Original Research Article

Gross Margin Cost and Returns and Factor Analysis of Watermelon Production in Patuakhali District, Bangladesh

ABSTRACT

This study examined the profitability and factor productivity of watermelon production in Patuakhali district, Bangladesh. A multi-stage stratified sampling design had been used for the selection of the watermelon growing farmers. Data were obtained with the aid of a pre tested structured questionnaire. The socio-economic characteristics of the respondents was described and categorized by Descriptive statistics, Gross margin analysis was used to analyze the cost and returns to watermelon production and Cobb Douglas production function was used to evaluate the input factor productivity. Results showed that the farmers are relatively middle aged with average age of about 41 years with a sizable number of the respondents (1.7%) having passed through tertiary education. It was also observed that the farmers are typically smallholders with average farm size of 50-249 decimal. The result of the gross margin analysis showed that watermelon production is profitable with a gross margin of Tk 756.243 per decimal. The result of the Cobb Douglas production function shows that the coefficients of cost of seed (0.137), cost of tillage (0.227), cost of irrigation (0.304), cost of labour (0.156), and cost of pesticide (0.305) were positively significant at 5% and 1%. The overall factor productivity index is 1.19 implying an increasing return to scale in water melon production in the study area. However, lack of irrigation facility and pesticide were identified as major production constraints.

Keywords: Profitability, Factor Productivity, Gross Margin, Cobb Douglas Function, Smallholders, Return to Scale

1. INTRODUCTION

One of the common characteristics of developing countries is the large share of agriculture in their economies (Boyce, 1985). Being an under developed country, Bangladesh is facing numerous economic problems. Agriculture is the main source of livelihoods of the rural people, which consists of 75.4 % of the total population in Bangladesh, and agriculture contributes 21.10 % of the GDP. (BBS 2011) The economic development of Bangladesh is still synonymous with Agricultural development. There can hardly be any rural or national development in neither Bangladesh, nor can there be any significant reduction of poverty without a significant development in agriculture sector. All efforts will, therefore, be geared to provide the thrust necessary for boosting agricultural production. So the overall economic development depends on the proper development of our agricultural sector to a great extent.

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Watermelon is a warm season crop that is cultivated worldwide because of its numerous nutritional benefits. It thrives very well in most well drained soils whether clayey or sandy but preferably sandy loams. Although China is reported to be the current world largest producer of the commodity (Huh *et al*., 2008), watermelons are generally believed to have originated from Africa.

Like many other parts of the world, in Bangladesh, watermelon is highly relished as a fresh fruit because of its thirst-quenching attribute in addition to many other identified nutritional values and advantages. It contains 90 percent water and it is very useful fruit during summer season to fulfill the demand of water. It bears vitamin A, B, C and minerals. (Rabbany *et al*., 2013) Therefore, in the recent times, the consumption of the commodity has witnessed remarkable development as it cuts across all socio economic classes. The potentials of watermelon as a cash generating crop is significant for farmers especially those residing near the urban areas**.** Watermelon is grown more or less all over the country, but some districts of this country are more prominent than others. According to BBS (2014) the most important districts covered by a high acreage of watermelon are Patuakhali, Feni, Jhinaidah, Faridpur, Chittagang and Barisal. The present study is conducted on Patuakhali district. The district is selected due to highest coverage of cultivated land under watermelon among all other districts. About 13,368 hectares of land in seven upazilas of Patuakhali district has been brought under watermelon cultivation in 2015 (DAE; Patuakhali, 2015). Sandy loams of coastal islands of this district are suitable for watermelon cultivation. The district's total production may cross six lakh tonnes. Land of Rangabali, Galachipa and Kalapara upazilas are large areas of watermelon fields and very suitable for watermelon cultivation due to soil, weather condition and availability of irrigation water.

The primary objectives of every producer include the maximization of satisfaction, profit maximization, cost minimization or combination of all these. (Olayide *et al*., 1982 and Ezeh, 1998) However, a typical entrepreneur in the farm – firm sector is commonly assumed the objective of profit maximization subject to resource constraints. Beyond the point where the resource adds just as much to his revenue as it adds to its cost, a profit maximizing entrepreneur will not use a given resource because this might lead to a loss. However, by using more of the resource below such a point the farmer can increase profit. In general, when the value of marginal product of each resource equals its price, resources are said to be efficiently allocated.

This study specifically examined the costs and returns and efficiency of resource use in watermelon production in Patuakhali district to serve as a guide to prospective investors on watermelon production investment decisions.

The broad objective of this study is to examine the costs and returns of farmers associated with Watermelon production in Patuakhali District, Bangladesh.
The specific objectives are to:

1. Highlight the socio –economic characteristics of the farmers growing melon;
2. Determine the costs and returns to watermelon production;
3. To evaluate the input factor productivity;
4. Highlight the constraints faced by farmers in melon production.

2. METHODOLOGY

2.1 The Study Area

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Considering the intensity of watermelon production coverage among different districts of Bangladesh, the study has chosen Patuakhali district largely due to its sandy soils nature of the coastal islands. Patuakhali district is the largest watermelon growing region, both in acreage and output over the last few years (BBS, 2014).

2.2 Sampling technique

A multi-stage stratified sampling design has been used for the selection of the watermelon growing farmers. In this study, Patuakhali district is specially chosen due to the production intensity of watermelon coverage among different districts of Bangladesh. Then three upazilas are selected from the district by using simple random sampling (SRS) technique. After selecting the upazilas, one union from each selected upazila is selected randomly using SRS technique. Then, two villages from each union are selected by same technique. Finally, 30 watermelon growing farmers from each village are selected using multistage stratified sampling technique with equal allocation. The ultimate sample size is 180 respondents from which primary data were obtained through the administration of a pre tested structured questionnaire. Information was collected on the respondents' socioeconomic characteristics such as age, education level, farm size, farming experience, production cost and revenue in water melon production etc.

2.3 Analytical techniques

Descriptive statistics (frequencies, percentages, mean and standard deviation) were used to describe and categorize the socioeconomic characteristics of the respondents. The Gross Margin analysis (difference between total revenue and total variable costs) was used to determine the costs and returns to watermelon production in the study area while in input factor analysis in watermelon production the Cobb Douglas function was used. The choice was based on widely acknowledged fitness of Cobb Douglas to agricultural production (Barman and Chaudhury 2000; Barman et al., 2002; Onyenweaku and Nwaru, 2005, Ogbonna et al 2009).

2.4 Gross Margin Analysis

The costs and returns to water melon production were estimated using the gross margin analysis as follows;

GM = TR-TVC (Mohammed, B. T., 2011)

Where:

GM = Gross margin in Tk/decimal

TR = Total revenue in Tk/decimal (i.e Unit Price x Quantity)

TVC = Total variable cost in Tk/decimal

TR = Total Revenue = Price x Quantity (PQ)

2.5 Cobb Douglas function

The Cobb Douglas function used in the factor analysis in watermelon production in the study area is specified in the logarithmic form as:

$$\ln Y_i = \ln \beta_o + \beta_1 \ln X_1 + \beta_2 \ln X_2 + \beta_3 \ln X_3 + \beta_4 \ln X_4 + \beta_5 \ln X_5 + \beta_6 \ln X_6 + \varepsilon_i$$ (Oladele, 2015)

Where;

Y = Gross return, measured in Tk/decimal

X_1 = Cost of Seed, measured in Tk/decimal

X_2 = Cost of Tillage, measured in Tk/decimal

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X_3 = Cost of Irrigation, measured in Tk/decimal
X_4 = Cost of Labour, measured in Tk/decimal
X_5 = Cost of Pesticide, measured in Tk/decimal
X_6 = Cost of Fertilizer, measured in Tk/decimal
β = constant
ε_i = Error terms.
These variables were expected to positively influence gross returns from watermelon in the study area.

3. RESULTS AND DISCUSSION

3.1 Socio - Economic Characteristics of the Respondents

The socio economics characteristics of the respondents are presented in Table 1.

Table 1: Socioeconomic Characteristics of the Respondents

Characteristics	Frequency	Percentage	Mean	SD
Age group (years)	21	11.7		
<30	138	76.6	40.73	10.19
30-50	21	11.7		
Educational qualification				
Never been to School	01	0.6		
Primary school	136	75.6		
Secondary	41	22.7		
Tertiary	2	1.1		
Extension service				
Yes	135	75.0		
No	45	25.0		
Farm Size (Ha)				
5-49	18	10.0	173.77	154.711
50-249	133	73.9		
250-750	26	14.4		
750 and above	03	1.7		
Formal training in watermelon				
Yes	45	25.0		
No	135	75.0		
Mode of Land Ownership				
Own land	37	20.6		
Rented	143	79.4		
Watermelon farming experience				
<6	87	48.3	4.51	2.24
6-8	28	15.6		
>8	65	36.1		

Source: Field survey, 2016.

From Table 1, the average age of the sampled farmers is 40.73 years with a standard deviation of 10.19. It means that the farmer who were physically strong were involved in watermelon production. A total of 136 respondents representing 75.6% had primary education and 41 respondents representing 22.7% had secondary education. Only 2 respondents accounting for 1.7% had tertiary education; highest rate of educated farmer was at primary level, that is, most of the farmers had primary knowledge of education who

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cultivates watermelon. A one-fourth per cent (45 respondents) of the sampled farmers have participated in agricultural training organized by different GOs and NGOs. They. This shows that there is a need for improved training facility in the study area to assist the farmers in modern and improved agricultural practices.

The average farm size of the respondents is 173.73 decimal with a standard deviation of 154.711. Majority of the farmers (representing 73.9%) cultivated between 50 and 249 decimal while only 3 respondents, representing 1.7% cultivated above 750 decimal. This shows that watermelon production in the study area is practiced mainly by small-scale farmers. About 75 per cent of the farmers under study have reported that they received extension services from their relatives and other experienced persons during watermelon production. Some of the information received includes; on pesticide, insecticide, plant diseases and input prices. This is expected to increase both resource use efficiency and productivity of the farmers. The average years of water melon production experience was 4.5 years. This further indicated that water melon production is relatively a new enterprise in the study area.

3.2 Cost and Returns Analysis of Water melon production per decimal

The result of cost and benefit analysis associated with water melon production in the study area is presented in Table 2**.**

Table 2: Gross margin analysis of water melon production

Items	Value
A. Gross Benefit Tk/ decimal	
1. Average Yield / decimal	13 piece
2. Average Price Tk / Piece	115
3 Gross Benefit Tk / decimal (1 x 2)	1495
B. Variable Input cost Tk /decimal	
1. Seed	86.359
2. Tillage	80.896
3. Irrigation	64.181
4. Labour	176.743
5. Pesticide	51.091
6. Fertilizer	79.484
7. Total Variable Cost	538.757
C. Gross margin Tk/decimal (A-B)	956.243

Source: Data analysis, 2016

From Table 2 the farmers recorded an average yield of 13 pieces of watermelon per decimal. Gross return from watermelon production was Tk 1495. The total variable cost (TVC) amounted to Tk 538.757. This indicates that watermelon production is profitable in the study area with a gross margin of Tk 956.243 per decimal.

3.3 Factor Productivity in watermelon production

The result of the Cobb Douglas production function used in evaluating the input factor productivity in water melon production in the study area is as presented in Table 3.

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Table 3: Summary of Regression Results.

Factor inputs	Coefficients	t – values
Seed	0.137	1.960**
Tillage	0.227	3.239***
Irrigation	0.304	4.352***
Labour	0.156	2.765***
Pesticide	0.305	3.737***
Fertilizer	0.064	1.291
Return to scale	1.19	
R^2	.818	
F- value	129.635***	
Number of observation	180	

Source: Data analysis, 2016, *** Significant at 1%, **Significant at 5%

From Table 3 the coefficients of costs of; seed, tillage, irrigation, labour, and pesticide are all positive indicating that any increase in the cost of these factors through employment of more of these resources will increase the gross revenue in watermelon production in the study area. However, it was the coefficients of cost of irrigation and cost of pesticide values of 0.304 and 0.305 were significant at 1%. This indicates that if the cost of irrigation is increased by 1%, as indication of more irrigation, the gross revenue in watermelon production will be increased by about 0.30% and if the cost of pesticide is increased by 1% by use of more pesticide to control pest and diseases, the gross revenue in watermelon production will increase by about 0.30%.

The sum of factor coefficients was 1.19. This is above unity, which implied that there was increasing return to scale in water melon production in the study area. Therefore, the farmers can still continue to employ more of the productive resources, especially irrigation and pesticide which have significant positive relationship with the gross margin. The coefficient of multiple determinations (R^2) was 0.818. This implies that the explanatory variables used in the model specification accounted for about 82% of variation in gross margin of the watermelon farmers. The F-value was observed to be 129.635 and highly significant at 1%. All these points to the fitness of the model used.

3.4 Constraints to water melon production

Constraints to watermelon production in the study area are as shown in Table 4.

Table 4: Distribution of the Respondents by the Problems Encountered during Production.

Problems encountered	Frequency	Percentage
Lack of Credit facility	45	25.00
Lack of Irrigation facility	52	28.89
Cost of inputs	41	22.78
Damage by disease, pest, insecticides	42	23.33
Total	180	

Source: Field survey, 2016.

All the farmers sampled had the primary objective of profit maximization. This is as a result of the fact that melon is mainly not consumed but serves also as soil protector. Table 4 explains the limiting factors of water melon production in the study area. From Table 4, lack

of irrigation facility ranked first among the constraints. The result shows that credit is one of the constraints to melon production. Since the respondents are small-scale farmers, they have low capital base and therefore cannot afford the high cost of inputs. According to the respondents, formal institution does not normally give credit to melon farmers. This may possibly be because watermelon is considered not to be popularly grown and given adequate recognition. The problem of inaccessibility of the farmers to the modern inputs such as fertilizer, improved seeds, and machineries because of high costing, hence they made use of the traditional tools which limit their output and farm size. Damage by disease, pest, and insecticides was also another cause of limiting their output Source: Field survey, 2016

4. CONCLUSION AND RECOMMENDATION

This study has shown that in the study area watermelon production is profitable. Also, the study revealed the cost of seed; cost of tillage, cost of irrigation, cost of labour, and cost of pesticide have positive productivity coefficients indicating that any increase in the use of these variable inputs will increase the gross revenue of the farmers. The overall factor coefficient is 1.19 implying an increasing return to scale in water melon production in the study area. Therefore, the farmers could still employ more of the resources with positive factor productivity to increase their gross margin. Watermelon production potential in terms of yield and quality of the production has not been fully exploited. Consequently, there is still deficit supply of watermelon in the country. This could be adduced to the inaccessibility of the farmers to the appropriate modern technology (fertilizer and improved seeds), needed machineries, lack of credit facilities, high cost of inputs and lack of irrigation facilities. It is therefore imperative for individual, cooperative bodies, government and non-governmental organization to assist the farmers in these areas of weakness, in order to boost watermelon production in Bangladesh.

The broad focus areas to improve watermelon productivity are pointed out as below:

Based on the result from the findings, the following policy recommendations are suggested:

1. Micro credit has influential effect on the farmer's efficiency. Farmers who have access to micro-credit can purchase inputs at right time and low price. In the present study, a few farmers have received this facility. So, institutional credit should be made more flexible for the watermelon producers as well as the interest rate for credit should reasonably be low.

2. Training has exerted a significant impact on increasing the farmer's technical efficiency. A few farmers have participated in farming related training. In this aspect, government can emphasize on the training programmes through the department of agricultural extension (DAE) especially for watermelon growers. To develop interest among the farmers to participate in training sessions, some incentives might be taken such as quality input supply at cheap rate, short-term credit facility, etc. Both government and non-government organizations may take initiatives to provide training to the farmers on the different aspects of watermelon production;

3. Farmers should be encouraged to keep farm records of their activities through the help of the extension services of DAE, which should try to extend its services to the majority

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