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HOW DO DIFFERENT LEVELS OF EDUCATION AFFECT RICE PRODUCTION IN BANGLADESH?

KAZI JULFIKAR ALI
Associate Professor, Department of Economics, University of Rajshahi, Bangladesh.
Email: julfikar.eco@ru.ac.bd

MD.SARIFUL ISLAM
Assistant Professor, Department of Economics, Government Azizul Haque College, Bogura, Bangladesh.

Abstract

This paper looks into the effect of different educational levels on rice production in Bangladesh for increasing rice productivity. Farm-level cross-sectional data are collected by employing a structured questionnaire with a random sampling technique. The chi-square test and econometric techniques, including multiple regression and ridge regression methods, are used in this analysis. The results of the multiple regression reveal that different educational levels have a statistically significant and positive impact on rice production, but these results may create a multicollinearity problem. Other findings of the ridge regression reveal that cost of input, cost of labour, cultivable land, and extension services also have statistical significance and positive consequences on rice production. Even this result overcomes the multicollinearity issue. The policy suggestions of the study are that the government places a greater emphasis on education through adult continuing education programs and literacy promotion training so that rice farmers can achieve higher productivity through better farming practices.

JEL classification: I25, Q10, C21

Keywords: Education, Rice production, Ridge regression, Bangladesh

1. Introduction

It is well recognized that education and training may increase farmers' ability to produce in the context of changing physical and economic situations. Farmers' education may affect agricultural productivity as well as rice productivity in several different ways. First, education should enable farmers to improve their decision-making skills to become better managers (Asadullah & Rahman, 2009). Second, education can improve farmers' access to information and should therefore enable them to pay and receive potentially better prices for inputs used and outputs sold (Jamison & Lau, 1982). Third, more-educated farmers can adopt modern technologies more quickly because they can take the risk of applying new technologies (Feder, Just, and Zilberman, 1985; Hossain et al., 1990; Lin, 1991; Asfaw & Admassie, 2004; Weir & Knight, 2004). Finally, more-educated farmers prefer risk production technologies over low-risk ones because they can adequately assess the implicit opportunities of technology (Asadullah & Rahman, 2009). Farmers' education is an essential factor in rice production in Bangladesh. It is because education possesses productive value in enabling the farmers to produce a larger quantity of output from the same amount of inputs. Educated farmers can better utilize modern agricultural methods than their uneducated counterparts. Rice is the

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leading food of more than 95 per cent of our country's population. The quantity demanded of rice is also increasing now a day in our country. On the contrary, cultivable land is shrinking with the demand for the habitation of the increased population as well as due to various national calamities. Therefore, rice production needs to increase to fulfil the demand for food for the growing population. Moreover, the people living in rural areas are mainly engaged in rice production in Bangladesh. Unfortunately, our country's education rate is lower than that of other leading rice-producing countries. To ensure our country's food security, rice production needs to be increased. To increase rice production, it is urgent to enhance the productive efficiency of farmers, for which proper training and education are badly needed. In that case, their use of extension services will be more effective, and educated farmers can utilize and take various agricultural training more significantly and accurately than uneducated ones. Development in agriculture and rice production mostly comes from technological change, and technological change, in turn, depends much on farmers' education. Educated formal farmers are believed to be more productive, particularly in modernizing agricultural methods. Therefore, education enhances rice productivity and contributes to rural development through increased food production. Therefore, this study investigates the different levels of farmers' education on rice productivity in Bangladesh.

This study complements the existing body of knowledge in two ways. First, it assess the impact of the different levels of education on rice production along with farm-level survey data instead of aggregate levels of education (Salehin et al., 2009, Nargis and Lee, 2013, Gross and Tales, 1952, Sing, 1974, Wu, 1977, Duraisamy, 1989, Rehaman et al. 2012). Second, the quantitative analysis, namely the ridge regression technique, applies to overcome the problem of multicollinearity.

The main objective of this study is to examine the different levels of education on rice production in Bangladesh using multiple regression and ridge regression methods. The rest of the paper is organized as follows: Section 2 reviews the literature. The methodology and analytical framework are presented in Sections 3 and 4. The results and discussion is displayed in Section 5 and 6. Lastly, the conclusions and policy suggestions are described in Sections 7 and 8.

2. Review of literature

A number of research studies have looked into the connection between education and agricultural production (Wu, 1977; Lockheed et al.,1980; Jamison & Lau,1982; Philips, 1987; Hassan et al., 2003; Minh-Phuong, 2006; Onphanhdala,2009; Yasmeen et al.,2011; Girgin,2011; Rehman et al., 2012), The another number of research studies have examined the effect of education on agricultural production (Singh,1974; Welch,1970; Pudasaini,1983) and some other number of studies have evaluated the effect of education on rice production (Asadullah & Rahman,2006; Salehin et al.,2009; Haq,2012; Nargis & Lee,2013; Duraisamy,1989) in the national and international arena. According to Asadullah and Rahman (2009), the various levels of schooling have a considerable and favourable impact on rice output in Bangladesh. It has been shown that primary and secondary education is more important in rice production than university education. It has also been discovered that education has an essential role in increasing production, increasing potential output, and enhancing farmer productivity. According to Salehin et al. (2009), educated farmers have a considerable and favourable impact on rice output in Bangladesh. It has been discovered that educated farmers are more likely to be responsive to new ideas and technology, and they have a lot of mental strength when making decisions about technology adoption and issue-solving in their everyday lives. It has also been discovered that farmers with a greater level of education are more inclined to embrace rice cultivation technology. According to Haq (2012), primary education has a considerable influence on rice yield due to its high positive value. Farmers with a rudimentary education appear to be more successful at increasing per unit rice yield in Bangladesh.

It has also been shown that farmers with only an elementary school degree may not devote enough time to agricultural output. Nargis and Lee (2013) show that education has a good and considerable impact on Bangladesh's rice output. It has been discovered that farmers with higher levels of education are more productive than their less-educated counterparts. This is likely due to their improved abilities, improved access to information and improved farm planning. According to research by Duraisamy (1989), education significantly and favourably affects India's ability to produce rice. He looks at how education increases the likelihood that new, modern methods of producing rice will be adopted. He demonstrates how a higher degree of knowledge is necessary to comprehend new material clearly and to make use of it effectively. He also discovers a favourable relationship between India's use of high-yielding rice varietals and educational attainment.

Dominique van de Walle (2003) examined how education affects agricultural output in Vietnam. Her investigation of irrigation and agricultural output in Vietnam yielded three key findings. First of all, the farm's profitability is greatly influenced by the education of the family's head of the home and other family members. Thirdly, primary education has a considerable influence on farm profitability. Second, there are significant synergies between education and irrigation, suggesting that education does help Vietnamese farmers employ agricultural technology more effectively. Even if the effect is minimal, years of education are proven to have a substantial impact on rice yield.

The majority of research used family labour, input costs, cultivable land, overall education level, and extension services as explanatory factors. However, the majority of them exclude the expense of hired labour. In the majority of research, the general versions of the Cobb-Douglas production function are employed. These researchers used an ordinary least squares regression model to investigate how different levels of schooling affect agricultural productivity.

Results from any form of regression are unreliable without diagnostic testing. They did not outline the drawbacks of their approach in relation to how different levels of

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schooling affect rice production. In-depth research is needed to provide a comprehensive picture of how education affects rice production in Bangladesh. Instead of using the aggregate level of education, this study applies several levels of education, including elementary, secondary, upper secondary, and tertiary are applied as explanatory variables. The flaws of the traditional linear regression model are carefully examined in this study.

Therefore, the results would be more trustworthy than those of previous research. Because of this, this study is more important in their field. The effect of the various levels of education on rice output has been investigated in this study using ridge regression as well as other statistical tools including the Chi-square test, and multiple regression. This is an opportunity to do research in this area in order to address this gap.

3. Methodology of the study

3.1 Selection of the study area, data collection, and sampling technique

The Shibganj Upazila under the Bogra district was purposively selected as the study area. The study was carried out to explore the influence of education on rice production in three villages in Shibgonj Upazila, Bogra district: Chapachil, Paschim Saidpur, and Asrafpur. The Shibgonj upazila is made up 409 villages (BBS, 2012). Agriculture is the primary source of income for the villages.

Different types of crops are produced in the study area. Rice is the main agricultural crop in this Upazila. This Upazila produces more rice than any other Upazila in the Bogra district (Bangladesh Bureau of Statistics, Bogra Branch, 2012). As a result, Shibganj was chosen for the research. Figure 1 represents the study area. This study uses both primary and secondary information.

The primary data be gathered using a structured questionnaire. Before developing and implementing the questionnaire for the final survey, the researcher conducted a pre-pilot and pilot survey. The Shibganj Agricultural Office, concerned Sub-Assistant Agriculture Officers (SAAO's), and academics all participated in the pre-pilot study.

Between November and December 2012, the pilot survey was carried out. Following that, the final survey was conducted from December 2012 to January 2013. The Upazila Agriculture Office has provided the latest list of all farmers in the specified villages. Following that, the final poll was conducted between December 2012 and January 2013. The population is made up of 551 farmers on the list. The random sample approach is used to acquire primary data in this study.

For regression analysis, the number of farming households is chosen at random in each village using the determination of the sample formula (Krejcie & Morgan, 1970). As a result, there are 171, 96, and 91 samples for Chapachil, Paschim Saidpur, and Asrafpur, respectively. Finally, 358 rice farmers were selected for this study. The

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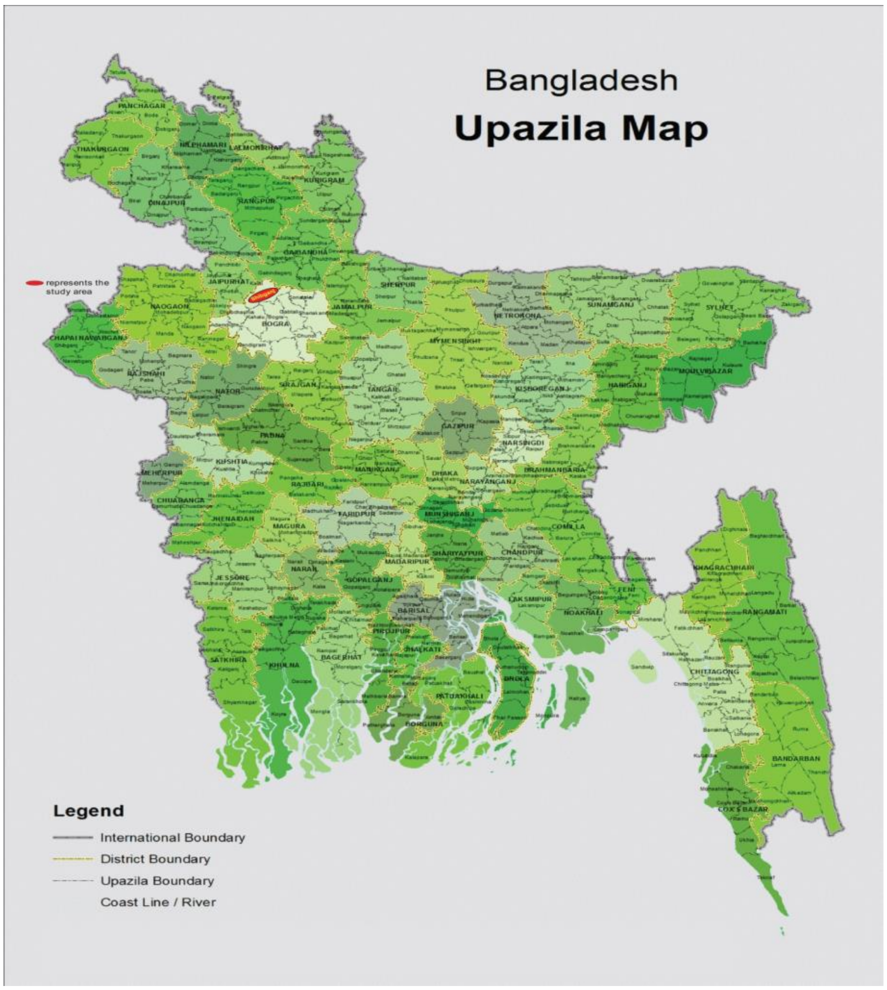
landless farmers have not been taken into account in this study to demonstrate the effect of education on rice output.

Fig1: Map of Bangladesh showing survey area (Source: Adapted from http://maps-of bangladesh.blogshot.com/)



4. Analytical Framework

The modified model of Jamison and Lau (1982) is utilized in this study.

$$Y = AK_i^{\beta_1} L_i^{\beta_2} T_i^{\beta_3} e^{\beta_4 D_1 + \beta_5 D_2 + \beta_6 D_3 + \beta_7 D_4 + DExt + \mu_i} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

The nonlinear relationships between output and inputs are represented by Equation (1). Five dummy variables are used in this model to get rid of dummy variable trap. In light of this, the study's fitted model is as follows:

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$$\ln Y_i = \beta_0 + \beta_1 \ln K_i + \beta_2 \ln L_i + \beta_3 \ln T_i + \beta_4 D_1 + \beta_5 D_2 + \beta_6 D_3 + \beta_7 D_4 + D_5 Ext + \mu_i ....(2)$$

Where, Y_i = output of rice, K_i = cost of input, L_i = labour cost, T_i = cultivable land

D_1 = 1 primary education of the farmer
= 0 otherwise
D_2 = 1 secondary education of the farmer
= 0 otherwise
D_3 =1 higher secondary education of the farmer
= 0 otherwise
D_4 =1 tertiary education of the farmer
= 0 otherwise
D_5Ext =1 if used agriculture extension service
D = 0 otherwise

μ_i = error term

The error term is considered to be random, serially independent, and to have a zero mean and finite variance. The empirical model is estimated using the ordinary least squares (OLS) approach in order to choose the best estimation technique. This research examines a variety of diagnostic tests, including heteroscedasticity, autocorrelation, and multicollinearity.

4.1 Description of Data

Table 1: Definition of the variables

Variable	Unit of measurement	Definition of the variable
Output	Kilogram	Output is referred to as the total output of rice farmed area given in kilograms per decimal.
Cost of input	Taka	Input cost is defined as the total cost of seeds, seedbed preparation, plough units, irrigation, organic and inorganic fertilizers, insecticides, fungicides, herbicides, harvesting and threshing costs.
Labour cost	Taka	Man-days of eight hours are used to calculate labor costs. In rice production, there are two types of labor costs: hired labor costs and imputed family labor costs.
Cultivable land	Decimal	Decimal is used to express cultivable land that is used for planting, tillage, and crop production.
Primary education	Years of schooling	A person who has completed five years of formal education is said to have received their primary education.
Secondary education	Years of schooling	The secondary level of education consists of five years of formal schooling culminating in the completion of the SSC.
Higher secondary	Years of schooling	Twelve years of formal education make up the higher secondary level.

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Tertiary education	Years of schooling	People with 14 years of formal education at a university or college are considered to have tertiary education.
Agriculture extension service	Dummy (1 = access to service,0= no access)	The exchange of information about new and improved inputs between agricultural extension agents or officers and farmers is introduced as a measure of the availability of information about new and improved inputs.

4.3 Bivariate analysis (χ^2)

The Chi-square test is frequently used to examine whether variables are statistically independent or not.

4.4 Regression analysis

As the primary objective of this study is to assess the impact of various levels of education on rice production, the cause - effect analysis is suitable for achieving this objective. In doing so, regression analysis has been used in this study. Regression analysis has become one of the most widely used statistical tools for analyzing functional relationship among variables.

4.5 Ridge regression

Ridge regression is the alternative estimation technique that may be employed to advantage when the explanatory variables are highly correlated. Ridge regression coefficients may be obtained by solving a slightly altered form of the normal equations. Hoerl and Kennard (1970) suggested the ridge regression as an alternative procedure to the OLS method in regression analysis, especially, when multicollinearity is exist.

The addition of a small positive number k is to the diagonal elements of $X'X$ causes $X'X$ to be non-singular. Therefore, the ridge solution is given by:

$$\hat{\beta}_R = (X'X + kI)^{-1} X'Y, k \geq 0 \ldots\ldots\ldots \text{(3)}$$

Where k is ridge parameter and I is identity matrix. Values of k belong the rang (0, 1). When k = 0, the ridge estimator turn into as the OLS.

From equation (3), by taking expectation on both sides, then

$E(\hat{\beta}_R) = A_k \beta$ Where $A_k = \left[I + k(X'X)^{-1}\right]^{-1}$

And $Var\left(\hat{\beta}_R\right) = \hat{\sigma}^2 A_k (X'x)^{-1} A_k'$

The ridge estimator $\hat{\beta}_R = \left[I + k(X'X)^{-1}\right]^{-1} \hat{\beta}$ is a linear transformation of the OLS. The sum of squares of the residuals (SSR) is a rising function of k. The mean squares error (MSE) of ridge estimator is given by:

$$MSE\left(\hat{\beta}_R\right) = E\left[\left(\hat{\beta}_R - \beta\right)'\left(\hat{\beta}_R - \beta\right)\right] = \hat{\sigma}^2 trace\left[A_k (X'X)^{-1} A_k'\right] + \hat{\beta}'(I - A_k)'(I - A_k)\hat{\beta}$$

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$$= \hat{\sigma}^2 \sum_{i=1}^{p} \frac{\lambda_i}{(\lambda_i + k)^2} + k^2 \hat{\beta}'(X'X + kI)^{-2} \hat{\beta} \ldots\ldots\ldots\ldots\ldots (4)$$

Where, $\lambda_1, \lambda_2, \ldots\ldots \lambda_p$ are the eigenvalues of $X'X$. In equation (4) the first term of the right hand is the trace of the dispersion matrix of the $\hat{\beta}_R$ and the second term is the square length of the bias vector. There is always a k > 0 such that has a smaller MSE than, implying that $MSE(\hat{\beta}(k)) < MSE(\hat{\beta})$. It indicates that ridge estimator performs better than the OLS estimator does. When multicollinearity exists, the ridge regression model produces more accurate and valid results than ordinary least squares.This is due to the fact that ridge regression has lower MSE of estimators and lower variance for most estimators than OLS.

5. RESULTS AND DISCUSSION

The impact of education on rice production is examined by using descriptive and inferential statistics. Chi square test is applied to assess the association between level of education and rice production. Regression analysis is employed to estimate the impact of education on rice production in the study area. Both quantitative and dichotomous variables are employed as explanatory variables in this study.

5.1 Summary statistics

Table 2 displays the summary statistics of variables used for the regression analysis. The summary statistics includes minimum value, maximum value, mean and standard deviation.

Table 2: Summary statistics of the variables

Variable	Measurement	Farms	Minimum	Maximum	Mean	St. Dev
Output	Kg	358	900.00	7600.00	3421.4665	1737.96792
Yield	Kg(per decimal)	358	18.26	26.77	22.5345	1.77997
Input cost	Tk.(per decimal)	358	50.88	75.76	67.4614	7.17910
Labour cost	Tk.(per decimal)	358	40.91	60.61	52.9838	5.57272
Cultivable land	decimal	358	49.00	330.00	152.8380	78.81766
Education	years of schooling	358	0.00	16.00	6.3184	4.60352
Agriculture extension service	percentage	Yes=58.7 No=41.3				
Tk. is the local currency which is exchanged approximately 85 taka for US $ 1						

Source: Field survey, January 2013

The minimum, maximum, average, and standard deviation of the variables were displayed in Table 2. It is observed that the mean yield is 22.53 kilograms with

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maximum yield of 26.77 kilograms and minimum yield of 18.26 kilograms in Table 2. The mean input cost is Tk. 67.46 with maximum and minimum input cost is Tk. 75.76 and Tk. 50.88 respectively. The mean labour cost is Tk. 52.98 with the maximum and minimum labour cost is Tk. 60.61 and Tk. 40.91 respectively. The mean cultivable land is 152.83 decimal with the maximum and minimum of the cultivable land is 330 decimal and 49 decimal respectively. The standard deviation of the respondent's educational level is 4.60 years, with the maximum and minimum levels of education being 16 years and 0.00 years, respectively. The mean educational level of the respondent is 6.31 years. A large variation in the respondents' education levels can be seen between the maximum and minimum. Approximately 58.7% of respondents in the research region receive agricultural extension services from Sub Assistance Agriculture Officers, while the remaining 41.3% do not.

5.2 Results of Bi variate analysis (chi-square (χ^2) test)

The relationship between various levels of education and rice production in the study area is evaluated using the chi-square test. The null hypothesis states that there is no correlation between rice production and various levels of education. The alternative hypothesis claims that there is a connection between rice production and various levels of education.

Table3: Impact of different levels of education on rice production

Yield(Kg per decimal)	Illiterate		Primary		Secondary		Higher Secondary		Tertiary	
	Illiterate	Others	Primary level	Others	Secondary level	Others	Higher Secondary Level	Others	Tertiary level	Others
18-23	52	181	94	139	68	165	10	223	11	222
23-28	0	125	24	101	60	65	16	109	23	102
Total	52	306	118	240	128	230	26	332	34	324
	$\chi^2 = 32.638$ df=1 p value = 0.000		$\chi^2 = 16.459$ df=1 p value = 0.000		$\chi^2 = 12.538$ df=1 p value = 0.000		$\chi^2 = 8.744$ df=1 p value = 0.003		$\chi^2 = 17.711$ df=1 p value = 0.000	

6. EMPIRICAL RESULTS

6.1 Reliability and validity, and Diagnostic of the model

The Cronbach’s alpha test has been used for understanding the reliability of the questionnire in this study. As can be seen, the Cronbach's alpha for our scale with this particular sample is 0.7870, which indicates an acceptable level of internal consistency. Variables and questions in this study were drawn from the literature, ensuring the questionnaire's validity (Ali and Noman, 2013). The diagnosis of normality,

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multicollinearity, heteroscedasticity, and autocorrelation is crucial for evaluating the dependability of the results mentioned above.

Accounting to the rule of thumb multicollinearity is not a problematic issue for our postulated model. Again, the test for presence or absence of autocorrelation or serial correlation and heteroscedasticity has been conducted to assess the validity of the results mentioned above.

The Jarque-Bera test is employed to establish normality. The JB test residuals have a normal distribution under the null hypothesis, but not under the alternative hypothesis. The Skewness and Kurtosis are, respectively, 0.099 and 3.004. The p-value is calculated using the Jarque-Bera statistics, which is 0.5954. We accept the null hypothesis because the p-value is greater than 5%, which indicates that the population residual is normally distributed, fulfilling the requirement for a good regression line.

The white heteroscedasticity test is used to determine heteroscedasticity. The alternative hypothesis for the white test states that the error term exhibits heteroscedasticity, contrary to the null hypothesis that there is no heteroscedasticity. The result is supported by White heteroscedasticity test. The obser*R2 =25.52597 has an asymptotically chi-square distribution with 44 df (Gujarati, 2003). The 5% critical value of chi-square for 44 df is 60.481. It can be concluded that there is no heteroscedasticity in the error term of the model because the calculated chi-square value is less than the critical value at the 5% level of significance.

To determine whether there is serial correlation among the residuals, the Breusch-Godfrey serial correlation and Durbin-Watson statistics have been identified. The Breusch-Godfrey serial correlation LM test's null hypothesis asserts that there is no serial correlation in the residuals, while the alternative hypothesis asserts that there is serial correlation in the residuals. Because the p-value of Obs*R-squared (0.483746) is greater than 5% (p>0.05), we can accept the null hypothesis, implying that residuals (u) are not serially correlated, which is desirable. As a result, the regression model is free of autocorrelation. The Durbin-Watson statistic has a value ranging from 0 to 4. (Gujarati, 2003). As a general rule, if the Durbin-Watson statistic is close to 2, and the acceptable range is 1.50 to 2.50, the residuals are not correlated (Alam et.al, 2013).The d statistic value is 1.960, which is close to 2. It means there is no serial correlation in the regression model.

The regression model has three VIF values greater than 5, as shown in Table 4.These findings reveal that the model is multicollinear. It is also discovered that the values of R^2 and adjusted R^2 are extremely high.

7. RESULTS OF MULTIPLE REGRESSION AND RIDGE REGRESSION

According to the results of the multiple regression model, input and lobour costs are insignificant, with one having the opposite sign. The results obtained from multiple regression reveal that there is high VIF among input cost, labour cost, and cultiviable

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Vol: 41 Issue: 12-2022
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land. These VIF indicate the high multicolinearity among these variables. In these case, this model may suffer from multicollinearity problem. So, ridge regression has been employed to solve the multicollinearity issue. Table 4 summarizes the results of the ridge regression analysis.

Table 4: Empirical findings of multiple regression and ridge regression

variable	Multiple regression			Ridge regression					
	$\hat{\beta}$	Tolerance	VIF	$\hat{\beta}_R$	St. Error	t	P value	Tolerance	VIF
1	2	3	4	5	6	7	8	9	10
Intercept	3.063*			1.189*	0.151	7.849	0.0000	-	-
Input cost(K)	0.007	0.011	90.991	0.263*	0.030	8.848	0.0000	0.207	4.836
Labor cost(L)	-0.0126	0.010	97.682	0.259*	0.029	9.039	0.0000	0.205	4.885
Cultivable Land(T)	0.996*	0.036	27.722	0.417*	0.028	14.857	0.0000	0.224	4.456
Primary (D1)	0.057*	0.457	2.187	0.048**	0.018	2.617	0.0093	0.695	1.440
Secondary (D2)	0.081*	0.421	2.374	0.072*	0.018	3.911	0.0001	0.651	1.536
Higher Secondary (D3)	0.072*	0.791	1.264	0.053***	0.028	1.929	0.0546	0.989	1.011
Tertiary (D4)	0.118*	0.630	1.588	0.098*	0.026	3.766	0.0002	0.865	1.156
Extension Service	0.096*	0.738	1.354	0.061*	0.015	4.162	0.0001	0.959	1.042
R^2	0.994			0.937					
Adjusted R^2	0.993			0.936					
Mean square error	97.11			1.66					
K (Ridge parameter)				0.130					

Source: Field survey, 2013

* Highly significant **1% level of significant***5% level of significant

The ridge regression results reveal that the values of variance inflating factor (VIF) are less than 5 as shown in Table 4. These findings show that multicollinearity problems are not present in this model. Even, all variables are statistically significant.

The input cost coefficient is 0.26 which is statistically significant. The findings show that as input cost increases by Tk.1, rice production increases by 0.262656 kilogram. The similar findings were obtained in the work of Appleton & Balihuta (1996) and Weir (1999). The labour cost coefficient is 0.26, which is statistically significant. The findings show that if the labour cost increases by Tk.1, then rice production increases by 0.26 kilogram. The results were consistent with studies by Cotlear (1986), Appleton & Balihuta (1996), Yang (1997) and Weir (1999).

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The cultivable land coefficient is 0.42 which is statistically highly significant. According to the findings, cultivable land increases by one decimal, while total production increases by 0.42 kilogram per decimal.The similar results were obtain by Cotlear (1986), Appleton & Balihuta (1996), Yang (1997), Weir (1999) and Rehman et al. (2012).

The coefficient of primary education dummy is 0.05 statistically significant can be tested by t test and probability value. The coefficient of primary education which is positively related to rice production. The same findings were obtained in the works of Singh (1974), Dominique van de Walle (2003),Onphanhdala (2009) and Haq(2012).

The coefficient of secondary education dummy is 0.07, which is highly significant. This result is related with the findings of Singh (1974) and Asadullah & Rahman (2006).

The coefficient of higher secondary education dummy is 0.05 which is significant. The same findings was establish by Pudasaini (1983).

The coefficient of tertiary education dummy is 0.10 which is highly significant. The same findings were obtained in the works of Pudasaini (1983) and Gemmell (1996).

The extension service coefficient is 0.06 which is statistically significant. The findings indicate that the extension service leads to the higher rice production. It is obseved that the more the extension services between extension agents and rice farmers leads to the higher the rice productivity. The similar findings were found by Huffman (1974), Haq (2011) and Nargis & Lee (2013).

In this study, we have tried to support that ridge regression technique is better than OLS technique. The coefficient of determination (R-squared) of multipule regression is 0.994, adjusted R^2 is 0.994 and the VIF is 97.682, which indicates greater multicollinearity. We also see that R-squared and adjusted R-squared are very high, and the least squares estimates are unstable absolutely. So, the explanatory variables are correlated in this study. For this reason, we can employ ridge regression method to obtain stable estimates.

Table 4 displays that the coefficient of determination and adjusted R2 are 0.937 and 0.936, respectively. We also see that R-squared and adjusted R-squared are less than OLS, and ridge estimates are stable than OLS estimates.

It is also found that the tolerance of OLS estimates is less than the tolerance of ridge estimates. As a result, the VIF for ridge estimates is less than the VIF for OLS estimates. These findings suggest that the ridge regression method is superior to OLS technique. We estimate $\hat{\beta}$ using OLS estimator and estimate $\hat{\beta}_R$ using ridge estimator with different choices of k from a grid (0.01, 0.02..., and 0.13). We compute mean square error for OLS estimator and mean square error for ridge regression estimator. The MSE of OLS exceeds the MSE of ridge regression. This result indicates that ridge estimator performs better the OLS estimator does. The F value is 650.49 and the overall results are highly significant.

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8. CONCLUSIONS AND POLICY SUGGESTIONS

This study looks at how different levels of education affect rice production in Bangladesh. The impact of different levels of education on rice production is critical for policy formulation and agricultural sector improvement strategies. The Chi Square test was used in this study to determine the relationship between rice yield and educational levels. The findings indicate that there is a significant relationship between rice yield and level of education. The effect of different levels of education on rice production was estimated using a multiple regression technique and ridge regression model. The results of the multiple regression model demonstrate that the majority of the explanatory variables have a severe multicolinearity issue. As a result, ridge regression was applied in this study to overcome the multicolinearity problem. The findings of ridge regression show that the various educational levels have positive and statistically significant effect on rice production. As a result, the production of rice rises as farmer education levels rise. This finding suggests that farmer education levels have a positive effect on rice production. The cost of the inputs has a positive impact on rice production. It is worth noting that when the multicollinearity problem is present in the model, the ridge regression method provides better results than the ordinary least squares method in terms of smaller MSE of estimators, smaller variation for estimates, and smaller coefficient of determination.

The positive impact of different levels of education on rice production demonstrates that education is critical for increasing rice output. To increase Bangladesh's rice output, the government should concentrate on education so that farmers can easily adopt modern agricultural practices. As a result, farmers should participate in literacy campaigns, training, IPM, and adult education programs. Findings confirm that most of primary educated people in the study area are involved in rice production. However, there is no agro-oriented module or text in the primary level schools or institutions. Although there are few agricultural training institutes in our country, it is not enough for the development of agriculture. Even, there are no agricultural trained teachers in the primary level schools in our country. Therefore, agro-based modules must be incorporated in the primary level schools or institutions. In addition, number of agricultural institutes should 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. At present in the secondary level an optional agricultural science subject or course is offered which in our view is very inadequate. Therefore, compulsory courses should be introduced in the secondary and higher secondary levels. It is believed that it will contribute to a rise in the number of person who are agricultural knowledgeable. For agricultural technological development, emphasis should be given on research and development activities. For this, agricultural universities, research institutes should be given enough funds or resource. Moreover, agriculture extension service is crucial for rice farmers and has a positive impact on rice production. The government should employ more trained extension service officers to provide agriculture related modern services to the farmers. In addition, some educated farmers can be trained who can works as advisors of farmers.

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