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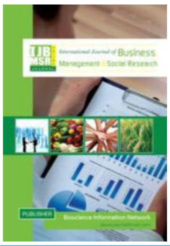

Profitability and productivity of rice production in selected coastal area of Satkhira district in Bangladesh

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ABSTRACT

The present study was conducted to assess the profitability, constraints and factors affecting rice production in coastal area of Shamnagar upazila, Satkhaira district, Bangladesh by using stratified random sampling method. Simple statistical technique as well as Cobb-Douglas production function was used to achieve the objectives of the study. The study found that the small farmers (Tk. 10292.89) got higher net returns than the medium (Tk. 6894.39) and large (Tk. 4798.70) farmers per hectare, respectively. The undiscounted BCR was 1.38, 1.23 and 1.15 for small, medium and large farmers respectively. It is found that the coefficient of seed, fertilizer, power tiller, irrigation cost and human labor have significantly impact on gross return. Lack of saline tolerable good quality seeds, high price of inputs, low price of outputs and natural calamity were the major problems for rice farming in the study area though rice farming was a profitable enterprise.

Key Words: *Rice, Profitability, Productivity and Coastal area*

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I. Introduction

Rice is an important cereal crop and leading crop in Bangladesh due to its higher yield, nutritional value and versatile uses. Demand of rice in Bangladesh is augmenting day by day as Bangladesh is the 8th most populous country in the world with a total population of 155.8 million, population growth rate is 1.37% (BER, 2014) and its density of population is 1015 persons per Km2 (BER, 2014). More than 70% of the country's population as well as 48.40% of its labour force directly and indirectly depend on agriculture and contributing 12.64% to the GDP (BBS, 2014). High production of rice depends on the expansion of HYV and saline tolerable variety of seeds, improved management and timely supplying of inputs. The rate of adoption of modern technology and sustainability of rice production depend largely on its economic profitability. The efficient use of resources is an important indicator of increased production in agriculture. Efficient utilization of present level of inputs is indispensable for higher productivity. In Bangladesh, the problem of food deficit can best be met by increasing rice production. The desirable characteristics of rice are higher yield than other cereals, well suitability to the rain fed condition and higher nutrition status. The people of Bangladesh can meet the calories requirements by increasing rice production. In Bangladesh, coastal areas constitute about 2.5 million hectare which amounts to about 25 percent of total crop land of the country. Of this, nearly 0.84 million hectare is affected by varying intensities of salinity (Karim et al 1990). Salinity Intrusion in Interior Coast found that the increasing concentration of salinity will create more pressure to the farmer by reducing yield and threatening livelihood, income generation and food security (Lubna and Baten, 2012). Acoording to Sikder (2012), Bangladesh is one of the worst affected countries that are facing the early impacts of climate change particularly in agricultural sector. Razzaque and Zaman (2007) carried out a study on comparative analysis of T. aman rice cultivation under different management practice in coastal area where demonstration plots showed higher benefit cost ratio than non-demonstration plot. Haque (2006) studied the salinity problems and crop production in coastal reason of Bangladesh which showed that about 53% of the coastal areas are affected by salinity. In addition, Singh (2003) shows that contract farming as a system affected growers positively or negatively depends on the context of the economy. Studies regarding the profitability of rice in coastal areas of Bangladesh are very few, that is why, the present study had been taken for measuring profitability of rice production in coastal areas of Shamnagar upazila of Satkhaira district for a successful rice revolution in Bangladesh and expected to provide valuable data and useful for formulating appropriate policy for widespread cultivation of rice in coastal areas of Bangladesh.

II. Materials and Methods

The present study was conducted in coastal areas of Shamnagar upazila, Satkhaira district, Bangladesh to examine the profitability of rice production during the period of January to April, 2014. Necessary data were collected through direct interviewing from the sample of 75 farmers which constituted 35 small, 20 medium and 20 large farmers respectively by a purposive random sampling method. The collected data were then sorted, scrutinized and analyzed to achieve the objectives set for the study. The average percentage, total cost, total return etc were the simple statistical measures employed to show the economic performance of rice production. A Cobb-Douglas production function model was used to estimate the contribution of key inputs to the production processes of rice. This is a conventional model where the level of production depends on the level of input use.

The specification of the Cobb-Douglas production function was as follows:

$$Y_i = aX_1^{b1} X_2^{b2} X_3^{b3} X_4^{b4} X_5^{b5} X_6^{b6} X_7^{b7} X_8^{b8} X_9^{b9} e^{ui}$$

In the linear form it can be written as follows:

$$\text{In } Y = \ln a + b_1 \ln X_1 + b_2 \ln X_2 + b_3 \ln X_3 \; b_4 \ln X_4 + b_5 \ln X_5 + b_6 \ln X_6 + b_7 \ln X_7 + b_8 \ln X_8 + b_9 \ln X_9 \times u_i$$

Where,

ln = Natural logarithm;
Y = Gross return (Kg/ha);
X_1 = Seed cost (Kg/ha);
X_2 = Human labor cost (Man days/ha);
X_3 = Power tiller cost (Tk/ha);
X_4 = Urea cost (Kg/ha);
X_5 = TSP cost (Kg/ha);
X_6 = MP cost (Kg/ha);
X_7 = Irrigation cost (Tk/ha);
X_8 = Manure cost (Kg/ha);
X_9 = Insecticide cost (Tk/ha);
a = Constant or intercept term;
b_1, b_2, b_3, b_4, b_5, b_6, b_7, b_8, b_9 = production coefficient of the respective input variable to be estimated; and
u_i = error term

Profitability analysis of rice production has been determined on the basis of net return analysis. To determine the net returns from rice production, gross costs (variable and fixed cost) were deducted from gross returns. For this purpose, the following equation was used (Dillon and Hardaker, 1993).

The equation has been applied for each of the selected farmers:

$$\pi = {}^{P}{}_{m} * {}^{Y}m + {}^{P}b * {}^{Y}b - \Sigma(Pxi * Xi) - TFC$$

Where,

π = Net return
P_m = Price of main product per units
Y_m = Total quantity of main product
${}^{P}b$ = Price of by-product per unit
Y_b = Quantity of by-product
P_{xi} = Price of ith input per unit used for rice production
X_i = Quantity of the ith input used for rice production
TFC = Total fixed cost
i = 1, 2, 3..........................n (number of input)

The estimation of Interest on operating capital (IOC) was as follows:

$$\text{Interest on OC} = AI \times i \times t$$

Where,

AI = (Total investment)/2;
I = Rate of interest per annum (%); and
T = Period of rice production (in month).

The benefit cost ratio (BCR) is a relative measure which is used to compare benefit per unit of cost. Benefit-cost ratio is the ratio of present net worth of benefit and present net worth of cost. It indicates that the benefit of per unit cost at present worth.

$$\text{Benefit-Cost Ratio} = \frac{\text{Present net worth of benefits}}{\text{Present net worth of cost}}$$

III. Results and Discussion

Farmers used both purchased and home supplied inputs for cultivating rice. Cost items were identified as human labor, power tiller, seed, manure, fertilizer, irrigation, insecticide, interest on operating capital and land use cost. All these input costs were than taken into account for one production period in calculating the per hectare cost of rice cultivation. The human labor is required for farm operations like land preparation, sowing, mulching**,** weeding, irrigation, insecticide application, application of fertilizer, harvesting, carrying, etc. In the study area, rate of human labor, on an average, was Tk. 320 per man-day. The total average costs of labor were Tk. 17334.97, 20028.09, 23103.68 and 20155.58 per hectare for the small, medium large and all farms respectively (Table 01). Per hectare power tiller cost was Tk. 1730.29, 1820.00 and 1887.50, for small, medium and large farms respectively. Power tiller cost was high in large farm and low in small farm (Table 01). In the study area, the seed cost per hectare was found to be highest for small farms (Tk. 553.57) followed by large farms Tk. 539.75 and medium farms Tk. 429.00. The average cost of seed for all categories of farms was Tk. 616.67 (Table 01). Farmers used four types of fertilizer namely urea, Triple super phosphate (TSP), Murrieta of potash (MP) and Gypsum for rice cultivation. The respective total average cost of fertilizer per hectare was found at Tk. 1786.90, Tk.2028.50, Tk.2192.50, and Tk.1959.49 (Table 01). Manure cost per hectare was Tk.891.43, Tk. 200.00 and Tk. 00.00 for small, medium and large farms. The average cost of manure for all categories of farms appeared to be Tk. 469.33/ha (Table 01). All sample farmers were observed to have used different kinds of insecticides in their rice fields. The total average costs of insecticides per acre were Tk. 216.86, 197.50 and 245.00, for small, medium and large farms respectively. So, the highest insecticide cost was borne by large farms followed by small and medium farms in the study area. Farmers used irrigation water in the rice fields during cultivation period. Irrigation cost was found to be the highest in large farm (Tk. 1911.00/ha.) and it was almost the same for small (1716.00/ha.) and medium (1782.00/ha.) farms. The average cost of irrigation for all categories was Tk. 1785.60/ha (Table 01). In computing land use cost, average leased value of land per acre for the particular year was considered on the basis of the reports of the farmers. Land use cost was estimated for the cropping period covering around 6 months in the study area. It was the highest in medium farms (Tk. 3513.80/ha) than that of the small farms (Tk. 2944.39/ha) and large farms (Tk. 2234.47/ha). The average cost of land use for all categories of sample farmers amounted to be Tk. 2906.92/ha (Table 01). Interest on operating capital (IOC) included both labor and materials used in the production of rice and were calculated for a period of four months at the rate of 13.00 percent per annum. It was assumed that if the farmers borrowed money from bank and other financial and nonfinancial institutions, they had to pay interest at specified rate. This rate was taken to calculate IOC. IOC per hectare was estimated at Tk. 465.71, 405.71 and 417.14 for small, medium and large farms respectively. The average IOC for all categories of farmers was Tk. 436.76 (Table 01). The average total cost of rice cultivation was estimated at Tk. 27086.54/ha for small farm, Tk. 29975.61/ha for medium farm, Tk. 31991.30/ha for large farm. So, large farm incurred the highest cost followed by the medium and small farms. Per hectare total cost for all categories of farms was Tk. 29684.48 (Table 01). Total return per hectare was calculated by multiplying total yield of rice produced by farm-gate price during the time of harvesting. The farmers sold their rice at different markets and at different prices. The average unit price of rice per kg. considered in the present study was Tk. 14.00. Total return per hectare was the highest in small farms of Tk. 37379.43 followed by the medium farms (Tk. 36870.00) and small farms (Tk. 36790.00). Per hectare total return for all categories of farms was estimated at Tk. 37086.40 (Table 01). Net return was calculated by deducting total cost from total return. Per hectare net returns for small, medium and large rice farms were appeared to be Tk. 10292.89, 6894.39 and 4798.70 per hectare respectively. So, net return is the highest in small farm which is followed by medium and large farms. An undiscounted benefit-cost ratio (BCR) is used to compare benefit per unit of cost. The overall benefit-cost ratio of rice farming came out to be 1.25 indicating that a one Taka investment resulted in a net benefit of Tk. 0.25.

Table 01 Cost of rice production by farm category (Per hectare)

Particulars	Small Farmers (Tk./ha)	Medium Farmers (Tk./ha)	Large Farmers (Tk./ha)	All Farmers (Tk./ha)
Variable cost				
Power tiller cost	1730.29	1820.00	1887.50	1796.13
Labor cost	17334.97	20028.09	23103.68	20155.58
Seed cost	553.57	429.00	539.75	516.67
Fertilizer cost	1786.90	2028.50	2192.50	1959.49
Manure cost	891.43	200.00	0.00	469.33
Insecticides	216.86	197.50	245.00	219.20
Irrigation charge	1716.00	1782.00	1911.00	1785.60
A. Total variable cost	**24230.02**	**26485.09**	**29879.43**	**26864.85**
Fixed cost				
Interest on operating capital	2944.39	3513.80	2234.47	2906.92
Land use cost	465.71	405.71	417.14	436.76
B. Total fixed cost	**3410.10**	**3919.52**	**2651.62**	**3343.68**
C. Total cost (A+B)	**27086.54**	**29975.61**	**31991.30**	**29684.48**
D. Total Return	**37379.43**	**36870.00**	**36790.00**	**37086.40**
E. Net Return (D-C)	**10292.89**	**6894.39**	**4798.70**	**7328.66**
F. BCR (Undiscounted)	**1.38**	**1.23**	**1.15**	**1.25**

Costs and returns were calculated to compare the income earning under different farm size groups i.e., small, medium and large. Per hectare net return of small, medium and large farmers were calculated at Tk. 10292.89, Tk. 6894.39 and Tk. 4798.70, respectively. Total costs of different categories of farmers were calculated at Tk. 27086.54, Tk. 29975.61 and Tk. 31991.30 respectively and BCR were estimated at 1.38, 1.23 and 1.15 for small, medium and large farmers respectively. Per hectare average net returns of all farmers were Tk. 7328.66 and BCR was 1.25 which shows that rice production is profitable in the study area. Cobb-Douglas production function model has been chosen to determine the effects of selected inputs on rice production. Production of rice was assumed to be influenced by nine cost items and other factors. Nine explanatory variables were taken into consideration for production function analysis of the farmers' efficiency in rice production.

For producing rice, different variables, such as seed, human labor, power tiller, irrigation, Urea, TSP, MP, manure etc. were employed by the sample farmers. Estimated values of co-efficient and related statistics of Cobb-Douglas production function is presented in Table 02. The result showed that, most of the co-efficient had positive sign. However, the co-efficient of Urea (X_4) and MP (X_6) were found to be positively significant at 1% level which indicated that 1% increase of urea and MP with other factors remaining constant would increase the gross return by 0.07 and 0.02 percent, respectively. The co-efficient for human labor (X_2) and irrigation (X_7) were positively significant at 5% level which indicated that 1% increase in urea and MP with other factors remaining constant would increase the gross return by 0.28 and 0.17 percent, respectively. Seed (X_1) was found to be significant at 10% level. This means, there is opportunity to increase gross return by using more quality and disease free keeping other factors constant. The fitted Cobb-Douglas production function was found to be valid as indicated by F-value and R-square. The co-efficient of multiple determinations, R^2, was 0.58 which indicate that the explanatory variables included in the model explained 58% of the variation in rice production.

Table 02. Estimated values of coefficients and related statistics of Cobb-Douglas production function model for rice production for all farmers

Explanatory variables	Values of coefficients	Standard error	t-value
Intercept/Constant	7.69	1.65	4.66
Seed cost (X_1)	0.08*	0.04	2.12
Human labor cost (X_2)	0.28**	0.06	4.78
Power tiller cost (X_3)	0.15	0.13	1.15
Urea cost (X_4)	0.07***	0.04	1.93
TSP cost (X_5)	-0.02	0.02	-0.84
MP cost (X_6)	0.02***	0.01	1.85
Irrigation cost (X_7)	0.17**	0.08	2.21
Manure cost (X_8)	0.003	0.006	0.44
Insecticide cost (X_9)	0.01	0.008	1.20
F-value	9.49		
R^2	0.58		
Returns to scale (Σb_i)	0.62		

*** = Significant at 1% level; ** = Significant at 5% level; * = Significant at 10% level

IV. Conclusion and Recommendation

Rice production is profitable in the study area and small farmers earned higher profit compared to medium and large farmers. Thus the present study might be helpful for the researcher, policy makers and to other concerned authorities for conducting further comprehensive research or to arrive at any plan for the development of the rice farmers in coastal areas of Bangladesh. However, the sustainability of rice production in coastal areas of Bangladesh depends on optimization of planting time, quality seed of appropriate varieties, and balanced nutrient management along with soil fertility conservation and other management. On the basis of the findings of the present study, the following specific recommendation may be made for the development of rice production in coastal areas of Bangladesh:

- Farmers cannot use the inputs i.e. seed, fertilizer, pesticides etc. in optimum amount because of higher price. So, government should take appropriate measures for the rice growers; so that they are afford to manage the essential inputs for rice production.
- As rice is a profitable enterprise, so government and other research institutions should provide adequate extension program to expand rice production that farmers can realize easily its financial importance.
- Saline tolerable rice based cropping pattern should be developed for salinity areas where rice production is suitable, particularly in the coastal areas of Bangladesh.
- It is very much necessary to build up agro based industry and for that public and private sectors both come forward from their own position.
- GOs and NGOs should run strong extension program in order to increase area under rice production in coastal areas of Bangladesh.
- It was realized that farmers did not get fertilizers at the government rate. So public interventions might be required for ensuring the reasonable price of fertilizers. Moreover, farmers reported that they were suffered from adulterated fertilizers. Thus, public awareness should be raised to maintain fertilizer quality in both rural and local level.

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Conflicts of Interest

Authors declared no conflict of interest.

Authors Contribution

Md. Zohurul Islam conceived, designed, collected and analyzed the data and wrote this manuscript as well. Ratna Begum and Sajia Sharmin helps in data collection and Akteruzzman Khan facilities as a supervisor of the experiment.

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