Original Article

Assessing the effect of farmer's choice of fund for vegetable production in Bangladesh

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A B S T R A C T

Farmer's source of fund is crucial for vegetable production in Bangladesh. This paper attempts to identify vegetable grower's choices of funds and factors responsible for their fund used for vegetable production. Primary data were collected from 354 farmers by using simple random sampling technique in three districts of Bangladesh. Farmers socio-economic characteristics were analyzed by descriptive statistics. Multinomial Logit Regression Model was used to identify factors responsible for farmer's choice of funds for vegetables production. Analysis showed that farmer's average age was 43.96 years and they had 5.24 years of formal education. In addition, they had 1.39 number of training and 10.79 years of farming experience. Personal savings, banks, NGOs, and friends and relatives were the sources of farmers funds for vegetables production. On average, 62.99% of the farmers used their own savings, 13.28% of the farmers used bank loans, 11.58% of the farmers used NGOs loans and 12.15% of the farmers took loans from friends and relatives. Results also showed that farmer's level of education influenced negatively while farm size and number of family members positively influenced the probability of using bank loans compared to farmer's own fund. Moreover, farmer's years of farming experience influenced positively, and farm size negatively influenced NGOs loans used compared to farmer's own fund. Besides, farmer's level of education was negatively, and agricultural training positively influenced the loans from friends and relatives compared to farmer's own fund. Vegetable farmers (24.86%) used institutional sources of funds for vegetable production. So, availability of institutional funds is required for the farmers to increase the vegetable production in Bangladesh.

Introduction

Vegetables place an important nutritious food in the food bundle of Bangladeshi people. Vegetables are important sources of vitamins and minerals (Hasan *et al*., 2014), and vegetables are good for health. A high vegetable diet has been associated with a lower risk of cardiovascular disease in humans (Mullie and Clarys, 2011). Moreover, crops and horticulture contribute 7.06% to the GDP in 2018-2019 (BBS, 2019a), and vegetables are an important component of horticulture. Bangladesh exports different vegetables to different countries. Vegetable contributes an essential share of the total agricultural export in Bangladesh (Islam *et al*., 2020). Different types of vegetables are grown in Bangladesh and these vegetables are categorized as summer and winter vegetables. The major winter vegetables are cauliflower, cabbage, tomato, carrot, radish, rabi brinjal, rabi pumpkin, water gourd, beans, and potato. The major summer vegetables are lady's finger, pointed gourd, ribbed gourd, teasle gourd, Kharif pumpkin, Kharif brinjal, Cucumber, green Banana, and bitter gourd. Still, there is a gap between per capita vegetable production and per capita vegetable requirement in Bangladesh. Per capita consumption of vegetables is 166.1 grams per day whereas per capita consumption of fruits is 44.8 grams. WHO/FAO minimum recommended level of vegetables and fruits is 400 grams per capita per day (FAO, 2014). So, it is necessary to increase vegetable production in Bangladesh. Total areas of vegetable (summer and winter) production were 1020.0 thousand acres and total production of vegetables was 4115.0 thousand tons in the year 2017-2018. However, the total area of vegetable

production was 1072.0 thousand acres and total production of vegetables was 4336.0 thousand tons in the year 2018-2019 (BBS, 2019b). Data showed that vegetable production area and vegetable production were increasing in recent years. But vegetable production is still behind the required level of Bangladeshi people.

Different researchers from different countries investigated various issues related to agricultural credit. Mitra and Prodhan (2018) studied factors determining credit access of tomato producing farmers in a selected area of Bangladesh. Total of 60 tomatoes producing farmers were randomly selected from Mymensingh district for this study. The Probit Regression Model was employed to estimate the determinants of credit access. The study found that the probability of credit access increased with years of schooling, own asset, and productivity of tomato farmers. The study also found that the probability of credit access reduces with the farmer's age. The study recommended that timely credit access to the tomato farmers was important. Moahid and Maharjan (2020) studied on factors affecting farmers' access to formal and informal credit in rural Afghanistan. The study used 292 farming household's data in the Afghanistan and the study used Double Hurdle Model to investigate what affects farming households' credit participation. This model revealed that household's financial activities were positively determined by crop diversity, education, number of adults in the household, size of land, and access to the extension service. Religious belief increased the chances of avoiding formal credit but not informal credit. It is suggested that formal credit should be expanded to rural areas, especially to small-scale farming households. Misra *et al*. (2016) studied on the agricultural credit in India in the 2000s: Growth, distribution and linkages with productivity. This study attempted to explore the relationship between agricultural credit and agricultural productivity. Study found a positive impact of the intensity of agricultural credit on total factor productivity in agriculture. The study recommended that appropriate policy should be adopted to expand agricultural credit leading to sustainable and higher growth path in India. Upadhyay *et al*. (2020) studied the credit's use performance and its determinants on farm household: A case of Chitwan district of Nepal. The study based on survey data consisting of 107 samples, and the study used the Probit Model to analyze the data. This study examined the performance of agricultural credit and has identified the determinants of increased use of credit at the farm household level in Nepal. The study found that if the household's economically active population increased by one unit, the probability of taking a loan increased by 16%. If household food sufficiency increased by one month, the probability of taking loans decreased by 4 %, but if the household head was a member of an organization, the probability of taking loan increased by 28%. The congenial environment to increase the household head's involvement to an organization like cooperative and farmers group and creating awareness on credit utilization helped to increase credit use performance in Agriculture. Etonihu *et al*. (2013) studied the determinants of access to agricultural credit among crop farmers in a farming community of Nasarawa State, Nigeria. Data were obtained from 125 farmers, and descriptive statistics and Stepwise Linear Regression Model were used to analyze the data. The study found that education, distance to source of credit and credit source types were significant factors affecting farmers' accessibility to agricultural credit in the study area. The

study recommended creating a favorable environment for the farmers to access to education and credit facilities.

Moreover, different papers investigated different issues related to vegetables in different countries. Xaba and Masuku (2013) studied factors affecting the choice of marketing channel by vegetable farmers in Swaziland. They collected data from 100 randomly selected vegetable farmers, and descriptive statistics and Multinomial Logistic Regression Model were used to analyze the data. They found that age of the farmer, quantity of baby corn produced, and farmer's level of education were significant predictors of the choice of marketing channel to sell their vegetables. Islam *et al*., (2019) studied farmer's constraints to vegetable marketing in Bangladesh. They found that farmer's training received about vegetable marketing and availability of market information were negative and significant with their marketing constraints. Lack of access to storage facilities was the first ranked problem of the vegetable growers. Mitra and Sharmin (2019) studied risk attitudes and financial profitability of tomato farmers in Bangladesh. They found that farmers' risk preferences increase with training and education while risk preferences decrease with age and experience. The study also found that tomatoes production was profitable in the study area. Kumar *et al*., (2018) studied profitability and resource use efficiency in vegetable cultivation in Haryana in India. The study investigated the profitability and resource use efficiency of potato and tomato, which are the major vegetable crops grown by farmers in Haryana. The study found that the revenue per rupee investment was 1.40 for potato and 2.09 for tomato. The study also showed that medium farms are more efficient and have more economies of scale due to better management practices, sound financial position and efficient use of resources.

Different papers investigated the profitability of vegetable production and marketing in different regions of Bangladesh. But no previous study investigated the determinants of the source of funds of farmers for vegetable production in Bangladesh. The source of the fund was very crucial for the farmers for vegetable production. To meet the existing research gap, this study was undertaken in three major vegetable producing districts: Cumilla, Mymensingh and Rajshahi. The study selected five popular vegetables namely bean, cauliflower, brinjal, tomato and bottle gourd. Key research questions of the present study were i) What were the socio-economic characteristics of vegetable growers? ii) What were the major sources of fund for the farmers for vegetable production? iii) What were the factors responsible for farmer's choice of funds for vegetable production? In this study, we set three specific objectives. a) to delineate different socio-economic characteristics of farmers in the study areas. b) to investigate the major sources of fund for the farmers for vegetable production in the research areas. c) to identify factors responsible for farmer's choice of fund for vegetable production. The findings of the study may be helpful for the researcher, policy-makers, and government officials to formulate policies related to vegetable production in Bangladesh.

Methodology of the study
Data source and sampling technique
Five vegetables growing farmers, namely tomato, brinjal, cauliflower, bean and bottle gourd, were selected for the present study. Three well-known vegetable-producing districts, namely Cumilla, Rajshahi and Mymensingh, were

selected purposively for this study. One Upazila from each district, one Union from each Upazila and one village from each Union selected purposively with the help of the Department of Agriculture Extension (DAE) personnel where the vegetable producers were concentrated. A structured questionnaire was used to collect data from May to July 2014. A total of 354 farmers were chosen randomly after collecting a comprehensive list of vegetable producing farmers in each village (More details see Table 1).

Table 1. The distribution of sample farmers in different districts.

Vegetables	Cumilla	Mymensingh	Rajshahi	Total
Bean	24	24	n/a	48
Cauliflower	33	n/a	21	54
Brinjal	30	30	30	90
Tomato	30	21	24	75
Bottle gourd	30	27	30	87
Total	147	102	105	354

Note: "n/a" denotes not available

Analytical techniques

Descriptive statistics were used to describe the different characteristics of the farmers. To determine the factors that influence the sources of funds, Multinomial Logit Regression Model was used. The advantage of the Multinomial Logit Regression Model is that, it includes the analysis of decisions in more than two categories and allowing the determination of choice probabilities for different categories (Woodridge, 2002). Multinomial Logit Regression Model was used by different researchers (Ishaq *et al*., 2017; Mustapha *et al*., 2017; Tiku *et al*., 2018; Dung, 2020) in the various countries for different issues. This study investigated the factors responsible for farmer's choice of fund for vegetable production using Multinomial Logit Regression. The farmers used four sources of the funds and they were personal savings, banks, NGOs, and friends and relatives. Categorized dependent variables were used for Multinomial Logit Regression.

1 = Personal savings, 2 = Banks, 3 = NGOs, 4 = Friends and relatives

Multinomial Logit Regression estimates the variation in independent variables (farmer's different characteristics) that affect the probability of dependent variables (sources of the fund). The Multinomial Logit Model may be specified as:

$$SF_{ij} = \beta_j X_{ij} + \varepsilon_{ij} \quad \text{equation (1)}$$

Where,

SF_{ij} denoted the four choices of funds of ith farmers for vegetable production. $j = 1,2,3,4$, which indicated personal savings, banks, NGOs, and friends and relatives. X_{ij} was the vector of farmer's characteristics that influence the sources of funds for vegetable production. ε_{ij} was the error term.

Multinomial Logit Regression may be defined as a function of seven independent variables influencing farmer's choice of fund for vegetable production.

$$SF_{ij} = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \varepsilon_{ij} \quad \text{equation (2)}$$

Farmer's different characteristics were age, education, number of agricultural training, years of farming experience, number of extensions contact, farm size, and numbers of family members. Explanation of different variables used in the Multinomial Logit Regression shown in Table 2.

Table 2. Variables used in the Multinomial Logit Regression Model.

Variables	Nature of variable	Variable description
Dependent variable		
Sources of the funds (Y_i)	Dummy	1 = Personal savings 2 = Banks 3 = NGOs 4 = Friends and relatives
Independent variables		
X_1	Continuous	Farmers age in years
X_2	Continuous	Farmer's education in years
X_3	Continuous	Number of agricultural training received by the farmers (lifetime)
X_4	Continuous	Farmer's years of farming experience
X_5	Continuous	Number of extension contacts made by the farmer
X_6	Continuous	Farm size in hectares
X_7	Continuous	Numbers of family members

Model specification

Farmers had four alternative sources of funds for vegetable production. Let S_{ij} represented the probability of choice of fund by the farmers, and then the equation was

$$S_{ij} = \beta_0 + \beta_1 X_1 + \ldots\ldots\ldots\ldots + \beta_j X_i + \varepsilon_i \quad \text{equation (3)}$$

Here j took the value 1,2,3,4 which represents the farmer's choice for source of fund. 1 represented personal savings, 2 for banks, 3 for NGOs, and 4 for friends and relatives. X_i was the explanatory variables. β_j was the parameters that need to be estimated and ε_i was the error term. With j choices the probability of choosing the source of fund j was given by (Greene, 2003)

$$\text{Probability } \left(Y_i = \frac{j}{x}\right) = \frac{e^{\beta_j X_i}}{1 + \sum_{k=0}^{j} e^{\beta_j X_i}} \quad \text{equation (4)}$$

The parameter estimated of the Multinomial Logit Model provided only the direction of the effect of the explanatory variables on the dependent variable (source of fund), but did not represent either the actual magnitude of change or probabilities. To interpret the effects of explanatory variables on the probabilities, marginal effects were usually derived as (Greene, 2003):

$$\frac{\partial P_j}{\partial X_i} = P_J\left(\beta_j - \sum_{k=0}^{j} P_k \, \beta_k\right) = P_i(\beta_j - \bar{\beta}) \quad \text{equation (5)}$$

Absence of Multicollinearity and omitted variable bias problem

Multicollinearity may be present in the Multinomial Logit Regression Model. For that reason, correlations among different independent variables were checked. Table 3 showed that majority of the correlation coefficient was less than 0.10. This means that there was no serious problem of multicollinearity among the independent variables used in the model.

Table 3. Multicollinearity test.

Variables	Age	Education	Training	Farming experience	Extension contacts	Farm size	Family members
Age	1.0						
Education	-0.124**	1.0					
	(0.019)						
Training	0.052	0.138***	1.0				
	(0.323)	(0.0)					
Farming experience	0.227***	-0.010	0.267***	1.0			
	(0.0)	(0.844)	(0.0)				
Extension contacts	-0.019	0.179***	0.376***	0.246***	1.0		
	(0.716)	(0.0)	(0.0)	(0.0)			
Farm size	0.102**	-0.10**	0.065	0.098*	-0.155***	1.0	
	(0.053)	(0.058)	(0.219)	(0.063)	(0.003)		
Family members	0.322***	0.012	-0.046	0.025	-0.053	-0.044	1.0
	(0.0)	(0.822)	(0.379)	(0.628)	(0.316)	(0.40)	

Notes: 1. ***, ** and * indicates significance at the 1%, 5% and 10% levels respectively
2. Figure in the parentheses indicate p values

Variance Inflation Factor (VIF) was also used to test the multicollinearity problem. The value of VIF in each variable was near 1 and there was no multicollinearity problem in the model. Ramsey RESET test was employed to test the omitted variable bias problem in the model. Null hypothesis of there was no omitted variable bias in the model, was accepted and there was no problem of omitted variable bias in the model (Table 4).

Table 4. The VIF of different variables and Ramsey RESET test.

Variables	VIF	1/VIF
Farmer's age	1.21	0.82
Farmer's education	1.07	0.93
Farmer's trainings (no.)	1.24	0.80
Farmer's farming experiences	1.18	0.84
Farmer's extension contacts	1.28	0.78
Farm size (ha)	1.08	0.92
No. of family members	1.14	0.88
Mean VIF	1.17	
Ramsey RESET test	Test value	P value
Ramsey RESET test, H_0 = model has no omitted variables	F (1.65)	0.177

Results and Discussion
Different characteristics of vegetable farmers
Table 5 shows different characteristics of vegetable farmers in the study areas. Farmer's average age was 43.96 years and the maximum and minimum age of the farmers was 66.0 and 20.0 years. Farmer's average years of schooling were 5.24 years. Farmer's maximum years of schooling were 16.0 and minimum years of schooling were no formal education. Farmer's average number of training was 1.39. Farmer's maximum number of agricultural training was 7.0 years and minimum training was zero. Farmer's average years of farming experience was 10.79. Farmer's had maximum 35.0 years of farming experience and minimum 1.0 years of farming experience. Farmers number of contacts with extension workers were 1.25 and they had 0.47 ha of land. Farmer's average number of family members was 3.34. Farmers had maximum of 6.0 family members and they had minimum of 2.0 family members. This result showed that most of the farmers age was over forty years and they had many years farming experiences.

Table 5. Different characteristics of vegetable growers in the study areas.

Variables	Mean	S.D.	Max.	Min.
Farmer's age (years)	43.96	9.59	66.0	20.0
Farmer's level of education (years)	5.24	2.83	16.0	0
Farmer's number of agricultural training	1.39	1.12	7.0	0
Farmer's years of farming experience	10.79	6.34	35.0	1.0
Farmer's number of extension contacts	1.25	0.94	5.0	0
Farm size (ha)	0.47	0.24	0.04	1.53
Numbers of family members	3.34	0.99	6.0	2.0

Source: Farmer's household survey, 2014.

Farmer's sources of funds for vegetable production
Table 6 reveals farmer's different sources of funds for vegetable production in the study areas. Personal savings was the major sources of funds for vegetable production and 62.99% of the farmers used their own savings. Bank loan was the second source of fund for the farmers, and 13.28% of the farmers took loans from banks for vegetable production. About 11.58% of the farmers used NGOs loans for vegetable production, and 12.15% of the farmers took loans from friends and relatives. This result showed that almost 63% of the farmers used their own fund for vegetables production and 24.86% of the farmers borrowed loans from banks and NGOs. So, it is necessary to ensure loans from banks and NGOs to the farmers for vegetable production in the study areas.

Table 6. Distribution of vegetable farmers by their sources of fund for vegetable production.

Sources of fund	No. of respondents	Percentage
Personal savings	223.0	62.99
Bank loans	47.0	13.28
NGOs	41.0	11.58
Friends and relatives	43.0	12.15
Total	354.0	100.0

Source: Farmer's household survey, 2014.

The determinants of farmer's choice of funds in the study areas

Table 7 shows the estimated marginal effect after multinomial logit regression results. In the case of using bank loans, the coefficient of farmer's level of education was negative and significant implying that a one-year increase in farmer's level of education would decrease the probability of using bank loan by 2.40 % compared to farmer's own fund. This result showed that more educated farmers were unwilling to take loans from banks. The coefficient of farm size was positive and significant implying that if farm size increases one hectare, the probability of using bank loan would increase by 11.5% compared to farmer's own fund. The result revealed that if farmers expand their farms, they prefer to borrow loans from banks. The coefficient of farmer's family member was positive and significant implying that a one-member increase in farmer's family would increase the probability of using bank loan by 7.4% compared to farmer's own fund. If farmer's family members increase, the farmers felt confident and finally they would like to borrow loans from banks.

In the case of using NGOs loan, the coefficient of farmer's level of education was positive and significant implying that a one-year increase in farmer's level of education would increase the probability of using NGOs loan by 1% compared to farmer's own fund. The result revealed that more educated farmers were interested to get loans from NGOs. The coefficient of farmer's years of farming experience was positive and significant implying that a year of farming experience increase of the farmer, the probability

of using NGOs loans would increase by 0.8% compared to farmer's own fund. This result showed that farmers years of farming experience positively influenced farmers to borrow loans from NGOs. The coefficient of farmer's farm size was negative and significant implying that if farm size increases one hectare, the probability of using NGOs loan would decrease by 17.5% compared to farmer's own fund. This result showed that if farmers wanted to expand their farms, they were unwilling to borrow loans from NGOs.

In the case of using loans from friends and relatives, the coefficient of farmer's level of education was negative and significant implying that a one-year increase in farmer's level of education would decrease the probability of using loans from friends and relatives by 1.6 % compared to farmer's own fund. This result showed that more educated farmers were unwilling to borrow loans from friends and relatives. The coefficient of the farmer's number of agricultural training was positive and significant implying that an increase of farmer's training increases the probability of using the loans from friends and relatives by 5.5% compared to farmer's own fund. This result showed that if farmers were receiving training, they were interested in the new farming methods and they were interested to apply in their field. Finally, they were interested to borrow loans from friends and relatives. Farmers were relying on their friends and relatives for the fund to apply their new knowledge which was earned from the training. In this case, farmers were unwilling to borrow loans from banks and NGOs.

Table 7. Parameter estimates of the multinomial logit regression model for the determinants of farmer's choice of funds.

Explanatory variables	Source of funds					
	Bank loans		NGOs		Friends and relatives	
	Coefficients	Marginal effect	Coefficients	Marginal effect	Coefficients	Marginal effect
Farmer's age (years)	-0.024	-0.0023	0.019	0.0019	0.0008	0.0001
Farmer's level of education (years)	-0.296***	-0.0243***	0.060**	0.010**	-0.187***	-0.016**
Farmer's number of agricultural training	0.174	0.009	-0.087	-0.015	0.557***	0.055***
Farmer's years of farming experience	-0.039	-0.0039	0.080***	0.008***	-0.021	-0.002
Farmer's number of extension contacts	0.093	0.0089	0.139	0.013	-0.189	-0.021
Farm size (ha)	1.169*	0.115**	-1.828**	-0.175**	0.305	0.038
Number of family members	0.874***	0.074***	0.093	-0.001	0.116	0.001
Model summary						
Base category	Personal savings					
Log-likelihood	-332.81					
LR chi-square	88.35***					
Probability of LR chi-square	0.0					
Pseudo R^2	0.117					
Number of observations	354					

Source: Farmer's household survey, 2014.

Notes: 1. ***, ** and * indicates significance at the 1%, 5% and 10% probability level respectively

2. Robust standard error was used in the model to remove the heteroskedasticity problem in the data set

Conclusions

Farmers used different sources of funds for their vegetable production. This paper investigated the socio-economic characteristics of farmers and their sources of funds used for vegetable production. This research also identified the factors responsible for farmer's choice of funds for vegetable

production. Results revealed that farmer's average age was above forty years and they had many years of farming experience. The analysis found that farmers used four sources for their capital needs: personal savings, banks, NGOs, and friends and relatives. Total 62.99% of the farmers used own savings, 13.28% of the farmers took loan

from banks, 11.58% of the farmers used NGOs loan, and 12.15% of the farmers took loan from friends and relatives. Multinomial Logit Regression results showed that, farmer's level of education negatively while farm size and number of family members positively influenced the probability of using bank loans by the farmers in compared with farmer's own fund. Farmer's years of farming experience was positively, and farm size was negatively influenced NGOs loan used by the farmers in compared with farmer's own fund. In addition, farmer's level of education was negatively, and agricultural training positively influenced the choice of taking loans from friends and relatives by the farmers in compared with farmer's own fund. The majority of the farmers used their own source of funds for vegetable production. It is necessary to make available the institutional sources of funds with easy terms and conditions for vegetable production, which will ensure more vegetable production in Bangladesh.

Conflicts of Interest
The authors declared that they have no conflict of interest regarding the publication of this paper.

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