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ORIGINAL RESEARCH ARTICLE

Role of credit on mustard production and food security in a selected area of Sirajganj District in Bangladesh

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ABSTRACT

Credit is a driving force behind increased crop productivity, and food security is essential to the general advancement of humanity. The current study was carried out to analyze the socio-economic profile of the respondents, examine the loan components, evaluate the effect of credit on mustard production, and find out how many calories each household member consumes on a per capita basis. A sample size of sixty respondents was selected randomly from Sirajganj district in Bangladesh. Primary data were collected through a field survey using a semi-structured interview schedule. Descriptive statistics, the multiple linear regression models, and the modified OECD scale were used to analyze the data. The study found that most of the respondents were in the active age group, and half of the respondents had a secondary level of education. About half of the respondents belonged to the middle-income group. Two-thirds of the respondents received a large loan. It was found that credit had a positive impact on mustard production. The poverty rate was much higher than the national average in the study area. Along with specialized banks, other financial institutions should extend agricultural loans to increase mustard production and food security for rural poor households in Bangladesh.

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INTRODUCTION

Bangladesh is one of the world's most densely populated countries, with its people crammed into a delta of rivers that empty into the Bay of Bengal (BBS, 2019). About 40.6% of people directly depend on agriculture (BER, 2022). It is essential to diversify crops to ensure food security. Agriculture has played a pivotal role in the sustainable growth and development of the Bangladeshi economy. Although the agriculture sector contributes to 11.50% (at the current price) of GDP in 2021–22, a large portion of the population are still dependent on agriculture as their major income source. Bangladesh has a high work force of 40.6% of the total population among which 59.15% are cultivators, and 29.85% are agricultural labourers. This statistics states the importance of agriculture in Bangladesh very vividly. Rapeseed and mustard are popularly called 'Mustard', which is a leading oilseed crop, covering about 80% of the total oilseed area and contributing to more than 60% of the total oilseed production in Bangladesh. It is a cold-loving crop that is grown during the Rabi season. Among different districts of the country, 46 districts like Dinajpur, Rangpur, Bogura, Tangail, Jamalpur, Mymensingh, and Dhaka are leading in mustard cultivation. In terms of area and production, mustard ranks first among the oilseed crops planted in Bangladesh in the fiscal year 2021–2022, with 6.10 lakh hectors and 822 thousand metric tons, respectively. Farmers are more inclined to boost their output since mustard oil is more costly than both soybean and palm oil. Department of Agricultural Extension DAE (Department of

Agricultural Extension) is encouraging the growth of mustard and rapeseed production through its extension efforts, and Bangladesh Agricultural Research Institute (BARI) and Bangladesh Institute of Nuclear Agriculture (BINA) have introduced over 20 varieties of mustard (USDA, 2022). In the winter, a large range of valuable crops are also grown. Therefore, when it comes to farmers' crop selection, mustard production must contend with fierce competition from high-value crops. They may be forced to sell their produce at a farm gate for a poor price in the absence of suitable marketing facilities, which may discourage them from producing mustard in the long run (Miah and Mondal, 2017).

An acute shortage of edible oils has been prevailing in Bangladesh during the last several decades, and spending on edible oils and oilseed imports has been increasing to meet the country's demand. Production of oilseeds is very important in Bangladesh since a lot of foreign exchange is spent on importing edible oils and oilseeds to meet domestic demand. Mustard is of great economic importance, as mustard seeds contain 34–47% of oil (iodine number 92–119) and white mustard seeds contain 25–39% of oil (iodine number 92–122), wherein there is a continuing need in various industries (canning, bakery and confectionery, margarine, pharmaceutical, textile, soap, etc.). At present, about 0.24 million hectares of land are employed in mustard cultivation in Bangladesh, with a yield of mustard oil in the order of 0.19 million metric tons per year. Just a small portion of the nation's needs for cooking oil are met by this amount. Therefore, a large quantity of soybean and sunflower oil is to be imported. Although mustard is grown in almost all the districts, Chittagong, Sylhet, Dhaka, Tangail, Jessore, Bogra, Sirajganj, and Pabna have comparatively higher acreages of land for the cultivation of this Rabi crop (Banglapedia, 2023). The COVID-19 epidemic caused a significant disruption to Bangladesh's mustard oil industry since it altered the demand dynamics. However, during the post-lockdown period, there was a significant shift in food consumption patterns. People started experimenting with new recipes and preferred cooking at home, which led to a significant decline in the popularity of eating out. Consequently, there was a rise in demand for edible oil packets for the home, including mustard oil. Changing consumer dietary habits and the use of mustard oil in Bangladeshi dishes are driving demand for mustard oil. Sampa *et al.* (2020) carried out a study to assess the profitability of mustard production which indicated mustard cultivation was profitable for producers and the gross return can be increased to 1.80%through the increase of the specified variable by 1%.

The necessity of credit for rural farmers in adopting modern technology like mustard production has been sought since long. Various nationalized commercial banks, other private commercial banks, and different big or small NGOs were encouraged by the GOB have to finance agriculture. Among these, BKB and RAKUB are the key institutions for providing an increased amount of credit to the farmers with a view to developing the agricultural sector by and large, different agro-based industries, and proper marketing of farm products in Bangladesh. Various NGOs are involved in providing credit to the landless, marginal, and small farmers in rural areas of Bangladesh. As modern technologies are always in favour of capital intensiveness, farmers feel a shortage of feed when adopting them. Credit is essential for agricultural enterprises because it allows farmers to access capital that would otherwise be unavailable to them. It assists them in obtaining the seeds, equipment, and land required to run a successful farm. The flow of funds has increased considerably since the independence of Bangladesh, although it has been still less compared to general credit needs. But in spite of increased funding, significant progress has not been achieved so far in this sector.

Agricultural credit is important to achieving food security. Food security refers to the situation 'when all people, at all times, have physical, social and economic access to sufficient, for an active and healthy life, safe and nourishing food that satisfies their dietary demands and food preferences FAO (2011). Food production, availability, and economic access to food are all components of food security. In Bangladesh, the most important priority is food security. In addition to domestic food production, everyone places a higher priority on having access to enough safe food at all times to support an active and healthy lifestyle (PRSP, 2005). Food security encompasses three elements: availability, accessibility, and utilization (USAID, 1996). The physical presence of food at all scales, from the home to the national, whether it comes from one's own production or through markets, is referred to as food availability (FANTA, 2006). Food access refers to the ability to obtain an appropriate and nutritious diet and is in particular linked to resources at the household level. Food utilization is the appropriate use of food, which involves having appropriate food handling and storage procedures, sufficient understanding about and application for child care and nutrition, and sufficient access to health and sanitation services (FANTA, 2006). The government of Bangladesh has therefore given priority to the agriculture sector to increase the production of oil seeds by giving subsidies to farmers on different inputs such as fertilizer, irrigation, etc. Oil cake, the by-product of mustard, is a nutritious food item for cattle and fish. It is also a good organic fertilizer. It is an important source of cooking oil in Bangladesh, and it meets one-third of the edible oil requirements of the country. The production of oilseed accounts for one-third of total oil seed production in Bangladesh. The majority of the supply of oil in the market is maintained through imports from abroad, at the cost of a huge amount of foreign exchange.

Given the significance of mustard farming in Bangladesh, it is imperative to determine the greatest amount of mustard that may be produced per unit of land while utilizing the resources already available. Farmers that utilize resources efficiently can increase their output with the resources that are available. The situation is particularly critical in a country like Bangladesh, where the per-hectare recommended amount is seldom used in production. However, a few systematic financial investigations on oilseed crops were undertaken either by private or government organizations and were not sufficient to satisfy the

demands of extension workers, policymakers, research personnel, and farmers. In this context, this study will help to diagnose the problems and prove our understanding of the interrelated problems of farmers' choice-making in producing mustard. The findings of the study will generate basic information on the production practices of mustard. The present study will provide valuable information to individual farmers and researchers who will conduct further studies of similar nature and encourage them to conduct more comprehensive and detailed investigations in this particular field of study. The specific objectives of the study were as follows: (i) To analyze the socioeconomic characteristics of sample households; (ii) To identify the adequacy, sources, utilization patterns, interest rate, and repayment of the loan of the respondents. (iii) To assess the impact of credit on mustard production; and (iv) To determine the calorie intake level of the sample households.

MATERIALS AND METHODS

A sample of 60 mustard cultivation households was selected from five villages, namely Jidhuri, Chala, Chandangati, Mukundogati, and Shernagar, under the Belkuchi upazila of Sirajganj district, who were the beneficiaries of the Rajshahi Krishi Unnayan Bank of Belkuchi branch. Primary data were collected through a field survey using a semi-structured interview schedule in the time period of March to May 2023. Focus group discussions (FGDs) and observation techniques were also used to get relevant information. Along with tabular analysis, descriptive statistics, multiple linear regression models, and the modified OECD scale were used to analyze the data. In order to explore the effects of different inputs on mustard production, a multiple linear regression function was chosen on the basis of a theoretical background. A general specification of the production function was considered by assuming that the area under mustard cultivation, seedlings, fertilizer, irrigation, manures, and labour (man-days) have an impact on mustard production. When the data were tested to check for multicolinearity among the independent variables, the researcher found that the variables area under mustard cultivation and labour-man days significantly correlated with other variables. So, the researchers removed these variables from the classical production function. On the basis of these assumed conditions, the multiple linear regression function was specified in order to examine the variation in production as a result of one unit of variation in the functioning factors.

The general specification of the function was as follows:

$Y = ¦ (S, F, I, M)$..... (i)

Where,

Y = Amount of mustard production (Kg)

S = Cost of seed (Tk.)

F = Cost of chemical fertilizer (Tk.)

I = Cost of irrigation (Tk.)

M = Amount of manure (Kg.)

As the objective is to assess the impact of agricultural credit on mustard production, credit has no direct impact on mustard production but has an impact on input utilization, mainly chemical fertilizer and irrigation. It was thought that fertilizer prices and bank credit availability affected the quantity of fertilizer applied to mustard fields, and that irrigation costs and bank credit availability affected the amount of irrigation per hectare used.

To estimate the impact of agricultural credit on mustard production, the following hypothetical model has been developed:

$Y = ¦ (F, I)$..... (ii)

Where,

Y = Amount of mustard production (Kg)

F = Cost of chemical fertilizer (Tk.)

I = Cost of irrigation (Tk.)

$F = ¦ (F_p, BC)$..... (iii)

$I = ¦ (I_p, BC)$..... (iv)

Where,

Fp = price of chemical fertilizer (Tk).

Ip = price of irrigation water (Tk.)

BC = Bank credit (Tk.)

Equation (ii) gives the mustard production function, while equations (iii) and (iv) give chemical fertilizer and irrigation water demand functions. To estimate the impact of bank credit (BC) on mustard production (Y), equation (ii) is partially differentiated with respect to bank credit (BC).

$$\delta Y/\delta BC = \left(\frac{\delta Y}{\delta F} \times \frac{\delta F}{\delta BC}\right) + \frac{\delta Y}{\delta I} \times \frac{\delta I}{\delta BC} \quad \text{----- (v)}$$

Equation (v) can be transformed into elasticity coefficients.

$$\left(\frac{\delta Y}{\delta BC}\right)\left(\frac{BC}{Y}\right) = \left[\left\{\left(\frac{\delta Y}{\delta F}\right)\times\left(\frac{F}{Y}\right)\right\}\times\left\{\left(\frac{\delta F}{\delta BC}\right)\times\left(\frac{BC}{F}\right)\right\}\right] + \left[\left\{\left(\frac{\delta Y}{\delta I}\right)\left(\frac{I}{Y}\right)\right\}\times\left\{\left(\frac{\delta I}{BC}\right)\times\left(\frac{BC}{I}\right)\right\}\right] \text{ - - - - - - - (vi)}$$

$$E_{Y.BC} = E_{Y.F} \times E_{F.BC} + E_{Y.I} \times E_{I.BC} \text{ - - - - - - - (vii)}$$

Where,

$E_{Y\cdot BC}$ = Elasticity of mustard production with respect to bank credit

EY.F. = elasticity of mustard production with respect to chemical fertilizer

$E_{F.BC}$ = Elasticity of chemical fertilizer with respect to bank credit

$E_{Y\cdot I}$ = elasticity of mustard production with respect to irrigation water

$E_{I.BC}$ = Elasticity of irrigation water with respect to bank credit

Empirical model

Applying the theoretical model led to the following specification of the empirical model:

$Y = \alpha S^{b1} F^{b2} I^{b3} M^{b4} e^{mi}$..... (viii)

Where,

Y = amount of mustard production (kg)

α = constant term

S = cost of seed (Tk.)

F = cost of chemical fertilizer (Tk.)

I = cost of irrigation (Tk.)

M = amount of manure (kg)

m_i = Error term

Taking logs on both sides of equation (viii), we get.

$\ln Y = \ln \alpha + b_1 \ln S + b_2 \ln F + b_3 \ln I + b_4 \ln M + m_i$ ..... (ix)

Now, the empirical model for the impact of agricultural credit on mustard production is $Y = \alpha F^{b1} I^{b2} e^{mi}$

Or, $\ln Y = \ln\alpha + b_1 \ln F + b_2 \ln I + m_i$ ..... (x)

$F = \alpha F_p^{b1} BC^{b2} e^{mi}$

Or, $\ln F = \ln\alpha + b_1 \ln F_p + b_2 \ln BC + m_i$..... (xi)

$I = \alpha I_p^{b1} BC^{b2} e^{mi}$

Or, $\ln I = \ln \alpha + b_1 \ln I_p + b_2 \ln BC + m_i$ ..... (xii)

The necessary model has been created in the manner described below in order to assess the effect of agricultural credit on calorie intake:

$C = \alpha \ln^{b1} Ed^{b2} BC^{b3} e^{mi}$ ..... (xiii)

Where,

C = Calorie intake

In = Households income (Tk.)

Ed. = Educational level of sample respondents (years of schooling)

BC = bank credit (Tk.)

Taking the log on both sides of equation (xiii), we get,

$\ln C = \ln \alpha + b_1 \ln \ln + b_2 \ln Ed + b_3 \ln BC + m_i$ ..... (xiv)

RESULTS AND DISCUSSION

Socioeconomic characteristics

Age: In this study, a family was considered a group of individuals living together, taking meals together, and living under the control of one head. It included husband, wife, son, father, mother, brother, sister, etc. The respondents were classified into three categories: (1) 15–29 years, (2) 30-64 years, and (3) 65 years and older. It is evident from Table 1 that about 93.3% of respondents were in the age group of 15–65, which implies that active people were more prevalent in the surveyed family. About 6.67% of respondents were over 65 years old. About 20% of respondents were 15–29 years old. It is seen that the maximum number of households (44) belonged to categories between 30 and 64 years old. That means the workable households are middle-aged.

Family size: People of all sexes living together or eating meals from the same kitchen that is managed and headed by a single person have been considered a family. Any family member who works outside the home but receives meals from the same kitchen and shares a portion or all of their income and expenses with the family head while at home is considered to be part of the same family. The size of the family is an essential indicator of the amount of money that will be spent on food and non-food products. A small family size can help to save the household's consumption expenditures, which can be used to deal with the danger of economic insolvency in the event of an unexpected shock (Parvin and Haque, 2017). Contrary to popular belief, having a large family is seen as a benefit for earning more revenue by involving multiple occupations. The average household size in rural areas obtained from the HIES 2022 survey is 4.30. Table 1 shows that among the 60 households, only 26.67% are small in size. About 40.00% of households consist of 5 or 6 members, and these are considered to be medium-sized families. On the other hand, 33.33% of households consist of more than 6 members, and these households are considered large families. Table 1 also represents that the average family size in the study area is 5.62, which is greater than the national average family size (4.11). A similar result was found in a study conducted by Shetu *et al.* (2017) on the socio-economic characteristics of the riverbank erosion-affected people in Sirajganj district, and in that study, the average family size was 5.69.

Educational status of the respondents: Education plays a vital role in calorie intake as well as in efficient management practices, proper utilization of credit, and successful production. The respondents were classified into four categories: literate, primary education, secondary education, and above secondary education. From Table 1, it is seen that the number of respondents who could sign was only 11.67% of the respondents. The number of respondents having primary education was about 31.67% in the study area. Table 1 also reveals that a higher number of respondents had a secondary level of education (about 46.67%) and a lower number of respondents (10%) had a higher secondary education.

Table 1. Socioeconomic characteristics of the respondents.

Characteristics			No. of Households/ Respondents	Percentage (%)
Age (years)	15-29		12	20
	30-64		44	73.3
	65 years and older		4	6.67
Family size	Small (1 to 4)		16	26.67
	Medium (5 to 6)		24	40.00
	Large (> 6)		20	33.33
Education level	Can sign only		7	11.67
	Primary (5 years of schooling)		19	31.67
	Secondary (6-10 years of schooling)		28	46.67
	Above secondary (Above 10 years of schooling)		6	10
Occupation	Primary	Secondary		
	Agriculture	-	20	33.33
	Agriculture	Business	12	20.00
	Business	Agriculture	25	41.67
	Agriculture	Politics	2	3.33
	Agriculture	Service	1	1.67
Household annual income (Tk.)	Low income (up to 60,000) ($ 560.75)		18	30
	Middle income (60001-100000) ($ 560.75- $ 934.58)		27	45
	High income (>100000) (> $ 934.58)		15	25

Source: Field Survey, 2023(US$ 1= Tk.107.00).

Occupational status of the respondents: The study found that the respondents were engaged in different types of occupations. About 58.33% of respondents were directly involved in agriculture, while the rest 41.67% had combined business and agriculture as occupation.

Average annual income of the sample households: Household income is the most significant measure of socioeconomic status. The annual income of a family has been estimated based on yearly earnings from all sorts of income-generating activities (IGAs) by the active male and female members of the family. The average total family income has been calculated by adding up farm and nonfarm sources of income during the study period. Income earned from agricultural sectors like crop, livestock, fisheries, homestead gardening, forest, and others was considered to be farm income in monetary value for the above-mentioned agricultural activities. In the study area, business, labour sales, and jobs were found to be the most important sources of income for the respondent households. Table 1 depicts the distribution of the sample households according to their average annual income earned from mustard as well as other nonfarm IGAs. From Table 1, it is found that 30% of the respondents belonged to low-income groups, whereas the respondents in middle- and high-income groups were 45% and 25%, respectively.

Table 2. Classification of loans.

Category	Amount (Tk.)
Small amount	<15,000 (< $ 140.19)
Medium amount	15000-30000 ($ 140.19- $ 280.37)
Large amount	>30000 (> $ 280.37)

Source: Field Survey, 2023(US$ 1= Tk.107.00)

Loan profile

Amount of loan received: A loan is important to invest in various IGAs. To meet the capital requirement, a loan is helpful as it creates scope for further investment. The demand for loans depends on the borrower's economic position and the scale of the activities in which they are involved. It is a difficult task to compare the loan needs of different enterprises based on their different levels of practice. The number and percentage of respondents according to the amount of loan received and loan utilization are shown in Table 3. Table 3 shows that about 68.33% of the respondents received a large amount of loan, and medium and small households received 21.67% and 10%, respectively. The maximum number of respondents (41) received a large amount above Tk. 30000 (> $ 280.37), whereas 13 respondents received a medium amount, which ranged from Tk. 15000-30000 ($ 140.19-$ 280.37), and 6 respondents received a small amount below Tk. <15,000 (< $ 140.19).

Table 3. Loan received and loan utilization.

Categories		No. of Respondents	Percentage (%)
Loan received	Small amount (Tk. <15000) (< $ 140.19)	6	10
	Medium amount (Tk.15000-30000) ($ 140.19- $ 280.37)	13	21.67
	Large amount (Tk. >30000) (> $ 280.37)	41	68.33
Loan utilization	Mustard growing	52	86.67
	Investment in business	3	5
	Food purchase, repair house, treatment	5	8.33

Source: Field Survey, 2023 (US$ 1= Tk.107.00).

Table 4. Adequacy of loans received by the respondents.

Category	Average amount applied for the loan (Tk.)	Average amount received for the loan (Tk.)	Amount received as % of amount applied for
Small amount	10500 ($ 98.13)	10500 ($ 98.13)	100
Medium amount	26333.33 ($ 246.11)	26333.33 ($ 246.11)	100
Large amount (Tk.	92103.77 ($ 860.76)	92103.77 ($ 860.76)	100

Source: Field Survey, 2023.

Table 5. Amount received and paid by the respondents.

Item	Amount (Tk.)
Principal amount received by the respondents	4181588 ($ 39080.26)
Interest after one year	376343 ($ 3517.22)
Total amount	4557931 ($ 42597.48)
Repayments by the respondents	4557931 ($ 42597.48)
Repayment performance(percentage)	100%

Source: Field Survey, 2023 (US$ 1= Tk.107.00).

Utilization of loans by the respondents: The pattern of loan utilization is very important in farming. Proper use of loans increases the production and benefits of borrowers. Proper utilization of loans is a pre-requisite to attaining the aims and targets of both loan receivers and lending institutions, as well as for the economic development of the country at large. Here, only 12 months of borrowing were taken into consideration, as it is difficult to remember the incidence beyond a period of one year. Table 3 shows the percentage distribution of the total amount of loans spent for different purposes. Loan utilization was made by the respondents for various purposes, such as mustard growing, investment in business, food purchasing, repairing houses, treatment, educational expenses, etc. RAKUB provided a loan for mustard production only. But it was found that about 86.67% of the loan was used for mustard production. Along with mustard production, about 5% of the loan was used in business for investment, whereas 8.33% of the loan was used for food purchases, house repairs, treatment, etc. It is clear that most of the respondents used the loan for mustard production perfectly, and a small part of it was used for other purposes. Their main priority was only mustard production. Table 4 shows the adequacy of the loan for the respondents. The lone receivers were categorized into three categories: small amount Tk. <15,000 (< $ 140.19), medium amount Tk. 15000-30000 ($ 140.19-$ 280.37), and above Tk. 30000 (> $ 280.37). Table 4 reveals that the average amount applied for a loan in the small category was Tk. 10500 ($ 98.13) and the average amount of loan received was Tk 10500 ($ 98.13), which was 100% of the total applied amount. On the other hand, the average amount applied for a loan in the medium category was Tk. 26333.33 ($ 246.11), and the average amount of loan received was Tk 26333.33 ($ 246.11), which was 100% of the total applied amount. The average amount applied for a loan in the large category was Tk. 92103.77 ($860.76), and the average amount of the loan received was Tk. 92103.77 ($860.76).

Repayment of the loan: The repayment tendency of loans among the respondents in the Dowani branch was very satisfactory. They paid the loan next year after harvesting their crop fully. They tried to pay the loan fully without any problem, as they knew that if they paid the amount in due time and fully, they would get more loans, which would help them expand their production and get more profit. By cultivating mustard production, the respondents improved their economic position. From Table 5, it shows that the total principal received by the respondents was about Tk. 4181588 ($ 39080.26) at 9% interest; it became Tk. 4557931 ($ 42597.48). The respondents repaid the loan after harvesting their crop. That's why the repayment performance of the respondents was 100%.

Table 6. Estimated coefficients and related statistics of the multiple log linear regression function of mustard production.

Variables	Coefficient	t values
Constant	2.314**	1.968
Cost of Seed (Tk.)	-0.295	3.053
Cost of fertilizer (Tk.)	-0.242**	-2.379
Cost of irrigation (Tk.)	0.126	2.728
Amount of manure (kg.)	0.901	2.525
R^2	0.957	
Adjusted R^2	0.953	
F	241.648	

** indicates significance at the 5% probability level. Source: Author's estimation.

Table 7. Estimated coefficients and related statistics of the multiple log linear regression function of mustard production (considering fertilizer and irrigation costs).

Variables	Coefficient	t -values
Constant	-1.103	-3.099
Cost of fertilizer (Tk.)	1.049	20.309
Cost of irrigation (Tk.)	0.044	1.094
R^2	.933	
Adjusted R^2	.931	
F	400.038	

Source: Author's estimation.

Table 8. Estimated coefficients and related statistics of the multiple log linear regression function of fertilizer demand.

Variables	Coefficient	t -values
Constant	-3.275	-22.92
Cost of fertilizer (Tk.)	0.998	1.192
Cost of bank credit (Tk.)	0.016	75.892
R^2	.993	
Adjusted R^2	.992	
F	3848.77	

Source: Authors estimation

Regression analysis: On the basis of the theoretical conception, the following values of the empirical model were found: The estimated coefficient and related statistics of the equation are presented in the following Table 6. R^2 demonstrated the model's high level of fitness. The five factors that made up the mustard production model explained almost 95% of the variance in the dependent variable. The coefficients of seed and fertilizer are negatively related to mustard production. The arguments in Table 7 are the cost of fertilizer (Tk.) and the cost of irrigation (Tk.). The coefficient of irrigation is negatively related to mustard production. The coefficients of fertilizer and irrigation are 1.049 and 0.044, respectively. The arguments in the fertilizer demand function are the price of fertilizer and bank credit (Table 8). It was assumed that demand for fertilizer was influenced by the price of fertilizer, and the current year's capability to buy fertilizer was indicated by the amount of credit received and used. In relation to fertilizer costs, the coefficient of demand was 0.998, and in relation to bank loans, it was 0.016. The fertilizer demand function seems to have fit best as evaded from R^2 (Table 8). It can be concluded that fertilizer demand is positively related to the cost of fertilizer and the cost of bank credit. That means, by increasing the cost of fertilizer and bank credit, fertilizer demand also increases. The irrigation demand function includes two independent variables: the price of irrigation and bank credit. The coefficient of bank credit and the irrigation demand function is 0.815. It indicated that the use of irrigation water was positively influenced by bank credit. The availability and uses of credit properly enhanced the use of irrigation water. The elasticity of irrigation demand with respect to the price of irrigation and bank credit is 0.083 and 0.815, respectively (Table 9). The value of R^2 = 0.699 indicates that the fitness of the model is quite good.

Elasticity of input demands with respect to bank credit: The elasticity of input demands with respect to bank credit is summarized in Table 10. These results are highly important. The elasticity of demand for fertilizer with respect to bank credit displayed a consistent sign and was 0.016, whereas the elasticity of irrigation with respect to bank credit was 0.815. The elasticity of fertilizer demand with respect to bank credit was 0.016, which provides an indication that if credit were increased by 10%, the demand for fertilizer might increase by 0.16%. Demand for irrigation was 0.815 times more elastic in relation to bank financing. It means that an increment in credit of 10% increased the demand for irrigation by 8.15%. Here, the elasticity of mustard production with respect to bank credit (BC) was 0.053, which indicates that if credit were increased by 10%, mustard production might increase by 5.3%. Credit affects the demand for inputs. Thus, production is affected by credit via the input-demand function. The foregoing discussion reveals that credit had a positive impact on mustard production. Though the impact of credit on mustard production was very poor, it affected a little, which helped to increase production. Thus, we can say that credit affects mustard production a little but positively. Agriculture credit and productivity have both short- and long-term links, according to Islam (2020). However, other dynamic variables like inflation, interest rates, and government spending on agriculture also have an impact on the productivity of the agricultural sector. According to Bidisha *et al.* (2015), compared to an otherwise identical home without credit, credit had a significant impact on household crop production. It was discovered that households with credit produced noticeably more agricultural commodities.

Table 9. Estimated coefficients and related statistics of the multiple log linear regression function of irrigation demand.

Variables	Coefficient	| t | values
Constant	-.110	-.221
Price of irrigation (Tk.)	.083	.309
Amount of Bank Credit (Tk.)	.815**	10.087
R^2	.699	
Adjusted R^2	.689	
F	54.471	

** indicate significance at the 0.01 probability level. Source: Author's estimation.

Table 10. Crop model fertilizer irrigation production.

Crop model	Fertilizer	Irrigation	Production
Mustard production model	0.016	0.815	0.053

Source: Author's estimation.

Table 11. Estimated coefficients and related statistics of the multiple log linear regression function of calorie intake.

Variables	Coefficient	| t | values
Constant	2.247**	15.528
Household income	.184**	7.195
Education level of respondent	.026	.660
Amount of Bank Credit	.010	.308
R^2	.718	
Adjusted R^2	.690	
F	25.80**	

** indicates significance at the 0.01 probability level. Source: Author's estimation.

Calorie intake: The independent variables used in explaining the behaviour of the caloric intake function were households' income, education, and bank credit. Here, the intercept term was positive, which means that if all the independent variables were absent, that is, if the respondents had very negligible income, were illiterate, and had bank credit that was unavailable, caloric intake must happen. The results of the calorie intake model are presented in Table 11.

Per capita calorie intake: To measure the weekly calorie intake level of the sampled households, a structured question including all commonly consumed food items was developed. Per capita calorie intake was calculated based on the amount of food consumed by the responder and their family members. It was divided into four groups. Table 12 depicts the calorie intake level of the sample households. About 6.66% of the respondents belonged to the ultra-poor category, whose per-day calorie intake was 1398.228 kcal. About 20% of respondents were hardcore poor, whose per-day calorie intake was 1788.99 kcal. The persons belonged to the absolute poor at 21.67%, and their per-calorie intake was 2065.87 kcal. The rest, 51.67%, belonged to the non-poor group. From the above discussion, it can be summarized that half of the respondents were non-poor, and they were the beneficiaries of credit. Although half of the members of the sample households are non-poor, there are still ultra-poor and hard-core poor groups of 6.67% and 20%, respectively. This is due to unconsciousness and a lack of knowledge about nutritious foods. Because most people had enough income to access a sufficient amount of food, they didn't know how to properly utilize it. Since food security has four fundamental components and dimensions, meeting only one or two still leaves a person in a food insecurity position. The main findings of the Household Income and Expenditure Survey (HIES) 2022 show that the nation's poverty rate decreased to 18.7% nationwide, or 20.5% in rural areas and 14.7% in urban areas. The survey findings also showed that the overall rate of extreme poverty in the country is 5.6%, which is 6.5% in the rural areas and 3.8% in the urban areas. The poverty rate in the country in 2016 was 24.3%, while the extreme poverty rate was 12.9%. The survey findings showed that the daily intake of calories in the country increased over the years, as it reached 2,393 kilocalories in 2022, compared to 2210.4 kilocalories in 2016 and 2,318.3 kilocalories in 2010. It said the income Gini coefficient will be 0.499 in 2022, compared to 0.482 in 2016 and 0.458 in 2010. On the other hand, the consumption Gini coefficient is 0.334 in 2022, 0.324 in 2016, and 0.321 in 2010. It indicates that there is a minor increase in income concentration. The government said the country was very much on track to reduce poverty to a "zero trajectory" by 2030, as targeted in the Sustainable Development Goal (SDG) (HIES, 2022). Paul and Islam (2015) found that the ultra-poor char people's lack of rights to development and accessibility to public services in char land areas at the Sirajganj district in Bangladesh. Kabir *et al.* (2019) found that 40% of the sample households in Sirajganj district of Bangladesh were moderately food secured, 25% of households had food secured, and 35% of households were low food secured. The farmer's annual income, training, experience, and credit received had a significant positive relationship with their household food security status.

Table 12. Calorie intake level of the sample households.

Categories	No. of respondents	Per person per day, average calorie intake (kcal)
Ultra poor <1600	4 (6.66)	1398.228
Hardcore poor 1600-1804	12 (20)	1788.99
Absolute poor 1805-2122	13 (21.67)	2065.87
Non-poor (Above 2122)	31 (51.67)	2743.92

Source: BER, 2022. Author's calculation (figures with parenthesis indicate percentage of total respondents).

Conclusion

It can be concluded from this study that borrowed money has been used to a greater extent for productive purposes by the loanee farmers. Credit works like a catalyst for mustard production. It affects mustard production via input demand and is positively influenced by credit. Elasticity of production with respect to credit is positive for mustard production, though it is not so high. Credit also has a positive impact on the calorie intake of the respondents. It was found that about 51.67% of households are not poor. As bank credit has a positive relationship with mustard production, the government and other non-government organizations should come forward to provide financial support to the mustard-producing farmers in the study area.

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Author's contribution

Conceptualization, M.A.R. and I.S.; Methodology, M.A.R.; Software, M.A.R.; Validation, M.A.R., I.S. and A.C.R.; Formal analysis, I.S.; Investigation, M.A.R.; Resources, M.A.R; Data curation, I.S.; writing—original draft preparation, M.A.R.; writing—review and editing, A.C.R.; visualization, I.S.; Supervision, M.A.R.; Project administration, M.A.R; Funding acquisition, M.A.R. All authors have read and agreed to the published version of the manuscript.

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