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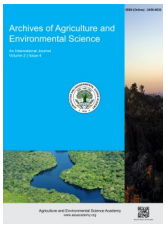

ORIGINAL RESEARCH ARTICLE

Impact of agricultural credit on profitability and efficiency of onion cultivation in a selected area of Bangladesh

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ABSTRACT

Onion is one of the most important commercial spice crops in Bangladesh, grown and consumed almost all over the country. The purpose of this study was to look at the socioeconomic factors, loan profile, profitability and efficiency, as well as the effect of credit on onion production in Bangladesh's Pabna district. Stochastic production frontier method and profitability analysis was used in this study. Primary data were collected through a field survey of 120 onion farmers using a semi-structured interview schedule. The major findings of this study revealed that the majority of the sample farmers were between the ages of 30 and 64; the average family size and annual household income were 5.36 persons and Tk. 264,450 (US$ 2409.57). About 85 percent of the loan money was used for onion cultivation in the study area. Onion production was profitable in the study area. Per hectare, total cost, total return, gross margin, net return, and benefit-cost ratio (BCR) were Tk. 384090.5 (US$ 3499.69), 973657 (US$ 8871.59), 671957.5 (US$ 6122.62), 589566.5 (US$ 5371.90), and 2.53, respectively, for the credit group and Tk. 378412 (US$ 3447.95), 895920 (US$ 8163.28), 599761 (US$ 5464.79), 517508 (US$ 4715.33), and 2.37, respectively, for the non-credit group. The mean farmer's technical efficiency was 94 percent. The impact of credit on onion cultivation was positive. The coefficient value was 0.081. Thus, the study area has tremendous potential for onion production; relevant authorities need to ensure the smooth, timely, and hassle-free flow of sufficient credit to the onion farmers.

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INTRODUCTION

One of the most important spices in Bangladesh is the onion. Every day of the year, every Bangladeshi family cooks with it. In Bangladesh, onions are used to make pickles, chutneys, and sauces in addition to adding flavor to curries (Sobhan, 2019). The bulb, which is made up of the stem plate and fleshy sheath, is the main edible part of an onion. The onion takes pride in its position in many different cuisines around the world and is a basic ingredient in many culinary dishes. Human consumption of onions and other major alliums can be traced back to the time when people lived in caves. According to FAOSTAT (2023) per capita/year onion consumption was 15.6 kg in Bangladesh in 2021. Consuming onions on a regular basis might help heal problems like blood sugar, rheumatism, cancer, heart disease, digestive issues, and persistent cough. In fiscal year 2021–2022, Bangladesh produced 3.6 million metric tons of onions, and in 2022–2023, which was 3.4 million metric tons, according to the Department of Agriculture Extension (DAE, 2023). Bangladesh's onion market has put the country in an odd situation in

recent years. The market is nevertheless unstable and dependent on imports even though the country is the third-largest producer of onions in the world, with supply exceeding domestic demand. Price shocks and sharp price swings are caused by unstable manufacturing of onion (Huda *et al*., 2021). Questions are raised by this paradox regarding the fundamental causes of the instability and potential solutions. Over the past ten years, Bangladesh's onion production has increased significantly, with a surplus of at least 4 to 6 lakh metric tons over domestic demand, according to data from the Department of Agriculture Extension.

While demand is between 28 and 30 million metric tons, the nation's output target for the 2023–2024 fiscal year is an outstanding 36 lakh metric tons. Although there appears to be no scarcity on paper, the market finds it difficult to stabilize in the absence of imports. The substantial waste of onions, which is thought to account for 25 to 30 percent of overall production, is one of the main causes of this instability. Due to the increased use of onions in many traditional cuisines, Hasan & Khalequzzaman (2020) observed that consumption of onions usually rises during the winter. However, during this time, domestic production frequently cannot keep up with demand, leading to imports, mostly from nearby India. This waste is caused by a number of factors, including inadequate storage facilities and improper handling techniques, which artificially create scarcity in spite of abundant output. Furthermore, the problem is made worse by inadequate oversight and poor marketing management, especially during periods of high output. In order to artificially increase prices and further disrupt the market, dishonest traders exploit supply chain flaws by hoarding goods. Authorities like the National Consumer Rights Protection Department are working to monitor and control the supply chain in an effort to stop these abuses, but problems still exist. Bangladesh's unpredictable weather is just one of several resource limitations. The effects of global climate change have significantly worsened the preexisting limits. Onion production is not yet sustainable as a result of these limitations, and regional and even national variations in productivity exist. Per-hectare productivity has been increasing annually in spite of these kinds of limitations, rising from 3.940 tons in 2009 to 12.25 tons in the 2021–2022 growing season (BBS, 2022). There are several underlying causes for Bangladesh's high reliance on imports of onions despite its abundant home supply. The market is unstable due to a number of factors, including ineffective post-harvest procedures that result in waste, poor storage facilities, and market manipulation by dishonest dealers. Stricter regulations to guarantee fair market practices, infrastructure investment, and excellent farming practices are all necessary components of a holistic strategy to address these problems.

Onion output can be increased by utilizing existing technologies to make onions more technically efficient. A research analyzing the technical efficiency of Bangladeshi onion (*Allium cepa* L.) farms was carried out by Baree (2012). According to estimates, the elasticity of output in relation to labor, capital, and land expenses was substantial and had positive values of 0.3026, 0.0718, and 0.0442, respectively. The inefficiency impacts in onion production decrease as age, experience, and farm size rise, according to the substantial negative signs of the coefficients for age, experience, and farm size. Onion farms' technical efficiency ranged from 58 to 99 percent, with an average of 83 percent. It is widely acknowledged that farmers are inefficient at growing onion crops, and there are significant inefficiencies among the many kinds of farms. Bangladesh's agricultural production policy is concerned about the lack of knowledge about the relative profitability of different agricultural productions. If farmers use their resources well, they can increase their output. In Bangladesh, where production hardly ever uses the recommended amount per hectare, the situation is particularly grave. Because of this, onions produce very little at the farm level in comparison to their optimum output. Farmers in the study sites also use different levels of management, depending on their socioeconomic situation and infrastructure, which ultimately results in heterogeneity in productivity. A comparative analysis of Bangladeshi onion-producing farms' technical efficiency was carried out by Baree *et al*. (2011). Small, medium, and large farms that produced onions had mean technical efficiencies of 77 percent, 87 percent, and 84 percent, respectively. Farm-specific technical efficiencies ranged from 55 percent to 99 percent, 57 percent to 99 percent, and 56 percent to 99 percent. Compared to its rival crops, such as mustard, groundnuts, and cabbage, Bangladesh's onion cultivation is profitable in terms of gross returns, according to Haque *et al.* (2011). According to Hasan (2010), growing onions is a profitable endeavour. Tk. 94350, Tk. 78098, and Tk. 67545 were the net returns for small, medium, and large farmers, respectively. The technical inefficiency effects model indicated that farmers with bigger farm holdings had a negative sign and that farm size was significant.

Rural farmers rely heavily on agricultural credit, which are essential to maintaining a country's rural economy and food security. Agricultural credits are an essential tool for raising crop yields and, in turn, our rural, impoverished agricultural community's standard of living. When farmers have little capital, they may use different mixes and amounts of inputs than is optimal, which can hinder their ability to produce at their highest level. Farmers are forced to use ineffective, inconvenient, and expensive alternatives due to a lack of savings options. This viewpoint may be addressed via agricultural financing. Small-scale loans for underprivileged business owners make up the majority of agricultural credits in Bangladesh. It gives them access to lending organizations so they may take out loans and launch their own rural development ventures (Islam *et al*., 2014). According to Feder *et al.* (1990), credit's contribution raises output and yields while also bringing input levels closer to their optimal values. When funding is available and timely, farmers—particularly marginal farmers—can increase output by investing in the tools and supplies required to run their farms (Abedullah *et al*., 2009; Saboor *et al*., 2009). It is necessary to strengthen the credit policy for the production of onions. Onion productivity and the effectiveness of credit recipient farmers must be

assessed (Khatun *et al.*, 2017). Furthermore, productivity and profitability are significantly impacted by loan availability. Credit-accessible farmers are better equipped to spend money on high-quality inputs that have a direct impact on yield, like better seeds, fertilizer, and irrigation systems. The availability of credit also makes it possible for farmers to implement improved management techniques and contemporary technologies, which raises productivity efficiency. However, smallholder farmers' potential production is sometimes hampered by inadequate access to reasonably priced loan choices. The lack of farm-level data on onion growing often prevents researchers from pursuing key study areas. Evaluating the function of credit in onion farming might yield important information on the relationship between financial inclusion and farm profitability and productivity. The results of the study are expected to help individual farmers increase the productive efficiency of their farms by managing and operating them effectively. The results of the study will also help extension experts and policymakers create practical policies, such as methods to increase loan availability, which can boost onion production's profitability and productivity. These were the research questions derived from the above discussion: Which socioeconomic circumstances are relevant to the sample's farmers? What was the agricultural credit utilization pattern for growing onions? What is the profitability of growing onions? How efficient are onion farms at using their resources? What effects does credit have on the production of onions? The study aimed to ascertain the profitability of onion cultivation, estimate the resource use efficiency of specific inputs in onion farms, examine the utilization pattern of agricultural credit for onion cultivation, analyze the socioeconomic characteristics of the sample households, and evaluate the effect of credit on onion production.

MATERIALS AND METHODS

For this study, samples from onion producers were gathered using a straightforward random sampling technique. From the Pabna district's Bera and Santhia upazilas, a total of 120 respondents—60 credit beneficiaries and 60 credit non-recipients were chosen. Primary data, which served as the study's major source, was gathered in-person utilizing a semi-structured interview schedule. To gather pertinent data, focus group discussions (FGDs) and observational methods were also employed. The gathered information was modified to conform to the study's analytical methodology. In addition to the econometric models, this study employed descriptive statistics like percentages and averages.

Functional analysis

Net return

The current study employed the following formula to calculate the net return on onion production:

$$\pi = P_y Y - \sum_{i=1}^{n} (P_{xi} X) - TFC \quad \text{(i)}$$

Where,

π = Net return (Tk./ha/season); P_y= Price of the product (Tk./kg); Y= Amount of the production per hectare/season (Kg); P_{xi}= Price of i^{th} inputs (Tk.); X_i=Amount of the i^{th} inputs per hectare/season (kg); TFC= Total fixed cost (Tk.); i=1,2,3.....,n (number of inputs).

Empirical Cobb-Douglas type production function

Two types of functions, namely Cobb-Douglas and Translog, dominate the technical efficiency literature. The stochastic production functions for the sample onion farmers used:

$$\ln Y = \ln\alpha + b_1 \ln X_1 + b_2 \ln X_2 + b_3 \ln X_3 + + b_4 \ln X_4 + b_5 \ln X_5 + b_6 \ln X_6 + b_7 \ln X_7 + V_i - U_i \quad \text{(ii)}$$

Where,

Y = Yield of onion (kg/ha/season); α = Parameters; *b* = Coefficients; X_1 = Seedling (kg/ha); X_2 = Urea (kg/ha); X_3 = TSP (kg/ha); X_4 = MoP (kg/ha); X_5= Irrigation (Tk./ha); X_6=Human Labor (man-days/ha); X_7 =Power tiller (Tk./ha); i = 1, 2, 3, 4,...

Vi - U_i = Disturbance term.

Technical Inefficiency Effect Model

The technical inefficiency effect in the equation as:

$$U_i = \delta_0 + \delta_1 Z_1 + \delta_2 Z_2 + \delta_3 Z_3 + \delta_4 Z_4 + \delta_5 Z_5 + W_i \quad \text{(iii)}$$

Where,

U_i = Inefficiency; δ_0 = Parameter; Z_1 = Age (Years); Z_2 = Education (Years of schooling); Z_3 = Family size; Z_4 = Experience Z_5 = Extension service; Wi= Error term

To assess the impact of credit on onion production, following regression model was used.

$$lnY = lnA + \beta_1 lnX_1 + \beta_2 lnX_2 + \beta_3 lnX_3 + \beta_4 lnX_4 + \beta_5 lnX_5 + \beta_6 lnX_6 + \beta_7 lnX_7 + \beta_8 X_8 + u \quad \text{(iv)}$$

Where,

Y = Onion yield (kg/ha); X_1= Seedling cost (Tk./ha); X_2= Manure cost (Tk./ha); X_3 = Fertilizer cost (Tk./ha); X_4= Human labour cost (Tk./ha); X_5 = Power tiller cost (Tk./ha); X_6 = Irrigation cost (Tk./ha); X_7 = Insecticide cost (Tk./ha); X_8 = Credit use = Dummy for credit use (1 if credit is used; 0 otherwise); β_1- β_8= Co-Efficient of related variables; u = Stochastic random error term.

RESULTS AND DISCUSSION

The socioeconomic traits of farmers have a significant impact on production planning. Individuals vary greatly from one another. An individual's traits play a major role in determining their conduct. Therefore, this study made an effort to look into certain common socioeconomic factors, such as household income, education, age, family size, and extension services.

Age distribution of the sample respondents

The age of a farmer has a significant impact on farming management

and operations. Farmers that have better managerial skills are more productive, based on their age and experience. According to several academics, elderly farmers have more life experience. Compared to their younger counterparts, they are more risk cautious, have a better understanding of manufacturing procedures, and are more equipped to control their inputs. According to several of the studies, younger farmers are more likely than their older colleagues to adopt new technology. The family members of the farmers who were sampled in this study were divided into three age groups: (i) those aged 15 to 29; (ii) those aged 30 to 64; and (iii) those aged above 64. According to Table 1, roughly 6.67 percent of the farmers in the credit group were between the ages of 15 and 29. 85 percent of farmers were between the ages of 30 and 64, with the remaining 8.33 percent falling into the over-64 age range. It is clear that the most of the farmers were between the ages of 30 and 64, which was the most productive age group. Additionally, Table 1 shows that roughly 3.33 percent of the farmers in the non-credit group were between the ages of 15 and 29. Approximately 85 percent of farmers were between the ages of 30 and 64, with the remaining 11.67 percent falling into the over-64 age range.

Family size

The total number of people of either sex living together and sharing meals in the same kitchen under the supervision of a single family head is known as the family size. The farm family consists of the husband, wife, parents, brothers, sons, and unmarried daughters. According to HIES (2022), the average family size in Bangladesh is 4.26 persons. The farmers were divided into three groups according to the size of their families: (i) three to four members, (ii) five to six members, and (iii) more than six members. As can be seen from Table 1, around 31.67 percent of respondents in the credit group have small families, 45 percent have medium-sized families, and 23.33 percent have large families. Additionally, Table 1 shows that approximately 38.33 percent of respondents in the non-credit group are from small families, 35 percent are from medium families, and 26.67 percent are from large families. In the research area, the average family size was 5.36 people.

Table 1. Socioeconomic characteristics (age, family size, education, household income and extension services).

Items	Credit Group		Non-Credit Group	
Age (years)	**Frequency**	**Percentage (%)**	**Frequency**	**Percentage (%)**
15-29	4	6.67	2	3.33
30-64	51	85.00	51	85.00
65 and above	5	8.33	7	11.67
Total	**60**	**100**	**60**	**100**
Family size				
Small family (3 to 4)	19	31.67	23	38.33
Medium family (5 to 6)	27	45.00	21	35.00
Large family (above 6)	14	23.33	16	26.67
Total	**60**	**100**	**60**	**100**
Average family size = 5.36				
Literacy level				
Illiterate	12	20.00	22	36.67
Primary (1-5)	24	40.00	24	40.00
Secondary (6-10)	12	20.00	8	13.33
Higher Secondary (11-12)	7	11.67	5	8.33
Graduate and above	5	8.33	1	1.67
Total	**60**	**100**	**60**	**100**
Average annual income (Tk.)				
Low income (<250000) (US$ 2277.90)	30	50.00	28	46.67
Middle income (250000-300000) (US$ 2277.90-US$ 2733.49)	21	35.00	24	40.00
High income (>300000) (US$ 2733.49)	9	15.00	8	13.33
Average income	**265800.00 (US$ 2421.87)**		**263100.00 (US$ 2397.27)**	
Total average income	**264450.00 (US$ 2409.57)**			
Extension service				
Received	5	8.33	4	6.67
Non-received	55	91.67	56	93.33
Total	**60**	**100**	**60**	**100**

Source: Field Survey, 2024 (US$ 1= Tk.109.75).

Educational level

Education is the foundation of the country. Education plays a significant impact in accelerating both agricultural and economic development rates. Education is crucial to a nation's entire growth process. With agriculture as its backbone, Bangladesh is a thriving nation. By adequately educating the rural populace, the agriculture industry may be modernized. The rural population's lack of literacy is one of the biggest barriers to improving agricultural output. To assess the respondents' level of literacy, literacy was divided into five categories: (i) illiterate; (ii) primary (1–5); (iii) secondary (6–10); (iv) higher secondary (11–12); and (v) graduate and above. People who are illiterate are people who are incapable of reading or writing. The literacy level of the onion farmers is shown in Table 1. About 20 percent of respondents in the credit group are illiterate, 40 percent have only completed primary school, 20 percent have completed secondary school, 11.67 percent have completed higher secondary school, and the remaining 8.33 percent are graduates or above. Of the respondents in the non-credit group, approximately 36.67 percent are illiterate, 40 percent have completed primary school, 13.33 percent have completed secondary school, 8.33 percent have completed higher secondary school, and the remaining respondents are graduates or above.

Average annual income of the sample households

The most significant determinant of socioeconomic position is income. The yearly earnings from various income-generating activities (IGAs) by the active male and female family members have been used to assess the family's annual revenue. The sum of the revenue from both farm and non-farm sources during the study period was used to determine the average total family income. In terms of the monetary value of agricultural operations, farm income was defined as revenue derived from agricultural sectors such as crops, animals, fisheries, homestead gardening, forests, and others. It would be discovered that the respondent households' primary sources of additional income in the research region were business, labour, sales, services, and other sources. The sampled farmers in this study were divided into three income-based groups: i) low income (less than Tk. 250000) (US$ 2277.90); ii) middle income (between Tk. 250000 (US$ 2277.90); and Tk. 300000 (US$ 2733.49); and iii) high income (more than Tk. 300000 (US$ 2733.49). The distribution of the sample families by average yearly revenue from onion farming and other non-farm IGAs is shown in the Table 1. It was discovered that 50 percent of the respondents in the credit group were from low-income groups, while 35 percent and 15 percent of the respondents were from middle- and high-income groups, respectively. Thus, the vast majority of those surveyed were low-income. Tk. 265,800 (US$ 2421.87) was the average yearly income overall. It was discovered that 46.67 percent of the respondents in the non-credit group were from low-income groups, while 40 percent and 13.33 percent, respectively, and were from middle-income and high-income groups. Thus, the vast majority of those surveyed were low-income. Tk. 263,100 (US$ 2397.27) was the average yearly income overall. In the study area, the average yearly income was Tk. 264,450 (US$ 2409.57).

Extension services received by the sample respondents

Extension services help farmers become more knowledgeable and proficient. Farmers can enhance their agricultural cultivation practices by using extension assistance from various government and non-government organizations. Only 8.33 percent of farmers in the credit group in the research area received extension services; the remaining farmers did not. Only 6.67 percent of farmers in the non-credit group received extension services; the remaining farmers were not provided with any assistance.

Adequacy of loan

The loan's sufficiency for the sample respondents is displayed in Table 2. Three groups of lone receivers were identified: (i) small amount (less than Tk. 30,000 (US$ 273.35); (ii) medium amount (between Tk. 30,000 (US$ 273.35) and Tk. 50,000 (US$ 455.58); and (iii) large amount (more than Tk. 50,000 (US$ 455.58). According to the table, the average loan amount received in the small category was Tk. 24000 (US$ 218.68), which was 100 percent of the total amount requested for. The average loan amount asked for was Tk. 24000 (US$ 218.68). In contrast, the average loan amount received in the medium category was Tk. 45166.67 (US$ 411.54), which was 100 percent of the total amount requested for, while the average loan amount applied for was Tk. 45166.67 (US$ 411.54). In the large category, the average loan amount asked for was Tk. 86,000 (US$ 783.60), while the average loan amount obtained was Tk. 86,000 (US$ 783.60) or 100 percent of the total amount applied.

Table 2. Adequacy of loan received by the respondents.

Category	Average Amount Applied for loan (Tk.)	Average Amount Received loan (Tk.)	Amount Received in % of Amount Applied
Small amount (<Tk. 30000) (US$ 273.35)	24000.00 (US$ 218.68)	24000.00 (US$ 218.68)	100
Medium amount (Tk. 30000-Tk. 50000) (US$ 273.35-US$ 455.58)	45166.67 (US$ 411.54)	45166.67 (US$ 411.54)	100
Large amount (>Tk. 50000) (US$ 455.58)	86000.00 (US$ 783.60)	86000.00 (US$ 783.60)	100

Source: Field Survey, 2024 (US$ 1= Tk.109.75).

Sources and purpose of loan of the respondents

The survey included 60 respondents who were Rajshahi Krishi Unnayan Bank (RAKUB) beneficiaries and others. Although the majority of the respondents cultivate onions, they also engage in a wide range of other activities. In such instance, RAKUB lends farmers money to grow onions. Instead of lending money for the production of onions, they did it for other IGAs. It was noted that RAKUB gave its beneficiaries loans for a variety of uses.

Loan utilization patterns by the respondents

In farming, the pattern of loan utilization is crucial. When credit is used properly, it helps borrowers and boosts output. Achieving the goals and objectives of loan recipients and lending organizations, as well as the overall economic growth of the nation, depends on the effective use of loans. Since it is hard to recall the incidence after a year, just 12 months of borrowing were taken into account in this case. Table 3 displays the percentage breakdown of the total loan amount utilized for each purpose. The respondents used their loans for a wide range of purposes, such as growing onions, investing in businesses, purchasing food, repairing their homes, receiving medical attention, funding their children's education, etc. It was found that growing onions accounted for 85 percent of the respondents. Ten percent of respondents were used for things like purchasing food, renovating a home, receiving medical care, funding children's education, etc., and five percent were used for company investments in addition to growing onions. It is clear that most respondents used the loan specifically for producing onions, with very few using it for other purposes.

Interest rate of RAKUB and others

RAKUB is a specialized bank that offers loans for agricultural use. Over the whole country, the RAKUB provides a standard interest rate. Sixty percent of the loan portfolio's annual allocation was set aside for crop finance. All of the nation's seasonal crops are covered under the credit scheme. The loan is paid out in accordance with guidelines established by the Bangladesh Bank. Interest rates were 9 percent for this sector and 20 percent for others, such as moneylenders, neighbours, and family members. However, the interest rate may fluctuate periodically. This loan is typically intended for both sharecroppers and landowners. The loan is also available to marginal farmers.

Loan repayment

The responders from the Santhia and Bera branches have a s tellar loan repayment record. The following year, they paid back the debt once their crop was entirely harvested. Since they were aware that they would be eligible for more loans that would allow them to boost their productivity and earnings, they made an effort to pay off the loan in full and without any problems. The respondents made an effort to increase their paddy crop, which contributed to their increased prosperity. The respondents' payback performance is displayed in Table 4. According to Table 4, the respondents got approximately Tk. 1170000 (US$ 10660.59) in total principal from RAKUB, which increased to Tk. 105300 (US$ 959.45) at a 9 percent interest rate. Following crop harvest, the respondents paid back the loan. As a result, the respondents' payback performance was almost 100 percent. Additionally, it demonstrates that the respondents received approximately Tk. 1835000 (US$ 16719.82) in total principal from others, which increased to Tk. 367000 (US$ 3343.96) at 20 percent interest. Following crop harvest, the respondents paid back the loan. As a result, the respondents' payback performance was almost 100 percent.

Table 3. Loan utilization patterns by the respondents.

Items	Frequency	Percentage (%)
Onion growing	51	85.00
Investment in the business	3	5.00
Food purchasing, repairing of houses, treatment, education	6	10.00
Total	60	100

Source: Field survey, 2024.

Table 4. Amount received and paid by the respondents.

Item	RAKUB	Others
	Amount (Tk.)	Amount (Tk.)
Principal amount received by the respondents (Tk.)	1170000 (US$ 10660.59)	1835000 (US$ 16719.82)
Interest after one year (Tk.)	105300 (US$ 959.45)	367000 (US$ 3343.96)
Total amount (Tk.)	1275300 (US$ 11620.05)	2202000 (US$ 20063.78)
Repayment by the respondents (Tk.)	1275300 (US$ 11620.05)	2202000 (US$ (US$ 20063.78)
Repayment performance (percentage)	100	100

Source: Field Survey, 2024 (US$ 1= Tk.109.75).

Table 5. Per hectare average costs and return of onion cultivation (In case of credit group).

Item	Unit	Quantity	Price/Unit (Tk.)	Total Cost (Tk.)
Variable cost (Tk.)				
Seedling	Kg	1879.5	65	122167.5 (US$ 1113.14)
Human Labour	Man-days	149.4	500	74700 (US$ 680.64)
Power tiller	Tk.			22453.5 (US$ 204.59)
Urea	Kg	374.4	27	10109 (US$ 92.11)
TSP	Kg	225.5	27	6088.5 (US$ 55.48)
MoP	Kg	225.5	20	4510 (US$ 41.09)
Others	Kg	62.5	220	13750 (US$ 125.28)
Manure	Kg	150.5	20	3010 (US$ 27.43)
Insecticide	Tk.			29940.5 (US$ 272.81)
Irrigation	Tk.			14970.5 (US$ 136.41)
A. Total variable cost (Tk.)			301699.5 (US$ 2748.97)	
Fixed cost (Tk.)				
Land use cost (Tk.)			74849 (US$ 682.00)	
Interest on operating capital (Tk.)			7542 (US$ 68.72)	
B. Total fixed cost (Tk.)			82391 (US$ 750.72)	
C. Total cost (Tk.)(A+B)			384090.5 (US$ 3499.69)	
Return				
Yield	Kg	17954.95	52	933657 (US$ 8507.13)
By-product	Tk.			40000 (US$ 364.46)
D. Total return (Tk.)			973657 (US$ 8871.59)	
Gross margin (Tk.)(D-A)			671957.5 (US$ 6122.62)	
Net return (Tk.)(D-C)			589566.5 (US$ 5371.90)	
BCR (D/C)			2.53	

Source: Field Survey, 2024 (US$ 1= Tk.109.75).

Table 6. Per hectare average costs and return of onion cultivation (in case of non-credit group).

Item	Unit	Quantity	Price/Unit (Tk.)	Total Cost (Tk.)
Variable cost (Tk.)				
Seedling	Kg	1877	64	120128 (US$ 1094.56)
Human Labour	Man-days	144.5	500	72250 (US$ 658.31)
Power tiller	Tk.			22414 (US$ 204.23)
Urea	Kg	369.2	27	9968 (US$ 90.82)
TSP	Kg	222.5	27	6008 (US$ 54.74)
MoP	Kg	222.5	20	4450 (US$ 40.55)
Others	Kg	59.5	220	13090 (US$ 119.27)
Manure	Kg	147.5	20	2950 (US$ 26.88)
Insecticide	Tk.			29936 (US$ 272.77)
Irrigation	Tk.			14965 (US$ 136.36)
A. Total variable cost (Tk.)			296159 (US$ 2698.49)	
Fixed cost (Tk.)				
Land use cost (Tk.)			74849 (US$ 682.00)	
Interest on operating capital (Tk.)			7404 (US$ 67.46)	
B. Total fixed cost (Tk.)			82253 (US$ 749.46)	
C. Total cost (Tk.)(A+B)			378412 (US$ 3447.95)	
Return				
Yield	Kg	16460	52	85592 (US$ 7798.82)
By-product	Tk.			40000 (US$ 364.46)
D. Total return (Tk.)			895920 (US$ 8163.28)	
Gross margin (Tk.)(D-A)			599761 (US$ 5464.79)	
Net return (Tk.)(D-C)			517508 (US$ 4715.33)	
BCR (D/C)			2.37	

Source: Field Survey, 2024 (US$ 1= Tk.109.75).

Profitability of onion cultivation

This section's primary goal is to evaluate the expenses, yields, and profitability of cultivating onions. A key factor in deciding whether to produce any crop at the farm level is profitability.

Farmers can make well-informed decisions about resource allocation that impact their agricultural operations and overall profitability by closely examining production costs. The ratio of return to total cost, net return, and gross margin can all be used to gauge it. To determine the overall cost of production, the prices of each item were computed. The value of the primary products and by-products has been used to estimate the crop returns. The sum of the fixed and variable input costs was used to determine the overall cost. According to Table 7, the total cost of growing onions in the current study was Tk. 384090.5 (US$ 3499.69) per hectare for the credit group and Tk. 378412 (US$ 3447.95) for the non-credit group. Table 7 displays the return on onion cultivation per hectare. The total amount of product and by-product (onion flower) was multiplied by the corresponding per unit price to determine the overall return per hectare. Tables 5 and 6 make it clear that the average yield of onions per hectare was 17954.95 kg and 16460 kg, that the average price of onions was Tk. 52/kg, and that the average value of the by-product was Tk. 40000 (US$ 364.46). Based on these factors, the total return of onions was determined to be Tk. 973657 (US$ 8871.59) for the credit group and Tk. 895920 (US$ 8163.28) for the non-credit group. The gross return over variable costs is known as the gross margin. The entire variable cost was subtracted from the gross return to determine the gross margin. According to the data, the credit and non-credit groups' respective gross margins were Tk. 671957.5 (US$ 6122.62) and Tk. 599761 (US$ 5464.79) per hectare, respectively. The entire cost of onion production was subtracted from the gross return to get the net return, or profit. The net return for the credit and non-credit groups was calculated to be Tk. 589566.5 (US$ 5371.90) and Tk. 517508 (US$ 4715.33) per hectare, respectively. According to Bapari *et al.* (2016), socioeconomic factors were crucial in the production of onions. Onion cultivation was lucrative, as evidenced by the yields of 1535.6 kg, production costs, and net benefit of Tk. 26329.63 (US$ 239.90), Tk. 26883.48 (US$ 244.95), and Tk. 26883.48 (US$ 244.95) per *bigha* (33 decimal), respectively. Benefits per unit of cost are compared using the benefit-cost ratio (BCR), a relative metric. The benefit-cost ratio (BCR) for the credit group was 2.53 and non-credit group was 2.37. Onion farming in Bangladesh is profitable for both credit and non-credit groups, according to tables 5 and 6. Anjum and Barmon (2018) found that benefit-cost ratios (BCR) for onion production in Kushtia and Jhenaidah districts of Bangladesh were 2.02 and 1.83, respectively. Rashid *et al.* (2022) found that the benefit-cost ratio of onion was 1.74. The many cost elements and their application dosages for farmers, yields, and returns per hectare of onion growing are easily understood from the explanation above. Effective utilization of contemporary inputs, including seeds, fertilizer, manpower, power tillers, pesticides, and irrigation, is crucial. Utilizing these inputs effectively and promptly is crucial for boosting output and profitability. It is possible to draw the cautious conclusion that growing onions is profitable in Bangladesh.

Technical efficiency analysis

Table 8 displays the maximum likelihood estimates for the

Table 7. Per hectare average total cost, total return, net return, and BCR of onion cultivation.

Items	Credit group	Non-credit group
Variable cost (Tk.)	301699.5 (US$ 2748.97)	296159 (US$ 2698.49)
Total cost (Tk.)	384090.5 (US$ 3499.69)	378412 (US$ 3447.95)
Total return (Tk.)	973657 (US$ 8871.59)	895920 (US$ 8163.28)
Gross margin (Tk.)	671957.5 (US$ 6122.62)	599761(US$ 5464.79)
Net return (Tk.)	589566.5 (US$ 5371.90)	517508 (US$ 4715.33)
BCR	2.53	2.37

Source: Field Survey, 2024 (US$ 1= Tk.109.75).

Table 8. Maximum likelihood estimates for parameters of Cobb-Douglas stochastic production function and the technical inefficiency effect for onion farmers.

Variables	Parameters	Coefficients	Standard Error	P>|Z|
Intercept	b_0	-41.71378**	17.25804	0.016
Seedling	b_1	-.2660343	.2770687	0.337
Urea	b_2	.5837071**	.2351136	0.013
TSP	b_3	.447742***	.1249684	0.000
Human labour	b_4	.3604433**	.1520623	0.018
Power tiller	b_5	4.575746***	1.719698	0.008
Inefficiency model				
Intercept	b_0	-5.19505***	1.490321	0.000
Age	b_1	-.0264175	.0495079	0.594
Education	b_2	-.0034107	.0373638	0.927
Family size	b_3	-.0306722	.0810006	0.705
Experience	b_4	.0768599	.0639101	0.229
Extension service	b_5	-.7919212	.5044316	0.116
Mean efficiency		0.9492		
		Log likelihood=236.24191		

Source: Authors estimation ***=Significant at 1% level **=Significant at 5% level

Table 9. Estimated values of coefficients and related statistics of regression for onion production.

Explanatory Variables	Onion			
	Unstandardized Coefficients	Standard Errors	T-values	Sig.
Constant (X_0)	-158.675*	91.089	-1.742	0.084
Seedling (X_1)	0.042	0.114	0.373	0.710
Fertilizer (X_2)	0.080**	0.039	2.061	0.042
Manure (X_3)	0.101***	0.035	2.840	0.005
Human labour (X_4)	0.002	0.073	0.033	0.974
Power tiller (X_5)	-0.540	0.991	-0.545	0.587
Irrigation (X_6)	-5.871	3.763	-1.560	0.122
Insecticide (X_7)	22.129***	7.539	2.935	0.004
Credit (X_8)	0.081***	0.004	19.165	0.000
R^2	0.881			
F-values	102.999***			

Source: Authors estimation ***=Significant at 1% level **=Significant at 5% level *=Significant at 10% level

technological inefficiency effect and Cobb-Douglas stochastic production type function parameters for onion farmers. Both the TSP and power tiller cost coefficients were statistically significant at the 1 percent level, whereas the human labor and urea coefficients were statistically significant at the 5 percent level. This suggests that farmers in the research area made precise use of power tillers, urea, TSP, and human labor, all of which helped them boost onion yields—all of which were crucial for onion production. According to the equations for power tiller, urea, TSP, and human labor, the yield rises by 0.36 percent, 0.58 percent, 0.45 percent, and 4.58 percent, respectively, for every 1 percent increase in the cost of these inputs. However, the seedling coefficient was not significant. The age, education, family size, experience, and extension services of a farmer were not statistically significant in the technical inefficiency model. With an average efficiency of 94 percent, the farmers' output of onions was 6 percent less than that of the frontier. An average 6 percent increase in yield per hectare can be achieved without adding to production expenses. The mean of technical efficiencies of farmers in Dallo-Manna district of south eastern Ethiopia was 76 percent (Mulatu & Gemechu, 2023). The factors influencing technical, allocative, and economic efficiency among small-scale onion farmers in Ethiopia's irrigation agriculture were described by Haile (2015). The socioeconomic traits of the farmers (age, market access, training access, experience, farm income, responsibility, and field visit) had a significant and positive impact on both the technical and productive efficiencies, he discovered, and land-related factors explained a large portion of the technical efficiencies.

Impact of credit on onion production

According to Table 9, the regression coefficient of credit has a positive sign and a magnitude of 0.081. At the one percent probability level, this coefficient is statistically significant. It suggests that a 1 percent increase in credit would result in a 0.081 percent rise in the gross return, all other things being equal. Azad *et al.* (2023) found that credit disbursed in agriculture significantly increase agricultural production in the long run.

Conclusion

One of the major spice crops that Bangladeshi farmers grown is onion. Onion agriculture has enormous potential in the research locations. According to the current study's findings, growing onions is profitable and would benefit the socioeconomic standing of the sample farmers in the research locations. Onions would contribute to job creation because they are a labor-intensive crop. Due to land constraints, it is challenging to expand the area of land under cultivation in Bangladesh in order to enhance onion production. However, there is a chance to boost onion production by advancing current production technologies. There is a chance to significantly boost productivity with the current level of agricultural inputs, agricultural extension services, and available technology because farmers are comparatively inefficient due to factors like lack of expertise, illiteracy, etc. Additionally, the study discovered that agricultural credit significantly boosts onion production. Compared to farmers who do not use agricultural loan, those who cultivate onions using agricultural credit produced 8.1 percent more onions per hectare. For the policy to be widely and successfully implemented, Bangladesh Bank (BB) and government officials should address the issues and difficulties farmers encounter when trying to obtain and use agricultural credit, as this has a substantial positive impact on the growth of onion production. The output of this crop may rise if farmers had timely access to modern inputs, which could help them reduce rural poverty in many places. Universal credit financing to impoverished rural agricultural households would undoubtedly be made possible by appropriate policy support for credit programs. This would guarantee sustainable growth in agricultural production, create national food security, and ultimately reduce poverty by raising household income levels.

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DECLARATIONS

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