CAULIFLOWER CULTIVATION PRODUCTIVITY AND RESOURCE UTILIZATION OF AGRO- ECONOMICS: A STUDY ON SELECTED AREAS OF JAMALPUR DISTRICT IN BANGLADESH

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Abstract

The study is an attempt to examine the economic analysis of cauliflower production in selected areas of Jamalpur district. A total of 80 farmers were randomly selected from three Chor that means less fertile land areas namely Chor Chukhnogori, Fulzur Chor, and Attattur Chor under Madargonj Upazila in Jamalpur district. The major findings of this study revealed that production of the selected homestead vegetables were profitable. Per acre gross cost of production of cauliflower was Tk. 93860.55 and the gross return was Tk. 229407.40. Per acre net returns of producing cauliflower was Tk. 135546.85. Benefit cost ratios of cauliflower was 2.44. The farmers earned the highest profit from cabbage production. The results of Cobb-Douglas production function model indicated that acre⁻¹ gross returns was significantly influenced by the use of human labor, tillage operation, seeds, fertilizers, manure, irrigation and insecticides. These factors were directly or jointly responsible for influencing acre⁻¹ gross returns of cauliflower. Some essential policy recommendations have been arisen which are: input and price support, and motivation and training programs should be arranged by different government and non-government organizations and public-private partnership should be emphasized for creating scope to improve the overall economic condition of the farmers through homestead vegetable farming.

Keywords: Productivity, Benefit Cost Ratio, Resource Use Efficiency, Cauliflower Farming, Jamalpur Chor, Bangladesh.

Introduction

Bangladesh, a country of 16.1 million people and covers an area of 147,570 square kilometer, is one of the predominantly agro-based developing countries in the world (WB, 2019). Since her independence in 1971, agriculture has been the core sector of Bangladesh economy, which is still contributing around 13.60 percent of the GDP and also providing employment to 40.6 percent labor force (MoF, 2019, BBS, 2018). Around 84 percent of the rural people of the country depend on agriculture for their livelihood directly or indirectly (LFS, 2016-17).

Agriculture has been playing a pioneering role in the growth and stability of the national economy of Bangladesh (Sharmin et al., 2018). The main agricultural commodities of our country are rice, wheat, pulse, jute and different vegetables. Vegetables are considered as one of the most important food crops due to their high nutritive value, relatively higher yield and higher return (Sharmin, 2015). Apart from nutritional importance, it helps to employment generation, increase income and reduce poverty in developing countries like Bangladesh (SOFA team et al., 2011; Weinberger & Genova, 2005). Vegetable production has experienced tremendous growth in last 40 years in Bangladesh. Winter vegetables of Bangladesh are tomato, water gourd, cauliflower, cabbage, rabi brinjal, rabi pumpkin, radish, bean, green spinach etc. Supply of vegetables increases in a large extent in the winter season. Surplus vegetables in winter reduce the market price and farmer's faces economic loss. Government may decide to export surplus vegetables after meeting domestic requirements or they can store surplus vegetables to reduce economic loss. Government or policy makers can take these decisions based on the growth and trend of winter vegetables production in Bangladesh. Vegetable contributes an important share of the total agricultural export in Bangladesh. Vegetables and crops sub-sector also contributes an important share to the agricultural GDP which is near about 9.71 % (MoF, 2018).

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Vegetables are generally labor intensive crops and thus offer a considerable promise for generating increased rural employment opportunities. Homestead crop production systems especially production of horticultural crops can, to a considerable extent, help to ensure food and nutrition security in addition to self-employment, poverty alleviation and income generation of the farmers. Vegetables can be identified as a significant one for this economy for its noteworthy contribution in raising the foreign exchange earnings and occupies an important position among the items exported from Bangladesh. Among more than 90 types of vegetables, Cauliflower (*Brassica oleracea* L. var. botrytis) is grown mainly as Rabi crop during winter. The production of vegetables including cauliflower is increasing day by day in Bangladesh. Among all the vegetables produced in the country, cauliflower dominates a major share in terms of total cropping area and production. It grows in all the districts of Bangladesh but plenty of cauliflower is produced in the region of Dhaka, Jessore, Rajshahi, Rangpur, Tangail and Kustia (BBS, 2016). It occupied 47749 acres of land with the total production of 268484 metric tons in Bangladesh (BBS, 2016).

The above discussion reveals that a good number of studies were also being conducted which are related to costs and returns of different vegetables including tomato, cauliflower and cabbage. That means a few researches have been conducted on homestead vegetables production, specifically cauliflower in Jamalpur district. The present study aims to examine the profitability of cauliflower production in Jamalpur district. It is expected to bring into focus important information regarding homestead vegetables production. The specific objectives are: i) to measure the profitability of cauliflower production; and ii) to determine the factors which influence cauliflower production.

Materials and Methods

Three Chor areas from Jamalpur district namely Char Chukhnogori, Fulzur Chor, and Attatur Chor under Madargonj Upazila were purposively selected for data collection. There were some reasons behind the selection of these areas which were: a) a good number of cauliflower farmers were available in the selected areas; b) cooperation from the respondents was expected to be high and reliable data was expected to be obtained; c) easy accessibility and communication system in the selected villages; and d) these villages had some identical characteristics like topography, soil and climate condition for producing cauliflower. Stratified random sampling technique was followed to select 15 respondents (i.e., 12 small, 2 medium and 1 large farmers) from each area. Thus, a total of 45 sample respondents were included in the

study for data collection using a structured questionnaire.

Analytical Techniques

Profitability Analysis

Per acre gross return, gross margin and net return of cauliflower was calculated for analysis the financial profitability.

Gross Return

Gross return was calculated by multiplying the total volume of output of an enterprise by the average price in the harvesting period (Dillon and Hardaker, 1993). It consisted of sum of the volume of main product and by-product. The following equation was used to calculate gross return:

Gross Return= Quantity of the product * Average price of the product + Value of by product.

Gross Margin

Gross margin calculation was done to have an estimate of the difference between total return and variable costs. The analysis is also easily understandable because of its simplicity. The Following equation used to assess gross margin:

$$GM = TR - VC$$

Where, (GM = Gross margin; TR = Total return; and VC = Variable cost)

Net Return

Net return or profit was calculated by deducting the total production cost from the total return or gross return. That is,

Net return = Total return – Total production cost

The following conventional profit equation was applied to examine farmer's profitability level of the cauliflower producing farms in the study areas.

Net profit, $\pi = \sum P_m Q_m + \sum P_f Q_f - \sum (P_{xi} X_i) - TFC$

Where, (π = Net profit/Net return from cauliflower farming (Tk/ha); P_m = Per unit price of cauliflower (Tk/kg); Q_m = Total quantity of the cauliflower production (kg/acre); Q_f = Per unit price of other relevant cauliflower (Tk/kg); P_f = Total quantity of other relevant cauliflower (kg/acre); P_{xi} = Per unit price of i-th inputs (Tk); TFC = Total fixed cost (Tk); and X_i = Quantity of the i-th inputs (kg/acre); $i = 1, 2, 3, \dots, n$ (number of inputs).

Benefit-Cost Ratio (BCR)

The BCR is a relative measure, which is used to compare benefit unit-1 of cost. The BCR is estimated as a ratio of gross returns and gross costs. The formula of calculating BCR (undiscounted) is shown below:

$$\text{BCR} = \text{Total Return} / \text{Total Cost}$$

Factors Influencing Cauliflower Production

Cobb-Douglas production function was used in the present study to determine the factors that influence cauliflower production.

Cobb-Douglas Production Function

Cobb-Douglas production function model was chosen to estimate the effects of key variables on gross return of cauliflower production. The double log form of the function proved to be a superior alternative on theoretical and econometric grounds. Therefore, the following Cobb-Douglas production function was used in the present study:

$$Y_i = \alpha X_1^{\beta_1} X_2^{\beta_2} X_3^{\beta_3} X_4^{\beta_4} X_5^{\beta_5} X_6^{\beta_6} X_7^{\beta_7} e^u_i$$

By taking log in both sides, the Cobb-Douglas production function was transformed into the following logarithmic form because it could be solved by the ordinary least square method:

$$\ln Y_i = \ln \alpha + \beta_1 \ln X_1 + \beta_2 \ln X_2 + \beta_3 \ln X_3 + \beta_4 \ln X_4 + \beta_5 \ln X_5 + \beta_6 \ln X_6 + \beta_7 \ln X_7 + u_i$$

Where, Y = Gross return (Tk.acre-1); $\ln \alpha$ = Constant or Intercept of the function; X_1 = Human labor cost (Tk.acre-1); X_2 = Tillage Cost (Tk.acre-1); X_3 = Seeds/seedlings cost (Tk.acre-1); X_4 = Fertilizer cost (Tk.acre-1); X_5 = Manure cost (Tk.acre-1); X_6 = Irrigation cost (Tk.acre-1); X_7 = Insecticide (Tk.acre-1); and $\beta_1, \beta_2, \dots, \beta_7$ = Coefficient of respective variables; $\ln$ = Natural logarithm; e = Base of natural logarithm; u_i = Error term; and $i = 1, 2, 3, \dots, n$.

Findings:

Socioeconomic characteristics of the selected farmers

Table 1 represents the basic information of the selected farmers in the study areas. It was found that average household and farm size of small, medium and large farmers was 6.0, 5.0 and 6.0; and 0.83, 2.11 and 3.09 ha, respectively. Average dependency ratio of large farmers (2.6) was comparatively lower than small and medium farmers (1.2 and 1.9, respectively) which indicated that large farmers were more self-sufficient and self-employed.

Table1. Basic Information about the Selected Farmers

Particulars		Farmers' categories		
		Small	Medium	Large
Average household size (no.)		6.0	5.0	6.0
Average farm size (ha)		0.83	2.11	3.09
Average dependency ratio (no.)		1.2	1.9	2.6
Average sex distribution	Male	62.0	72.1	67.5
(% of farmers)	Female	38.0	27.9	32.5
Average age (years)		31	38	35
Literacy rate	Illiterate	32.0	56.5	55.6
(% of farmers)	Sign only	42.0	27.5	22.4
	Primary and above	26.0	16.0	22.0
Occupational status	Agriculture only	26.0	22.0	29.0
(% of farmers)	Agriculture and others	74.0	78.0	71.0

Source: Field Survey, 2019

The percentages of male and female respondents were 62.0, 72.1 and 67.5; and 38.0, 27.9 and 32.5 for small, medium and large farmers, respectively. Average age of small, medium and large farmers was 31, 38 and 35 years, respectively. Though 42.0% small farmers could put sign only, majority of the medium and large farmers (56.5 and 55.6%, respectively) were illiterate in the study areas. Most of the farmers were engaged in agriculture as well as other income generating activities like labor selling, service, small business, etc. (74.0, 78.0 and

71.0% small, medium and large farmers, respectively) (Table 1).

Profitability of Cauliflower Production Estimation of Production Cost

For calculating total production cost, variable and fixed costs were taken into consideration. The components of variable cost were land preparation, sowing, weeding, harvesting, power tiller, seed/seedlings, fertilizer, manure, irrigation, insecticides, wastage and miscellaneous. Fixed

cost items for crop production were agricultural equipment, land use cost and interest on operating capital.

It is evident from **Tables 2** that total cost of human labor for land preparation amounted to Tk. 3433.33 and which covered 3.66% of the total cost (TC) of production. TC of human labor for sowing amounted to Tk. 3117.78 per acre in cauliflower production; that covered 3.32% of the respective TC of production. TC of human labor for weeding amounted to Tk. 3273.33 per acre in cauliflower production; that covered 3.48% of the TC of production. Total cost of human labor for harvesting amounted to Tk. 4493.33 per acre in cauliflower production; that covered 4.79% of the total cost of production. For cauliflower production, the average per acre power tiller cost was Tk. 6085.19. In percentage terms it shared 6.48% of total cost (Tables 2).

The farmers used different kinds of fertilizers for higher yield of vegetables. Commonly used fertilizers were Urea, TSP, MP, Gypsum, etc. All

the fertilizers were purchased. Costs of fertilizers were estimated according to the cash price paid. Market prices of Urea, TSP, and MOP were Tk. 20, Tk. 25, and Tk. 18, respectively. Most of the farmers used cow dung as manure in producing cauliflower. The cost of cow dung acre⁻¹ was Tk. 5863.03. The total amount of seeds requirement acre⁻¹ for producing cauliflower production was 0.064 kg and its respective cost was Tk. 3105.83 which shared 3.31% of total cost of production. The cost of insecticides amounted to Tk. 6640 acre⁻¹ for cauliflower production, which occupied 7.08% of its respective total costs. Per acre cost of irrigation water in cauliflower was Tk. 6242.72 which represented 6.65% of their respective total costs. Per acre miscellaneous cost in cauliflower was Tk. 2554.44 which represented 2.72% of its respective total costs. Summation of the costs of variable inputs gave the total variable costs which was Tk. 61591.06 per acre for cauliflower production. In percentage term, total variable costs covered 65.62% of total costs for cauliflower production (Tables 2).

Table 2. Cost and Return of Cauliflower Production Acre-1

Items	Unit	Quantity	Price unit ⁻¹ (Tk.)	Total value (Tk.)	% of Total
A. Gross returns					
Main Product	No.	11470.37	20	229407.4	
By Product	Tk.	-	-		
Total gross return	Tk.	-	-	229407.4	
B. Variable cost					
Human Labor					
Land preparation	Man-days	11.44	300	3433.33	3.66
Sowing	Man-days	10.39	300	3117.78	3.32
Weeding	Man-days	10.91	300	3273.33	3.48
Harvesting	Man-days	14.98	300	4493.33	4.79
Power Tiller	Times	-	-	6085.19	6.48
Urea	Kg.	95.40	20	1908.15	2.03
TSP	Kg.	294.95	25	7373.70	7.86
MOP	Kg.	112	18	2016.00	2.15
Cow dung	Kg.	2162.59	2.71	5863.03	6.25
Seeds	Kg.	0.064	48444.44	3105.83	3.31
Pesticides	Tk.	-	-	6640.97	7.08
Irrigation	Tk.	-	-	6242.72	6.65
Wastage	Tk.	-	-	5483.26	5.84
Miscellaneous	Tk.	-	-	2554.44	2.72
Total variable cost				61591.06	65.62
C. Fixed cost					
Ag. Equipment	Tk.	-	-	2664.12	2.84
Land Use Cost	Tk.	-	-	20000.00	21.31
Interest on OC	Tk.	-	-	9605.37	10.23
Total fixed cost	Tk.	-	-	32269.49	34.38
D. Gross cost (B+C)	Tk.	-	-	93860.55	100
E. Gross margin (A-B)	Tk.	-	-	167816.35	
F. Net return (A-D)	Tk.	-	-	135546.85	

Source: Authors' estimation, 2019.

Per acre cost of agricultural equipment in cauliflower was Tk. 2664.117 which represented 2.84% of its total costs. The land use cost acre⁻¹ was Tk. 20000 for cauliflower production; which covered 21.31% of TC of cauliflower production. In production practice, per acre interest on operating cost was Tk. 9605.37 cauliflower production. In percentage term, this cost covered 10.23% of TC for cauliflower production. Summation of the costs of fixed inputs made total fixed costs. Total fixed costs were Tk. 32269.49 per acre for cauliflower production. In percentage term total fixed costs covered 34.38% of TC for cauliflower and production. In order to estimate gross costs acre⁻¹, all the resources used in cauliflower production have been recaptured together. Per acre gross costs of cauliflower production were Tk. 93860.55 (Tables 2).

Estimated Returns

It was seen from Tables 2 that acre⁻¹ average yields of cauliflower was estimated to be 11470.37 kg acre⁻¹. Per acre gross returns of cauliflower was Tk. 229407.4. Per acre gross margins were estimated at Tk.167816.35 for cauliflower. Per acre net returns of cauliflower was Tk. 135546.85. Benefit cost ratios of cauliflower production acre⁻¹ was 2.44, which implies that Tk. 2.44 will be achieved for corresponding crop by investing Tk. 1.00 in cauliflower production.

Factors Affecting Cauliflower Production

To identify and measure the effects of relevant variables of production on gross returns of cauliflower, Cobb-Douglas production function model was used. Estimated values of the production function analysis, estimated values of the coefficients and related statistics of the Cobb-Douglas production functions of cauliflower are presented in Tables 4.

Factors Affecting Production of Cauliflower Human Labor Cost (X1)

The magnitude of the regression coefficient of human labor costs was 0.142 with a positive sign. This coefficient was statistically significant at 5% probability level it implies that, 1% increase in human labor costs, keeping other factors constant, would lead to an increase in the gross return by 0.14% (Table 4).

Tillage Cost (X2)

The magnitude of the regression coefficient of tillage cost was 0.043 with a negative sign. This coefficient was insignificant. This indicates that an increase in 1% of tillage cost, remaining other factors constant, would result in decrease in the gross return by 0.04% (Table 4).

Seeds Cost (X3)

It can be seen from Table 4 that regression coefficient of seeds cost was 0.406 with a positive sign. This coefficient was statistically significant at 1% probability level it implies that, 1% increase in seed costs, keeping other factors constant, would lead to an increase in the gross return by 0.41%.

Fertilizers Cost (X4)

It can be seen from Table 4 that regression coefficient of fertilizer (Urea, TSP, MOP, etc.) cost was 0.274 with a positive sign. This coefficient was statistically significant at 1% probability level it implies that, 1% increase in fertilizer costs, keeping other factors constant, would lead to an increase in the gross return by 0.27%.

Manure Cost (X5)

It can be seen from Table 4 that the magnitude of the regression coefficient of manure cost was 0.36 with a positive sign. This coefficient was insignificant. This indicates that an increase in 1% of manure cost, remaining other factors constant, would lead to an increase in the gross return by 0.36%.

Table 4. Estimated Values of Cobb-Douglas Production Function Model for Cauliflower Production

Explanatory variables	Cauliflower		
	Estimated coefficient	Standard errors	T-values
Constant	4898.012	905.779	5.408
Human labor (X ₁)	0.142**	0.062	2.292
Tillage cost (X ₂)	-0.043	0.065	-0.657

Seed cost (X_3)	0.406 ^{***}	0.093	4.382
Fertilizers cost (X_4)	0.274 ^{***}	0.054	5.122
Manure cost (X_5)	0.36	0.099	0.366
Irrigation cost (X_6)	0.032	0.062	0.518
Insecticides (X_7)	0.020	0.107	0.187
	0.632		
F-value	11.797 ^{***}		
Returns to scale ($\sum\beta_i$)	1.19		

Source: Authors' estimation, 2019.

Note: *** Significant at 1% level, ** Significant at 5% level, * Significant at 10% level.

Irrigation Water Cost (X_6)

It can be seen from **Table 4** that the magnitude of the regression coefficient of irrigation water cost was 0.032 with a positive sign. This coefficient was insignificant. This indicates that an increase in 1% of irrigation water cost, remaining other factors constant, would lead to an increase in the gross return by 0.03%.

Insecticides Cost (X_7)

It can be seen from Table 4 that regression coefficient of insecticides cost was 0.020 with a positive sign. This coefficient was statistically insignificant. This indicates that an increase in 1% of insecticides cost, remaining other factors constant, would result in an increase in the gross return by 0.02%.

Coefficient of Multiple Determinations (R^2)

It is evident from Table 4 that the value of the coefficient of multiple determinations (R^2) was 0.632. It indicated that about 63% of the variations of the gross return are explained by the explanatory variable included in the model.

Goodness of Fit (F-value)

The F-value (11.797) of the estimated production function was significant at 1% probability level (Table 4), which implies good fit of the model. That is, all the explanatory variables included in the model were important for explaining the variation of cauliflower production.

Returns to Scale ($\sum\beta_i$)

The summation of all the regression coefficient of the estimated production function of cauliflower was 1.19. This implies that the production function exhibited increasing returns to scale. In this case, if all the variables specified in the production function were increased by 1%, gross return on an average would increase by 1.19% (Table 4).

Conclusion and Recommendations

The study concludes that cauliflower production is highly profitable in the study areas. It is experienced that involvement with cauliflower production created ample scope to increase

income, employment and nutritional status of farmers; ameliorate the problem of gender issue by enabling the women to participate in the household decision making in rural areas. The study reveals that human labor, seed cost and fertilizers cost had significant impact on cauliflower production. Considering the findings of the study, some essential policy recommendations have been arisen which are: input and price support, and motivation and training programmed should be arranged by different government and non-government organizations; and public-private partnership should be emphasized for creating scope to improve the overall economic condition of the farmers through homestead vegetable farming.

References

1. BBS (2016). Statistical Yearbook of Bangladesh, Bangladesh Bureau of Statistics, Statistics Division, Ministry of Planning, Government of the People's Republic of Bangladesh, Dhaka.
2. BBS (2018). Statistical Yearbook of Bangladesh, Bangladesh Bureau of Statistics, Statistics Division, Ministry of Planning, Government of the People's Republic of Bangladesh, Dhaka.
3. Dillon J L and Hardaker J B. (1993). Farm management research for small farmer development, FAO, Rome.
4. FAO (2013). Production Yearbook. Food and Agricultural Organization of the United Nations, Rome. Italy Mitra, S., & Yunus, M. (2018). Determinants of tomato farmer's efficiency in Mymensingh district of Bangladesh: Data Envelopment Analysis approach. Journal Bangladesh Agricultural University, 16(1), 93-97.
5. MoF (2018). Bangladesh Economic Review, Economic Advisory Section, Department of Finance, Ministry of Finance, Bangladesh.
6. MoF (2019). Bangladesh Economic Review, Economic Adviser's Wing Finance Division, Ministry of Finance, Government of People's Republic Bangladesh.
7. Report on Labour Force Survey (LFS) 2016-17 (PDF). p. 173. ISBN 978-984-519-110-4. Retrieved 26 July 2018.

8. Sharmin, S., Rashid, M. H. Ar., Begum, R., & Hoque, S.S. (2018). Relative profitability of farming systems research and development (FSRD) project farmers and non-project farmers of integrated farming systems in Tangail district of Bangladesh. *Journal of Bangladesh Agricultural University*, 16(1), 117–122.
<https://doi.org/10.3329/jbau.v16i1.36492>
9. Sharmin, S. (2015). Relative profitability and resource use efficiency of participatory and non-participatory farmers of integrated FSRD project in Tangail district. M.S. Thesis. Department of Agricultural Economics, Bangladesh Agricultural University, Mymensingh.
10. Team, S.O.F.A., & Doss, C. (2011). The role of women in agriculture. Agricultural development economics division. Food and Agricultural Organisation of the United Nations. working paper 11: 02.
11. Weinberger, K., & Genova II, C.A. (2005). Vegetable production in Bangladesh: commercialization and rural livelihoods. AVRDC-World Vegetable Center.
12. World Bank (2019). "Population, total". World Bank. Retrieved 19 August 2019.