Bangladesh J. Nuclear Agric, 38(1): 65-80, 2024 *ISSN 0258-7130*
DOI: https://doi.org/10.3329/bjnag.v38i1.76567

FARMERS' PERCEPTION AND FINANCIAL PROFITABILITY OF MUSTARD PRODUCTION IN BANGLADESH

M.T. Uddin[1*], N.D. Kundu[2] and M.T.I. Tushar[3]

Abstract

The study was undertaken to assess farmers' perception and explore the factors affecting farmers' decision to adopt mustard production along with estimate financial profitability and identify potentials and problems of mustard production. Based on stratified random sampling, 120 farmers were interviewed using a structured questionnaire to collect primary data from different villages of Ullahpara upazila under Sirajganj district of Bangladesh. A combination of descriptive statistics, mathematical and statistical technique was used to analyze the data and to achieve the objectives. The study depicts that the highest number of the respondents (35%) belong to the 31-45 age group. Seventy two percent respondents were small farmers having land less than 1.0 hectare and they allocated 34% of their farm area for mustard production. Financial profitability analysis shows that mustard production was profitable on both variable cost and total cost basis and its benefit cost ratio (BCR) was more than one. In case of farmers perception, it was revealed that short duration crop, consumers' preferences, product price, extension services and sharing of work among household members were the main driving factors for mustard production. Applying dichotomous logistic regression model, four factors namely, farmers' age, number of family members, experience and farm size were found as significant determinants of adoption of mustard production. Large domestic market, limited use of high-yielding varieties, growing demand for mustard oil and attack of pests and diseases were found as important strength, weakness, opportunities and threats of mustard production, respectively. Finally, the study recommends that there are ample opportunities to enhance mustard production by ensuring access to quality seeds, adopting new technologies, securing fair prices, providing input subsidies, and improving institutional credit facilities with favorable terms and conditions.

Key word: financial profitability, farmers' perception, adoption factors, mustard production.

Introduction

Agriculture is one of the most important sectors in the economy of Bangladesh which plays significant role in terms of food, nutrition, employment creation, income generation and foreign exchange earnings. Bangladesh has suitable climate and soil conditions for the production of oilseed crops round the year. The major oilseed crops grown are mustard, soybean, sesame, sunflower, linseed, groundnut, etc. Rapeseed and mustard are major oilseed crops in Bangladesh which covers about 80% of total oilseed area and contributes to more than 60% of total oilseed production (BER, 2022). Oilseed crops are promising crop

[1]Professor, Department of Agricultural Economics, Bangladesh Agricultural University (BAU), Mymensingh-2202. [2]PhD student, Department of Agricultural Economics, BAU and Scientific Officer, Agricultural Economics Division, Regional Pulses Research Station, BARI, Gazipur. [3]MS student, Department of Agricultural Economics, Bangladesh Agricultural University, Mymensingh-2202. *Corresponding Author e-mail: tajbau@yahoo.com

with high potentials to improve human diets and prevent malnutrition. Mustard is mostly consumed as oilseed in the household level of Bangladesh. The special features of mustard herbs is that it gives oil from its seeds. Mustard seed contains 40-45% edible oil which acts as a fat substitute in our daily diet. Mustard oil is being used as medium of cooking from the time immemorial. It is essential for health. Mustard oilcake is used as nutritious animal feed and high quality manure for crop production. There are many varieties of mustard that all are very rich in several minerals, such as copper, calcium, iron, magnesium, etc. Mustard seeds are also a good source of several vitamins including vitamin C and K, thiamin, etc. They have a high percentage of dietary fiber and are a valuable source of several bioactive compounds such as antioxidants and polyunsaturated fatty acids. These nutrient compositions help to increase human efficiency and span of working life, which eventually influence the economic potentials of the nation (Abul-Fad *et al.*, 2011).

Since independence in Bangladesh, acute shortage of edible oil has been prevailing and our country needs to import a noticeable amount of edible oil and oilseeds almost in every year. As a consequence, there takes place heavy depletion of foreign exchange reserve. At present, about 975 thousand metric tons of oilseeds are produced from 330 thousand hectares of land which is 3.1% of the country's total cultivable land (BBS, 2022). The domestic production of which can only meet about 40% of the country's annual demand and the rest 60% is imported from abroad to meet the existing demand (UNB, 2022). With the increase in population, the demand for edible oil and oilseeds is rising. Under rice based cultivation system in Bangladesh, where three fourth of total cultivable land is engaged in rice production, it is an urgent need to take immediate actions for increasing the production of oilseed to reduce the import cost. Accordingly the government has been pursuing a crop diversification strategy to reduce the dependency on rice cultivation. Mustard is an important oilseed crop because of its dietary values and source of making additional income.

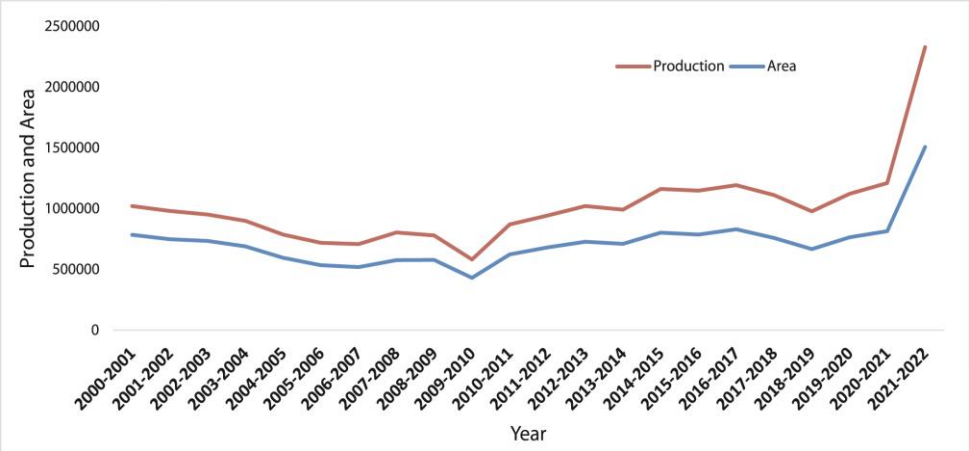

Figure 1. Trend of area and production of mustard in Bangladesh, 2000-2022
Source: BBS, 2022.

It has earned popularity to farmers as it is labor intensive cash crop. It is also considered more profitable than staple crops and less risky as compared to the production of cereal crops and vegetables. Mustard cultivation increases soil fertility and preserves the balance of the environment. It has relatively shorter production cycle as compared to many field crops. Above all, the demand for mustard has been increasing day by day. Figure 1 shows that after 2018-19, the area and production of mustard is increasing (BBS, 2022). The highest production of oilseed is coconut which is 412 thousands metric tons that shares 42% of total oilseed crops. The second highest production of oilseed is rape and mustard which is 358 thousands metric tons that contributes 36% of total oilseed crops (BER, 2022).

There are some studies on mustard showing its different aspects, such as, Sampa *et al.* (2020) estimated profitability and resource use efficiency of mustard cultivation in Bangladesh; and concluded that mustard cultivation was profitable in the selected region and has a high potentiality to improve the present production scenario. Tithi and Barmon (2018) conducted a study on comparative advantages of lentil and mustard production and their profitability in a selected district of Bangladesh; and found that Bangladesh has a comparative advantage in both lentil and mustard production compared to other countries. Miah *et al.* (2015) studied on factors affecting the adoption of improved varieties of mustard cultivation in some selected sites of Bangladesh; and revealed low level adoption of the improved mustard technologies at the farm level. Besides, there are also lots of study outside the country. Jha *et al.* (2021) conducted research on impact of front line demonstrations on mustard in Sahibganj district of Jharkhand, India; and reported that the cluster front line demonstrations had enhanced the yield of mustard vertically and ensured rapid spread of recommended technologies of mustard production horizontally by implementation of various extension activities. Sharma (2013) conducted a study in Alwar district zone of Rajasthan state of India with the objective to analyze economics of mustard crop; and computed costs and returns of mustard production and found the gap between recommended and actual use of input and yield of mustard.

However, research relevant to the issues and goals outlined in this study is limited and many policy level questions are still remained unanswered. Considering such research gap, the study has been conducted to get some ideas regarding farmers' financial profitability, influencing factors of mustard production and constraints to mustard production and thereby way to the expansion of this crop. Thus the proposed study will provide necessary information for the policy makers in order to formulate appropriate policy for its widespread cultivation. The academician and researchers could get information for further research in line with the expansion of this study. The study has been conducted to achieve some specific objectives, which are: i) to estimate the financial profitability of mustard production in the study areas; ii) to assess farmers' perception and explore the factors affecting adoption of mustard production; and iii) to identify the potentials and problems associated with the production of mustard and its possible solution.

Material and Methods

The study was conducted at Ullapara upazila, a major mustard-growing region in the Sirajganj district, from November 2023 to February 2024. A total of 120 farmers were selected from eight villages of two unions following stratified random sampling technique (Table 1). Necessary data and information was collected through field survey method using pre-tested interview schedule under direct supervision of the researchers. Collected data were summarized, tabulated and analyzed. Profit equation, descriptive statistics like average, percentage, ratio, etc and econometric model such as logit model were used in presenting the results.

Table 1. Study areas and sample size

District	Upazila	Unions	Villages	No. of farmers
Sirajgonj	Ullapara	Koyra	Nagarkoyra-20, Bagolpara-11, Charpara-9, Agkoyra-8, Koyrabazar-6, Minarpara-6	60
		Bangala	Parchim Satbaria-27, Binayekpur-15, Dharoil-6, Shemaildoh-8, Mazipara-4	60
Total sample size				120

Analytical Technique

Profitability analysis

To analyze the costs and returns of the mustard farmers, the following profit equation was used:

$$\Pi = P_m Q_m + P_b Q_b - \Sigma(Px_i.X_i) - \text{Other costs}$$

Where,

Π = Profit from mustard production (Tk ha^{-1});
P_m = Price of mustard (Tk kg^{-1});
Q_m = Quantity of mustard (kg ha^{-1});
P_b = Price of by-product (Tk kg^{-1});
Q_b = Quantity of by-product (kg ha^{-1});
Px_i = Price of i^{th} inputs (Tk kg^{-1});
X_i = Quantity of i^{th} inputs (kg); and
I = 1, 2, 3,……., n.

Logit model

A logit regression model (Kundu *et al.,* 2022) was employed to identify the factors influencing farmers' adoption of mustard cultivation as farmers are sacrificing other competitive crops i.e potato, pulses, wheat etc. The logit regression model is one of the binary choice regression model in which a dichotomous regression variable is considered as the dependent variable. The logit model was chosen for this study because it guarantees that

the estimated probability lie between 0-1 and they are not linearly related to the explanatory variables. The logit model is based on the cumulative logistic distribution as follows:

$$P_i = E(Y = \frac{1}{X_i}) = \alpha + \beta_i \ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

$$P_i = E(Y = \frac{1}{X_i}) = \frac{1}{1+e^{-z}} \ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

For ease of exposition

$$Z_i = \alpha + \beta_1 X_1 + \beta_2 \ldots\ldots\ldots\ldots\ldots\ldots\ldots X_n$$

Where,

Pi = Probability to cultivate mustard crops

The log of odd ratio or logit is
Logit Li = (Probability of cultivating mustard crops / Probability not to cultivate) = Zi + Ui

To estimate the logit model, a dichotomous dependent variable (Yi) is required. A value of 1 for Yi indicates that the farmer adopts mustard cultivation, while a value of 0 indicates that the farmer does not cultivate mustard.

Seven explanatory variables were included in the model to find out the determinants of adoption of mustard cultivation. The independent variables are specified as follows:

X_1 = Age of the household head (Years);
X_2 = Education level of the household head (No. of schooling years);
X_3 = Family members (No.);
X_4 = Experience (Years);
X_5 = Farm size (Hectare);
X_6= Short duration crop (No.);
X_7= Training (No.); and
U = Error term.

According to Gujrati (1995), the marginal probabilities of factors determining the adoption of mustard cultivation and the elasticity of probability of adoption of mustard cultivation were estimated based on expressions derived from the logit model is as follows:

$$\frac{dp}{dx} = \beta_i [P\ (1 - p_i)]$$

$$E_p = \beta_i \overline{X_i}\ \ (1\text{-}P_i)$$

Where,

β_i = Estimated logit regression coefficient with respect to the i^{th} factor;
Pi = Estimated probability of adoption of mustard cultivation;
$\overline{X_i}$ = Arithmetic mean; and
E_p= Elasticity of probability of adoption of mustard cultivation.

SWOT analysis

SWOT analysis was done to identify the prospects and challenges of mustard production. This analysis guides to identify the positives and negatives inside of the organization (S-W) and outside of it, in the external environment (O-T) (Kotler *et al.,* 2009). A SWOT analysis dissects a business or project into four key components. Strengths (S) are internal advantages like a strong brand or skilled workers. Weaknesses (W) are internal limitations that hinder performance, such as resource scarcity or operational inefficiencies. Opportunities (O) are external factors presenting chances for growth, like new market trends or competitor weaknesses. Threats (T) are external factors that could cause harm, such as economic downturns, new competition, or technological shifts. By examining these internal and external factors, businesses gain a comprehensive picture and can develop strategies to leverage strengths, address weaknesses, capitalize on opportunities and mitigate threats.

SWOT analysis is a simple but effective tool that can be used by businesses/projects of all sizes. It helps develop a clear understanding of current position and creates a roadmap for future success. As benefits of SWOT analysis, it (i) gives a comprehensive view of business, highlights areas of strength and also areas need to be improved; (ii) improves decision making through better resource allocation and strategic choices; and (iii) identifies risks and opportunities by analyzing threats and opportunities to be prepared better for the future.

Results and Discussion

Socioeconomic status of the respondent farmers

Regarding socioeconomic status of the respondent farmers, it was found from Table 2 that the highest percentage (33%) of farmers was in the age group of 31- 45 years. On an average, 27% farmers were illiterate and others having different levels of academic background. Among the educated farmers, 46% had primary level of education, 16% had secondary level, 9% had education at SSC and 3% had education at HSC and 1% had education at above HSC. Average farm size is 1.58 ha with a family size of 5.25 persons. Number of male members (2.78) was higher than female members (2.47). Among the responded farmers, 62% were married and 38 % were unmarried (Table 2).

Table 2. Socioeconomic characteristics of the farmers

Characteristics	% of farm household responded
Farmers Age (% of farm household responded)	
Up to 30 years	30
31- 45 years	35
46 - 60 years	28
Above 60 years	7
Education level (% of farm household responded)	
Illiterate	27
Primary	46
Secondary	16
SSC	9
HSC	3
Above HSC	1
Family members description (No.)	
Family members	5.25
Male	2.78
Female	2.47
Marital Status (%)	
Unmarried	38
Married	62

Source: Field survey, 2023-2024

Land tenancy arrangements of mustard producers

The land tenancy is the entire land area operated by a farm operator. Mustard producers were stratified into three groups based on the size of operational holding, viz., small (<1.0 ha), medium (1.01-3.0 ha), and large (>3.0 ha). Most of the farmers (72%) surveyed were small whereas DAE (2018) reported that (85% of farm households in Bangladesh operate below one hectare of land) and allocated 34% of the farm area in mustard production. It is seen that the average farm size of small, medium and large farmers was 0.39, 1.34 and 3.01 hectares, respectively. Farmers' own land occupied a major share of land leasing arrangements. The study also found that a small portion of land was rented/leased-out by the medium and large farmers (Table 3).

Table 3. Land tenancy arrangements of mustard producers

Farmers' categories	% of farmers	Farm size (ha)	Land leasing arrangements (ha)			Percentage of area in mustard cultivation
			Own land	Rented/ leased-in	Rented/ leased-out	
Small farmers (less than 1.0 ha)	72	0.39	0.31	0.06	0.02	34
Medium farmers (1.01 to 3.0 ha)	25	1.34	1.12	0.07	0.15	29
Large farmers (above 3.0)	3	3.01	3.21	-	0.20	26

Source: Field Survey, 2023-2024

Farmers' perception of mustard production

A set of particulars was used to understand farmers' perception towards mustard production. It is apparent in Table 4 that short duration, consumers' preferences, product price, extension services and sharing of work among household members were the main factors influencing farmers' perception of mustard production. It is noted that the respondents in the study areas agreed on these particulars to different extents.

Table 4. Factors affecting farmers' perception of mustard production

Particulars	Agree to cultivate mustard	
	No. of farmers	% of farmers
Credit facilities	41	34
Soil fertility/organic matter	69	58
Extension services	79	66
Training facilities	66	55
Sharing work	75	63
Short duration crop	86	72
Product price	81	68
Consumers' preferences	84	70
Intercropping practices	36	30
Use of fallow land	49	41

Source: Field Survey, 2023

Credit facilities

Easy access to credit is crucial for mustard cultivation, as evidenced by 34% farmers indicating their dependence on it. The availability of credit facilities significantly impacts the adoption of mustard production. Small-scale farmers, who are the backbone of mustard cultivation in many regions, often lack the upfront capital needed for seeds, fertilizers and proper equipment. Easy access to loans through agricultural credit programs can provide them with the financial resources to invest in these essentials, allowing them to venture into mustard production. This can lead to increase acreage under mustard cultivation and potentially higher yields. Conversely, limited access to credit can hinder a farmer's ability to adopt mustard production, restricting its overall growth in the region.

Soil fertility/ Organic matter

Soil fertility and organic matter were identified by 58% respondents as the key factors influencing their decision to cultivate mustard. Soil fertility, particularly the level of organic matter significantly influence a farmer's decision to adopt mustard production. Mustard thrives in well-drained, moderately fertile soils with good organic matter content. Organic matter acts like a sponge, retaining moisture and nutrients crucial for mustard growth. Low soil fertility can lead to poor yields and increased susceptibility to pests and diseases. Therefore, farmers with naturally fertile soil rich in organic matter are more likely to adopt mustard production, knowing they have a strong foundation for a successful crop.

Extension service

About 66% farmers reported that the extension service motivated them to grow mustard (Table 4). Effective extension services can significantly influence mustard production. Strong extension programs can educate farmers on improved seed varieties, proper planting techniques, efficient use of fertilizers and pesticides, and effective disease and pest management. By providing farmers with knowledge and resources, extension services empower them to make informed decisions that can lead to higher yields and better quality mustard production.

Training facilities

The study found that more than half (i.e., 55%) of the respondents cited training facilities as a motivating factor for cultivating mustard. The availability of training facilities can significantly impact the adoption of mustard production. A well-equipped training center can empower new growers with the knowledge and confidence needed to embark on mustard production. These facilities can also foster a sense of community among mustard farmers, allowing them to share best practices and troubleshoot challenges.

Sharing work

The survey found that sharing the workload is a significant motivator for 63% of farmers to cultivate mustard. Sharing work, a common practice in agriculture, can have a complex impact on adoption for mustard production. On the one hand, it can encourage knowledge sharing and collaboration among farmers, potentially leading to improved yields and techniques. The success of shared work in mustard production likely depends on factors like farm size, task complexity, and the clarity of communication between collaborators.

Short duration crop

The development of short duration mustard varieties has been a major factor influencing the rise of mustard production. These quicker maturing crops (within 75-85 days) compared to traditional varieties allow farmers to efficiently utilize fallow land. This is particularly beneficial after harvesting *Boro* rice, a common practice in the study area. By cultivating a short duration mustard crop, farmers can maximize land use and generate additional income before planting the next main season rice crop.

Product price

Profitability is the main reason why nearly 68% farmers choose to cultivate mustard (Table 4). Product price plays a significant role in influencing farmers' decisions to cultivate mustard. A high and stable mustard price incentivizes farmers. With good profits, they are more likely to allocate land and resources towards mustard production. This price sensitivity is particularly important for small-scale farmers who rely heavily on income from their harvests.

Consumers' preferences

The growing popularity of mustard among consumers is driving cultivation, with 70% farmers reporting it as a key factor in their decision to grow the crop. Consumers' preferences play a significant role in shaping mustard production. The rise of health consciousness has led to a demand for clean-label mustard with natural ingredients and potential health benefits. This steers production towards mustard varieties using minimal processing and simple ingredients.

Intercropping practice

Intercropping method let farmers (30%) to cultivate mustard in the study areas (Table 4). Intercropping, the practice of growing two or more crops together, can significantly motivate farmers for mustard production. While mustard yield might be slightly lower when intercropped compared to a sole crop, intercropping offers several advantages. Mustard can be paired with crops that have different nutrient requirements or growth cycles, leading to more efficient land use and potentially higher overall yield from the combined crops. Additionally, intercropping can suppress weeds and even attract beneficial insects that can help control pests in the mustard crop.

Use of fallow land

Fallow land is a key reason why many farmers cultivate mustard, according to a survey where 41% of respondents mentioned it (Table 4). Fallow land can be a double-edged sword for mustard production. On one hand, readily available fallow land creates an opportunity to cultivate mustard during seasons when the primary crop isn't using the field. This can increase overall agricultural output and income for farmers. However, the decision to cultivate mustard depends on several factors related to the fallow period. These include the length of time available before the next main crop, soil moisture levels, and the availability of fast-maturing mustard varieties. If the fallow window is too short or the land is too dry, growing mustard may not be feasible.

Input use pattern of mustard production

Different material and non material inputs were used in mustard production. Labour required for mustard cultivation were 65 man-days of which 35 man-days were own labour and 30 man-days were hired labour. Farmers in the study areas use very low level of recommended fertilizers except urea. BARI Sarisha-14 was the most popular mustard variety among farmers in the region cultivated by 73% farmers followed by BARI Sarisha-15 by 18% farmers and other varieties by remaining farmers. On an average, mustard farmers used 7 kg seed per hectare. Farmers give more emphasis on macro nutrient like urea, TSP and MoP than micro nutrient. In case of fertilizers, farmers used 300 kg urea, 175 kg TSP, 99 kg MoP and 9 kg zinc sulphate per hectare. Besides, farmers also used cowdung as organic fertilizer which is 1360 kg per hectare (Table 5).

Table 5. Input use pattern of mustard production

Types of inputs	Per hectare amount
Human labour (No. ha^{-1})	65
Own	35
Hired	30
Seed (kg ha^{-1})	7
Chemical fertilizers (kg ha^{-1})	
Urea	300
TSP	175
MoP	99
Zinc sulphate	9
Organic fertilizer (kg ha^{-1})	
Cowdung	1360

Source: Field survey, 2023-2024

Financial profitability of mustard production

To calculate total cost of mustard production, different input costs along with opportunity cost were also included. Total cost of mustard production was Tk.71393 ha^{-1} where total variable cost was 62% and remaining 38% was fixed cost. Among the variable cost, the highest cost was incurred by hired labour (21%) followed by other items. The average yield of mustard was 1805 kg ha^{-1} (Table 6). However, Uddin's study in 2019 revealed that the yield of high yielding BARI Sarisha was 1851 kg ha^{-1}. Gross return from mustard production was Tk. 128386 ha^{-1} where Tk. 126350 ha^{-1} from mustard grain and remaining amount of Tk. 2036 ha^{-1} from by-product. Gross margin from mustard production was Tk. 84058 ha^{-1} with a net return of Tk. 56993 ha^{-1}.

Benefit cost ratio (Undiscounted) was calculated on both variable cost and total cost basis which were 2.90 and 1.80, respectively. This exhibits that the production of mustard in the study areas is profitable (Table 6). The result of BCR on full cost basis is also higher than the findings of Chandra (2020). Standard deviation, a statistical measurement is used to quantify the variation of a set of data points around the mean (average). A higher standard deviation indicates a wider spread of data points, while a lower standard deviation suggests the data points are clustered closer to the mean. In this study, the highest standard deviation was found for gross return (7611) and the lowest standard deviation (0.008) was found for benefit cost ration on variable cost basis.

Table 6. Average cost and return of mustard production (Tk. ha^{-1})

Particulars	Amount (Tk. ha^{-1})	Standard deviation	% of total
Variable cost			
Land preparation cost	7000	575	10
Hired labour	15218	1052	21
Purchase seed	1050	52	1
Urea	4500	271	6
TSP	3500	253	5
MoP	1470	254	2
Zink sulphate	1368	256	2
Cowdung	3500	164	5
Insecticides cost	5000	335	7
Interest on operating capital	1704	363	2
A. Total Variable cost (TVC)	44328	3340	62
Fixed cost			
Family labour	17282	1013	24
Land use cost	9784	506	14
B. Total fixed cost (TFC)	27065	1519	38
C. Total cost (A+B)	71393	4556	100
D. Yield (kg ha^{-1})	1805	202	
E. Return from mustard grain	126350	7594	
F. Return from by-product	2036	80	
G. Gross return (E+F)	128386	7611	
H. Gross margin (G-A)	84058	4321	
I. Net return (G-C)	56993	3055	
J. BCR on variable cost basis (G/A)	2.90	0.052	
K. BCR on total cost basis (G/C)	1.80	0.008	

Source: Authors' calculation, 2024

Factors affecting the adoption of mustard production

Dichotomous logistic regression model depicts that adoption of mustard production by the farmers depends on various factors. The factors determined the adoption of mustard production of farmers is presented in Table 7. The results showed that age, family members, experience and farm size were significant determinants of adoption of mustard production. The coefficient of age is significant at 1% level, family member is at 1% level, experience is at 5% level and farm size is significant at 10% level. The value of marginal effect for age is -0.05 which indicates that the probability of adoption of mustard production decreases by -0.05 unit with the increases of age. Marginal effect for family members is 0.21 which indicates that the probability of adoption of mustard production increases by 0.21 unit with the increases number of family members. Marginal effect for experience is 0.04 which indicates that the probability of adoption of mustard production increases by 0.04 unit with the increases of experience. Again, marginal effect of farm size is (-) 0.001 which indicates that the probability of adoption of mustard production decreases by (-) 0.001 unit with the increases in farm size (Table 7).

Table 7. Coefficient of logit model for adoption of mustard production

Determinant	Coefficient	Std. Err.	Z	P>z	Marginal effect
Farmers' age (X_1)	-0.21***	0.073	-2.83	0.005	-0.05
Education (X_2)	-0.01	0.17	-0.07	0.94	-0.002
Family members (X_3)	0.92***	0.29	3.1	0.002	0.21
Experience (X_4)	0.16**	0.07	2.08	0.03	0.04
Farm size (X_5)	-0.005*	0.003	-1.68	0.09	-0.001
Short duration (X_6)	1.15	0.77	1.49	0.13	0.26
Training (X_7)	-0.03	0.07	-0.36	0.72	-0.006
Constant	1.45	2.78	0.52	0.60	
Number of observation	120				
LR chi2 (7)	59.55				
Prob > chi2	0.0000				
Pseudo R2	0.56				
Log likelihood	-23.15				

Source: Authors' estimation, 2024
*** Co-efficient significant at 1% level;
** Co-efficient significant at 5% level; and
* Co-efficient significant at 10% level.

Constraints to mustard production and probable solutions

There were five categories of problems in the study areas, such as, credit related problems, support and service related problems, financial problems, technical problem and marketing problems. In case of credit related problems, maximum farmers (49%) responded on insufficient institutional credit facilities followed by complex loan distributing process (28%). In case of support and service related problems, 39% farmers responded on untimely training and input supply followed by lack of scientific knowledge (31%). In case of financial problems, 50% farmers reported on high price of seed and fertilizers followed by low price of output (30%). Drought and uneven rainfall (64%) and attack by pest and diseases (73%) were the major technical problems. In the case of marketing related problems 41 % farmers reported on price fluctuation of output and 38 % responded on high market toll etc. (Table 8).

Introducing sufficient and adequate credit facilities, easy process with low interest rate, providing update knowledge through training by DAE and research organizations, ensure timely training facilities and supply major inputs, ensuring reasonable price of output with govt. intervention, provide input subsidy, use of quality pesticides for destroying pest and disease, develop drought and water logged tolerant variety, strengthening market monitoring with the help of local govt. ensuring availability of quality seed and fertilizers and reduce market toll were found to be the probable solution of the problems mentioned.

Table 8. Problems faced by the mustard farmers and their probable solutions

Problems and constraints	Farmers responded (%)	Probable solutions
A. Credit related problems		
Insufficient institutional credit	49	Introduce sufficient and adequate credit facilities
Complex loan distributing process	28	Easy process with low interest rate
B. Support and service related problems		
Lack of scientific knowledge	31	Provide update knowledge through training by DAE and research organization
Untimely training and input supply	39	Ensure timely training facilities and to supply major inputs
C. Financial problems		
Low price of output	30	Ensure reasonable price of output with govt. intervention
High price of seed and fertilizers	50	Provide inputs subsidy
D. Technical problems		
Attack by pest and disease	73	Use of quality pesticides for destroying pest and disease
Drought and uneven rainfall	64	Develop drought and water logged tolerant variety
E. Marketing problems		
Price fluctuation of output	41	Strengthening market monitoring with the help of local govt. Ensuring availability of quality seed and fertilizers.
F. High market toll	**38**	**Reduce market toll**

Source: Field survey, 2023-2024

Potentials and challenges of mustard production

SWOT analysis is a valuable tool used for strategic planning and decision-making. The SWOT analysis (Uddin *et al*., 2023) of mustard production is given in Table 9. The important strength of mustard cultivation was large domestic market (84%) followed by favorable climate (80%) and relatively low production cost (69%). However, limited use of high-yielding varieties (79%) followed by traditional farming practices (74%) and low yield (73%) were found to be the major weakness of mustard production. Farmers also responded that mustard production was growing demand for mustard oil (96%) followed by improved storage and processing techniques (76%) and development of improved varieties (72%). Besides, the crucial threats of mustard cultivation was attack of pests and diseases (93%) followed by uneven rainfall (86%) and drought during the season (73%).

Table 9. SWOT analysis of mustard production (% of farm household responded)

Strength	% of farmers responded	Opportunities	% of farmers responded
Favorable climate	80	Growing demand for mustard oil	96
Large domestic market	84	Developing improved varieties	76
Relatively low production cost	69	Improved storage and processing techniques	72
Weakness		**Threats**	
Low yield	73	Drought during the season	73
Limited use of high-yielding varieties	79	Uneven rainfall	86
Traditional farming practices	74	Attack of pests and diseases	93

Source: Field survey, 2023-2024

Conclusion and Recommendations

Mustard production is a crucial component of Bangladesh's agriculture sector and economy due to its favorable climate and fertile land. Cultivation of mustard is widespread across Bangladesh, driven by its short growth cycle and lucrative returns, as evidenced by a benefit-cost ratio close to two. Factors such as household age, family size, farming experience and land holding significantly influence farmers' adoption of mustard cultivation. Beyond providing income, mustard cultivation plays a vital role in meeting the nation's edible oil demand while promoting agricultural diversity and sustainable practices and thereby improving food security and rural livelihood. However, farmers encounter various challenges including limited access to institutional credit, troublesome loan processes, inadequate training and input supply, lack of scientific knowledge, high costs of seeds and fertilizers, low market prices, seed quality issues, transportation and communication difficulties, and pest and disease threats. Addressing these challenges could incentivize greater adoption of mustard cultivation and contributing to national self-sufficiency in the long run. However, the recommendations mentioned can be helpful to increase profitability of mustard production, such as, i. it is important to ensure quality seed to the farmer’s level, facilitates community based training system of mustard production technologies, strengthening research on the development of different stress tolerant variety of mustard, develop location wise appropriate mustard based cropping pattern. Encourage the farmers to cultivate crop through cooperatives which would minimize the cost of production along with strengthening the bargaining power of the farmers for their product through forming cooperatives. Upazila Agriculture Office could be a medium to form these types of cooperatives.

References

Abul-Fad, M.M., El-Badry, N. and Ammar, M.S. 2011. Nutritional and Chemical Evaluation for Two Different Varieties of Mustard Seeds. *World Applied Sci. J.*, 15 (9): 1225-1233.

BBS. 2022. Statistical Yearbook of Bangladesh, Bangladesh Bureau of Statistics, Statistics Division, Ministry of Planning, Government of the People's Republic of Bangladesh.

BER. 2022. Bangladesh Economic Review, Finance Division, Ministry of Finance, Government of the People's Republic of Bangladesh.

Chanda, S.C., Khan, M. J., Ali M. A., Sarker, S.C. and Sarwar, A.K.M.G. 2020. Economic Analysis of Mustard and Sesame Cultivation in Some Selected Areas of Sirajganj District. *Bangladesh J. Ecol.* 2 (2): 87-90.

DAE, 2018. Department of Agricultural Extension. Ministry of Agriculture, Government of the People's Republic of Bangladesh.

Gujarati, D.N., 2003. Basic Econometrics. McGraw- Hill, New York.

Jha, A.K. 2021. A Study on Impact of Frontline Demonstrations on Mustard in Sahibganj District of Jharkhand. *Indian J. Ext. Edu.*, 57(3): 28–31.

Kotler, P. and Keller, K. 2009. Marketing Management. Global Edition, Pearson Education Inc., Upper Saddle River.

Kundu, N.D., Uddin, M. S., Islam, M.M., Khatun, M., Khandoker, S. and Hoq, M.S. 2022. Determinants, Challenges and Opportunities of Pulses Crop in Southern Char Land Areas of Bangladesh. *Farm Economy*, 17: 91-102.

Miah, M.A.M., Afroz S., Rashid, M.A. and Shiblee, S.A.M. 2015. Factors Affecting the Adoption of Improved Varieties of Mustard Cultivation in Some Selected Sites of Bangladesh. *Bangladesh J. Agril. Res.*, 40(3): 363-379.

Sampa, A.Y., Sarker, F., Rahman, M.R. and Begum, R., 2020. Profitability and Resource Use Efficiency of Mustard Cultivation. *SAARC J. Agric.* 18(2): 195-206.

Sharma, R.P. 2013. A Study on Economic Analysis of Mustard Crop in Rajasthan. Indian Res. J. Genet. & Biotech, 5(4): 264–269.

Tithi, S.M. and Barmon, B.K. 2018. Comparative Advantages of Lentil (*Lens culinaris*) and Mustard (*Brassica nigra* L.) Production and Their Profitability in a Selected District of Bangladesh. *The Agriculturists*, 16(1): 21-33.

Uddin, M. T., Reza, M. and Dhar, A.R. 2023. Green Grass Production for Improving Farmers' Socioeconomic Status in Major Milk Pocket Areas of Bangladesh. *Journal of World Development Sustainability*, 2 (2023). DOI: 10.1016/j.wds.2023.100052.

Uddin, S.F. 2019. A Study on Adoption and Farmers Attitude of BARI Rapeseed Mustard Variety in Manikganj District. *Bangladesh J. Agril. Res.* 7(4).235-244.

UNB. 2022. Bright Prospect for Soybean Farming in Bangladesh. The Daily Star, https://www.thedailystar.net/news-detail-114970.