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A Comparative Economic Analysis of Bitter Gourd and Snake Gourd Production in Some Selected Areas of Mymensingh District

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Abstract

The study attempts to examine the costs, returns and relative profitability of bitter gourd and snake gourd production and socio-economic characteristics of sample farmers in two selected villages of Mymensingh district. Two villages namely Noudar and Solimpur under Trishal upazila in Mymensing district. Data were collected from the study areas by direct interview method. The duration of data collection was June 2024 to May 2025. Total 100 sample farmers from two villages were selected by multi-stage random sampling method. Collected data were processed and analyzed. Both tabular and statistical techniques were used. In this study, Regression analysis, STATA software was used for the results. In the study Cobb-Douglas production function model was used. Secondary data were also used in the study. The major findings of the study are: i) farmers of Noudar received higher gross and net returns than those of Solimpur, ii) benefit-cost ratio of bitter gourd farming was 1.82 and it was 1.34 for snake gourd farming. Bitter gourd production was profitable compared to Snake gourd, iii) years of schooling in Noudar was 5.9 and it was 4.5 in Solimpur. For bitter gourd farming, the co-efficient of multiple determinations R^2 was 0.98 and F-value was 237.42. F-value of the estimated production function was significant at 1% probability level which implied good fit of the model. The co-efficient of multiple determinations R^2 was .86 and F-value was 20.79. The F- value was significant at 1% probability level which implied good fit of the model. However, the production of bitter gourd and snake gourd vegetables were profitable in the study areas. Measures should be taken to ensure easy availability of chemicals fertilizers and other essential agricultural inputs to the farmers.

Keywords: Production, Economic analysis, Profitability, Farmers, Agriculture, Bitter gourd, and Snake gourd.

1. Introduction

The economy of Bangladesh is predominantly agrarian. Agricultural sector accounts for 11.00 percent of gross domestic product (GOB, 2020). The performance of this sector has impacted on macro-economic objectives of our country like food security, income earning, employment generation and poverty reduction. The sector remains the major sector in terms of livelihood and employment in Bangladesh (BBS 2022). It may be noted that, Bangladesh is a densely populated country. Now Bangladesh has population

density of 1115.62 people per square kilometer in 2023 (Ullah, 2022; GOB. 2023).

Higher pressure of population on limited land is a vital constraint to promote economic development. Many people live on the verge of starvation or suffering from food deficiency. To meet the food requirements of the growing population of the country the production of rice will not be sufficient to meet the deficiency of food. As a result, alternative sources of food are explored. In Bangladesh vegetables are also used as food. Vegetables production plays a vital role for economic development of the country. Vegetables contain protein, vitamin, mineral and iron etc. Increased production of vegetables can help to solve the problems of malnutrition to a great extent. Government of Bangladesh has given enormous emphasis for the production of vegetables. Government also take steps to increase the production of vegetables to a large extend in the country. In Bangladesh, vegetables are cultivated in 9,31,000 acres of land and annual production of vegetables is 293000 metric tons (BBS,2013). Bitter gourd and snake gourd are the popular vegetables in Bangladesh. The production of bitter gourd and snake gourd vegetables has been increasing day by day in the country. The adequate supply of bitter gourd and snake gourd stabilizing the vegetables market. Bitter gourd and snake gourd vegetables are produced extensively in Bangladesh. It is evident from the available data that total product of bitter gourd in the country was about 83093.27 metric tons in 2022-23 and it was cultivated in 29044.51 acres of land areas in 2022-23. On the other hand, total production of snake gourd was nearly 51910.40 metric tons in 2022-23 and cultivated in 19796.61 acres in 2022-23 (BBS 2023). Commercial production of Bitter gourd and snake gourd are getting momentum in rural Bangladesh. Farmers of Bangladesh are coming forward to undertake this venture (Lutfunneher, 2023).

Over the last few years remarkable improvement has been achieved in the production of bitter gourd and snake gourd vegetables. It may be noted that, bitter gourd is a good source of vitamin, mineral, soluble fiber, iron. It contains carbohydrate, calcium, phosphorus, protein (Mila *et al.,* 2015). On the other hand, snake gourd contains many vitamin, nutrient, iron and mineral which are essential for human health. In terms of vitamin, snake gourd contains vitamin A (9.8)%, vitamin B-6(11.3%), vitamin C (30.5%), Iron (5.7%), as well as calcium (5.1%), Iron (5.7%), magnesium (6-7%) (Shilpa Mathew *et al.,* 2019; Lutfunneher and Mim, 2021). Due to diversified uses demand for bitter gourd and snake gourd vegetables are increasing in Bangladesh. The climate and soil conditions of Bangladesh are favorable for bitter gourd and snake gourd production. But research studies on this line are not sufficient. Very little economic investigation for bitter gourd and snake gourd vegetables production has so far been undertaken by different researchers. Keeping this in view, the present study is, therefore, undertaken to analyze the socio-economic characteristics of farm households and to compare the relative profitability of bitter gourd and snake gourd production in selected areas of Mymensingh district.

2. Review of Literature

Here a modest attempt has been made to review the previous research works. Shewli, (1993) observed that per hectare net returns for white gourd and snake gourd vegetables production were tk.1,10,466 and tk. 52,922 respectively. She also estimated that white gourd vegetables production was more profitable than snake gourd.

Hasan, (2005) pointed out that export quality of fresh vegetables was significantly affected by price. He also estimated that per hectare gross margin for contract French bean, bitter gourd and okra vegetables production were tk.181548, tk.261395 and tk.95057, but it was tk.88070, tk.112053, tk.18522 for non-contract French bean, bitter gourd and okra production respectively.

Suriya, (2008) found that per hectare net returns for cucumber, okra, white gourd and snake gourd vegetables were tk.934,52, tk. 70,380, tk.96,896 and tk. 58843 respectively. She also stated that, all the selected summer vegetables production in her study areas were profitable. She further pointed out that farmers received highest profit from white gourd vegetables production. M. N. Islam, (2012) conducted a study on summer vegetables production in Trishal Upazila at Mymensingh District. He observed that

bitter gourd production was relatively more profitable than those of brinjal and cucumber production.

Shilpa *et al.* (2019) estimated that snake gourd vegetables production was a profitable enterprise. They also stated that benefit -cost ratio of snake gourd was 1.51. they further pointed out that the MVP(marginal value product) to MFC(marginal factor cost) ratio was more than one which indicated that the snake gourd vegetables had further advantages for increasing the output under given conditions of the production. Mila *et al.* (2015) conducted a study on the production of bitter gourd vegetables in some selected areas of Narshingdhi district. They estimated that average yield of bitter gourd vegetables was found to be 27.5 tons per hectare. Average gross return per hectare was tk.5,50,000. While net return was tk. 2,43,190. per hectare and benefit - cost ratio of bitter gourd was found to be 1.79. They also estimated that human labour, urea, tsp, cow dung and irrigation had positive and significant effect on the yield bitter gourd vegetables production.

Harshit Mishra *et al.* (2017) found that in their study areas bitter gourd vegetables production was profitable in comparison to cucumber. They also indicated that a marginal farm was shown to be more profitable than small and medium farms. Benefit- cost ratio of bitter gourd was 1.37 and it was 1.21 for cucumber. Kshirsagor *et al.* (2017) observed that per hectare gross return and net return were tk. 258468 and tk. 87581 respectively. They pointed out that the snake gourd vegetables production was profitable. They also stated that the intensive use of labour and irrigation water had positive impact on snake gourd production. They found that the co-efficient of multiple multiple determination (R^2) was 91 percent, which indicated that 91% of variation of the dependent variable were explained by the included independent variables for snake gourd production. The above review of literatures reveals that research studies on this line are not sufficient. Very little economic investigations are undertaken by the researchers. Keeping this in view, the study is therefore; undertake to analyze the socio-economic characteristics of farm households and to compare the relative profitability of bitter gourd and snake gourd production in selected areas of Mymensingh district.

Bitter gourd and Snake gourd are considered particularly important vegetables due to their rich nutritional profiles and potentials medicinal properties, offering benefits beyond many other common vegetables. While other vegetables offer their own unique nutritional advantages, bitter gourd and snake gourd stand out due to their potent combination of vitamins, minerals, and antioxidants, along with their traditional uses in managing various conditions. From literature review, it was clear that, there were many studies on potato, brinjal, cucumber, okra, and white gourd vegetables but there were no comparative economic analysis between bitter gourd and snake gourd vegetables has so far been taken. For this reason, we have undertaken to analyze the economic importance of bitter gourd and snake gourd comparatively.

Objectives of the Study

The main objective of the study was to investigate the relative profitability of bitter gourd and snake gourd vegetables production. However, the specific objectives of the study are:

1) To determine the socio-economic characteristics of sample farmers.
2) To examine the costs, returns and the relative profitability of bitter gourd and snake gourd production.
3) To investigate the factors affecting the productivity of bitter gourd and snake gourd production.
4) To identify the major constraints of bitter gourd and snake gourd production.
5) To suggest some policy guidelines.

Justification of the Study

The findings of the study may help the policy makers in making decisions regarding the yield, output, profitability and cost of bitter gourd and snake gourd production. Farmers, extension workers may utilize the findings of the study in making decisions regarding bitter gourd and snake gourd production. The results of the study may also help the planners in making decision regarding the yield, returns, and cost of production and marketing. The result will be helpful to the researchers for further studies in similar nature. The findings of the study has also academic impor-

tance to the students and the teachers of social sciences.

Plan of the Study

The study consists of six sections. Section-1 describes introduction of the study. Section - 2 deals with the methodology of the study. The results and interpretations of the study are presented in section-3. Section - 4 is designed to identify the different problems of farmers of the study areas. Policy implications are presented in section-5. Conclusion is presented in section-6.

3. Methodology

The present study was based on mainly primary data. The primary data were collected from different farmers. Two samples Upazila of mymensingh district were selected purposively for this purpose and two sample villages namely Noudar and Solimpur in Mymensingh district were selected by using multi-stage random sampling method. The Noudar village is situated within 20 kilometers from Mymensingh town and Solimpur village is situated within 20 kilometers and a half from Mymensingh town. Two villages border each other. Two villages have homogenous physiographic conditions.

The reasons for choosing the areas were: i) the areas are easily accessible, ii) the university in which the researcher work is located nears the areas, iii) the researcher has good knowledge about the areas. After selecting the study areas a list of households was prepared. In Noudar village, the list included 53 farm households but in Solimpur village the list included 47 farm households. This total 100 farm households from the two villages was selected by simple random sampling technique. An interview schedule was used for data collection. Data were collected by direct interview method. Due to time and resource constraint only bitter gourd and snake gourd vegetables were studied. The duration of data collection was June 2024 to May 2025.

Collected data have processed and some statistical techniques were used. Regression analysis and Stata software also used for calculation of the result. Cobb-Douglas production function was also used in the study. In case of necessary, secondary data were collected from different official and non-official documents.

4. Results and Discussion

Socio-economic Characteristics of the Farm Households

Table 1: Socio-economic Characteristics of Sample Farmers.

Items	Noudar village	Solimpur village
1. Average family size of farmers (persons)	5.92	6.28
2. (a) Male population (percent).	55	52
(b) Female population (percent)	45	45
3. Average age of farmers(years)	45	48
4. Average education of farmers (years of schooling)	5.90	4.50
5. Occupational status	55	53
(i) Agriculture (percent)		
(ii) Agriculture and other activities (percent)	45	47
(iii) Average size of land (acre)	2.20	2.15

Socio-economic characteristics of the farm households are the important things in making production planning. The socio-economic characteristics of the farm families influence their production pattern and technology use. In this study, a number of socio-economic aspects of sample households were examined. These were composition of family size, age distribution, educational status, occupation and farm size.

Size and Composition of Farm Families

It is evident from the table 1 that the average size of farm families in Noudar village was 5.92 persons, while, the average size of farm families in Solimpur

village was 6.28 persons. These figures are higher than that of the national average (about 5.6 per household is the national average). Out of 53 respondents in Noudar village about 55 percent were males and 45 percent were females. Out of 47 respondents in Solimpur village only 52 percent were males and 45 percent were females. It clearly indicates that, the dominance of males in bitter gourd and snake gourd vegetables farming in the study areas.

Average Age of the Farm Households

It is evident from table 1 that the average age of farm household was about 45 years in Noudar village. But, in Solimpur it was nearly 48 years (**Table 1**).

Educational Status of the Farmers

Educational status of the farmers can play a vital role in efficient farm management and cultural practices. An average year of schooling was about 5.9 years in Noudar village. On the other hand, it was only 4.50 years in Solimpur village (**Table 1**)

Occupational Status of Farmers

Occupation means a person's profession. Occupation is the important socio-economic component. In the study areas the respondents were engaged in different types of occupation. Agriculture is the vital source of employment in the study areas, besides agriculture, some were engaged in business, rickshaw pulling and van pulling etc. It is shown in table-1 that, of the 53 households in Noudar village only 55 percent of the respondents were pure agriculturists. While only 45 percent of the respondents were engaged in agriculture and other activities. On the other hand, of the 47 households in Solimpur village 53 percent of the respondents were pure agriculturists. But, only 47% of the respondents were engaged in agriculture and other activities.

Average Size of Land Area

It can be seen from table 1 that the average size of the land area of farmers in Noudar village was 2.20 acres, while, the average size of the land area of farmers of Solimpur was only 2.15 acres.

Estimation of Costs, Returns, And Relative Profitability of Bitter Gourd and Snake gourd Production

Estimation of Costs of Bitter Gourd and Snake gourd Production

Table 2: Per Acre Costs and Returns of Bitter Gourd: Village Noudar.

Particulars	Quantity	Price per unit (tk)	Total product value (tk.)	Percentage of total cost (%)
A. Gross return	14553 (kg)	60.55	873202.4	-
B. Total cost	_	_	478300	-
1. Seed	1kg		5181.62	1.08
2. Trellis cost			323675.9	37
3. Power tiller	_	_	3038.385	.63
4. Irrigation	_	_	4771.31	.99
5. Laboure	73 man-days		118598.7	24.79
6. Total fertilizer	_	_	15137.86	3.16
7. Fencing	_	_	1956.389	.40
8. Land preparation	_	_	2711.119	.56
C. Net return			394902.4	
D. Benefit cost ratio (Undiscounted)			1.82	

Table 3: Per Acre Cost and Returns of Snake Gourd: Village Solimpur.

Particulars	Quantity	Price per unit (tk)	Total product value (tk.)	Percentage of total cost (%)
A. Gross return	13649kg	55	750720.1	-
B. Total cost	_	_	556115.5	-
1. Seed/seedlings	1kg		5578.663	1.90

2. Trellis cost			367903	49
2. Power tiller	_	_	5845.574	1.06
3. Irrigation	_	_	7205.24	1.30
4. Laboure	96 man-days		134799.1	24.50
5. Total fertilizer	148kg		19601.03	3.56
6. Fencing	_	_	14291.41	2.59
7. Land preparation	_	_	6014.29	1.09
C. Net return			194604.6	
D. Benefit cost ratio (Undiscounted)			1.34	

Costs of Seeds/Seedlings

In the study areas, farmers used purchased seeds. In case of bitter gourd production per acre cost of seeds/seedlings was only tk.5181.62 in Noudar village which constituted 1.08 percent of gross cost. On the other hand, per acre cost of seeds/seedlings of Snake gourd production was tk.5578.663 in Solimpur village, which shared 1.90 percent of gross cost (**Table 2** and **3**).

Cost of Power Tiller

In the study areas power tiller was widely used by the farmers. For bitter gourd production in Noudar village, per acre cost of power tiller utilization was about tk. 3038.385 which occupied .63percent of gross cost (table 2). On the other hand, per acre cost of power tiller utilization for producing snake gourd in Solimpur village was tk.5845.574 which constituted only 1.06 percent of the gross cost (**Table 3**).

Cost of Total Fertilizers

For bitter gourd production, per acre cost of total fertilizers was tk.15137.86 in Noudar which represented 3.16 percent of the total cost (**Table 2**). On the other hand, per acre cost of total fertilizers for producing Snake gourd was tk. 19601.03 in Solimpur which shared 3.56 percent of the total cost (**Table 3**).

Cost of Irrigation

Per acre cost of irrigation water was tk.4771.31 for bitter gourd production in Noudar which occupied 0.99 percent of the total cost. For producing Snake gourd per acre cost of irrigation was tk. 7205.24 in Solimpur which shared 1.30 percent of the total cost (**Table 2** and **3**).

Cost of Human Labour

Human labour constitutes the major input in the production process. It is observed from the **Table 2** that in Noudar village per acre labour cost for bitter gourd production was tk.118598.7 which shared 24.79 percent of the gross cost. For producing Snake gourd per acre cost of labour was tk. 134799.1 in Solimpur village which occupied 24.50 percent of the gross cost (**Table 2** and **Table 3**).

Cost of Fencing

Per acre cost of fencing for bitter gourd vegetables in Noudar village was tk.1956.389 which occupied .40 percent of gross cost, While, per acre cost of fencing for snake gourd was tk.14291.41 in Solimpur village which occupied 2.59 percent of the gross cost (**Table 2** and **3**).

Trellis Cost

Per acre cost of trellis for bitter gourd vegetables in Noudar village was tk.323675.9 which occupied 37 percent of gross cost, While, per acre cost of trellis for snake gourd was tk.367903.9 in Solimpur village which occupied 49 percent of the gross cost (**Table 2** and **3**).

Cost of Land Preparation

Per acre cost of land preparation for bitter gourd vegetables in Noudar village was tk.2711.119 which represented .56 percent of the gross cost. Whereas, per acre cost of land preparation for snake gourd in Solimpur village was Tk. 6014.29 which was 1.09 percent of the gross cost (**Table 2** and **Table 3**).

Table 4: Profitability of bitter gourd and snake gourd production.

Particulars	Noudar village (Bittle gourd)	Solimpur village (Snake gourd)
A. Per Acre Gross Return (tk)	873202.4	750720.1

B. Per Acre Total Cost (tk)	478300	556115.5
C. Per Acre Net Return (tk)	394902.4	194604.6
D. Benefit-cost (undiscounted)	1.82	1.34

Gross Cost

In the study areas gross cost was calculated by adding all the variable cost and fixed cost. In Noudar village per acre gross cost of bitter gourd production was tk.478300. While, per acre gross cost of Snake gourd production was tk.556115.5 in Solimpur village (**Table 2**, **Table 3**, and **Table 4**)

Gross Return

Gross return was calculated by multiplying the amount of total product by the prevailing market price. In Noudar per acre gross return achieved from bitter gourd production was tk. 873202.4. On the other hand, while, per acre gross return earned from snake gourd production was tk.750720.1 in Solimpur village (**Table 3** and **Table 4**).

Net Return

Net return was estimated by subtracting gross cost from gross return. In Noudar village farmers received per acre net return from bittter gourd production was tk.394902.4. While, the farmers of Solimpur village received per acre net return from snake gourd production was tk.194604.6 (**Table 2**, **Table 3** and **Table 4**).

Benefit- Cost Ratio (Undiscounted)

Benefit - cost ratio (undiscounted) was estimated by dividing gross return by gross cost. Per acre benefit-cost ratio (undiscounted) for bitter gourd vegetables in Noudar was 1.82 while, in Solimpur it was only 1.34 for Snake gourd vegetables (**Table 2**, **Table 3** and **Table 4**)

Profitability of Bitter Gourd and Snake Gourd Production

It is evident from the discussion made above, that the farmers of Noudar village received higher gross and net returns than those of Solimpur village. Farmers of Noudar village earned per acre gross and net returns were tk. 873202.4 and tk.394902.4 respectively. While the farmers of Solimpur village earned per acre gross and net returns were tk.750720.1 and tk. 194604.6 respectively. It is also evident from the discussion that, in the study areas the major costs were incurred for trellis and human labour cost for bitter gourd and snake gourd production in Noudar and Solimpur villages. It may be noted that, benefit-cost ratio of bitter gourd production was found to be higher in Noudar village compared to snake gourd vegetables production of Solimpur village. The undiscounted benefit-cost ratio of bitter gourd and snake gourd production were 1.82 and 1.34 respectively (table 4). It indicates that tk.1.82 would be earned by investing every tk. 1.00 in bitter gourd production. While tk.1.34 would be earned by investing every tk 1.00 for snake gourd production. This findings is also indicating that, investment of resources in bitter gourd and snake gourd production in both the study areas are highly remunerative for the farmers. Thus, it is clear that, bitter gourd and snake gourd production were profitable in the study areas. It is evident that gross and net returns of bitter gourd vegetables production are found to be higher than those of snake gourd production in the study areas (**Table 4**).

Factors Affecting the Productivity of Bitter Gourd and Snake Gourd Vegetables

Discussion of Regression Results

In the study**,** Cobb-Douglas production function was used because of the best fit of the sample data. The following specification was made for the Cobb-Douglas model.

$$Y = aX_1^{b1}X_2^{b2}X_3^{b3}X_4^{b4}X_5^{b5}X_6^{b6}X_7^{b7}X_8^{b8}\ ui$$

The log linear form of the Cobb-Douglas production function be:

$$\ln Y = \ln a + b_1\ln X_1 + b_2\ln X_2 + b_3\ln X_3 + b_4\ln X_4 + b_5\ln X_5 + b_6\ln X_6 + b_7\ln X_7 + b_8\ln X_8 + ui$$

Where, Y = Dependent variable = Average Total Production in tk (Goss return)

a=Constant/ bench mark category

X_1= Land size (per acre).

X_2 = Seed/Seedlings cost per acre.

X_3 = Irrigation cost per acre.

X_4 = Trellis cost.

X_5= Power tiller cost.

X_6 = Medicine cost per acre.

X_7= Total fertilizers cost per acre.

X_8 = Labour cost per acre.
Ln = Lagaritham , u_i= Error term.
$b_1, b_2, \ldots . b_x$ Regression coefficient

The estimated Cobb-Douglas production function for Bitter Gourd Production was

$\ln Y = -100222.09+787050.7\ln X_1+.3126063\ln X_2 - 9.400962\ln X_3+.70017781\ln X_4 -9.217417\ln X_5 +2.07722\ln X_6$
$-.4942843\ln X_7+ 3.205541\ln X_8$
Se = (22618.47) (99924.6) (.1752547) (10.16474) (.4068302) (4.012501) (1.231514) (6.369378) (3.064397)
t= (-0.44)*** (7.88)* (1.78)** (-0.92) (1.72)** (-2.30)* (2.60)* (-0.08)*** (-0.18)***
R^2=.9891
Where '*" indicates the less than 5% significance level, "**'indicates significant at more than 5% significance level and ***" indicates more than 10% significance level.

Interpretation of the Estimated Values of Bitter Gourd Production: Noudar Village

The estimated values of the regression co-efficient and related statistics of the production function are presented in section 3.5.1.

Land Size

The magnitude of the regression coefficient of land size was 787050.7 with a positive sign. It implies that on a 1% increase of land size cost, keeping other factors remaining constant, would lead to an increase of total return by 787050 percent. The estimated magnitude for the land size is statistically significant as its p-value is low and its t-value is quite high.

Seed/Seedlings Cost

The magnitude of the regression coefficient of seedlings cost was .3126063 with a positive sign. It implies that on a 1% (Percent) increase of seed/ seedlings cost, other factors remaining constant would lead to an increase of gross return by 31.26 percent. The estimated magnitude for the regression coefficient of seedlings cost is not statistically significant as its p-value is quite high and t-value is low.

Power Tiller Cost

The magnitude of the regression coefficient of power tiller cost was-9.400962 with a negative sign. It indicates that on an 1% (percent) increase of power tiller cost, other things remaining the same would lead to a decrease of the gross return by -9.400962 percent. The estimated magnitude for the regression coefficient of power tiller cost is not statistically significant.

Irrigation Cost

The magnitude of the regression coefficient of irrigation cost was .7001778 with a positive sign. It indicates that on a 1% (percent) increase of irrigation cost, other things remaining the same would lead to an increase of the gross return by 70.01778 percent. The estimated magnitude for the regression coefficient of irrigation cost is not statistically significant as it's p-value is high and it's t-value is quite low.

Labour Cost

The magnitude of the regression coefficient of labour cost was -9.217417 with a negative sign. It implies that on a 1% (percent) increase of labour cost, keeping other factors remaining constant would lead to a decrease of gross return by -9.217417 percent. The estimated magnitude for the regression coefficient of labour cost is statistically significant as its p-value is very low and its t-value is very high.

Total Fertilizer

The magnitude of the regression coefficient of total fertilizers cost was 2.07722 with a positive sign. It implies that on a 1% increase of total fertilizer cost, other factors remaining constant would lead to an increase of gross return by 2.07722 percent. This magnitude for the regression coefficient of total fertilizers cost is not statistically significant because its p-value is quite high and t-value is low.

Trellis cost

The magnitude of the regression coefficient of trellis cost was 3.25541 with a positive sign. It implies that on a 1% increase of trellis cost, other factors remaining constant would lead to an increase of gross return by 3.25541 percent. This magnitude for the regression coefficient of trellis cost is statistically significant because its p-value is quite low and t-value is high.

Medicine cost

The magnitude of the regression coefficient of medicine cost was -.4942843 with a positive sign. This

implies that on a 1% increase of medicine cost, other factors remaining constant would lead to a decrease of gross return by - 49.42 percent. This magnitude for the regression coefficient of medicine cost is not statistically significant as its p-value is high and its t-value is low.

Co-efficient of Multiple Determination (R^2)

It is evident from the table that the value of co-efficient of multiple determination (R^2) was.9891 for bitter gourd production. It indicates that about 98% (percent) of the variation of the gross return were explained by the explanatory variables included in the model.

The F-value

The F-value was 237.42for bitter gourd production. The F-value of the equation is significant at one percent probability level. It implies good fit of the model. That is, all the explanatory variables included in the model were important for explaining the variations of bitter gourd production

The estimated Cobb-Douglas production function for snake gourd production was

$\ln Y=18331.47–77.6201\ln X_1+2.601301\ln X_2 +2.390934\ln X_3+.47042\ln X_4+4.210134\ln X_5 +6.019708\ln X_6 +8.618528\ln X_7$

Se= (93835.6) (45.4113) (.8269) (1.0313) (32.9298) (14.366) (6.4635) (6.7590)

t= (0.20)*** (1.71)* * (3.15)* (2.32)* (0.01)*** (0.29)*** (0.93)*** (1.28)** (0.79) ***

$R^2 = 96\%$

Where '*" indicates the 1% significance level.

"**" indicates 5% significance level.

"*" indicates 10% significant level.

Interpretation of the Estimated Values of Snake Gourd Production: Solimpur Village

The estimated values of the regression co-efficient and related statistics of the production function are presented in section 3.6.1.

Seedlings cost

The magnitude of the regression coefficient of seed-lings cost was -77.6201 with a negative sign. It implies that on a 1% increase of seedlings cost, keeping other factors remaining constant, would lead to a decrease of total return by 77 percent. The estimated magnitude for the seed cost is not statistically significant.

Trellis Cost

The magnitude of the regression coefficient of seed cost was 2.6013 with a positive sign. It implies that on a 1% (Percent) increase of trellis cost, other factors remaining constant would lead to an increase of gross return by 2.6 percent. The estimated magnitude for the regression coefficient of trellis cost is statistically significant at 1% probability level.

Labour Cost

The magnitude of the regression coefficient of cost was 2.3909 with a positive sign. It indicates that on an 1% (percent) increase of labour cost, other things remaining the same would lead to a increase of the gross return by 2.39percent. The estimated magnitude for the regression coefficient of labour cost is statistically significant as its p-value is low and its t-value is quite high.

Irrigation Cost

The magnitude of the regression coefficient of irrigation cost was .3472with a positive sign. It indicates that on a 1% (percent) increase of irrigation cost, other things remaining the same would lead to increase of the gross return by 34 percent. The estimated magnitude for the regression coefficient of irrigation cost is statistically significant as its p-value is low and its t-value is quite high (**Table**). The possible cause of this negative sign might be the irrational use of irrigation water for different activities of cultivation of snake gourd.

Power tiller Cost

The magnitude of the regression coefficient of power tiller cost was 4.2101 with a positive sign. It implies that on a 1% (percent) increase of power tiller cost, keeping other factors remaining constant would lead to an increase of gross return by 4.21 percent. The estimated magnitude for the regression coefficient of power tiller cost is not statistically significant as it's p-value is very high and it's t-value is very low.

Medicine cost

The magnitude of the regression coefficient of medicine cost was 6.09with a positive sign. It implies that on a 1% increase of medicine cost, other factors

remaining constant would lead to a increase of gross return by .099 percent. This magnitude for the regression coefficient of medicine cost is not statistically significant because its p-value is quite high and t-value is low.

Total fertilizers cost

The magnitude of the regression coefficient of Total fertilizer cost was 8.61with a positive sign. This implies that on a 1% increase in total fertilizer cost, other factors remaining constant would lead to an increase in gross return by 8.61 percent. This magnitude for the regression coefficient of total fertilizers cost is not statistically significant as its p-value is high and its t-value is quite low.

Co-efficient of Multiple Determination (R^2)

It is evident from the above that the value of co-efficient of multiple determination (R^2) was .86 for snake gourd production. It indicates that about 86% (percent) of the variation of the gross return were explained by the explanatory variables included in the model.

The F-value

The F-value was 20.79 for snake gourd production. The F-value of the equation is significant at one percent probability level. It implies good fit of the model. That is, all the explanatory variables included in the model were important for explaining the variations of snake gourd production.

Problems Faced by the Farmers of the Study Areas

Farmers of the study areas faced different problems in producing snake gourd and bitter gourd vegetables. Some of the major problems are discussed here.

Table 5: Problems Faced by the Sample Farmers.

Particulars	Noudar Village Percentage of farmers Reported	Solimpur Village Percentage of farmers reported
1. Lack of Capital	54	57
2. High price of chemical fertilizers	45	48
3. Inadequate supply of good quality of seed/seedlings	71	73
4. Lack of storage Facilities	24	26
5. Lack of marketing facilities	30	31

Lack of Capital

Lack of sufficient capital was the vital problem of the farmers. Only 54 percent of the farmers of Nouder village and 57 percent of the farmers of Solimpur village were reported that they suffered due to lack of capital. Due to lack of capital many farmers of the study areas could not produce bitter gourd and snake gourd in large scale in their land (**Table 5**).

High Price of Chemical Fertilizers

High price of chemical fertilizers was the major problem for the farmers. About 45 percent of the farmers of Noudar village and about 48 percent of the farmers of the Solimpur village were reported that the high prices of chemical fertilizers were the vital problem for the farmers of the study areas (**Table 5**). Moreover, they did not get chemical fertilizers in time of need.

Inadequate Supply of Good quality of Seeds/ Seedlings

In the study areas farmers used purchased seeds, which was not good quality. About 73 percent of the farmers claimed that in the open market, the supply of good quality seeds was not available in time of need (**Table 5**).

Lack of Storage Facilities

Lack of storage facilities was a vital problem in the study areas. Only 24 percent of the farmers of Noudar village reported that the storage facilities were not sufficient. Only 26 percent farmers of Solimpur village reported that the storage facilities were not sufficient (**Table 5**).

Lack of Marketing Facilities

Lack of marketing facilities was also a vital problem in the study areas. About 30 percent of the sample farmers of Noudar reported that the marketing

facilities were not sufficient for them. About 31 percent farmers of Solimpur reported that marketing facilities were not sufficient for them (**Table 5**).

Suggestions for Policy Implications

On the basis of the findings of the study, it is evident that the bitter gourd and snake gourd production are profitable enterprises. Therefore, the following recommendations are made on the basis of the objectives and findings of the study.

- The findings of the study reveal that bitter gourd and snake gourd production are profitable business. Measures should be taken to increase the productivity of bitter gourd and snake gourd.
- Lack of capital is a great problem for the poor farmers. The commercial banks should be encouraged to provide loans at a lower interest rate to enable farmers to operate their farming on commercial basis
- Measure should be taken to ensure easy availability of chemical fertilizers and other input to the farmers. As a result, the growers are willing to invest more in bitter gourd and snake gourd production.
- Establishment of cold storage and food processing industries at the bitter gourd and snake gourd growing areas can be helped to the farmers to preserve and process bitter gourd and snake gourd vegetables during pick period
- Irrigation water is essential for the cultivation of these vegetables. So adequate measures should be taken to improve irrigation water management.
- Policy makers and extension workers should take necessary steps to encourage farmers to produce more bitter gourd and snake gourd.

5. Conclusion

Bitter gourd and snake gourd sub-sector plays a vital role for the development of our country. It is observed that, the bitter gourd and snake gourd production are a profitable business. It is found that the farmers of Noudar village received higher gross and net returns than those of Solimpur village. In the study areas major costs were incurred for Trellis cost and human labour. Moreover the benefit-cost ratio (undiscounted) of bitter gourd production was found to be higher than that of snake gourd production. Farmers of Noudar village earned per acre gross and net returns were tk. 873202.4 and tk.394902.4 respectively while farmers of Solimpur village received per acre gross and net return were tk.750720.1 and tk.194604.5 respectively. For bitter gourd production in Noudar, regression co-efficients of Trellis cost, land size and labour cost was statistically significant. Regression co-efficient of seedlings, powertiller cost, medicine cost, and irrigation cost were not significant. In Noudar for bitter gourd farming the co-efficient of multiple determinations R^2 was 0.98. F-value was 237.42. The F-value of the estimated production function was significant at 1% probability level which implied good fit of the model. In Solimpur for snake gourd farming the regression co-efficient of seeds/seedlings, total fertilizer, irrigation cost was not significant. The co-efficient of multiple determinations R^2 was .86 and F-value was 20.79. The F-value of the estimated production function for Snake gourd farming was significant at 1% probability level which implied good fit of the model. On the basis of the discussion, it could be concluded that the production of the bitter gourd and snake gourd were profitable in the study areas. Bitter gourd and snake gourd farming would help the growers to increase their income earnings. Measures should be taken to ensure easy availability of chemicals fertilizers and other essential agricultural inputs to the farmers. Policy makers should take necessary steps to encourage the growers to produce more bitter gourd and snake gourd vegetables.

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7. Conflicts of Interest

No conflict of interest at the author ends.

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