Productivity, Profitability and Resource Use Efficiency: A Comparative Analysis between Conventional and High Yielding Rice in Rajbari District, Bangladesh

Md. Yahia Bapari

Pabna University of Science & Technology,
Department of Economics, Lecturer, Bangladesh

Abstract. The study was analyzed the determinants, costs and benefits and resources allocation of both conventional and high yielding rice cultivation over the Rajbari district of Bangladesh. Data were accumulated from 300 regular rice growers of conventional and high yielding varieties and random sampling technique was applied for selecting the respondents from the study area from which information was collected through pre-tested questionnaire. Cobb – Douglas production function and gross margin were mainly used to determine the productivities and profits of both rice and the marginal value of the product was highly recommended to derive the optimal use of the resources. Results obtained by applying ordinary least square method showed that the most important factors of production in the study area were irrigation, labor, fertilizer and insecticide costs whose elasticities were 0.904, 0.048, 0.045 and 0.044 respectively and insignificant factors were seed and ploughing costs whose elasticities were – 0.009 and 0.030 respectively for high yielding rice. On the other hand, irrigation, insecticide, seed and ploughing costs of elasticities 0.880, 0.589, 0.116 and – 0.127 respectively were the important factors and minor role playing factors were labor and fertilizer costs whose elasticities were 0.098 and 0.077 respectively for conventional yielding rice. The core message from productivity analysis was that the irrigation was key variable which played a positive and vital role in producing rice of both varieties. All variables (resources) were economically misallocated in the production activities of both varieties along the study area but high yielding rice was more profitable than conventional one. Results also showed that the farmers of the study area produced rice of both varieties in the inefficient range of production. Continuous supply of electricity, flexible credit and improving the existing resources were the prime policy recommendations of producing more rice efficiently in future in the study area.

Keywords: productivity; resource use efficiency; conventional and high yielding rice; Rajbari.

UDC 338.43 **JEL Classification: O13, Q1**

DOI: http://dx.doi.org/10.22178/pos.15-10

Introduction

Agriculture is the most primitive occupation in the world and is considerated as a heart of the human civilization and settlement. Bangladesh is an agrobased land which is blessed with many natural resources and its climate and environment are very suitable for the successful production of food and cash crops. Rice is the most important and fundamental food crop in Bangladesh. It dominates the crop sector of Bangladesh agriculture approximately more than 73 % of total cropped area and is treated as principal food to the people of Bangladesh [14]. Bangladesh has been familiar as the sixth largest rice producer country in the world [7] where rice area had prolonged faintly during 2001 to 2010 [4] and rice area under irrigation increased from about 30 % in 1995 to 73 % in 2008 [3]. During the similar period, the share of Conventional Yielding Varieties was lower than modern High Yielding Varieties which also increased from 52 % to just about 80 % [3]. Rice is the seed of monocot plant called paddy. Generally, paddy is husked out in order to get rice. The scientific name of rice is Oriza Sativa L. It is a staple food for more than half of the world's population [13] and more than 95 % of population consumes rice in Bangladesh.

Though agricultural production both of food and cash grains is increasing day by day in Bangladesh but the country has to import food grains especially rice every year in the last decades to fulfil the extra demand [11]. Hopefully, Bangladesh didn't import any rice officially but only private sector imported 2.15 lakh metric tons rice in

2015-16 [10]. So, it can be said that Bangladesh is at the door of self-sufficiency in the production of food grains which can be achieved if productivity could be pulled up through enhancing technical and economic efficiency in agriculture [8].

Rice mainly grows in Asia, Europe, America and Africa continents in the world. It requires plain and moist land and heavy rainfall for its growth. So, rice production largely depends on weather and climate factors like solar radiation (including sunshine and day length), temperature, rainfall, evaporation, wind and humidity, soil structure, social values and customs, land-tenure, fragmentation and sub-division of land. But, the climate in Bangladesh changes every year where hazards like floods, droughts, cyclones occurred. So, rice production hampered every year.

Rice in Bangladesh is grown in three distinct seasons; namely Boro (January to June), Aus (April to August) and Aman (August to December) [5]. The first is the High Yielding Variety (HYV) while the last two are Conventional Yielding Variety (CYV) in Bangladesh [2]. CYV is the summer and rain-fed crops whereas HYV is the winter crop. The development and perfection of rice varieties are very essential because the enhancement of world supply largely depends on it and various conventional and biotechnological procedures are applied to develop the HYVs that having resistance against biotic stresses [17].

The People of Bangladesh live on rice. Various products are made from rice. Rice flour, Rice syrup, Rice born oil, Rice milk, Chira, Muri, Khai and many kinds of cakes are made of it. Polao, Khichuri, and Payes are also made of rice. Around 68 % of the protein in the national diet, 78 % of the value of agricultural output and 30 % of consumer spending comes from rice [1]. Again, straw is used as fodder for cattle, as fuel and as a roof. It is proved by many researchers that Rice is an every 165 grams brown rice (1 cup) contains calories 10 %, Protein 7 %, carbohydrate 15 %, fat and fatty acid 1 %, vitamin B3 14 %, Vitamin B6 4 %, Calcium 1 %, Iron 16 %, Magnesium 2 %, Phosphorus 6 %, Zinc 5 % , Copper 3 %, Manganese 28 % and Selenium 22 %.

So, in the agriculture sector of Bangladesh, rice is the single crop which plays the most important contribution to GDP, income and employment generation, and meets the challenges to self-sufficiency in food production [7], reducing rural poverty and to foster sustainable economic development in Bangladesh. So, the people of Bangladesh can't live without rice ever for a day.

The current study is designed to focus the following objectives: (1) comparing the production functions and profitability between conventional and high-yielding varieties of rice and (2) showing an allocative efficiency of the resources use in the study area for both CYV and HYV of rice.

Materials and methods

The study was based on the multistage random sampling procedure where Rajbari district was the first stage purposively chosen as the study area and the selection of respondents were the last stage. The pilot survey was chosen for the data collection from the rice growers.

Rajbari district is situated on the bank of Padma river and lies between 22º40' and 23º50' north latitudes and between 89º19' and 90º40' east longitudes. It covers 1092.28 square kilometres having five upazilas namely, Rajbari sadar, Pangsha, Baliakandi, Goalanda and Kalukhali and the annual average temperature varies from maximum 35.8º to minimum 12.6º and total annual rainfall is 2105 mm that are very supportive of agricultural activities throughout the season. The district is predominantly an agriculture-oriented area in which many agricultural products such as rice, jute, onion, oilseed, pulse, garlic, ginger, wheat, sugarcane, potato, cataract, cucumbers, ground nut and so on are produced in different seasons. Rajbari is one of the most important districts of growing CYV and HYV rice in Bangladesh. Most of the rice growers produce rice of conventional varieties during the summer season and of high yielding varieties during the winter season.

The primary data were collected for a total of 300 farmers from three Upazilas videlicet Rajbari sadar, Pangsha and Goalanda of Rajbari district that are more suitable for rice production in comparative to other upazilas and considering time and fund constraints ten villages were selected from these three upazilas such as Bhabadia, Kamalpur, Urakanda and Baniboh were taken from Rajbari sadar upazila, Debogram, Doulatdia and Sajapur from Goalanda upazila and Mrigee, Habaspur and Dowki from Pangsha upazila and finally fifteen regular farmers of using CYV and another fifteen of using HYV were selected from each village randomly (Table 1).

Table 1 – Distribution of Sample by Study areas

District	Upazila	Name of villages	No. of rice farming households interviewed	
			CYV	HYV
Rajbari	Rajbari Sadar	Bhabadia	15	15
		Kamalpur	15	15
		Urakanda	15	15
		Baniaboh	15	15
	Goalanda	Dabogram	15	15
		Doulatdia	15	15
		Sajapur	15	15
	Pangsha	Mrigree	15	15
		Habaspur	15	15
		Dowki	15	15

The data given by the respondents were collected through the use of well-structured and pre-tested questionnaire developed by the researcher and also by face to face interview method. Therefore, the main source of data consists of a primary source as the primary data were collected from the rice growers during the crop year. Secondary data were brought together from the various publications, relevant journals and printed documents, Bangladesh Bureau of Statistics (BBS), Bangladesh Economic Review (BER), Yearbook of Agriculture Statistics of Bangladesh, various websites etc.

Finally, the editing and transferring data from questionnaire into worksheet after completing the field work, the Statistical Package for Social Science (SPSS) version 21 was used as a database file and obtained results for productivity and allocative efficiency of inputs.

Analytical techniques

Profitability Analysis. *Gross Margin.* The Gross margin (GM) of both conventional and high yielding variety's rice is obtained by deducting the Total Variable Cost (TVC) from the Total Revenue (TR) of the rice production [15]:

$$GM = TR - TVC. \quad (1)$$

Net Return. The Net Return (NR) refers to the actual profit from the rice cultivation of the farmers which is found by comparing the TR and TC (total cost) of cultivating rice. Mathematically [12, 17]:

$$NR = TR - TC. \quad (2)$$

Average Rate of Return. Average Rate of Return (ARR) was derived by dividing total gross margin by the total cost of production per bigha, multiplied by 100. It is defined as follows [13]:

$$ARR = \frac{GM}{TC} \times 100. \quad (3)$$

Benefit – Cost Ratio (BCR) analysis. This ratio was measured in the study in two different ways:

$$BCR = \frac{TR}{TVC}. \quad (4)$$

Many economists called it as I/O.

$$BCR = \frac{TR}{TC}. \quad (5)$$

It is widely used in Economics. If $BCR > 1$, then the production of revenue from rice is economically satisfactory; if $BCR < 1$, then the revenue from rice is not economically satisfactory and if $BCR = 1$, then there is economic breakeven point of rice production which is similar to other crop cultivation.

Empirical Model of Productivity Analysis. The production function analysis of rice for both CYV and HYV is used to determine the factors affecting rice production. It gives the technical relationship between dependent and independent variable of production process. To determine the contribution of the most important variables in the production process, the following stated in implicit of the model (6):

$$Y = AX_1^{\beta_1} X_2^{\beta_2} X_3^{\beta_3} X_4^{\beta_4} X_5^{\beta_5} X_6^{\beta_6} e^{\mu_i}, \quad (6)$$

The natural logarithms from of the Cobb-Douglas production function is:

$$\ln Y = \ln A + \beta_1 \ln X_1 + \beta_2 \ln X_2 + \\ + \beta_3 \ln X_3 + \beta_4 \ln X_4 + \beta_5 \ln X_5 + . \quad (7) \\ + \beta_6 \ln X_6 + \mu_i$$

where Y – total return of rice production, Tk/bigha;

X_1 – seed cost, Tk/bigha;
X_2 – labor cost Tk/bigha;
X_3 – fertilizer cost, Tk/bigha;
X_4 – insecticide cost, Tk/bigha;
X_5 – ploughing cost, Tk/bigha;
X_6 – irrigation cost, Tk/bigha;
μ_i – error term.

Symbol μ_i is assumed to be normally distributed with constant mean and zero variance. In the production function seed cost, labor cost, fertilizer cost, insecticide cost, ploughing cost, irrigation cost were assuming to be independent variables and total return was assumed to be dependent variable. By applying Ordinary Least Square (*OLS*) method in this equation, the researcher was derived the value of input coefficients, return to scale, F-value, adjusted R^2 and Durbin-Watson (*D-W*) value for CYV and HYV rice.

Returns to Scale (RTS). The term *RTS*, a long run concept in the production function analysis, refers to the responsiveness of output when a set of input changes by the constant or same proportion [9]. In the production process, if the output increases faster than the rise in inputs then it is called increasing *RTS*, if output changes less than the change in inputs it is familiar as decreasing *RTS* and if output and inputs change in same proportion it is called constant *RTS*. In this study, the *RTS* was dignified by adding together all regression coefficients of production function for all independent variables. Symbolically:

$$RTS = \sum_{i=1}^{6} \beta_i \,. \quad (8)$$

Here, β_i is the production or regression coefficients of the variables X_1 to X_6.

Therefore, it can be said that if RTS is greater than 1, lesser than 1 and equal to 1 then it will be called increasing, decreasing and constant RTS respectively.

Elasticity of Production. Elasticity of Production (E_p) is defined as the percentage change in output/gross revenue (dependent variable) relative to a unit change in an input (independent variable) while other inputs (independent variables) are kept constant in the production process. So, in the Cobb-Douglas production function, the coefficients of independent variables are known as the production elasticities [16]. Symbolically, $E_p = \beta_i$ and if $E_p > 1$, $E_p < 1$ and $E_p = 1$, then the elasticity of production is elastic, inelastic and unity respectively.

Allocative efficiency of inputs. The allocative efficiency of resource use in the production of rice was determined by using tools for projected efficiency. The marginal value product (MVP) of the resource used in rice production was estimated by multiplying the marginal physical product (MPP) by the unit price of the output (Y). That is [6]:

$$MVP = b_i \frac{Y(GM)}{X(GM)} \,. \quad (9)$$

The marginal value product was divided by the cost of one unit of the (marginal factor cost) to make influence on allocating use efficiency. In order to make the relative efficiency of resource use the following ratio were computed (10):

$$R = \frac{MVP}{MFC} \,, \quad (10)$$

where R – fficiency ratio;
MFC – marginal factor cost [6].

If $R = 1$, resource is efficiently used; $R < 1$, resource is underutilized and $R > 1$, resource is over utilized [18].

Results and discussion

Productivities and production functions analysis. The collected data for 300 rice growers of which 150 farmers are CYV rice growers and remaining 150 farmers are HYV rice growers were analyzed by SPSS software version 21 and applying *OLS* method on the six important variables relating to rice production the researcher obtained different results for each variety. Table 2 shows CYV and HYV lead equations of production functions.

Table 3 shows the productivities of CYV and HYV user rice growers.

www.pathofscience.org
ISSN 2413-9009

Table 2 – Estimated rice production functions for CYV and HYV of the Respondents

The estimated production function for Conventional Yielding Varieties (CYV) in the study area	$\ln Y = 1.136 + 0.116 \ln X_1 + 0.077 \ln X_2 + 0.098 \ln X_3 + 0.589 \ln X_4 - 0.127 \ln X_5 + 0.880 \ln X_6$
The estimated production function for High Yielding Varieties (HYV) in the study area	$\ln Y = 0.683 - 0.009 \ln X_1 + 0.048 \ln X_2 + 0.045 \ln X_3 + 0.044 \ln X_4 + 0.030 \ln X_5 + 0.904 \ln X_6$

Table 3 – Estimated regression coefficients of the explanatory variables of Cobb-Douglas model

Variables (in bigha)	HYV				CYV			
	coefficient	stan. error	t-value	sig.	coefficient	stan. error	t-value	sig.
(Constant)	0.683	0.394	1.733	0.085	1.136	1.036	1.097	0.275
Seed cost	-0.009NS	0.016	-0.370	0.712	0.116*	0.048	1.899	0.060
Labor cost	0.048*	0.022	1.817	0.071	0.077NS	0.055	1.262	0.209
Fertilizer cost	0.045*	0.036	1.758	0.081	0.098NS	0.072	1.639	0.103
Insecticide cost	0.044*	0.031	1.837	0.068	0.589***	0.059	7.544	0.000
Ploughing cost	0.030NS	0.034	1.174	0.242	-0.127*	0.073	-1.874	0.063
Irrigation cost	0.904***	0.027	32.794	0.000	0.880***	0.050	11.329	0.000
RTS	1.062				1.63			
Adjusted R^2	0.920				0.490			
F	286.266			0.000	24.847			0.000
Durbin-Watson	2.045				2.053			

Source: Author's own calculation. N.B: *** and * are 1 % and 10 % level of significance respectively.

From table 3, it is seen that only four variables viz. labor, fertilizer, insecticide and irrigation costs per bigha play a positive and significant role in producing HYV rice over the study area whereas the seed, insecticide and irrigation costs per bigha play the same role in case of CYV rice cultivation. An important message is that irrigation is the key variable and plays a chief role in the cultivation of both CYV and HYV rice. If the irrigation cost increases by 1 % the gross revenue of HYV and CYV rice increased by 0.904 % and 0.880 % respectively.

Other variables for HYV rice are seed and ploughing costs that are insignificant but the seed cost plays an inverse role with a minor elasticity (0.009) and ploughing cost acts a positive role with also minor elasticity (0.030) and for CYV rice, labor and fertilizer costs are non-significant and ploughing cost plays an inverse role in the production process.

The values of adjusted R^2 for HYV and CYV rice are 0.920 and 0.490 respectively which imply that around 92 % variations of gross revenue (dependent variable) were explained by the explanatory variables in case of HYV rice and approximately 49 % variations of gross revenue (dependent variable) were created by independent variables of the CYV rice along the study area. So, the HYV rice is very fruitful in the study area if these variables work effectively.

The F-values of the rice productions obtained for 286.266 and 24.847 for CYV and HYV rice respectively were highly significant which indicates that all variables taken in this study were important and capable to explain the variations of the gross returns throughout the rice production process. The Durbin-Watson values for HYV and CYV rice were approximately 2 which implies that the data were free from auto correlation problem.

The values of *RTS* for HYV and CYV rice were 1.062 and 1.63 respectively which indicate that farmers faced increasing *RTS*, i.e., if inputs of rice production for both HYV and CYV are increased then the gross return of the rice cultivation will increase at a faster rate.

In this table 3, it is seen that the elasticity of each input is less than unity which imply the inelastic phenomenon of rice production. Since the elasticities of all farmers for both HYV and CYV rice were greater than unity the rice growers allocated their resources in the irrational stage

(stage-I) of production. They cannot operate their production activities at efficient range of production and also cannot use the production inputs in optimal way.

Cost analysis. Table 4 shows the difference of cost of the production between HYV and CYV rice and also shows the various components of cost incurred throughout the production process by the rice farmers of both varieties.

Table 4 – Cost components of CYV and HYV rice growers in the study area

Variables	HYV		CYV	
	average cost (Tk/bigha)	%	average cost (Tk/bigha)	%
Variable costs				
Seed cost	583.6878	3.61	342.1953	2.65
Labor cost	4201.3776	26.01	3791.6747	29.36
Fertilizer cost	2688.8554	16.64	2563.6967	19.85
Insecticide cost	316.5900	1.96	336.9324	2.61
Ploughing cost	806.8794	4.99	753.8699	5.84
Irrigation cost	6307.9431	39.05	3876.9345	30.02
A. Total Variable Cost (Tk/bigha)	14905.33	92.26	11665.3	90.32
B. Total Fixed Cost (Tk/bigha)	1250.00	7.74	1250.00	9.68
Total costs (Tk/bigha) (A+B)	16155.33	100.00	12915.3	100.00

The variable costs dominate the whole production where irrigation cost is the major cost item around 39.05 % and 30.02 % of the total cost for HYV and CYV rice respectively. Another important cost is labor which contributes approximately 26.01 % and 29.36 % of the total cost for HYV and CYV correspondingly. The total fixed cost consists of land rent and land use cost during the production season that contributes only 7.74 % and 9.68 % of the total cost in case of HYV and CYV respectively. During the data collected period, the total variable cost, fixed cost and total cost per bigha incurred by the rice farmers were Tk. 14905.33, Tk. 1250 and Tk. 16155.33 and Tk. 11665.3, Tk. 1250 and Tk. 12915.3 for HYV and CYV rice respectively. Therefore, it can be said that the HYV rice cultivation consumes more costs than that of CYV in the study areas.

Return and profitability of rice production. Return and profit are the most important concept by which a farmer takes the decision of continuing production activities. Although there are many farmers lived in our country who cultivate rice without the consideration of profit, but a researcher provides basic policies of increasing the productivity of rice with profitability analysis. Table 5 shows the different components of return and profit of rice cultivation. Return from the rice cultivation comes in terms of yield and by product (straw). By adding the values of yield and straw the researcher obtained gross return of the rice production. The gross return of HYV rice was Tk. 18703.8641 which was larger than that of CYV rice (Tk. 13126.92).

Table 5 – Return and profitability analysis of CV and HYV rice growers in the study area

Particulars	HYV	CYV
Yield of rice (Kg/bigha)	1166.92	795.13
Yield of by product (Kg/bigha)	240	240
Value of rice (Tk./bigha)	17503.8641	11926.92
Value of by product (Tk./bigha)	1200	1200
Gross Return (Tk/bigha)	18703.8641	13126.92
Total Variable cost (Tk/bigha)	14905.33	11665.3
Total Fixed cost (Tk./bigha)	1250.00	1250.00
Total cost (Tk/bigha)	16155.33	12915.3
GM(Tk/bigha)	3798.5341	1461.62
NR(Tk/bigha)	2548.5341	211.62
ARR (for bigha) (%)	23.513	11.317
I/O (for bigha)	1:1.25	1:1.13
BCR (for bigha)	1:1.16	1:1.02

www.pathofscience.org
ISSN 2413-9009

The profitability analysis was completed with aid of *GM* and *NR* which were Tk. 3798.5341 and Tk. 2548.5341 for HYV and Tk. 1461.62 and Tk. 211.62 for CYV respectively. Many economists examine the profit rate by the *ARR* which was 23.513 and 11.317 for HYV and CYV rice. It implies that the cultivation of HYV rice is around twice profitable than the CYV rice. The *BCR* in variable cost basis *(I/O)* and total cost basis were 1.25 and 1.16 for HYV and 1.13 and 1.02 for CYV rice during the crop season.

Allocative efficiency analysis. The optimal utilization of resources or inputs was derived by the analysis of allocative efficiency which is shown in table 6.

Table 6 – Allocative efficiency of inputs used by the CYV and HYV rice growers in the study area

Variables (bigha)	HYV				CYV			
	GM	Coefficient	MVP	Remark	GM	Coefficient	MVP	Remark
Gross Return	18703.86				13126.92			
Seed cost	583.69	-0.009	-0.29	Over utilized	342.20	0.116	4.45	Under utilized
Labor cost	4201.38	0.048	0.21	Over utilized	3791.67	0.077	0.27	Over utilized
Fertilizer cost	2688.86	0.045	0.31	Over utilized	2563.70	0.098	0.50	Over utilized
Insecticide cost	316.59	0.044	2.60	Under tilized	336.93	0.589	22.95	Under utilized
Ploughing cost	806.88	0.030	0.70	Over utilized	753.87	-0.127	-2.21	Over utilized
Irrigation cost	6307.94	0.904	2.68	Under utilized	3876.93	0.880	2.98	Under utilized

It could understand from the table 6 that all of factors of production are not economically allocated. Since Marginal Factor Cost is assumed to be 1, only *MVP* indicates the optimum utilization of inputs used in rice production. If *MVP > 1, < 1 and = 1*, then the allocation of resources is under, over and optimum utilization. Here is in the study area all of the factors of production are mis- allocated. The seed, labor, fertilizer and Ploughing costs were over utilized as *MVP < 1*, and insecticide and irrigation were underutilized as *MVP > 1* for HYV rice production. On contrary, the seed, insecticide and irrigation were under utilized as *MVP > 1* and labor, fertilizer and Ploughing costs were over utilized as *MVP < 1* for CYV rice.

Conclusion and Suggestions

The core message of this study is that the HYV rice is more suitable and profitable than the CYV rice in the Rajbari district. All of the factors namely seed cost, labor cost, fertilizer cost, insecticide cost, Ploughing cost and irrigation cost are very important for both rice cultivation of which labor, fertilizer, insecticide and irrigation are the dominant factors for HYV rice and seed, insecticide, ploughing and irrigation are the prime factors of CYV rice in the study area. The production function analysis also concludes that the farmers produce their both HYV and CYV rice in the inefficient range. Finally, the resource use efficiency gives an alarm that all resources used in the production activities over the study area are not economically optimal, they have mis-allocation.

Some policies can be suggested for higher productivity, profitability and efficiently allocated inputs of HYV and CYV rice cultivation in the study area.

Since irrigation is the key factor of the production, so the supply of electricity should be launched in a continuous process and should be very cheap and available for the farmers during the crop season in the study area.

It is obvious that rice production for both HYV and CYV can be enhanced either by extending the cropped area under rice cultivation or by improving the productivity of existing resources allocated to rice production. The cropped area is limited by nature so the only way to increase the efficiency of the factors of production. For this, the institutional investment in input delivery in time, infrastructural development, improving marketing channels, increase in farm management services and rising farmers' technical efficiency should be very strong in the study area.

Government should increase its expenditures in research and development on improving CYV for obtaining higher profit from the study area.

Flood resistance dam should be made in Doulatdia where huge amount of CYV rice are damaged every year due to flood.

Agricultural credit should be more flexible and available to the farmers so that they can invest more in their field.

References

1. Ahmed, R., Haggblade, S., & Chowdhury, T. E. (Eds.). (2000). *Out of the Shadow of Famine: Evolving Food Markets and Food Policy in Bangladesh*. Baltimore, MD: Published for the International Food Policy Research Institute (IFPRI) by Johns Hopkins University Press. Retrieved from http://ebrary.ifpri.org/cdm/ref/collection/p15738coll2/id/129702
2. Backman, S., Islam, K. M. Z., & Sumelius, J. (2011). Determinants of technical efficiency of rice farms in North-Central and North-Western regions in Bangladesh. *The Journal of Developing Areas, 45,* 73–94. doi: 10.1353/jda.2011.0001
3. Bangladesh Bureau of Statistics. (2010). *Yearbook of Agricultural Statistics of Bangladesh 2010*. Dhaka: Statistics Division, Ministry of Planning. Government of the People's Republic of Bangladesh.
4. Bangladesh Bureau of Statistics. (2011). *Yearbook of Agricultural Statistics of Bangladesh 2011*. Retrieved from http://www.bbs.gov.bd/PageWebMenuContent.aspx?MenuKey=234
5. Bapari, M. Y., & Joy, M. A. K. (2016). Estimation of Rice Production Function in Rajbari District, Bangladesh: an Econometric Analysis. *Asian Journal of Humanity, Art and Literature, 3(1),* 99-112. Retrieved from http://journals.abc.us.org/index.php/ajhal/article/view/790
6. Grema, I. J., & Gashua, A. G. (2014). Economic analysis of onion production along river Komadugu area of Yobe state, Nigeria. *IOSR Journal of Agriculture and Veterinary Science (IOSR-JAVS), 7(10),* 05-11. Retrieved from http://www.iosrjournals.org/iosr-javs/papers/vol7-issue10/Version-1/B071010511.pdf
7. Hasnain, M. N., Hossain, M. E., & Islam, M. K. (2015). Technical Efficiency of Boro Rice Production in Meherpur District of Bangladesh: A Stochastic Frontier Approach. *American Journal of Agriculture and Forestry, 3(2),* 31-37. doi: 10.11648/j.ajaf.20150302.14.
8. Hossain, M. E., & Rahman, Z. (2012). Technical Efficiency Analysis of Rice Farmers in Naogaon District: An Application of the Stochastic Frontier Approach. *Journal of Economics and Development Studies, 1(1),* 1–20.
9. Koutsoyiannis, A. (1979). *Modern Microeconomics* (2nd ed.). NY, USA: Macmillan Education. doi: 10.1007/9781349160778
10. Ministry of Finance Government of The People's Republic of Bangladesh. (2011). *Bangladesh Economic Review 2011.* Retrieved from http://www.mof.gov.bd/en/index.php?option=com_content&view=article&id=211
11. Nargis, F., & Lee, S. H. (2013). Efficiency analysis of boro rice production in North-Central region of Bangladesh. *The Journal of Animal & Plant Sciences, 23(2),* 527-533. Retrieved from http://www.thejaps.org.pk/docs/v-23-2/32.pdf
12. Nimoh, F., Asuming-Brempong, S., & Sarpong, D. B. (2012). Consumer Preference for Processed Cowpea Products in Selected Communities of the Coastal Regions of Ghana. *Asian Journal of Agriculture and Rural Development, 2 (2),* 113-119. Retrieved from http://www.aessweb.com/pdf-files/2-30-2(2)2012-AJARD-113-119.pdf
13. Omotesho, O. A., Lawal, A. M. & Yusuf, Y. K. (2010). Economics small scale rice production in Patigi and Edu local government areas of Kwara sate, Nigeria. *African Journal of Agricultural Research, 5(4).*

14. Sarkar, M. S. K., Hasan, M. R., Feardous, M. A., Shuhel, M. M. H., Moniruzzaman (2010). Comparative Economic Analysis of Borrower and Non – Borrower Boro Rice Farmers in some selected sites of Mymensingh District. *Bangladesh Journal of Agricultural Research, 35(1)*, 65-76. doi: 10.3329/bjar.v35i1.5867.
15. Sarma, P. K., Raha, S. K., & Jorgensen, H. (2014). An economic analysis of beef cattle fattening in selected areas of Pabna and Sirajgonj Districts. *Journal of the Bangladesh Agricultiral University, 12(1),* 127–134. doi: 10.3329/jbau.v12i1.21402
16. Tan, Bao Hong. (2008). *Cobb-Douglas production function*. Retrieved from http://docentes.fe.unl.pt/~jamador/Macro/cobb-douglas.pdf
17. Wagan, S. A., Noonari, S. M, Memon, I. N., Bhatti, M. A., Kalwar, G. Y., Sethar, A. A., & Jamro, A. S. (2015). Comparative Economic Analysis of Hybrid Rice v/s Conventional Rice Production in District Badin Sindh Province Pakistan. *Journal of Environment and Earth Science, 5(3),* 76-89. Retrieved from http://www.iiste.org/Journals/index.php/JEES/article/viewFile/20109/20295
18. Wosor, D. K, & Nimoh, F. (2012). Resource use efficiency in Chili Pepper production in the Keta municipality of Volta Region of Ghana. *Elixir Production Management, 47,* 8595-8598. Retrieved from http://www.elixirpublishers.com/articles/1350379464_47%20(2012)%208595-8598.pdf

Received 2016-10-20, Accepted 2016-10-28, Published online 2016-10-30

Производительность, рентабельность и эффективность использования ресурсов: сравнительный анализ обычной и высокой урожайности риса в провинции Раджбари, Бангладеш

Md. Yahia Bapari

Pabna University of Science & Technology, Department of Economics, Lecturer, Бангладеш

Аннотация. В исследовании были проанализированы определяющие факторы, затраты, выгоды и распределение ресурсов как обычного, так и высокопродуктивного выращивания риса в провинции Раджбари, Бангладеш. Данные были получены от 300 постоянных рисоводческих хозяйств, выращивающих обычные и высокоурожайные сорта риса; метод случайной выборки был применен для отбора респондентов из исследуемой области, информация о которой была собрана через предварительное тестирование. Для определения продуктивности и прибыли от обоих сортов риса были использованы производственная функция Кобба-Дугласа и показатели валовой прибыли. Оптимальное использование ресурсов настоятельно рекомендуется для определения предельной стоимости продукта.

Результаты, полученные с применением обычного метода наименьших квадратов показали, что наиболее важными факторами производства в районе исследования были орошение, рабочая сила, удобрение и затраты на инсектициды, эластичность которых составила 0,904, 0,048, 0,045 и 0,044, соответственно, и незначимые факторы, такие как затраты на семена и вспашку, эластичность которых составила 0,009 и 0,030 соответственно для высокоурожайных сортов риса. С другой стороны, орошение, инсектициды и затраты на семена и вспашку эластичностью 0,880, 0,589, 0,116 и − 0,127 соответственно были важными факторами для риса с обычной урожайностью, в то время как второстепенную роль играли факторы рабочей силы и удобрений эластичностью 0,098 и 0,077 соответственно.

Главным выводом по результатам анализа производительности является то, что орошение – это ключевая переменная, которая сыграла позитивную и важную роль в производстве риса обоих сортов. Все переменные (ресурсы) были экономически нерациональны в производстве обоих сортов в регионе исследования, но рис высокой урожайности был более выгодным, чем рис обычной урожайности. Результаты также показали, что фермеры области исследования выращивали рис обоих сортов в неэффективном диапазоне производства. Непрерывная подача электроэнергии, гибкое кредитование и совершенствование существующих ресурсов были главными рекомендациями по эффективному выращиванию риса в исследуемой области в будущем.

Ключевые слова: производительность; эффективность использования ресурсов; обычные и высокоурожайные сорта риса; Раджбари.

УДК 338.43 **JEL Classification: O13, Q1**

DOI: http://dx.doi.org/10.22178/pos.15-10

Статья получена 20.10.2016, принята 28.10.2016, опубликована online 30.10.2016