__Original Research Article__

Gross margin and Factor Analysis of Watermelon Production in Patuakhali District, Bangladesh

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ABSTRACT

This study examined the Gross margin 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 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 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.

1. INTRODUCTION

One of the common characteristics of developing countries is the large share of agriculture in their economies. [1] 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. [2] 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.

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, [3] 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. [4] 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 [5] 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.[6] 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. [7] 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.

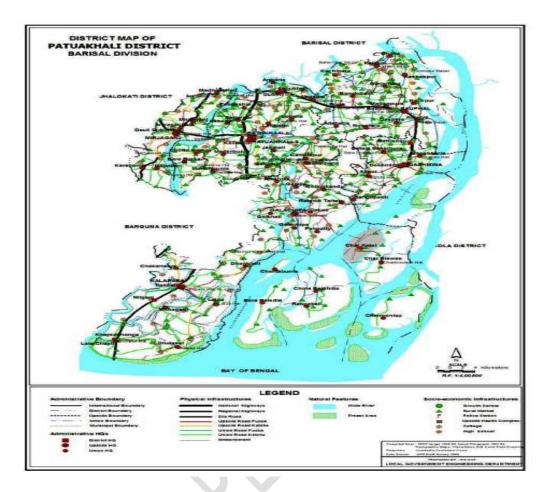## 2. METHODOLOGY

2.1 The Study Area

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Figure 1: Map of the study area

71

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. [5] Patuakhali a coastal district, a sub-division of Barisal district Region which is situated at the fringe of the Bay of Bengal. It is bounded on the north by Barisal district, on the east by Bhola district, on the south by the Bay of Bengal and on the west by Barguna. It lies between 21º 48' and 22º 36 north latitudes and between 90º 08 and 90º 41 east longitudes. The total area of the district is 3221.31 sq. km and 768.11 sq. km is under forest. Annual average temperature - maximum 33.3°C, minimum 12.1°C and rainfall 2506 mm.

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

90 stratified sampling technique with equal allocation. The ultimate sample size is 180
91 respondents from which primary data were obtained through the administration of a pre
92 tested structured questionnaire. Information was collected on the respondents'
93 socioeconomic characteristics such as age, education level, farm size, farming experience,
94 production cost and revenue in water melon production etc.

95 **2.3 Analytical techniques**

96 Descriptive statistics (frequencies, percentages, mean and standard deviation) were used to
97 describe and categorize the socioeconomic characteristics of the respondents. The Gross
98 Margin was analyzed through the difference between total revenue and total variable costs
99 while in input factor analysis in watermelon production the Cobb Douglas function was used.
100 The choice was based on widely acknowledged fitness of Cobb Douglas to agricultural
101 production [8, 9, 10, and 11] and also the distribution of analyzed data was appropriate in
102 log-log function.

103 **2.4 Gross Margin Analysis**

104 The costs and returns to water melon production were estimated using the gross margin
105 analysis as follows;
106 GM = TR-TVC [12]
107 Where:
108 GM = Gross margin in Tk/decimal
109 TR = Total revenue in Tk/decimal (i.e Unit Price x Quantity)
110 TVC = Total variable cost in Tk/decimal
111 TR = Total Revenue = Price x Quantity i.e. PQ
112

113 **2.5 Cobb Douglas function**

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

116 $\ln Y_i = \ln \beta_o + \beta_1 \ln X_1 + \beta_2 \ln X_2 + \beta_3 \ln X_3 + \beta_4 \ln X_4 + \beta_5 \ln X_5 + \beta_6 \ln X_6 + \varepsilon_i$ [13]
117 Where;
118 Y = Gross return, measured in Tk/decimal

119 X_1 = Cost of Seed, measured in Tk/decimal
120 X_2 = Cost of Tillage, measured in Tk/decimal
121 X_3 = Cost of Irrigation, measured in Tk/decimal
122 X_4 = Cost of Labour, measured in Tk/decimal
123 X_5 = Cost of Pesticide, measured in Tk/decimal
124 X_6 = Cost of Fertilizer, measured in Tk/decimal
125 β = constant

126 ε_i = Error terms.
127 These variables were expected to positively influence gross returns from watermelon in the
128 study area.

129 **3. RESULTS AND DISCUSSION**
130
131 **3.1 Socio - Economic Characteristics of the Respondents**
132 The socio economics characteristics of the respondents are presented in Table 1.
133 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 (Decimal)				
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		

134 Source: Field survey, 2016.

135 From Table 1, the average age of the sampled farmers is 41 years with a standard deviation
136 of 10.19. It means that the farmer who were physically strong were involved in watermelon
137 production. A total of 136 respondents representing 75.6% had primary education and 41
138 respondents representing 22.7% had secondary education. Only 2 respondents accounting
139 for 1.7% had tertiary education; highest rate of educated farmer was at primary level, that is,
140 most of the farmers had primary knowledge of education who cultivates watermelon. A one-
141 fourth per cent (45 respondents) of the sampled farmers have participated in agricultural
142 training organized by different Government organizations and Non-Government
143 organizations. This shows that there is a need for improved training facility in the study area
144 to assist the farmers in modern and improved agricultural practices.

145 The average farm size of the respondents is 173.73 decimal with a standard deviation of
146 154.711. Majority of the farmers (representing 73.9%) cultivated between 50 and 249
147 decimal while only 3 respondents, representing 1.7% cultivated above 750 decimal. This
148 shows that watermelon production in the study area is practiced mainly by small-scale
149 farmers. About 75 per cent of the farmers under study have reported that they received
150 extension services from their relatives and other experienced persons during watermelon
151 production. Some of the information received includes; on pesticide, insecticide, plant
152 diseases and input prices. This is expected to increase both resource use efficiency and
153 productivity of the farmers. The average years of water melon production experience was

154 4.5 years. This further indicated that water melon production is relatively a new enterprise in
155 the study area.

3.2 Gross margin Analysis of Water melon production per decimal

157 The result of gross margin analysis associated with water melon production in the study area
158 is presented in Table 2.

159 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

160 Source: Data analysis, 2016

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

3.3 Factor Productivity in watermelon production

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

168 **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	

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

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

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

187 **3.4 Constraints to water melon production**

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

189 Table 4: Distribution of the Respondents by the Problems Encountered during
190 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	

197 Source: Field survey, 2016.
198

199 All the farmers sampled had the primary objective of profit maximization. This is as a result
200 of the fact that melon is mainly not consumed but serves also as soil protector. Table 4
201 explains the limiting factors of water melon production in the study area. From Table 4, lack
202 of irrigation facility ranked first among the constraints. The result shows that credit is one of
203 the constraints to melon production. Since the respondents are small-scale farmers, they
204 have low capital base and therefore cannot afford the high cost of inputs According to the
205 respondents, formal institution does not normally give credit to melon farmers. This may
206 possibly be because watermelon is considered not to be popularly grown and given
207 adequate recognition. The problem of inaccessibility of the farmers to the modern inputs
208 such as fertilizer, improved seeds, and machineries because of high costing, hence they
209 made use of the traditional tools which limit their output and farm size. Damage by disease,
210 pest, and insecticides was also another cause of limiting their output Source: Field survey,
211 2016

212 **4. CONCLUSION AND RECOMMENDATION**
213

214 This study has shown that in the study area watermelon production is profitable. Also, the
215 study revealed the cost of seed; cost of tillage, cost of irrigation, cost of labour, and cost of
216 pesticide have positive productivity coefficients indicating that any increase in the use of

217 these variable inputs will increase the gross revenue of the farmers. The overall factor
218 coefficient is 1.19 implying an increasing return to scale in water melon production in the
219 study area. Therefore, the farmers could still employ more of the resources with positive
220 factor productivity to increase their gross margin. Watermelon production potential in terms
221 of yield and quality of the production has not been fully exploited. Consequently, there is still
222 deficit supply of watermelon in the country. This could be adduced to the inaccessibility of
223 the farmers to the appropriate modern technology (fertilizer and improved seeds), needed
224 machineries, lack of credit facilities, high cost of inputs and lack of irrigation facilities. It is
225 therefore imperative for individual, cooperative bodies, government and non-governmental
226 organization to assist the farmers in these areas of weakness, in order to boost watermelon
227 production in Bangladesh.

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

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

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

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

242 3.   Farmers should be encouraged to keep farm records of their activities through the
243 help of the extension services of DAE, which should try to extend its services to the majority
244

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