

Resource-use Efficiency in Watermelon Production in the Patuakhali District, Bangladesh

ABSTRACT



This study was conducted to determine the efficiency of resource use in watermelon production in the Patuakhali District, Bangladesh. One eighty farmers were selected using the multi-stage stratified sampling technique. The Cobb-Douglass production function was used to estimate the coefficients of the various variables analysed and, MVP index was also used to estimate the efficiency of resource use in the study area. From the regression results, land, seed, labour and pesticide were observed to affect watermelon output significantly (1%) and hence are the determinants of watermelon production in the study area. The results of the efficiency computation indicated that land (33.62), seed (10.17), labour (19.32) and fertilizer (1.92), were being underutilized and pesticide were being highly over utilized in the study area.

Keywords: Resource use, Efficiency, Cobb-Douglas, Watermelon, Bangladesh

1. INTRODUCTION



Watermelon is an important summer cash crop which has great demand in the domestic market. Its demand is increasing day by day but both acreage and production are decreasing. [4] In any production activity resources are used regarding as the inputs that drive the production process. In watermelon farming, the resources required include the seeds, land, labour, capital, fertilizer and pesticide. The main equipment applied is the conventional cutlass and hoe technology which has been blamed for the low output levels of farmers. A resource or input is said to be efficiently utilized when it is placed to the greatest apply achievable and at minimum cost permissible.

In a bid to aid farmers enhance productivity; the spotlight is usually on whether farmers are using better and superior technologies. It is however essential to explore whether these farmers are even making maximum use of what is existing to them in terms of inputs so that the stakeholders involved in agriculture will be persuaded that the new technologies they intend to introduce to farmers will be used efficiently and cost—effectively to further output. Farmers might use resources wisely but not at the financially viable level. Since the aim of every agribusiness firm is to maximize profit while minimizing cost, it is relevant to determine the efficiency of resource-use.

This study seeks to express the socio-economic characteristics of watermelon farmers, calculate approximately the farm production function of watermelon with a view of deriving the marginal factor productivity so as to estimate how competently the watermelon farmers are using their resources.

2. METHODOLOGY

For the selection of the watermelon growing farmers a multi-stage stratified sampling design has been used. Among different districts of Bangladesh the study has been chosen Patuakhali district, considering the intensity of watermelon production coverage especially in sandy lands of coastal islands. This district is the largest watermelon growing region, both in acreage and output over the last few years [1]. 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, cost and revenue in water-melon production etc. under the study.

2.1 Analytical techniques

Descriptive statistics using percentage and frequency tables were used in the analysis of the socio-economic characteristics of the farmers.

Ordinary Least Squares (OLS) was used to obtain the farm production function. The Cobb Douglas production function was employed in this study as it gave the best fit compared to the linear, exponential and semi-log functional forms.

The linear stochastic form of the specified Cobb – Douglas function is given as;

$$\ln Y = \ln A + b_1 \ln X_1 + b_2 \ln X_2 + b_3 \ln X_3 + b_4 \ln X_4 + b_5 \ln X_5 + \mu_i$$

Where:

Y=Watermelon output (piece), X1=Farm size (decimal), X2=Quantity of seed (kg), X3= Labour (man-days), X4= Quantity of fertilizer (kg), X5= Pesticide (litre) A=the intercept parameter, b1-b5 = Regression coefficients, μ = random error term

The coefficients are the marginal productivities of the corresponding inputs with respect to output. To ensure maximum profit and efficiency of resource, a farmer must utilize resources at the level where their marginal value product (MVP) is equal to their marginal factor cost (MFC) under perfect competition. [5] The efficiency of a resource was determined by the ratio of MVP of inputs (based on the estimated regression coefficients) and the MFC. Following [3, 2] and [6] the efficiency of resource is given as;

$$r = \text{MVP} / \text{MFC}$$

r = Efficiency coefficient MVP=Marginal Value
Product MFC=Marginal Factor Cost of inputs

MFC = P_{xi} where P_{xi} =Unit price of input X_i

MVP is obtained from the expression, $MVP = MPP \times P_y$

Where MPP=Marginal Physical Product and P_y =Unit Price of Output

The MPP is obtained from the estimated regression coefficients which are the elasticities of Production (E).

$$MPP_x = dy/dx \text{ But } E_x = dy/dx \cdot x/y, \text{ Hence } E_x \cdot y/x = dy/dx = MPP_x \text{ Therefore, } MVP_x = E_x \cdot y/x \cdot p_x$$

y = mean value of output, x = mean value of input x

MVP for each in input was therefore obtained by multiplying the regression coefficient of that input with the ratio of the mean value of output and that input and with the unit price of output.

MFC of each input was however obtained from data collected on the unit market prices of the various inputs during the 2016 production season.

The decision rule for the efficiency analysis is if:

r = 1; resource is been used efficiently

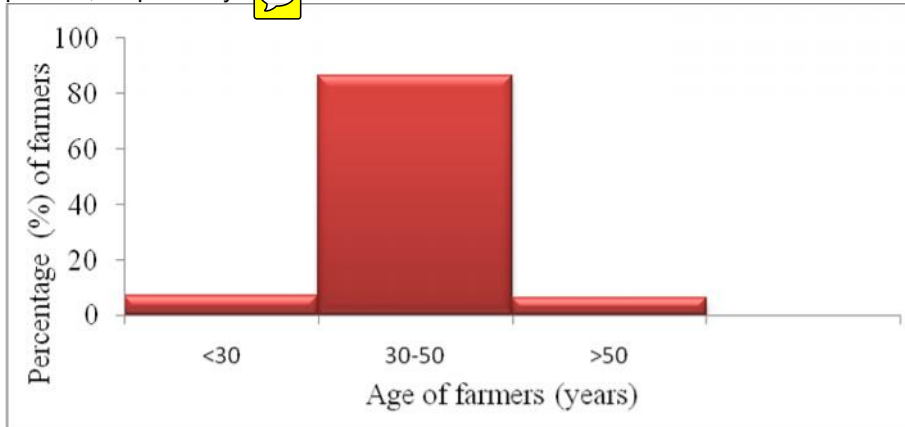
r >1; resource is under utilization and increased utilization will increase output.

r <1; resource is over utilized and reduction in its usage would lead to maximization of profit

83 **3. RESULTS AND DISCUSSION**

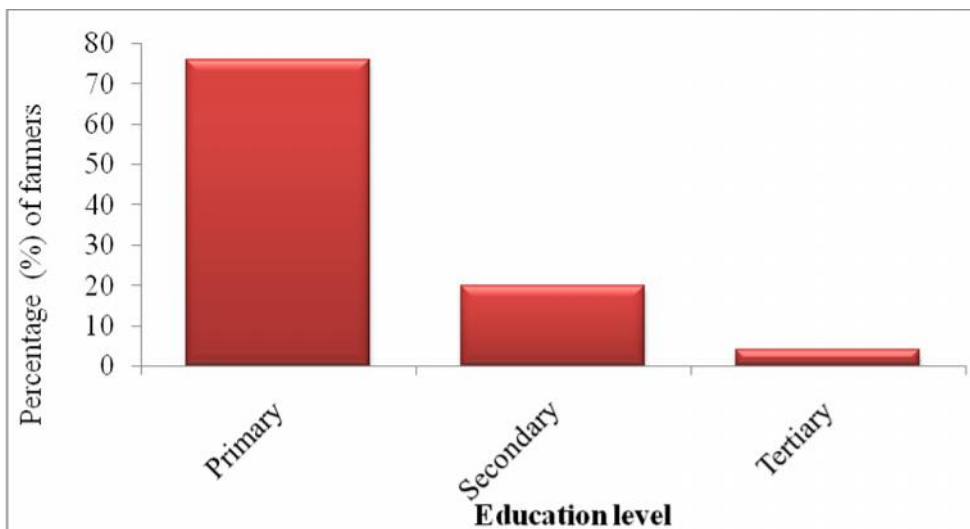
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85 The study considered age, education, experience, extension service taken, training received, credit
86 taken by the farmer, farm size, access to TV or radio and other profession of the farmers as socio-
87 economic characteristics. These characteristics have got high interest because of their significant
88 influence on both productive and economic efficiency. A brief discussion on each of these
89 characteristics is presented below.

90 The age distribution of the farmers under study is presented in Figure 3.1. Most of the farm operators
91 were of 30-50 years. It means that the farmer who were physically strong were involved in watermelon
92 production. Besides, the young (< 30 years) and old farmers (> 50 years) were found 7 and 6.3
93 percent, respectively.



94
95
96 **Figure 3.1 Age distribution of the farmers**

97 The education levels of the farmers under study were presented in Figure 3.2. The education levels of
98 the farmer were categorized by primary, secondary and tertiary level. However, about 76, 20 and 4
99 per cent of them were primary, secondary and tertiary level, respectively. Highest rate of educated
100 farmer was at primary level, that is, most of the farmers had primary knowledge of education who
101 cultivates watermelon.



103
104
105 **Figure 3.2 Education levels of the farmers**

106 Experience of the farmers on farming is presented as a histogram in Figure 3.3. About 39 per cent
107 farmers have experienced on farming years 6-8. This experience include not only on watermelon
108 farming but also on other crop cultivation such as rice, wheat, maize, vegetables, etc.

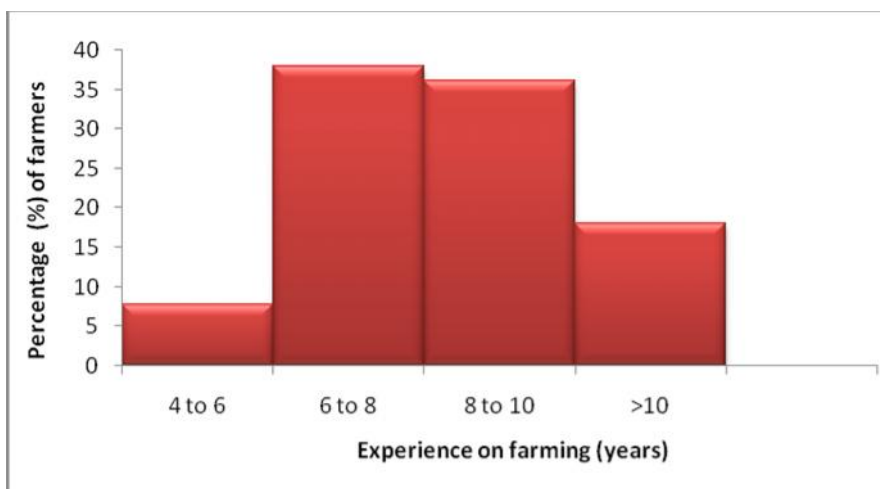


Figure 3.3 Experience on farming of the farmers

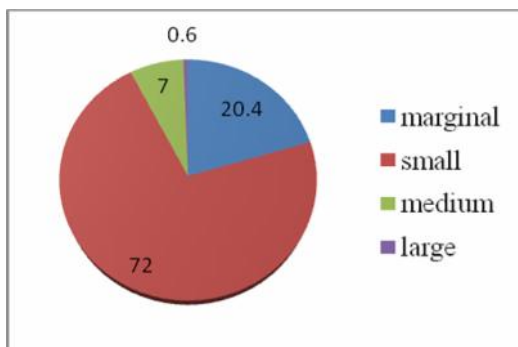


Figure 3.4 Percentage of the farms in each farm category

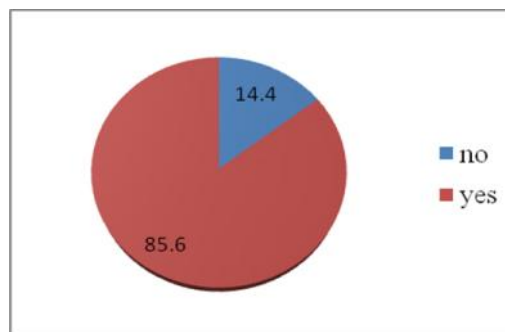


Figure 3.5 Percentage of the farms having extension contact

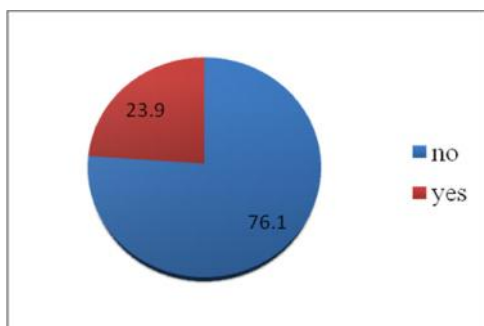


Figure 3.6 Training received by the farmers (in percentage)

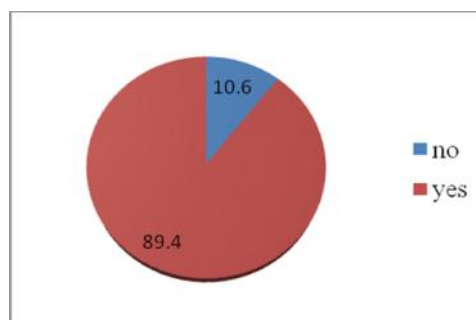


Figure 3.7 Percentage of the farmers credit taken for watermelon production

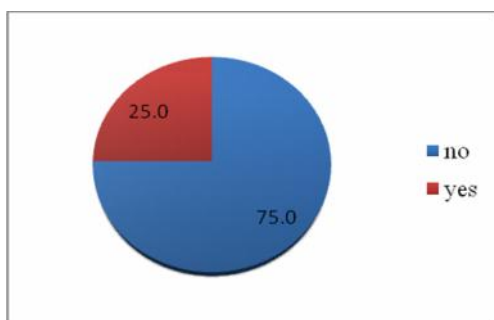


Figure 3.8 Watching and/or listening to agriculture related programmes on TV and/or Radio (in percentage)

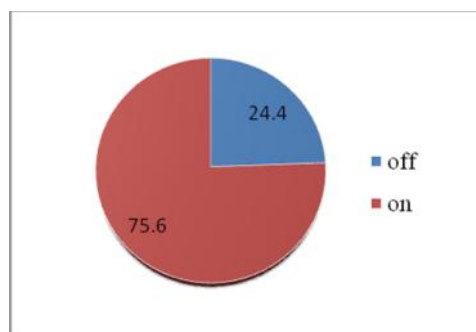


Figure 3.9 Involvement in farming among the farmers (in percentage)

Figure 3.4 reveals that among the farms, about 20, 72, 7 and 1 per cent are marginal, small, medium, and large farms, respectively. Most of the farmers were of small category (72 percent) in this study. Range of land for marginal, small, medium, and large farmers were 5-49 decimals, 50-249 decimals, 250-749 decimals, and above 750 decimals.

In Figure 3.5, a pie chart for sample farmers who have received extension contact is shown. About 85 per cent of the farmers under study have reported that they took extension contact from their relatives or any experienced person during watermelon production. They received information on pesticide, insecticide, plant diseases and input prices.

Only a small portion of sample farmer received training on farming (Figure 3.9). A little per cent of the sample farmers have participated in agricultural training organized by different GOs and NGOs. They have received different techniques on farming, such as, cultivation techniques, fertilization and tillage operation. The duration of the training they received varied from 1 to 12 days.

Watermelon cultivation needs high requirement of working capital for watermelon cultivation compared with rice, wheat, maize and vegetables. Most of watermelon growing farmers must take credit from NGOs or relatives or other institutes due to possess insufficient land and capital (Figure 3.7).

TV and Radio have become common devices in rural areas which not only entertain people but also provide education. Thus, in the present study, an attempt is made to find out whether watching and/or listening to agricultural programmes on TV and/or radio has any significant impact on farmer's efficiency. Among the farmers under study, only 25 per cent of them reported that they have taken this facility more or less regularly which is shown in Figure 3.8.

Farming is the main livelihood of rural people. All the farmers of this study are involved in farming whereas about 76 per cent of them depend solely on agriculture for their livelihood (Figure 3.9). The remaining farmers were involved in other activities.

3.2 Production Data

The average area under watermelon cultivation among the farmers is 173.76decimals (Table 3.1), about 60 per cent farmers have cultivated in watermelon less than 150 decimals. All the farmers have grown local watermelon variety. The mean output of the farmers was 64.98kg/decimal.

Table 3.1 Different characteristics of input resources of watermelon cultivation

Input	Mean value	Standard Error (Mean)
Area (decimal)	172.682	11.5315
Watermelon output (piece/decimal)	64.988	0.1232
Human labour (man-day/decimal)	0.0614	0.0044
Seed (kg/decimal)	0.0028	0.0002

Fertilizer (kg/decimal)	7.6465	0.0050
Pesticide (liters/decimal)	0.4293	0.0406

The average human labour used by the farmers is 0.006 man-day per decimal. The labourers are of family and hired. Most of the labourers are used for land preparation and harvesting. The average amount of seed used by the farmers is 0.0028 kilogram per decimal. The average fertilizer used by the farmers is 7.646 kg/decimal. The farmers mainly use Urea, TSP (Triple super phosphate) and MP (Muirate of potash). In addition to these three fertilizers, some farmers have used Gypsum, Zinc, Boron, DAP (Di-ammonium phosphate) and mixed fertilizer. The average amount of Pesticide used by the farmers is 0.4293 litre per decimal.

The result for the production function analysis is shown below in table 3.2.

Estimated Cobb-Douglas production function for watermelon production

Table 3.2: Dependent Variable: LOG (OUTPUT)

Factor inputs	Coefficients	Std. Error	t – values
Land	0.784	0.033	24.080***
Seed	0.090	0.031	2.867***
Labour	0.171	0.043	4.013***
Fertilizer	0.017	0.018	0.934
Pesticide	-0.058	0.017	-3.419***
constant	5.035	0.225	22.360***
R ²	0.956		
F- value	758.523***		

*** Significant at 1% Source: Field survey, 2016

From the regression results, land, seed, labour and pesticide were observed to affect watermelon output significantly and hence are the determinants of watermelon production in the study area. All of them were significant at 1%. The R² value for the regression is 95.6% and this means that 95.6% of the variations in the watermelon output are explained by the factor inputs. Also from the F – statistic it can be concluded that the overall regression is significant at 1% significance level. The values of the coefficients indicate the elasticity of the various inputs to the output. Considering land the elasticity value indicates that if land under cultivation is increased by 1%, the yield of watermelon would increase by 78.4%. If quantity of seed and labour increase by 1%, yield of watermelon would increase by 9.0%, and 17.1% respectively. Pesticide, however had a negative coefficient indicating that an increase in pesticide will lead to a decrease in yield and this corroborates [6] who studied on resource-use efficiency in cowpea production in North East Zone of Adamawa State and reported an inverse relationship between pesticide and output.

From the result of resource-use efficiency estimation shown in table 3.3, the use of pesticide was found to have a negative efficiency coefficient. This indicates an extreme use of pesticide by the farmers which in turn leads to reduction in profit obtained. On the other hand, seed, land, labour, and fertilizer were the inputs being underutilized as their Efficiency coefficient is greater than one. To increase output, there is the need for the farmers to increase the utilization of seed, land, labour, and fertilizer.

178 Table 3.3: Efficiency of resource – use in watermelon production

Resource / Input	Coefficient	MVP	MFC	r
Land	0.784	5805.52	173	33.61972
Seed	0.090	4.92115	0.48	10.17
Labour	0.171	204.9312	11	19.323
Fertilizer	0.017	2536.502	1320	1.921
Pesticide	-0.058	-485.801	74	-6.554

179

180 Source: Field survey, 2016

181 4. CONCLUSION

182 Findings from the study indicate enough potential therefore exist for increased production of
 183 watermelon in the study area. The farmers receive financial assistance in form of credit from formal
 184 sources with a high interest rate which has been blamed for the high cost of farmers. So, the
 185 government and financial institutions in the area should consider making loans available and
 186 accessible to the farmers so that they can afford to increase the use of the inputs that are currently
 187 being underutilized. Also, there is the need for extension service through department of agricultural
 188 extension in the study area to train the farmers to increase the use of land, hired labour and seed
 189 and also the right quantities of pesticide and fertilizer in order to boost profitability of the farm.

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