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A SOCIOECONOMIC STUDY OF SOYBEAN PRODUCTION IN BANGLADESH

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Abstract

This study was undertaken to estimate the financial profitability and to assess the factors affecting adoption of soybean production in Noakhali and Lakshmipur districts of Bangladesh. To collect primary data, a structured interview schedule was used to interview 90 farmers using stratified random sampling technique. A combination of descriptive, mathematical and statistical techniques were employed to analyze the data. According to the findings, 47 percent of farmers were small in farm size category. Financial profitability analysis shows that soybean production was profitable with benefit cost ratio (1.43). The logit regression model demonstrated that farmers' education, farm size, farm income, extension contact, crop diversification practiced, and distance to market had a significant effect on farmers' decision to pursue soybean cultivation.The research findings also indicated that higher price of seed and fertilizer, low price of output and lack of transportation facilities were the major problems for input, production and marketing of soybean, respectively. Among all the problems, high price of seed and fertilizer had the highest problem confrontation index value (255) as first rank. The study recommended for ensuring affordable price of seed and fertilizers along with better infrastructure and transportation facilities to overcome the problems. Furthermore, government needs to implement subsidy scheme and assistance should be provided from the personnel of Department of Agricultural Extension to enhance soybean production in Bangladesh.

Keywords: Adoption, Bangladesh, financial profitability, potential and Soybean.

Introduction

Bangladesh has suitable environment and soil conditions for the production of oilseed species all the year round. Since our country's independence, there has been a severe lack of edible oil. Currently, about 975 thousand metric tons of oilseeds are produced from 484 thousand hectares of land which is 3.1% of the country's total cultivable land (BBS, 2017). The indigenous production of major oilseeds can only meet about 40% of the country's annual demand and the rest 60% is imported from outside (UNB, 2019).

Soybean, recognized as 'golden bean' is a very well-known oil seed and protein crop in the world. It is considered as an important economic food legume cultivated

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worldwide because of its superior nutritional and industrial values (Bisaliah, 1986). Global soybean output was projected to reach 346.0 million tons annually in 2017–18 (INFO, 2018). Bangladesh has 78.95 thousand hectares of total land dedicated to soybean farming, yielding 1420 MT in 2018–19. (Krishi Diary, 2020). Bangladesh produces 1.59 tons of soybeans per hectare, far less than the global average of 2.76 tons per hectare (Terzić*et al*., 2018). Bangladesh's own output of oil is insufficient to fulfill the country's yearly needs. The oil crop acreage of Bangladesh is steadily shrinking due to its replacement by HYV *Boro* rice. As a result, the government must import oilseeds and oil each year, primarily soybeans, at a significant financial loss (Amin *et al.,* 2009). Considering the rising demand of edible oil in our country, it is extremely needed to increase the total production of oil crops through increasing the area of cultivation where possible. However, research on farmers' perceptions and the factors influencing the adoption of soybean cultivation in Bangladesh is scarce and many concerns at the policy level remain unsolved.

Salam and Kamruzzaman (2015) discovered that Bangladesh's soybean output has a competitive advantage over imports. Uddin and Nasrin (2013) assessed the farming patterns and farmers' livelihood in coastal regions of Bangladesh; and found that the amount of land devoted to agricultural crop cultivation was declined due to shrimp cultivation for all categories of farmers. Alam *et al.* (2009) studied on nodulation, yield and quality of soybean as influenced by integrated nutrient management in Bangladesh while Amin *et al.* (2009) estimated the growth dynamics of soybean as affected by varieties and timing of irrigation. It is evident from the aforementioned discussion that till now very limited empirical research has been conducted concerning farmers' perception and factors affecting soybean production in Bangladesh. The specific objectives of the study are as follows:

i) To assess farmers' perception of soybean production and calculate its financial profitability;

ii) To explore the factors affecting adoption of soybean production by the farmers; and

iii) To identify the potentials and problems associated with the production of soybean.

Methodology

The study was carried out at several villages of Subornachor and Ramgati *Upazilas* in Noakhali and Lakshmipur districts, respectively in order to gather the necessary data. These two districts are important hubs for soybean production in Bangladesh, for this they were chosen as the research region. So, it was simple to get relevant and reliable data for completing the study successfully. Data were collected for

two groups of farmers (those who cultivate soybean in their farm and those who do not cultivate soybean).

Table 1. Sample size distribution in the study area

Districts	Upazilas	Unions	Villages	No. of farmers	
				Adopter	Non-adopter
Noakhali	Subarnachar	Char Jubli	Kocchopia	6	2
			Tumchar	3	3
		Char Jobbar	Char Hasan	10	6
			Jahazmara	9	6
Sub-total				28	17
Lakshmipur	Ramgati	Poragacha	Char kolakopa	11	9
			Sayed Nagar	2	0
		Char Aalgi	Char Neyamot	4	3
			Char Meher	8	8
Sub-total				25	20
Sample size in each group				53	37
Total sample size				90	

Source: Field survey, 2022.

After collecting necessary data and information from field surveys, interviews, communications and interactions, those were classified, edited and coded. To assess farmers' perception of soybean production, descriptive statistics (i.e., sum, average, percentages, ratios, etc.) with the support of tables was used. The financial profitability of soybean production from the individual farmer's point of view was measured in terms of gross return, gross margin, net return and benefit cost ratio (undiscounted). Logit regression model was used to identify the determinants that affect adoption of soybean production. Here, the dependent variable that is adopting soybean production was coded as 1 for farmers adopting soybean production and it was coded as 0 for otherwise. The logit model used in this analysis is given below:

$$Li = \ln\left(\frac{p}{1-p}\right) = \propto + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \beta_9 X_9 + Ui$$

Where,

P = Probability that the farmers will adopt soybean production;

1-P = Probability that the farmers will not adopt soybean production;

X_1= Age of household head (years);

X_2= Education of household head (years);

X_3 = Farm size (decimal);
X_4= Farm income (Tk./farm/year);
X_5= Off-farm employment (1=Involved in off-farm employment, 0 = otherwise);
X_6= Crop diversification (1= Farmers who practice crop diversification, 0 = otherwise);
X_7= Extension contact (1=Received extension services in previous season, 0 = otherwise);
X_8= Distance to market (km);
X_9= Fallow land (1 = Having fallow land during last year, 0 for otherwise);
$\propto$ = Constant/Intercept;
$\beta_1, \beta_2, \ldots\ldots\ldots\ldots, \beta_9$ = Coefficients of the respective variables; and
U_i = Error term.

To address the problems in relation to input, production and marketing of soybean, problem confrontation index (PCI) was used. For input related problems, three selected items were computed. For problems related to production and marketing, four items were calculated, respectively using the following formula:

$$PCI = (P_s \times 3) + (P_m \times 2) + (P_l \times 1) + (P_n \times 0)$$

Where,

P_s = Number of respondents with severe problems;
P_m = Number of respondents with moderate problems;
P_l = Number of respondents with low problems; and
P_n = Number of respondents with no problems.

The value of problem confrontation index (PCI) for any of the selected problems regarding input availability, production and marketing of soybean could vary from 0 to 270, where 0 means no problems and 270 means severe problems.SWOT analysis was done to identify the prospects and challenges of soybean production. SWOT is an acronym for Strengths, Weaknesses, Opportunities and Threats. SWOT 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). Recommendations pointed out the facts of intervention for enhancing soybean production in the study areas.

Results and Discussion

Assessing farmers' perception of soybean production

To assess farmers' perception towards soybean production a set of particulars were employed. It can be seen from Table 2 that cultivation time, minimum tillage, cropping pattern and soil fertility are the main factors that influence farmers'

positive perception towards soybean production. It is noted that the respondents in the study areas were agreed on these particulars in different extents. Majority (98%) of farmers agreed that selection of time of cultivation and minimum tillage were the major driving force for adopting soybean cultivation followed by cropping pattern (85%), soil fertility (73%), soil organic matter content (65%), etc. Very few farmers agreed on access to training facilities as well as credit facilities of having influence on farmers' decision of adopting soybean cultivation followed by credit facilities (16%).

Table 2. Farmers' perceived factors affecting adoption of soybean production

Particulars	Agree		Disagree	
	No. of farmers	% of farmers	No. of farmers	% of farmers
Credit facilities	14	16	74	84
Training facilities	12	14	76	86
Selection of time of cultivation	86	98	2	2
Cropping pattern change	75	85	13	15
Soil fertility	64	73	24	27
Soil organic matter content	57	65	31	35
Extension services	46	52	42	48
Minimum tillage	86	98	2	2

Source: Field survey, 2022.

Profitability of soybean production

For determining the viability of soybean production, it is necessary to estimate the financial profitability. Farmers in the study areas incurred following cost items for soybean production:

Cost of human labour: Human labours were required from the beginning of the soybean production process to the end of it. They are required for land preparation, planting, mulching, fertilizer application, manure application, weeding, irrigation, harvesting, carrying, drying and sorting. Table 3 shows that about 52 man-days of labours were required for producing soybean in one hectare of land and average cost on them was Tk. 21840 (31 % of the total cost).

Cost of power tiller: It is one of the modern agricultural tools which is now frequently used for land preparation for soybean production. Cost of power tiller for producing one hectare of soybean land was calculated at Tk. 7500 and it covers 11% of total cost (Table 3).

Cost of fertilizers: Fertilizer is generally used in the field to provide environment which facilitates an increase in production of soybean. Farmers in the study area generally used 94 kg urea, 45 kg TSP, 24 kg MoP and 53 kg gypsum, respectively for producing soybean in one hectare. Average per hectare costs were Tk. 1504,

Tk. 990, Tk. 360 and Tk. 530 for urea, TSP, MoP and gypsum, respectively and fertilizer cost covers 5% of total cost.

Cost of manure: Cowdung was used as manure for producing soybean. It helped to improve the quality of the soil. Farmers used 1167 kg cowdung per hectare and incurred a cost of Tk. 2451 for soybean production which covers 3 % of the total cost.

Cost of irrigation: Farmers also use irrigation for soybean production. Cost of irrigation was Tk. 2000 (3 % of the total cost) for producing per hectare soybean in the study area.

Cost of seed: It was calculated based on actual market price. A total of 72 kg seed was required for producing one hectare of soybean and the cost was Tk. 8520 which covered 12 % of the total cost.

Cost of pesticide: Pesticide is also applied for soybean production. It is generally required if there is any diseases and insects attack. Cost of pesticide for per hectare soybean production was Tk. 3600 and it covers 5 % of the total cost(Table 3).

Total cost: Total cost was calculated by summation of variable costs and fixed costs. Fixed cost itemincludes land use cost. Land use cost for producing one hectare of soybean was calculated at Tk. 19500 which is 28% of the total cost. It has been calculated that farmers spent Tk. 70767 for producing one hectare of soybean (Table 3).

Table 3. Input use and cost of soybean production per hectare

Cost items	Input use (Quantity/ha)	Cost (Tk./ha)	% of total cost
Human labour	52 man-days	21840	31
Power tiller	-	7500	11
Fertilizers			5
Urea	94 kg	1504	2
TSP	45 kg	990	1
MoP	24 kg	360	1
Gypsum	53 kg	530	1
Manure: Cowdung	1167 kg	2451	3
Irrigation	-	2000	3
Seed	71 kg	8520	12
Pesticide	-	3600	5
Interest on operating capital		1972	3
A. Total variable cost		51267	72
Land use cost	-	19500	28
B. Total fixed cost		19500	28
C. Total cost (A + B)		70767	100

Source: Authors'estimation based on field survey, 2022.

Gross return: It was calculated by multiplying the total production of soybean with its respective market price. Table 4 showed that gross return for producing one hectare of soybean was Tk.100880/-.

Gross margin: Gross margin was calculated by deducting the variable cost from the gross return. Gross margin for producing one hectare of soybean was Tk. 49613/-.

Net return: Net return is the actual amount of money that farmer gets after subtracting all the cost items from the total return. Table 4 showed that net return for per hectare soybean production was Tk. 30113 (Table 4).

Benefit cost ratio: Benefit cost ratio is the ratio of gross return to gross cost. It was calculated to summarize the overall relationship between the relative cost and benefits of soybean production. Benefit cost ratio for per hectare soybean production was 1.43 (Table 4). The result is similar with the study of Salam and Kamruzzaman (2015) where the authors also found that soybean production is profitable than other comparative crops in the areas.

Table 4. Financial profitability of soybean production per hectare

Item	Amount (Tk./ha)
Total fixed cost (TFC)	19500
Total variable cost(TVC)	51267
Total cost (TC = TVC + TFC)	70767
Total production (kg/ha)	1552
Price (Tk./kg)	65
Gross return (GR)	100880
Gross margin (GM = GR - TVC)	49613
Net return (GR – TC)	30113
BCR (Undiscounted) (BCR = GR / TC)	1.43

Source: Authors' estimation based on field survey, 2022.

3.3 Factors Affecting Adoption of Soybean Production

A dichotomous logistic regression model was employed to ascertain the variables influencing the adoption of soybean production. For logistic model, marginal effects have been interpreted below. Marginal effect was computed differently for discrete (i.e., categorical) and continuous variables. Marginal effect is estimated for a discrete change of dummy variable i.e., how predicted probabilities were changed as the binary independent variable changed from 0 to 1. Marginal effects for continuous variables measured the instantaneous rate of change. The association between the dependent and explanatory variables is also strong, as described by pseudo R^2 = 0.714, indicating fitness of model predictors for prediction of dichotomous dependent variable.

The result shows that the age of household head influences adoption of soybean production technology positively although insignificant. The implication is that the increase in farmers' age increases farmers' experience and understanding of the benefits of soybean production. This could also mean that farmers who have more years of farm experience are more likely to adopt soybean production technology than those who have less number of years of farm experience. The positive relationship was also found in the study of Miruts (2016). However, this result is in contrary to the findings of Akudugu *et al.* (2012), Samuel and Wondaferahu (2015) and Diro *et al.* (2017) who found negative significant relationship between age and adoption of soybean production. Education level of household head positively and significantly influences the probability of adoption of soybean production at 1% level. The result indicates that, the increase in schooling year of the head of a householdwould lead to increase in the likelihood of adopting soybean production by 8.1% (Table 5). The result of this study was consistent with the findings by Eba and Bashargo (2014), Afework and Lemma (2015), Sisay (2016), Abebe (2017), Iticha and Taresa (2020) who stated that adoption of soybean production was positively associated with level of farmers' education.

Farm size had a positive and significant influence on adoption of soybean production at 10% level. One percent increase in land size would increase the probability of adopting soybean production by 3.7 percent. This indicates that farmers who have large farm land are more likely to adopt soybean production. The reason for this could be that a farmer with large farm size will harvest more and likely to generate sufficient income, which could help them to buy agricultural inputs. This is similar to the findings of Gibegeh and Akubuilo (2013), Miruts (2016) and Diru *et al.* (2017).

Farm income was found to be positively and statistically significant at 5% level of significance in influencing the adoption of soybean production. Accordingly, as farm income of the head of household increase by one percent, this would lead to the increase in the probability of adopting soybean production by 2.9%. Apparently, farmers who obtained comparatively higher income from their annual agricultural production could invest his / her proportion of income to buy soybean improved seed as well as purchasing other agricultural inputs. The result is in line with the results found by Musba (2017) and Iticha and Taresa (2020).

Farmers can earn additional income by engaging in different off-farm activities. Off-farm activities are believed to raise farmer's financial position to acquire new inputs. Based on this assumption the variable was hypothesized that there will be a positive significant relationship between adoption of soybean production and farmers' participation in off-farm activities. However, this variable turns out insignificant although positive. Similar result was found by Miruts (2016). On the other hand, it can be seen from Table 5 that, the marginal effect for crop diversification was 0.301 which means that likelihood of adopting soybean production for farmers who diversified their farm production are 0.301percent

higher than their counterparts. Crop diversification is one of the major decision making tools for minimizing risk in farm production. On that regard, including soybean production in the farm plan could improve farmer's risk taking capability.

The study also reveals a positive and significant relationship between extension contact and adoption of soybean production. This shows that the households, who had contact with the extension personnel, are more probable to adopt soybean production technology than those who have no contact and the expected level of adoption would increase by 0.305 percent (Table 5). Extension contact determines the information which the farmers obtain and apply in farm production through counseling, meeting and demonstration. Thus, increased farmers' interaction with extension agents greatly increases farmers' knowledge of available technologies and their potential benefits. Saka and Lawal (2009), Olagunju *et al*. (2010), Miruts (2016), Dereje *et al.* (2016) and Iticha and Taresa (2020) also found similar results in their respective studies.

Table 5. Result of logistic regression on adoption of soybean production

Variables	Coefficients	Standard Error	P value	Marginal effect (dY/dX)
Constant	2.201	1.738	0.883	0.812
Age (years)	0.507	1.138	0.650	0.055
Education (years)	1.302**	0.644	0.032	0.081
Farm size (decimal)	0.425**	0.062	0.042	0.037
Farm income (Tk. /year)	1.706**	0.514	0.011	0.294
Off-farm employment (1 = involved in off-farm employment)	1.374	1.883	0.738	0.182
Crop diversification (1= practice crop diversification)	2.001*	0.428	0.007	0.301
Extension contact (1= received)	0.276**	0.059	0.017	0.305
Distance to market (Km)	-1.448**	0.722	0.029	0.016
Fallow land (1= had fallow land)	1.024	0.982	0.325	0.431
Model summary				
Log likelihood ratio		29.48		
LR chi^2 (10)		258.93		
Prob> chi^2		0.000		
Pseudo R^2		0.714		
Total number of observations		90		

Source: Authors' estimation based on field survey, 2022.

Note: * and ** indicate significant at 1% and 5% probability level, respectively.

Distance to market is measured in kilometers and the result of the model revealed that the coefficient is negatively and significantly related to adoption of soybean.

It is consistent with the hypothesized sign. This result is also supported by the findings of Samuel and Wondaferahu (2015), Sisay (2016) and Musba (2017).The increase in the distance from household to market would lead to the decrease in the probability adoption of soybean production by 1.6%. It implies that since the farmer is far from market, he / she cannot obtain enough information about price, quality and transportation. The result indicates that farmers with fallow land have 0.431 percent more likelihood of adopting soybean production as opposed to those who does not have fallow land.

Problems Related to Input, Production and Marketing of Soybean

Among the identified problems related to production, high price of seed and fertilizer has the highest PFI value which is 255 and it is at the rank of 1 (Table 6). Inadequate extension service is at the bottom of the table with a PFI score of 204 meaning it creates lesser problem for soybean production among the three problems. Lack of quality seed and fertilizer has a PFI score of 224 with a rank order of 2.

Table 6. Problems along with problem facing index and rank order

Particulars	Extent of problems				PFI	Rank order
	Severe (3)	Moderate (2)	Low (1)	Not at all (0)		
Input related problems						
High price of seed and fertilizer	81	5	2	0	255	1
Lack of good quality seed and fertilizer	58	22	6	2	224	2
Inadequate extension service	42	36	6	4	204	3
Product related problems						
Low price of output	76	8	2	2	248	1
Storage of product during harvesting	62	18	6	2	234	2
Temporal and spatial price fluctuation	43	28	14	3	199	3
Lack of fair market	38	32	13	5	191	4
Marketing related problems						
Lack of transport facility	58	15	4	1	212	1
Lack of facilities to develop value added product	44	28	14	2	202	2
Lack of grading knowledge	36	25	23	4	181	3

Source: Authors' estimation based on field survey, 2022.

Four problems related to products were identified and opinions about them were asked to the farmers. Table 6 showed that low price of output has the highest PFI value which is 248 and hence it secures the 1st rank. Other product related problems such as: storage of product during harvesting, temporal and spatial price fluctuation and lack of fair market had a PFI score of 234, 199 and 191 with a rank order of 2, 3 and 4, respectively. Among marketing related problems, lack of transport facility had a PFI score of 212 which is highest among all the three identified problems and had a rank order of 1. Lack of facilities to develop value added product and lack of grading knowledge had a PFI score of 202 and 181 with a rank order of 2 and 3, respectively.

SWOT Analysis for Soybean Production

SWOT analysis was conducted to find out the strengths, weakness, opportunities and threats for soybean production. Soil fertility (76.2%) and availability of human labour (64.7%) were the major strengths for soybean production. High price of seed and fertilizer (85.4%), low price of output (71.7%) and lack of transport facility (61.8%) were found to be the weakness of soybean production. High local demand for soybean (88.3%), wide export market (67.0%) and infrastructural development could facilitate soybean production (57.6%) were the major opportunities of soybean production. Lack of training (82.6%), lack of credit facilities (62.1%) and disease and insect infestation (73.8%) were found as the major threats.

Table 7. SWOT analysis for soybean production

	Statements	% of farmers		Statements	% of farmers
Strengths	Appropriate climate and environment for soybean production	80.0	Weakness	High price of seed and fertilizer	85.4
	Soil fertility	76.2		Low price of output	71.7
	Availability of human labour	64.7		Lack of transport facility	61.8
Opportunities	High local demand for soybean	88.3	Threats	Lack of training	82.6
	Wide export market	67.0		Lack of credit facilities	62.1
	Infrastructural development could facilitate soybean production	57.6		Disease and insect infestation	73.8

Source: Authors' estimation based on field survey, 2022.

Conclusion

The research evaluated farmers' perceptions on soybean production and determined the socio-economic level of soybean growers. The results of the study demonstrated

that time of cultivation, minimum tillage, cropping pattern and soil fertility were the major drivers that influence farmers' adoption towards soybean production. The calculated benefit cost ratio implied that soybean farming in the research regions was profitable. Regression analysis revealed that farmers' decision to embrace soybean production was significantly influenced by their level of education, farm size, farm income, extension contact, practiced crop diversification, and distance to market. The analysis also showed that the main issues with input, production, and marketing of soybean were rising costs for seed and fertilizer, low output prices, and a lack of transportation infrastructure. The provision of formal and informal education in rural regions should be improved through various GOs and NGOs. Extension contacts should be improved by the personnel of the Department of Agricultural Extension (DAE). The government should implement a subsidy scheme for the production of soybeans, especially to provide farmers with high quality seed, as the enterprise is time demanding and has the potential to advance agricultural growth as a whole. The government should take action to dissolve market syndicates in order to guarantee reasonable market prices.

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