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A COMPARATIVE ECONOMIC STUDY ON BARI GOM-24 AND BARI GOM-23 PRODUCTION IN A SELECTED AREA OF DINAJPUR DISTRICT

M. Toufiqul Islam[1], M. Taj Uddin[2] and M. Nahid Sattar[3]
Department of Agricultural Economics, Bangladesh Agricultural University
Mymensingh-2202, Bangladesh

ABSTRACT

This study was designed to determine the costs, returns and relative profitability of BARI GOM-24 and BARI GOM-23 production in Dinajpur district. In total 60 farmers were selected of whom 30 produced BARI GOM-23 and 30 produced BARI GOM-24 from two villages of Khanshama Upazila of Dinajpur district. Cost-return and functional analyses were done to achieve the objectives of the study. It was revealed that the cultivation of both BARI GOM-24 and BARI GOM-23 were profitable for the farmers. Per hectare gross cost of production of BARI GOM-23 and BARI GOM-24 were Tk. 49898.54 and Tk. 54104.15, respectively and the corresponding gross returns were Tk. 77715.02 and Tk. 65608.44. The per hectare net returns of producing of BARI GOM-23 and BARI GOM-24 were Tk. 27816.48 and Tk. 11504.29, respectively. The results indicated that BARI GOM-24 was more profitable than BARI GOM-23. Cobb-Douglas production function was applied to address the effects of individual inputs on gross return of BARI GOM-24 and BARI GOM-23. It was observed that most of the included variables had significant impact on gross return from BARI GOM-24 and BARI GOM-23 production and gross return could be increased further by increasing the use of some inputs like human labour, seed and fertilizer. The study also identified some problems faced by the producers in producing BARI GOM-24 and BARI GOM-23. Based on the findings of the study, some recommendations were made to improve the cultivation and management practices for BARI GOM-24 and BARI GOM-23 farming in order to increase the income of the farmers.

Key Words: BARI GOM-24, BARI GOM-23, Profitability, Production Function

INTRODUCTION

Wheat is the second most important staple food grown in Bangladesh after rice during the winter season. Wheat provides almost 3.8 per cent of per capita calorie intake and 4.7 per

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[1] The authors are [1]former MS student, [2]Professor and [3]Lecturer, respectively, in the Department of Agricultural Economics, Bangladesh Agricultural University, Mymensingh-2202, Bangladesh
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cent of per capita protein intake in Bangladesh (HIES, 2010). However, there is enough potential to increase these proportions in the diet of the people of this country. Wheat protein ranks high in nutritional quality among cereals. It provides more nourishment for humans than any other food source. Bangladesh produced 8,49,046 metric tons and imported 23,25,000 metric tons of wheat in 2008-09 (BBS, 2010). So, Bangladesh imports almost three-fourths of the quantity required for its consumption. In order to reduce dependency on import, wheat production needs to be increased. In the past, increases in wheat supply mostly came from expansion in the wheat area (Matin and Alam, 2004). However, the scope of expanding wheat area is declining further over time due to transformation of agricultural land to non-agricultural uses. A study by Hasan (2007) indicated that there is potential to increase efficiency in wheat production by improving production and management practices. Moreover, the recent changes in climate have put extra pressure on wheat production among other crops, and this necessitates the development of stress tolerant high yielding wheat varieties (Karim and Talukder, 2008). Also, as wheat is a staple food for Bangladesh, an increase in its price adversely affects the food security of poor households (Nahar *et al.*, 2010). Increase in wheat production will save the consumers from any undesirable price shock in the global wheat market.

There is a long history of research and development of modern varieties of wheat in Bangladesh. The initial rapid improvement in wheat production came mostly from modern varieties that exhibited constantly higher yield potential in the field. In 2005, two such high yielding varieties, i.e., BARI GOM-23 (Bijoy) and BARI GOM-24 (Prodip) were released. Both the varieties are grown in the same season and compete with each other for limited resources. Both the varieties have good level of resistance to diseases. Moreover, BARI GOM-24 is a heat tolerant variety. If these varieties are to be successfully adopted in the field by the farmers, they have to be profitable from the perspective of the farmers. Therefore, a comparative economic analysis is needed to determine the superiority of one over another. However, no comparative economic study has yet been conducted on newly introduced BARI GOM-24 and widely used BARI GOM-23 varieties. This study is an attempt to evaluate and compare the profitability of BARI GOM-23 and BARI GOM-24 varieties. This study is expected to provide some basic information for the researchers and the policy makers about the sustainability of the two varieties. It is also expected that the present study would provide valuable information to the farmers and would also indicate the adjustment needed in the allocation of farmers' scarce resources. The overall objective of the study is to show the comparative profitability of BARI GOM-23 and BARI GOM-24 production. The specific objectives of the study are as follows:

i. To determine the costs and return of BARI GOM-23 and BARI GOM-24 production;
ii. To compare profitability of producing BARI GOM-24 and BARI GOM-23;
iii. To determine the factors responsible for the variation in gross return from wheat production; and
iv. To identify the major problems faced by the farmers in producing BARI GOM-24 and BARI GOM-23.

METHODOLOGY

The villages named Goaldhihi and Purbapara under Khanshama Upazila of Dinajpur district were selected for the survey because of the availability of a large number of BARI GOM-23 and BARI GOM-24 growers in the area. The two villages had identical physical characteristics like topography, soil and climatic conditions for producing both the varieties.

The farm survey method was followed for interviewing wheat farmers. A questionnaire was prepared keeping the objectives of the study in mind and after pretesting and making necessary modifications for collecting information from the sample farmers. At first, a list of the farmers who produced either BARI GOM-23 or BARI GOM-24 was taken. Thirty farmers growing BARI GOM-23 and another 30 farmers growing BARI GOM-24 were selected randomly from that list. The data on the costs and returns of BARI GOM-23 and BARI GOM-24 were collected during February 2012. The gathered data were classified, tabulated and analyzed in accordance with the objectives of the study. Descriptive statistics like averages, percentage and ratios were used. Farm business analytical techniques such as enterprises costing, gross margin analysis, etc. were performed to see the profitability of the enterprises. Finally, statistical technique such as Cobb-Douglas production function was used to examine the effects of the key independent variables on the gross return of BARI GOM-23 and BARI GOM-24 production. The specification of the Cobb-Douglas production function in logarithm form for both BARI GOM-23 and BARI GOM-24 was as follows:

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

Where,
Y = Gross return (Tk./ha);
X_1 = Human labor cost (Tk./ha);
X_2 = Seed cost (Tk./ha);
X_3 = Fertilizer cost (Tk./ha);
X_4 = Irrigation cost (Tk./ha);
X_5 = Power tiller cost (Tk./ha);
lna = Constant or intercept term;
b_1, b_2, b_3, b_4, b_5 = production coefficients of the respective inputs variables to be estimated; and
u_i = Error term.

Returns to scale (RTS) reflects the degree to which a proportional change in all inputs causes change in the output. Empirical analysis of production routinely investigates RTS by estimating the total elasticity of production. The total elasticity of production can be shown to be equal to the sum of all the partial production elastic ties. When the Cobb-Douglas production function takes the form of multiple linear regression in logarithm, the regression coefficients represent production elasticity and if all the inputs related to the production are taken into account, the sum of the production elasticity (RTS) indicates

whether the production process as a whole yields increasing, constant or decreasing returns to scale.

COMPARATIVE PROFITABILITY OF BARI GOM-24 AND BARI GOM-23 PRODUCTION

This section analyzes the costs and returns of producing BARI GOM-24 and BARI GOM-23 in order to find out their comparative profitability. Full cost and cash cost have been considered in calculating gross cost. The cost components of production for BARI GOM-24 and BARI GOM-23 were considered divided into variable cost and fixed cost items. The results of cost return analysis are discussed below:

Estimation of variable costs: Variable costs are the costs of using the variable inputs. These costs for using inputs like seed, human labor, fertilizer, irrigation, etc. are considered as variable costs of producing BARI GOM-24 and BARI GOM-23. Human labor is the most important input for producing BARI GOM-24 and BARI GOM-23 as it occupies the largest share of the cost of production for both the varieties (Table 1). In case of BARI GOM-24, per hectare total labor cost was estimated at Tk. 37003.52 and the average wage rates for a male labor were considered Tk. 250 per day. Here, harvesting and carrying required higher labor cost which was 24.32 per cent of the total cost. On the other hand, in case of BARI GOM-23, total labor cost was estimated at Tk. 32201.24 per hectare which was lower than the labor cost for BARI GOM-24. Among the labor costs, the harvesting and carrying operation needed 24.23 per cent.

Material inputs used in BARI GOM-24 and BARI GOM-23 production were seed, fertilizers, power tiller and irrigation. The seed cost for BARI GOM-24 and BARI GOM-23 were 3921.99 and Tk.3670.92 per hectare, respectively which were 7.86 per cent and 6.78 per cent of total cost respectively. For BARI GOM-24, 153.79 kg seed was required per hectare and the price of seed was Tk. 25 per kg in the study area. On the other hand, the requirement of BARI GOM-23 seed was 183.79 kg per hectare and the price of seed was Tk. 30.00 per kg. Hence, it was clear that per hectare seed cost is relatively higher for BARI GOM-23 production than that of BARI GOM-24 because most of the BARI GOM-23 grower purchases their wheat seed from the open market at a higher price. On the other hand, BARI GOM-24 growers get their seed from Bangladesh Agricultural Research Institute (BARI) at a lower price. For this reason, per hectare seed cost was lower for BARI GOM-24 than that of BARI GOM-23 in the study area.

BARI GOM-24 wheat producers used only one type of fertilizers that is urea in the study area. On the other hand, BARI GOM-23 wheat producers used TSP and MP besides Urea. From Table 1, it can be seen that in the case of producing BARI GOM-24 per hectare costs of Urea was Tk. 3073.50, which was 6.16 per cent of total cost. For BARI GOM-23 production, per hectare Urea, TSP and MP costs were Tk. 3298.21 Tk. 5551.43, Tk. 4365.54, respectively, which was 6.10 per cent, 7.78 per cent and 2.73 per cent of total cost, respectively. For BARI GOM-23 production, the total cost for fertilizers was estimated at

Tk.16886.05 per hectare which was higher than the estimated fertilizer cost for producing BARI GOM-24.

Per hectare power tiller cost for BARI GOM-24 and BARI GOM-23 productions were estimated at Tk. 4327.51 and Tk. 4059.105, respectively. In the study area, all the farmers used irrigation for wheat cultivation. Per hectare irrigation costs for the production of both BARI GOM-24 and BARI GOM-23 were estimated at Tk. 2249.20 and Tk. 2121.40, respectively.

Interest on operating cost which included variable costs in the production of both BARI GOM-24 and BARI GOM-23 for a period of 4 months. Interest rate of 10 per cent per annum for both varieties was considered for calculation. For BARI GOM-24, it was Tk. 1152.16 and for BARI GOM-23, it was Tk. 915.15.

Estimation of fixed cost: The land use cost was considered as fixed cost for wheat production in this study. Since all the farmers cultivated their own land, the seasonal rental cost of land was treated as land use cost for the farmers. The per hectare land use cost were Tk.2093.00 and Tk.1529.00 for BARI GOM-24 and BARI GOM-23 production, respectively.

Gross cost: Gross cost was calculated by adding all costs of variable and fixed inputs. Gross costs of BARI GOM-24 and BARI GOM-23 were estimated at Tk. 49898.54 and Tk. 54104.15 per hectare, respectively (Table 1). Per hectare production cost of BARI GOM-24 was lower than that of BARI GOM-23 in the study area.

Gross return: Per hectare gross return was calculated by multiplying the total amount of product and by-product with their respective farm gate prices. Per hectare yield of BARI GOM-24 was 3728.43 kg and 3244.80 kg, respectively (Table 2). In terms of value, the product value of BARI GOM-24 and BARI GOM-23 ton per hectare was Tk. 67111.82 and Tk. 58406.40. Taking the by-product value into account, the total gross returns were Tk. 77715.02 and Tk. 65608.44 for BARI GOM-24 and BARI GOM-23, respectively which are considerably different. Thus, it is clear that BARI GOM-24 production earned higher gross return than that of BARI GOM-23 per hectare.

Gross margin, net return and the benefit cost ratio

Per hectare gross margin of the enterprises was obtained by deducting total variable cost from total return. Per hectare gross margins of BARI GOM-24 and BARI GOM-23 were estimated at Tk. 19306.28 and Tk. 5831.25, respectively. So, the gross margin of BARI GOM-24 was greater than that of BARI GOM-23 (Table 3). In the study area, variable cost of BARI GOM-24 and BARI GOM-23 was almost the same, but the total return of BARI GOM-24 is more than the BARI GOM-23. For this reason farmers were choosing BARI GOM-24 production.

Net return was calculated by deducting total cost from total return. Net return from BARI GOM-24 and BARI GOM-23 was Tk. 17212.93 and Tk. 4301.00, respectively. Net return

from BARI GOM-23 was comparatively lower than BARI GOM-24 since the cost of production for both the varieties were almost same but per hectare yield from BARI GOM-23 was less than the BARI GOM-24. So, per hectare profitability of BARI GOM-24 was higher than that of BARI GOM-23 (Table 3).

Table 1. Per hectare costs for producing BARI GOM-24 and BARI GOM-23

Items	BARI GOM-24		BARI GOM-23	
	Value (Tk.)	Percentage of total cost	Value (Tk.)	Percentage of total cost
A. Variable costs				
Human labor cost	37003.52	74.16	32201.24	59.52
Land preparation	6500.98	13.03	3546.46	6.55
Cleaning	7250.32	14.53	6487.95	11.99
Weeding	6750.41	13.53	7828.30	14.47
Fertilizer application	1000.63	2.01	820.23	1.52
Harvesting and carrying	9000.88	18.04	7802.23	14.42
Threshing	6500.30	13.03	5716.07	10.56
Seed cost	3921.98	7.86	3670.92	6.78
Fertilizer cost	3073.50	6.16	8982.98	16.60
Urea	3073.50	6.16	3298.21	6.10
TSP	-	-	4208.82	7.78
MP	-	-	1475.95	2.73
Power tiller cost	4327.51	8.67	4059.10	7.50
Irrigation cost	2249.20	4.51	2121.40	3.92
Miscellaneous cost	850.00	1.70	625.00	1.16
Interest on operating cost	1152.16	2.31	915.15	1.69
Total variable cost (A)	47805.54	95.81	52575.15	97.17
B. Fixed costs				
Land rental cost	2093.00	4.19	1529.00	2.83
Total fixed cost (B)	2093.00	4.19	1529.00	2.83
C. Total cost (A+B)	49898.54	100.00	54104.15	100.00

Source: Authors' calculation based on field survey, 2012

Table 2. Per hectare gross returns from BARI GOM-24 and BARI GOM-23 production

Wheat variety	Main product			Value of by-product (Tk.)	Gross return (Tk./ha)
	Quantity (kg/ha)	Price (Tk./kg)	Value (Tk.)		
BARI GOM-24	3728.43	18	67111.82	10603.2	77715.02
BARI GOM-23	3244.80	18	58406.4	7202.07	65608.44

Source: Authors' calculation based on field survey, 2012

Table 3. Per hectare production costs and returns of BARI GOM-24 and BARI GOM-23

Items	Value (Tk.) for BARI GOM-24	Value (Tk.) for BARI GOM-23
A. Gross return	77715.02	65608.44
B. Variable cost	47805.54	52575.15
C. Fixed cost	2093.00	1529.00
D. Gross cost (B+C)	49898.54	54104.15
E. Gross margin (A-B)	29909.48	13033.29
F. Net return (A-D)	27816.48	11504.29
G. Benefit cost ratio (A/D) (undiscounted)	1.56	1.21

Source: Authors' calculation based on field survey, 2012

Benefit cost ratio (BCR) was calculated by dividing gross return by gross cost. Table 5.3 shows that BCR (undiscounted) of BARI GOM-24 and BARI GOM-23 production was 1.56 and 1.21, respectively implying that Tk. 1.56 and Tk. 1.21 would be earned by investing every Tk. 1.00 in BARI GOM-24 and BARI GOM-23 production. The results are consistent with previous studies conducted by Haque (2000); Baksh (2003) and Sarker (2012) which estimated the BCR for wheat cultivation. Haque (2000) estimated the BCR for cultivating irrigated and non-irrigated wheat in Pabna to be 1.20 and 1.18, respectively. In the research on economic efficiency of wheat production in North-West Bangladesh, Baksh (2003) found the BCR for wheat production to be 1.52 for Dinajpur and 1.30 for Rangpur districts. Sarker (2012) estimated BCR for wheat cultivation by farm size in Dinajpur district and found them to be 1.06, 1.08 and 1.14 for small, medium and large farms, respectively.

FACTORS AFFECTING GROSS RETURN OF BARI GOM-24 AND BARI GOM-23

Efforts have been made in this section to determine the effects of selected variables on gross return of BARI GOM-24 and BARI GOM-23 production using Cobb-Douglas production function model. In case of BARI GOM-24, human labour cost, seed cost and fertilizer cost had positive significant effect on gross return. Human labour cost was significant at 5 per cent level of significance while seed cost and fertilizer cost were significant at 1 per cent level of significance. The coefficients for human labour cost, seed cost and fertilizer cost were 0.125, 0.452 and 0.351, respectively. The meaning can be expressed as one per cent increase in the value of human labour would increase the gross return by 0.125 per cent, keeping other factors constant. Similarly 1 per cent increase in the cost of seed would increase the gross return by 0.452 per cent and 1 per cent increase in the cost of fertilizer would increase the gross return by 0.351 per cent respectively, while other factors are kept constant. The positive significant coefficients mean that these inputs are used rationally in the production process and the gross return can be increased further by using more of these inputs.

Similarly, in case of BARI GOM-23, human labour cost, seed cost, fertilizer cost and irrigation cost had positive significant effect on gross return. The coefficients for human labour and fertilizer costs were significant at 10 per cent level of significance, while seed and irrigation costs were significant at 1 per cent level of significance. The coefficients for human labour cost, seed cost, fertilizer cost and irrigation cost were 0.225, 0.321, 0.210 and 0.035, respectively, meaning one per cent increase in the respective variable would increase the gross return by 0.225 per cent, 0.321 per cent, 0.210 per cent and 0.035 per cent respectively, while keeping other factors constant. Here human labour, seed, fertilizer and irrigation are positive significant coefficients mean these inputs are used rationally in BARI GOM-23 production and the gross return can be increased further by using more of these inputs.

Table 4. Coefficient and related statistics of Cobb-Douglas production function of BARI GOM-24 and BARI GOM-23

Explanatory variables	BARI GOM-24		BARI GOM-23	
	Estimated coefficients	t- value	Estimated coefficients	t- value
Constant	2.895**	4.898	2.410**	2.939
	(0.591)		(0.820)	
Human labor cost (X_1)	0.125**	2.314	0.225*	2.142
	(0.054)		(0.105)	
Seed cost (X_2)	0.452***	2.825	0.321***	3.487
	(0.160)		(0.092)	
Fertilizer cost (X_3)	0.351***	3.857	0.210*	2.079
	(0.091)		(0.101)	
Irrigation cost (X_4)	0.042	1.55	0.035***	2.916
	(0.027)		(0.012)	
Power tiller cost (X_5)	0.221	1.63	0.216	1.56
	(0.135)		(0.138)	
R^2	0.75		0.65	
Adjusted $\overline{R}^2$	0.65		0.50	
F-value	6.961***		4.472***	
Return to scale	1.19		1.007	

Source: Author's estimation, 2012

Note: Figures in the parentheses indicate standard error; ***Significant at 1 per cent level; ** Significant at 5 per cent level; and * Significant at 10 per cent level

It is evident from Table 4 that the values of the coefficient of multiple determinations (R^2) are 0.75 and 0.65 for BARI GOM-24 and BARI GOM-23 which means the explanatory variables included in the model explained 75 and 65 per cent of the variation of BARI GOM-24 and BARI GOM-23 production, respectively. The values of adjusted R^2 are 0.65

and 0.50 indicating that after taking into account the degrees of freedom, those explanatory variables in the model still explain about 65 and 50 per cent of the variations in the dependent variable Y respectively.

Returns to scale for BARI GOM-24 and BRRI GOM-23 were 1.19 and 1.007 which is greater than one. It implies that both BRRI GOM-24 and BRRI GOM-23 were in increasing returns to scale. So, the production of both BRRI GOM-24 and BRRI GOM-23 can be increased by increasing the use of the variable inputs as well.

PROBLEMS FACED BY FARMERS IN PRODUCING BARI GOM-24 AND BARI GOM-23 WITH PROBABLE SOLUTIONS

The experience obtained from the field survey indicates that the farmers are facing a number of problems in case of producing both BARI GOM-23 and BARI GOM-24. A common problem identified by both BARI GOM-23 and BARI GOM-24 farmers was the high price of fertilizer. In this study, 73 per cent of BARI GOM-23 growers and 63 per cent of BARI GOM-24 growers reported it as a problem for which they could not apply adequate doses of fertilizers. Another major problem faced in BARI GOM-23 was low production (reported by 66 per cent of BARI GOM-23 growers). Again, 50 per cent BARI GOM-24 farmers complained the problem of seed collection since it was a new variety and not many farmers were cultivating the variety. Other problems reported by farmers were insect infestation, seed purity, grain unfitting and seed germination.

The following suggestions were made in order to solve these problems:

i. Government and non-government research institutions should strengthen the wheat research and seed production in order to develop more productive and disease resistant varieties;
ii. In the production of BARI GOM-24, price of seed should be decreased by increasing the supply of seed, so that farmers could be capable for production of BARI GOM-24;
iii. The price of fertilizer and pesticides should be regulated strictly by the government;
iv. The government should provide more subsidies on fertilizer and diesel for BARI GOM-24 and BARI GOM-23 production and make efforts to ensure that farmers timely receive the benefits of such subsidies for achieving higher yield of wheat.

CONCLUSION

The study assesses the relative profitability of growing BARI GOM-24 and BARI GOM-23. The results indicated that both BARI GOM-24 and BARI GOM-23 production are profitable for the farmers, but BARI GOM-24 was more profitable than BARI GOM-23. The Cobb-Douglas production function was used to determine the effects of some important inputs on value of gross return for BARI GOM-24 and BARI GOM-23 wheat. The estimated values of the relevant co-efficient revealed that among the included variables, human labor, seed, fertilizer, and irrigation had significant impact on the gross

return of BARI GOM-24 while human labor, seed, fertilizer and irrigation had significant impact on the gross return of BARI GOM-23 production. Also, both the regression showed increasing returns to scale for the two wheat varieties, meaning that farmers could further increase their return by increasing the use of the variable inputs. The major problems faced by the farmers were impure seed, seed collection, low germination rate, high price of seed, high price of fertilizer and insecticides and attack by insect.

However, it could be concluded that since both BARI GOM-24 and BARI GOM-23 are profitable, necessary steps can be taken to extend their cultivation in similar agro-climatic regions. Moreover, more priority should be given to BARI GOM-24 because it is more profitable than the other variety.

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