Fruit Cultivation in Bangladesh: An Analysis of Profitability and Employment Potential

valuable insights for dragon fruit farmers and policymakers to enhance the sustainability and profitability of dragon fruit cultivation in Bangladesh.

3.0 RESULT AND DISCUSSION

The findings of the study refer to the results and conclusions derived from a research project or study. The findings are a critical component of a research, as they provide evidence and support for the study's overall objectives and contribute to the existing body of knowledge on the topic under investigation.

3.1 Estimation of Cobb-Douglas Production Function

To accomplish the effect of the production of Dragon fruits, on farmers' income in study areas, we estimated cobb-Douglas production function. Several explanatory variables were taken into consideration to analyze the productivity of Dragon fruits. The effects of variables on the farmers' income are interpreted in the following tables. The first table 3.1 represents the estimated results of the Cobb-Douglas production function.

Table 3.1 Estimation of Cobb-Douglas Production Function

Method: Ordinary Least Squares				
Dependent variable: Total Revenue/Output (lnY)				
Number of Observation: 160 (farm owners)				
Explanatory Variables	Coefficients	Std. Err.	t-Statistic	Probability
C	-24.29720	2.253992	-10.77963	0.0000
Labor Cost (lnX ₁)	0.772310	0.176925	10.01727	0.0000
Land Preparation Cost (lnX ₂)	0.412760	0.144503	2.856417	0.0056
Seedling Cost (lnX ₃)	0.376515	0.137365	2.740981	0.0077
Irrigation Cost (lnX ₄)	0.089927	0.118115	0.761345	0.4489
Pesticide Cost (lnX ₅)	0.327458	0.279954	1.169687	0.2460
Fertilizer Cost (lnX ₆)	0.373750	0.147115	2.540532	0.0132
Cost of the pillar-rope-wire (lnX ₇)	0.072226	0.098482	0.733393	0.0028
R-squared	0.898303			
Adjusted R-squared	0.888415			
F-Statistic	90.85474			
Prob (F-Statistic)	0.000000			

Source: Estimated by EViews 12 using survey data

Table 3.1 represents the gross outcome of the Cobb-Douglas production function. The estimated results indicate that labor, land preparation, seedling, fertilizer and pillar-rope-wire costs exhibit statistically significant positive impacts, while irrigation and pesticides have a statistically insignificant impact on farmers' income. Among these factors, labor cost exhibits the highest output elasticity (0.772), suggesting it plays the most critical role in farm productivity, followed by land preparation, seedling, and fertilizer costs—all of which are statistically significant. In contrast, irrigation and pesticide costs have low and statistically insignificant contributions, pointing to possible inefficiencies or misallocation. Interestingly, the cost of pillar-rope-wire, while statistically significant, shows a minimal impact on output. The sum of the input elasticities is 2.425, indicating increasing returns to scale, meaning that proportionally increasing all inputs would result in more than proportional increases in output. These findings suggest that optimizing input use, particularly enhancing labor and fertilizer efficiency, while reviewing irrigation and pesticide practices, could significantly improve farm productivity. The coefficient of R-square 0.898303 represents that the explanatory variables can explain 90 percent of the variation in the farmer's income from dragon fruit cultivation. The F-statistic value is positive (90.85474) and its respective probability value is less than 5 percent, indicating that all the factors have a combined positive impact on the income/output of Dragon fruit cultivation.

3.2 Profitability of Dragon Cultivation

A comparative scenario of the benefit-cost ratio of the Dragon fruit culture technique has been delineated in the following Table 3.2 at aggregate levels. While calculating total cost, all variable costs, i.e., labor, land preparation, seedling, fertilizers, pesticides, irrigation, and the cost of pillar-rope-wire, etc. have been considered. All costs and returns are computed on a per bigha (33 decimal) basis. In the analyses, we have presented the financial performance of two districts (Jhenaidah and Chuadanga) at the aggregate level, in the case of Dragon cultivation. We have examined the total cost, total revenue, net profit, and benefit-cost ratio at the aggregate level. All costs and returns are computed on a per bigha (33 decimal)/per year basis.

Opportunities of Dragon Fruit Cultivation in Bangladesh: An Analysis of Profitability and Employment Potential

Table 3.2 Cost - Benefit Analysis of Dragon Fruit (N=160)

Items	BDT (Per 33 decimal)
Total Cost	334,572.19
Total Revenue	611,868.75
Net Profit	277,296.56
Benefit-Cost ratio	1.8288

Source: Field Survey, 2024

Table 3.2 represents the results regarding total costs, total revenue, net profit, and the benefit-cost ratio. Total revenue significantly exceeds total cost, indicating that dragon fruit cultivation in the given area (33 decimal) is economically viable and profitable. A net profit of BDT 277,296.56 suggests a healthy return on investment. The substantial difference between revenue and cost highlights the economic attractiveness of dragon fruit farming. The BCR of 1.8288 means that for every BDT 1 invested, approximately BDT 1.83 is returned. A BCR greater than 1 indicates strong profitability and economic feasibility. The cost-benefit analysis clearly demonstrates that dragon fruit farming in the studied area is highly profitable. Farmers can consider dragon fruit cultivation as a promising agricultural venture due to the favorable financial returns indicated by the high BCR value.

4.0 IMPACT OF DRAGON CULTIVATION ON OCCUPATION AND EMPLOYMENT

The following two measures have been considered to assess the impact of dragon fruit cultivation on occupation and employment.

- Labor force participation rate of the beneficiary households and
- Changes in the Employment Situation Due to the Dragon Cultivation.

4.1 Labor Force Participation Rate of the Beneficiary Households

The labor force participation rate is a calculation that estimates the number of individuals actively engaged in Dragon cultivation in the survey area. This calculation divides the total number of individuals aged 16 and above employed in dragon fruit cultivation by the overall working-age population in the surveyed area.

Table 4.1 Changes in Labor Force Participation Rate of the Beneficiary Households

Variables	Before Dragon Cultivation (N=160)	At the of Survey (N=160)
	Number of persons	
Average household size	4.88	4.86
Income earners per household	2.38	2.55
Income Earners (%) per household	48.77%	52.47%
Dependency ratio %	51.23%	47.53%

Source: Field Survey, 2024

Table 4.1 highlights the changes in labor force participation among beneficiary households before and after engaging in dragon fruit cultivation. The average household size remained almost unchanged, shifting marginally from 4.88 to 4.86 persons. However, the number of income earners per household increased from 2.38 to 2.55, indicating a positive shift in labor engagement. Consequently, the percentage of income earners per household rose from 48.77% to 52.47%, suggesting an improvement in household labor force participation. This was accompanied by a decline in the dependency ratio from 51.23% to 47.53%, reflecting a reduction in the economic burden on earners within the household. These changes imply that dragon fruit cultivation may have contributed to enhanced economic involvement and reduced dependency within beneficiary families.

4.2 Changes in the Employment Situation

Employment generation encompasses two key dimensions: i. creating new job opportunities for those previously unemployed, and ii. increasing the level of employment for those already unemployed. In this discussion, we have primarily focused on creating new employment by examining changes in the primary occupation of household heads both before and after their involvement in Dragon cultivation. Furthermore, our assessment also seeks to determine whether dragon cultivation positively mitigates unemployment, particularly among household heads.

Table 4.3 Changes in the Working Hour due to Dragon Fruit Cultivation			
Indicators	Employment Status		Increase/Changes in employment
	Before Dragon Cultivation	At the time of Survey	
	N=225	N=225	N=225
i. Average working hour	6.03	8.16	2.13
ii. Maximum working hour per day	10	12	2
iii. Minimum working hour per day	2	4	2
iv. Eight-hour days (per month)	21.71	28.77	7.06

Source: Field Survey, 2024

Table 4.3 presents a comparative analysis of employment indicators before and after the adoption of dragon fruit cultivation among 225 respondents. The data reveals a significant increase in labor engagement across all measured dimensions. The average working hours per day increased from 6.03 to 8.16 hours, indicating a 2.13-hour rise, which suggests that farmers are now more fully employed and involved in productive activities. Similarly, the maximum working hours per day rose from 10 to 12 hours, while the minimum working hours per day doubled from 2 to 4 hours, reflecting a more consistent and extended work schedule across farming households. Additionally, the number of standard eight-hour working days per month increased from 21.71 to 28.77, representing a gain of 7.06 full working days per month. This shift highlights the transition from seasonal or part-time employment to more regular and full-time labor engagement due to dragon fruit cultivation. The increased workload suggests that dragon farming not only boosts income potential but also contributes meaningfully to rural employment generation, offering a sustainable source of livelihood throughout the year.

5.0 POLICY RECOMMENDATIONS

The analysis shows that the growing dragon fruit positively impacts households' economic status. Based on the study findings, the following policy recommendations have been suggested:

- **Promote Labor-Intensive Cultivation Practices with Skill Training:** Given the high output elasticity of labor (0.772) and the significant increase in employment and working hours, targeted policies should promote labor-intensive dragon fruit cultivation. Training programs should be introduced to enhance labor productivity and ensure efficient practices across propagation, maintenance, and harvesting stages.
- **Support Fertilizer and Seedling Input:** Fertilizer and seedling costs significantly influence productivity. Government and agricultural extension agencies should provide subsidized inputs or soft agricultural loans for quality seedlings and fertilizers to encourage wider adoption and efficiency.
- **Reassess Irrigation and Pesticide Practices:** As irrigation and pesticide costs were found statistically insignificant, policymakers should investigate the current usage patterns, offer guidelines to optimize their use, and encourage integrated pest and water management systems. This could reduce input waste and improve cost-efficiency.
- **Encourage Investment in Infrastructure (Pillar-Rope-Wire Systems):** Despite its relatively low elasticity, the pillar-rope-wire input was statistically significant. Support in the form of shared infrastructure, cooperatives, or subsidies can reduce setup costs for smallholders and promote scale efficiency.
- **Facilitate Year-Round Employment Through Crop Diversification:** Since dragon cultivation contributes to increased working days and a shift from seasonal to year-round employment, policymakers should encourage complementary crop planning (e.g., intercropping with vegetables or herbs) to fully utilize farm labor capacity and land during off-peak periods.
- **Expand Extension Services Focused on Dragon Fruit Cultivation:** Extension services should include specialized support for dragon fruit farmers, covering best cultivation practices, pest/disease management, marketing, and export procedures. This would ensure knowledge dissemination and productivity gains, especially in new-growing regions.
- **Provide Market Linkage and Post-Harvest Support:** With high profitability (BCR = 1.83), the crop has strong commercial potential. Policies should support post-harvest handling, cold storage, and direct-to-market supply chains, including access to domestic and international markets, to ensure price stability and farmer profitability.
- **Establish Regional Research and Development (R&D) Centers:** To address the broader research gaps, dedicated R&D centers focusing on dragon fruit can drive innovation in cultivar development, climate resilience, disease resistance, and environmentally sustainable practices specific to Bangladesh's agro-ecological zones.

Opportunities of Dragon Fruit Cultivation in Bangladesh: An Analysis of Profitability and Employment Potential

- **Promote Female Participation and Household-Based Employment Models:** The evidence suggests increased household labor force participation and reduced dependency ratios. Tailored initiatives that encourage female involvement in cultivation, propagation, and value addition (e.g., jam or juice production) can enhance inclusive rural employment. These policy recommendations are based on the study's findings and aim to promote dragon fruit cultivation as a profitable and sustainable agricultural practice while optimizing the factors contributing to income and productivity. These policy recommendations aim to leverage the positive impact of dragon cultivation on occupation, and employment status to enhance the well-being of households and communities involved in dragon farming.

6.0 IMPLICATIONS OF THE STUDY

The study's implications are significant and can provide valuable insights for various stakeholders, including dragon fruit farmers, policymakers, researchers, and the agricultural sector as a whole. The study's analysis of technical efficiency using Data Envelopment Analysis (DEA) provides insights into the performance of dragon fruit farms in Jhenaidah and Chuadanga Districts. Farmers can use this information to identify areas where they can improve resource utilization and enhance their overall efficiency in cultivation. Policymakers can use the findings to develop targeted policies and interventions that support the dragon fruit cultivation sector. It may include providing subsidies, training, or technological access to improve cultivation practices. The study's profitability and benefit-cost ratios assessment highlight the economic viability of dragon fruit cultivation in the study area. This information can attract new farmers and encourage existing farmers to expand their dragon fruit cultivation operations. By comparing the Jhenaidah and Chuadanga Districts, the study provides insights into regional disparities in dragon fruit farming. Policymakers can address these disparities by allocating resources and support to lower efficiency and profitability districts. Dragon fruit cultivation is often considered a sustainable and eco-friendly agricultural practice. The study's findings can promote the adoption of sustainable farming methods and reduce the environmental impact of agriculture. The profitability of dragon fruit cultivation may encourage agricultural diversification, reducing dependency on traditional crops. This diversification can enhance the resilience of farmers against market fluctuations and climate change. The profitability of dragon fruit cultivation can contribute to the economic growth of rural areas and create income opportunities for local communities. It can reduce rural-urban migration and stimulate rural development. If dragon fruit cultivation is shown to be highly profitable, it can open doors for export opportunities. The study can attract the attention of international markets and trade, potentially increasing the export of dragon fruits from Bangladesh. In summary, the implications of this study extend to multiple facets of the agricultural sector, including economic, environmental, and social aspects. The findings offer actionable insights for farmers, policymakers, and researchers, contributing to the development and sustainability of dragon fruit cultivation in Bangladesh.

7.0 CONCLUSIONS

The study findings offer valuable perceptions into the multifaceted influence of dragon fruit cultivation on farmers' livelihoods. Dragon cultivation is profitable, elevating farm owners' income and bolstering their living standards. Notably, labor, land preparation, seedlings, and fertilizer play pivotal roles in enhancing income and productivity, with labor emerging as the most influential factor in delivering substantial income growth. The study's model, incorporating various explanatory variables, impressively captures 88.84% of income variation. Moreover, the favorable net profit figures underscore the economic sustainability of this agricultural endeavor, with Jhenaidah District showing a slightly superior performance in this regard. The benefit-cost ratios in both districts emphasize the financial viability of dragon fruit cultivation, with Jhenaidah District exhibiting more efficient cost management. The transformative impact on farmers' occupations, as they shift towards year-round engagement in dragon cultivation, is significant, along with the surge in labor force participation rates and the reduction in dependency ratios. The generation of additional employment opportunities, mainly due to the year-round nature of dragon cultivation, reinforces its socio-economic importance. In summary, dragon fruit cultivation emerges as a promising and sustainable agricultural practice with the potential to elevate incomes, and boost employment opportunities. These findings underscore the compelling case for further promoting and expanding dragon fruit cultivation within agricultural development strategies, ultimately contributing to enhanced rural livelihoods and economic growth.

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