Bangladesh Journal of Political Economy

Vol. 31, No. 5, January 2017, pp. 375-392
Bangladesh Economic Association
(ISSN 2227-3182)

Determinants of Rice Production in the Northern Districts of Bangladesh: A Stepwise Regression Analysis

Md. Sariful Islam*
Kazi Julfikar Ali*
M. Moazzem Hossain Khan*

Abstract: *This study examines the impact of education on rice production in Bangladesh. The study employed farm level cross sectional data from the village of Paschim Saidpur of Shibganj Upazila of Bogra. Farm level data used in this study are collected by employing random sampling technique. Structured questionnaire is used to collect data from 96 rice farmers in the study area. The Ordinary Least Squares (OLS) Regression and Stepwise Regression methods are used to identify the determining factors of rice production in Bangladesh. Stepwise Regression is used to identify the most important variables or the inappropriate variables, which are not important in the model. The results of the study show that education has a statistically significant and positive effect on rice production in Bangladesh. The study also shows that input cost, labour cost, cultivable land and extension service have also statistical significance and positive effect on rice production in Bangladesh. The policy suggestion of the study that the government should emphasize on education through literacy campaigning, training and adult continuing education programs so that rice production is increased. In addition, the government should also take the initiative so that the farmer can easily adapt modern agricultural inputs.*

1. Introduction

The development vision for agriculture under seventh Five Year Plan emphasises on ensuring food security in Bangladesh (GOB, 2015). Rice is the staple food for 153.6 million people (Economic Review, 2013). Rice is the main and most dominant food crop. It provides 47.5 percent of rural employment (Economic Review, 2013). More than 95% of population consumes rice and it alone provides 76% of calorie and 66% of the total protein requirement of daily food intake (Bhuiyan et

* Assistant Professor, Department of Economics, Joypurhat Govt. College,Joypurhat, Bangladesh, Assistant Professor, Department of Economics, University of Rajshahi, Bangladesh and Professor, Department of Economics, University of Rajshahi, Bangladesh

al., 2002). About 77% area of arable land is used for rice production in Bangladesh (IRRI, 2012). Bangladesh needs to import rice almost every year as it faces a deficit of rice. In 2011-12 FY, the total import of rice through public and private sectors was 5.23 lakh metric tons (Economic Review, 2012). This deficit can be overcome by enhancing the productivity of rice and introducing new technology. Adoptions of new technologies are difficult, especially for a poor developing country with low-skilled workers, low GDP and huge unemployment. Most of the farmers are illiterate and live on a subsistence farm. As a result, their income level is very low compared to other developing countries. So, it is difficult for them to gear up income without identifying the determinants of rice production. Although agriculture is the main stream of her economy, education for scientific method of agriculture is still felt necessary in this country. It means that lack of productive education is too acute in her agriculture. It is notable that productivity increases income with education. As education is an indispensable element for economic and social progress (Dev et al.1995). Most of the people live in rural areas and maintain their livelihood from the cultivation of rice. Rice cultivation also provides a safety net for the poor. Given the importance of rice in Bangladesh, this study focuses the determinants of rice production.

Agriculture sector alone is employing 47.3 percent of the total labour force of the country (Labour Force Survey, 2010). That is why; agriculture is not only the mainstay of the rural populace, but also the main occupation of the nation as a whole.

Several past studies have so far been done in this field.The findings of these studies differed widely from each other. A number of studies have assessed the relation between education and agricultural production (Wu, 1977; Lockheed et al.,1980 ; Jamison & Lua,1982; Philips, 1987; Hassan et al., 2003; Minh-Phuong, 2006; Asadullah and Rahman,2006; Onphanhdala,2009;Yasmeen et al.,2011; Girgin,2011; Rehman et al.2012) and another number of studies has assessed the impact of education on agricultural production (Singh, 1974; Welch, 1970; Pudasaini,1983) in national and international arena. Asadullah and Rahman (2006) found that the different level of education have a positive and significant effect on rice production in Bangladesh. They found that the primary and secondary level of education is more relevant in rice production than tertiary level. They also found that the education is a matter in raising production, boosting potential output and improving farmer productive efficiency. Salehin et al. (2009) found that the education of the farmers has a significant and positive effect on rice production in Bangladesh. They also found that educated farmers are likely to be more receptive to the modern facts and ideas, they have much mental strength in deciding on a matter related to problem solving or adoption of technologies in their everyday life. Haq (2012) showed that primary education has positive value and its impact on rice productivity is significant. He found that farmers with primary education seem effective to rise per unit of rice productivity in Bangladesh. He also found that the farmers, who have only a primary school degree, might spend enough time for farm production. Nargis and Lee (2013) found that education has a statistically significant and positive effect on rice production in Bangladesh. They also found that farmers who are more educated are likely to be more efficient compared to their less-educated counterparts, perhaps because of their better skills, access to information, and good farm planning. Cotlear (1986) found that education has a vital role in agricultural production, but this role depends significantly on its technical and economic situation. He found that the effect of completing primary education in urban areas was much larger than that of completing primary education in rural schools. He also found that the different levels of education are related with a higher possibility of adoption, but only in the initial stages of the distribution process. Duraisamy (1989) found that education has a positive and significant effect on rice production in India. He found that education, expand the probability of adoption of modernization on new techniques in rice production. He found that the higher level of education is required to better understand, make out new information and utilise in an effective way. He also found that the level of using high-yielding rice varieties in India was positively related to level of education. Appleeton & Balihuta (1996) found that the years of schooling of farmers have a positive and statistically significant effect on agricultural production in Uganda. They found that crop production was increased if the education level of farmers increased. They found that the education changes farmer's techniques and practices. They also showed that education affects the use of controlling for capital and purchased inputs. Dominique van de Walle (2003) studied the impact of education on agricultural productivity in Vietnam. Three major results come out of her study of irrigation and agricultural productivity in Vietnam. First, education of the household head and other family members make a significant contribution to farm profitability. Second, there also seems to exist important complementarities between education and irrigation, thereby giving some indication that education does help Vietnamese farmers make better use of agricultural technology, and third, primary education, but not higher levels of education, has significant impact on farm profitability. Years of schooling are found to have a significant impact on rice productivity, even though it is a small one. Grigin (2011) found that a statistically positive relationship between education and wheat output in Turkey. He also found that there is a great chance that educated farmer contributed positively to agricultural productivity growth, which was just one of the intended aims of the education. Rehman et al. (2012) founded education is one of the most important determinants of agricultural production. They examined that education makes aware the producer about the latest production techniques, which enables him to increase crop production. They also showed that education affects crop production positively in Pakistan. One percent increase in education enrollment leads to 4% increase crop production. Most of the studies included aggregate level of education, input cost, cultivable land, family labour and extension service as explanatory variables. However, most of them did not include hired labour cost. The general forms of Cobb-Douglas production function used most of the studies. These studies have applied to examine the effect of education on agricultural production through ordinary least squares regression model. They did not explain the pitfalls of their model regarding the impact of education on rice production. To have a clear picture of impact of education on rice production in Bangladesh, it is required to enquire deeply. Disaggregate level of education is used as explanatory variable rather than aggregate level of education in this study. The shortcomings of the classical linear regression model have discussed systematically In this study,. As a result, the findings would provide more reliable than others study. That is why, this study demands greater importance in their arena. In this study, the ridge regression applied to explore the impact of education on rice production. This is a scope to do research in this area to fill this gap. To our knowledge, this research is first of its kinds in Bangladesh.

The main objective of this study is to identify the determinants of rice production of northern district in Bangladesh by using cross sectional data. The rest of the paper is structured as follows: Methodology and data of the study is presented in Section 2, while the results and discussion are presented in Section 3. Finally, summary and policy implications are presented in Section 4

2. Methodology of the Study

2.1 Selection of the Study Area

Shibganj Upazila of Bogra district has been purposively selected as the study area for the study. The study has been conducted to identify the determinants of rice production in the village of Paschim Saidpur in Shibgonj Upazila under Bogra district. The Shibgonj upazila comprises of 409 villages (BBS, 2012). The villagers primarily rely on agriculture activities. Therefore, their earnings depend on agricultural activities. Rice is the main agricultural crops in the study area. That is why; Shibganj has been selected for the study. Comparatively the rice production of this Upazila is higher than the other Upazila of Bogra district (Bangladesh Bureau of Statistics, Bogra Branch, 2012).

2.2 Methods of Data Collection

The study is based on primary and secondary data. The primary data have been collected by using a structured questionnaire. Before preparing and applying the questionnaire to the final survey, pre pilot and pilot survey have been done. The pre pilot survey is carried out through the Agricultural Office of Shibganj, concerned Sub-Assistant Agriculture Officer`s (SAAO's), and academics. The pilot survey was conducted during November 2012 to December 2012. Afterwards, the final survey was carried out during December 2012 to January 2013.

Secondary data have also been collected from related books, articles, journals, unpublished theses, Population Census of Bangladesh, various issues of Economic Review, Agriculture census, Bangladesh Rice Research Institute (BRRI), Department of Agriculture Extension (DAE), Bangladesh Bureau of Statistics (BBS), Bangladesh Bureau of Statistics Bogra Branch, Ministry of Agriculture, Ministry of Planning, and Internet Sources etc.

2.3 Sampling Technique of the Study

An up to date list of all farmers of the selected village has been collected from Upazila Agriculture Office. The list comprised 127 farmers, which constituted the population. In this study, random sampling technique was employed to collect the data. The numbers of farm household were selected randomly by using determination of sampling formula (Krejcie and Morgan, 1970) for regression analysis. Thus, the sample size was 96.

2.4 Empirical Theory and Method

In this study, the standard method of analysis follows Jamison and Lau (1982). They used a production function for agriculture output as their basic tool to analyze the effect of education on crops production. They included various explanatory variables in their model particularly area under cultivation, labour input (family labour), education level of household head and extension service. The input cost and hired labour cost for crops production are not included in their model. Input and hired labour is a vital ingredient in any stage of production. In this aspect, we have modified their model through including input cost and hired labour cost. The Cobb-Douglas type production function is used in this study.

$$Y = AK_i^{\beta_1} L_i^{\beta_2} T_i^{\beta_3} e^{\beta_4 Ed + DExt + \mu_i} \ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Equation (1) provides nonlinear relationship between output and inputs. So, the nonlinear relationship can be linearized by both side natural logarithms (ln).

$$\ln Y = \ln A + \beta_1 \ln K_i + \beta_2 \ln L_i + \beta_3 \ln T_i + (\beta_4 Ed + DExt + \mu_i) \ln e$$

$$= \beta_0 + \beta_1 \ln K_i + \beta_2 \ln L_i + \beta_3 \ln T_i + \beta_4 Ed + DExt + \mu_i \ldots\ldots (2)$$

Where, $\ln A = \beta_0$ and lne =1.

Thus, the model is linear in the parameters $\beta_0, \beta_1, \beta_2, \beta_3$ and β_4. So, the model is a linear regression model. So, the fitted model of this study is as follows

$$\ln Y = \beta_0 + \beta_1 \ln K_i + \beta_2 \ln L_i + \beta_3 \ln T_i + \beta_4 Ed + DExt + \mu_i \ldots\ldots\ldots (3)$$

where, Y_i = total output of rice (kilogram), K_i = input cost (irrigation and others input cost),

L_i = labour cost (family labour and hired labour), T_i = cultivable land (decimal),

E_d= education of the farmer

Ed = years of schooling of the farmer

Ext = extension service (from friends/Neighbours /agriculture officers/others)

D =1 if taken extension service

D = 0 otherwise

μi = error term

The error term is assumed random and serially independent having zero mean with finite variance. In order to determine the appropriate technique of estimation, the empirical model is estimated by the ordinary least squares (OLS) method. To better facilitate different diagnostic tests like heteroscedasticity, autocorrelation, multicollinearity are checked in this study.

2.5 Definition of the Variables and Research Hypothesis

Output

Output is defined as the physical output of rice per decimal. Physical output is defined as the total production of rice cultivated area. It is measured in kilogram per decimal.

Input Cost

Input cost is defined as the sum total of expenditures on seeds, seedbed preparation, plough units, irrigation, organic and inorganic fertilizers, insecticides, fungicides, herbicides, harvesting and threshing cost.

Labour Cost

Labour unit is measured in man-days of eight hours. There are two types of labour cost in rice production. One hired labour cost and another family labour cost. Labour cost consist of these two types.

Cultivable Land

Cultivable land that is used by ploughing, sowing, and raising crops. It is expressed as decimal.

Education

Year of schooling may be represented as a level of education. It is defined as the number of academic years that a person has taken his/her lesson in educational institutions in this study. Level of education can be divided into five categories. These are illiterate, primary, secondary, higher secondary and tertiary.

Extension Service

The contact between agriculture extension agents or officers and farmers is introduced as a measure of the availability of information about new and improved inputs. It is measured in dummy variable.

2.6 Regression Analysis

As the main objective of this study is the determinants of rice production, the cause effect analysis is suitable for achieving this objective. To do so, regression analysis has applied in this study. It is appealing because it provides a conceptually simple method for investigating functional relationship among variables.

2.6.1 Stepwise Regression

Stepwise regression can be achieved either by trying out one independent variable at a time and including it in the regression model if it is statistical significant, or by including all potential independent variables in the model and eliminating those that are not statistically significant, or by a combination of both methods. Stepwise regression includes regression models in which the choice of predictive variables is carried out by an automatic procedure.

Stepwise regression model is a step-by-step iterative construction of a regression model. Process of independent variables carried out in two ways-by including independent variables in the regression model one by one at a time if they are statistically significant, or by including all the independent variables initially and then removing them one by one if they prove to be statistically insignificant semi-automatic selection.

3. Results and Discussion

The determinants of education on rice production have been examined by using descriptive and inferential statistics. Regression analysis has been employed to estimate the determinants of rice production in the study area. Both quantitative and dichotomous variables are employed as explanatory variables in this study.

3.1 Descriptive Statistics

Table 3.1 shows the variables that are used in estimations and their sample statistics namely maximum and minimum values, mean and standard deviation.

Table 3.1: Descriptive Statistics of the Variables

Item	No. of cultivators	Minimum	Maximum	Mean	Standard Deviation
Output (Kg)	96	950.00	7400.00	3349.4792	1818.48744
Yield (kg)	96	18.29	26.77	22.5571	1.80761
Input cost (Tk.)	96	2825.00	18500.00	9919.7292	4848.35533
Input cost(Tk.) per decimal	96	51.52	75.76	68.4541	6.88155
Labour cost (Tk.)	96	2150.00	15800.00	7907.2500	4064.15996

Labour cost (Tk.) per decimal	96	42.42	60.00	53.9425	4.89606
Cultivable land (decimal)	96	49.00	330.00	148.7604	80.75144
Education (years of schooling)	96	0.00	16.00	5.4479	4.35979
Extension service (percentage)	Yes= 63.5 No= 36.5				

Source: Field survey, December 2012 and January 2013

The mean, standard deviation, minimum and maximum of the variables have been presented in Table 3.1. In Table 3.1, it is found that the average yield of rice is 22.55 kilograms with maximum average yield of 26.77 kilograms and minimum average yield of 18.29 kilograms. The average value of input cost is 68.45 Tk. with maximum and minimum average value of input cost is 75.76 Tk. and 51.52 Tk. respectively. The average value of labour cost is 53.94 Tk. with the maximum and minimum average value of labour cost is 60.00 Tk. and 42.42 Tk. respectively. The average of cultivable land is 148.76 decimal with the maximum and minimum of the cultivable land is 330 decimal and 49 decimal respectively. Table 3.1, the average level of education of the respondent is 5.45 years and the standard deviation of the education level of the respondent is 4.35 years. Maximum education level of the respondent is 16 years and minimum is 0.00 years. Maximum and minimum education level shows a wide variation of the respondents. About 63.5% respondents of the study area are taken agricultural extension service from Sub Assistance Agriculture Officers and rest of 36.5% do not take one.

3.2 Empirical Results

The empirical results of the production function in equation (3) presented in Table 3.2.

Table 3.2: Empirical Results of Multiple Regressions

	$\hat{\beta}$	St. Error	t	P value	Eigenvalue	Tolerance	VIF
1	2	3	4	5	6	7	8
Intercept	2.958936*	0.203502	14.5401	0.000	5.580	-	-
Input cost(k)	0.094997	0.076228	1.246219	0.21591	0.334	0.01031	96.990
Labor cost(L)	-0.08956	0.080282	-1.11562	0.26755	0.080	0.008665	115.40
Cultivable Land(T)	0.985187*	0.0447	22.04012	0.000	0.006	0.026428	37.838
Education (E)	0.128338*	0.01413	9.082654	0.000	0.000093	0.605364	1.6518
Extension Service(S)	0.07379*	0.010781	6.844345	0.000	0.000017	0.591772	1.6898
R^2		0.9953					
Adjusted R^2		0.9950					

Source: Field survey, December 2012 and January 2013

* Highly significant

In Table 3.2, the findings show that the input cost of production is insignificant and the coefficient of input cost of production is 0.094997. The results indicate that as input cost of production increases by Tk.1 with output increases by 0.094997 kilogram. The labour cost of production is statistically insignificant .The coefficient of labour cost of production is

-0.08956. The results indicate that if the labour cost of production increases by Tk.1, then the total output decreases by -0.08956 kilogram. The cultivable land is statistically highly significant. The coefficient of cultivable land is 0.985187.The results indicate that the cultivable land increases by 1 decimal, total production increases by 0.985187 kilogram per decimal.

The coefficient of illiterate farmer is 2.958936, which is highly significant. This is because, if the farmers experience increases, their total output increases. In this study, the level of experience is the highest of illiterate rice farmer. The coefficient of education of farmer (literate farmer) is (2.958936+ 0.128338) = 3.087274, which is highly significant. It indicates that if the education of farmer increases, their total output increases by 3.087274 kilogram. The coefficient of extension service is 0.074288 and it is statistically highly significant. It indicates that if the extension service increases, their total output increases by 0.074288 kilogram.

In Table 3.2, two variables of this model provide insignificant results and one is opposite sign. So, this model might suffer from multicollinearity problem.

3.3 Reliability and Validity

To ensure the reliability of the questionnaire Cronbach's alpha test has been used in this study. The result of Cronbach's alpha test is given in Table 3.3.

Table 3.3 Test of Reliability

Number of observation	Number of items	Cronbach`s Alpha
96	6	0.860

In Table 3.3, it is observed that Cronbach`s alpha is 0.860 which indicates a high level of internal consistency for our scale with this specific sample. In this study, variables and questions are drawn from literature, which ensured the validity of the questionnaire (Ali and Noman, 2013).

3.4 Diagnostic of the Model

To check the reliability of the above results, the diagnosis of normality, multicollinearity, heteroscedasticity and autocorrelation are essential. For our postulated model, accounting to the rule of thumb multicollinearity is not a troublesome problem. Again, to judge the validity of the above-mentioned results, though not predictable for cross-section data, the test for presence or absence of autocorrelation or serial correlation has been conducted.

3.5 Normality Test

Jarqua-Bera test is used to identify the normality of the model.

Table 3.4 Normality test by Jarqua-Bera test statistic

Skewness	Kurtosis	Jarque-Bera statistic	*P* value
0.232	2.905	0.900345	0.637518

Source: Field survey, December 2012 and January 2013

3.6 Fit of the Model

Table 3.5: Analysis of Variance (ANOVA)

	Sums of Squares	df	Mean Squares	*F*	*P* value
Regression	29.24732	8	3.655915	2669.48	0.000
Residual	0.119149	87	0.00137		
Total	29.36647	95			

Source: Field survey, December 2012 and January 2013

Table 3.5, ANOVA summarizes how much of the variance in the data (total sum of squares) are accounted for by the factor effect (factor sum of squares) and how much is random error (residual sum of squares). From Table 3.5, F value is 2669.48 and the p value is 0.000. This indicates that the results obtained from regression output are highly significant. Therefore, it is clear that the model is a better fit statistically.

3.7 Heteroscedasticity

Heteroscedasticity is obtained by white heteroscedasticity test.

Table 3.6: White Heteroscedasticity Test

		P value
F Statistic	1.592681	0.115773
Obser* R^2	16.56698	0.121353

Source: Field survey, December 2012 and January 2013

As can be observed from Table 3.6, there is no heteroscedasticity in the error term of the model. The result is confirmed by White heteroscedaticity test. Obser*R2 =16.56698 which has, asymptotically, a chi-square distribution with 44 df. The 20% critical chi-square value for 44 df is 51.639. Since the calculated value of chi-square is less than the critical value at 20% level of significance, it can be said that there is no heteroscedasticity in the error term of the model.

3.8 Autocorrelation

The Breusch-Godfrey serial correlation and Durbin-Watson statistic have been used to test for presence of serial correlation among the residuals. From Table 3.7, the Breusch-Godfrey LM test statistic of 3.4275 exceeds the critical chi-square (1) value. So, it can be said that the model is free from autocorrelation. The value of the Durbin-Watson statistic ranges from 0 to 4(Gujarati, 2003). As a general rule of thumb, the residuals are not correlated if the Durbin-Watson statistic is approximately 2 and an acceptable range is 1.50 to 2.50 (Alam et.al, 2013).

Table 3.7: Breusch-Godfrey Serial Correlation LM and Durbin-Watson Tests

		P value
F Statistics	1.570064	0.214005
Obser**R-squared*	3.420147	0.180852
d Statistic (DW)	1.833	

In Table 3.7, the value of d statistic is 1.833, which is about to 2. It indicates that there is no serial correlation.

3.9 Multicollinearity

Table 3.2 shows that there are three of eigenvalues close to zero and three VIF`s values more than 10. These results indicate that the model suffers from multicollinearity. It can also be found that the value of R2 and adjusted R2 are very high.

3.10 Results of Stepwise regression

The results of stepwise regression have been shown in Table 3.8.

Table 3.8: Empirical Results of Stepwise Regression

	$\hat{\beta}$	St. Error	*t*	*P* value	Tolerance	VIF
1	2	3	4	5	6	7
Cultivable Land (T)	0.390515*	0.053678	7.275116	0.0000	0.215944	4.630838
Input cost (K)	0.289784*	0.058724	4.934686	0.0000	0.204707	4.885027
Labour cost (L)	0.284742*	0.05717	4.980611	0.0000	0.201343	4.966646
Education (E)	0.135826*	0.042759	3.176541	0.002042	0.77894	1.283796
R^2	0.944759					
Adjusted R^2	0.941690					

Source: Field survey, December 2012 and January 2013
* Highly significant

All VIF values are less than 5 which is shown in Table 3.8. These results indicate that this model is free from multicollinearity problems. It also shows the different results between Table 3.2 and Table 3.8. All variables are statistically significant in Table 3.8.

The coefficient of cultivable land is 0.390515 it is statistically highly significant. The results indicate that the cultivable land increases by 1 decimal, total production increases by 0.390515 kilograms per decimal. The same results were found by Cotlear (1986), Appleton & Balihuta (1996), Yang (1997), Weir (1999) and

Rehman et al. (2012).

The coefficient of the input cost of production is 0.289784 and it is statistically highly significant. The results indicate that as an input cost of production increases by Tk.1, output increases by 0.289784 kilograms. The same results in line with Appleton & Balihuta (1996) and Weir (1999).

The coefficient of labour cost of production is 0.284742 it is statistically highly significant. The results indicate that if the labour cost of production increases by Tk.1, then output increases by 0.284742 kilograms. The findings were consistent with studies by Cotlear (1986), Appleton & Balihuta (1996), Yang (1997) and Weir (1999).

The coefficient of illiterate farmer is 0.791315, which is highly significant. This is because, if the farmers experience increases, their total output increases. In this study, the level of experience is the highest of illiterate rice farmers.

The coefficient of education is (0.791315 +0.135826) = 0.927141, which is significant. It indicates if the education of farmer increases, their total output increases by 0.927141kilogram. The similar results were found by Singh (1974), Dominique van de Walle (2003),Onphanhdala (2009) and Haq (2012).

4. Conclusion

In this study, the determinants of rice production are very important for policy formulation and strategies for the development of agriculture sector. In this study, multiple regression model and stepwise regression model have been used to estimate the determinants of rice production. In addition, the empirical findings of the multiple regressions show that most of the variables are highly involved in multicolinearity. In order to overcome this problems ridge regression has been used in this study. The empirical results of stepwise regression reveal that the all the explanatory variables have positive and statistical significance effect on rice production. The findings of the study show that the main determinant of the rice production is land. The second important determinant of rice production is input cost. The input cost of production has positive effect on rice production. Labour cost is the third important factors of rice production. Education is the fourth important factors of rice production. To boost up rice production of Bangladesh the government should put emphasis on education so as to the farmer can easily adapt modern agricultural inputs, pest and irrigation management. There are a few agricultural training institutions in our country. Agro based courses must be included in the primary level schools or institutions. In addition, number of agricultural institute must be increased throughout the country, which in turn will increase the number of people with agricultural knowledge. It certainly would have a positive impact on the agricultural productivity. In Bangladesh, the government should take the responsibility of the expansion of agricultural education, research and development. The illiterate farmers do not know about the modern technological cultivation technique. The government should create the eagerness among the farmers about the modern cultivation. At first, it needs to expand the general education on the emphasis of agricultural education in the rural area. Now, it is very important to expand the agricultural education and research because educated and trained farmers show their eagerness to use the modern technology and input. The lack of education is the barrier of development. Therefore, the government should try to expand education among the farmers. Besides, the government should take proper steps to teach the people practically who are educated in modern agricultural system, HYV seeds, the use of insecticide, fertilizer, irrigation etc., so that their productivity may increase. To avoid excessive use of seeds, irrigation, fertilizer, pesticides, herbicides and fungicides, farmers should have a minimum level of education and training. Extension service plays a pivotal role in raising the awareness of farmers to respond changing the production pattern. Extension service is important for rice farmers and it has positive effect on rice production. Government should take necessary step to increase extension service to the farmers. Day by day land fragmentation is increasing. So, policies should be formulated in such a way that the existing land tenure and land fragmentation system cannot reduce cultivable land. Therefore, the farmer could be educated and proper trained so that they become capable to operate the latest technologies and inputs should be adapted by rice farmers for reducing the land and environmental degradation, increasing productivity and welfare of rice farmer in Bangladesh. Labour cost is a very essential factor, which affects the rice production. Government should be emphasizing the need of education to improve the ability of rice farmers to receive and understand information regarding modern technology, so that their productivity may increase.

References

Adnan. N, Ahmad. H.M and Adnan, R(2006). "A Comparative Study On Some Methods For Handling Multicollinearity Problems", Mathematika, Department of Mathematics, Universiti Teknologi Malaysia(UTM)Volume 2,pp.109-119.

Alam. S.M, Saeed. S.A, Sahabuddin. M and Akter. S (2013). "Relationship between Employee Recognition and Employee Contribution in Service Industry", International Journal of Business and Marketing Management, vol.1 (1), pp.1-8.

Ali and Noman (2013), "Determinants of Demand for Health care in Bangladesh: An Econometric Analysis", World Journal of Social Sciences.Vol.3, and No.6.November.Issue.Pp.153-163.

Appleton, S. and Balihuta, A. (1996), "Education and Agricultural Productivity : Evidence from Uganda", Journal of International Development : Vol.8, No.3,415-444.

Asadullah, M. Niaz. and Rahman, Sanzidur,(2006), "Farm Productivity and Efficiency in Rural Bangladesh: The Role of Education Revisited, Contributed paper prepared for presentation at the International Association of Agricultural Economists Conference, Gold Coast,Australia,August12-18.

B.B.S (2010) Labour Force Survey 2010, Bangladesh Bureau of Statistics (BBS). Planning Division, Ministry of Planning; Government of the People's Republic of Bangladesh.

B.B.S. (2012) Population and Housing Census 2011. National Volume, Bangladesh Bureau of Statistics (BBS). Planning Division, Ministry of Planning; Government of the People's Republic of Bangladesh.

B.B.S.(2012), Bangladesh Bureau of Statistics (BBS), Bogra Branch.

Bhuiyan, N. I., D. N. R. Paul and M. A. Jabber (2002) Feeding the extra millions by 2025–

Challenges for rice research and extension in Bangladesh, National Workshop on Rice Research and Extension in Bangladesh, Bangladesh Rice Research Institute, Gazipur, 29-31 January.

Cotlear, D. (1986) Farmer Education and Farm Efficiency in Peru : The Role of Schooling, Extension Services & Migration. Education Policy Division, Education and Training Department, December, The World Bank.

Dev, U.K. and M. Hossain.(1995).Farmers' Education, Modern Technology and Technical Efficiency Of Rice Growers. Bangladesh Journal of Agricultural Economics. Vol.18, No2.

Duraisamy, P. (1989). Human Capital and Adoption of Innovation in Agricultural Production : Indian Evidence, Center Discussion Paper No.577, July, Economic Growth Center, Yale University.

Durbin, J., and Watson, G. S. (1950) "Testing for Serial Correlation in Least Squares Regression, I." Biometrika 37, 409–428.

Durbin, J., and Watson, G. S. (1951) "Testing for Serial Correlation in Least Squares Regression,II." Biometrika 38, 159–179.

George, D. & Mallery, P. (2003). SPSS for Windows step by step: A simple guide and reference.11.0 update (4th ed.). Boston: Allyn & Bacon.

GOB (2015). 7th Five Year Plan FY 2016-FY2020, General Economic Division(GED),Planning commission, Government of the People's Republic of Bangladesh.

GOB (2013).Bangladesh Economic Review 2013, Ministry of Finance, Government of the People's Republic of Bangladesh.

GOB (2012).Bangladesh Economic Review 2012, Ministry of Finance, Government of the People's Republic of Bangladesh.

Greene, W. (2003). Econometric Analysis (5th Edition). Upper Saddle River: Prentice-Hall.

Grigin, A. (2011) The role of Education in Agricultural Productivity: The Case of Village Institutes in Turkey,1940-1966, School of Economics and Management, Lund University.

Gujarati, D. (2003). Basic Econometrics. 4th edition, New York: McGraw-Hill.

Hassan,Y,Z,M. Khan,S,A. and Malik,H,N.(2003) Effect of Education of the Respondents on the Adoption of Recommended Chemical Control Measures Among the Rice of Thesile Kamoke, District Gujran Wala–Pakistan, International Journal of Agriculture & Biology, Vol.4,pp.564-565.

Haq, A. Z. M., A. Ishida, S. Yokoyama and K. Taniguchi (2003) Outcomes and issues of agricultural extension services in Bangladesh. Journal of Agricultural Extension and Research Japan. 8(17): 17-22.

Haq,A,Z,M.(2011) Effect of Extension Contact on Rice Productivity in Some Selected Sites of Gazipur District. Bangladesh Journal of Agricultural Research, 36(4): 723-732, December.

Haq,A,Z,M.(2012) Farmers Education and Farm Productivity in Bangladesh. Mediterranean Journal of Social Sciences, Vol 3 (15) December.

Hoerl, A. E. and Kennard, R. W. (1970).Ridge regression: biased estimation for nonorthogonal problems. Technometrics, 12, pp.55-67.

Huffman, Wallace E. (1974).Decision Making: The Role of Education. American Journal of Agricultural Economics, 56, pp.85-97.

Jamison, D.T., and L.J. Lau.(1982). Farmer Education and Farm Efficiency. Baltimore: John Hopkins University Press.

Krejcie and Morgan (1970), Determining Sample Size for Research Activities, Educational and Psychological Measurement, Vol. 30, pp. 607-610.

Lockheed, M. E., Jamison. T., & Lau, L. J. (1980).Farmer Education and Farm Efficiency: A Survey, Economic Development and Cultural Change, 29(1), 37-76.

Lopez,M.(2007). Estimation of Cronbach's alpha for sparse datasets, 20th Annual Conference of the National Advisory Committee on Computing Qualifications (NACCQ), Nelson, New Zealand. Samuel Mann and Noel Bridgeman (Eds).

Nargis, F., & Lee,S,H.(2013). Efficiency Analysis of Boro Rice Production in North-Central Region of Bangladesh, The Journal of Animal & Plant Science, 23(2), 527-533

Ngo, Minh-Phuong, T. (2006).Education and Agricultural Growth in Vietnam, Department of Agricultural and Applied Economics, University of Wisconsin-Madision

Onphanhdala.P. (2009).Farmer Education and Rice Production in Lao PDR, Journal of International Cooperation Studies, Vol.16.No.3.

Phillips,M,J. (1987) A Comment on Farmer Education and Farm Efficiency : A Survey, Economic Development and Cultural Cahnge, Vol.35, No3, pp.637-641.

Pudasaini, Som.P. (1983).The Effects of Education in Agriculture: Evidence from Nepal, American Journal of Agricultural Economics, Vol. 65, No. 3, pp.509-515

Rehman, U.N., Khan. J. and Tariq.M.(2012). The impact of education on agricultural production in Khyber Pakhtunkhwa province of Pakistan (1975-2008). Sarhad Journal of Agriculture, 28(2), pp.345-352.

Rogerson, P.A (2003) Statistical Methods for Geography,SAGE Publication Ltd.,6 Bonhill Street,London.

Salehin,M,M., Kabir,S.M.,Morshed.M.K. and Farid.S.K. (2009). Socioeconomic Changes of Farmers Due to Adoption of Rice Production Technologies in Selected Areas of Sherpur District, Journal of Bangladesh Agricultural

University,7(2),pp.335-341.

Sargan, J.D. and Alok Bhargava (1983). "Testing residuals from least squares regression for being generated by the Gaussian random walk". Econometrica, 51, p. 153-174.

Singh,B.(1974).Impact of Education on Farm Production, Economic and Political Weekly (September), pp. A92-A96.

Tavakol,M. and Dennick,R.(2011).Making sense of Cronbach's alpha, International Journal of Medical Education, 2:pp53-55.

Van de Walle,D.(2003). Are Returns to Investment Lower for the Poor? Human and Physical Capital Interactions in Rural Vietnam. Review of Development Economics,7(4),pp. 636.

Von Neumann, John. (1941). "Distribution of the ratio of the mean square successive difference to the variance" Annals of Mathematical Statistics, 12, 367-395.

Weir, Sharada.(1999). The Effects of Education on Farmer Productivity in Rural Ethiopia. CSAE Working Paper 99 (7).

Welch,F.(1970).Education in Production, Journal of Political Economy,78,pp.35-59.

Wu, Craig C.(1977).Education in Farm Production: The Case of Taiwan, American Journal of Agricultural Economics, 59, pp.699-709.

Yang,T,D. (1997).Education in Production : Measuring Labour Quality and Management, American Journal of Agricultural Economics, 79, pp.764-772.

Yasmeen, K.Abbasian, E and Hussain, T. (2011). Impact of educated farmer on Agricultural Product, Journal of Public Administration and Governce, Vol.1, No.2.