



Effect of Agricultural Credit on Rice Productivity: A Case from Dinajpur District, Bangladesh

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ABSTRACT

The study aimed at estimating the effect of agricultural credit received from either of formal or semi-formal credit sources on rice productivity. Socio-economic characteristics of rice farmers were also explored. The study used both secondary and primary data. The primary data was collected from 240 rice farmers by using field survey during July, 2019 by means of multistage random sampling design. OLS regression model using the Cobb-Douglas Production Function was estimated to predict the effects of agricultural credit along with conventional inputs of production on rice productivity. The findings showed that the overall socio-economic status of the formal source credit recipients is better than that of the semi-formal source credit beneficiaries. In the regression outcome for formal source beneficiaries, five out of nine regressors viz, 'agriculture credit amount', 'seeds', 'fertilizer', 'tillage cost' and 'plantation cost' had a significant positive impact on rice productivity. While, in the regression result for semi-formal source beneficiaries, five independent variables viz, 'credit amount', 'seeds', 'fertilizer', 'pesticide cost' and 'tillage cost' had a significant positive effect but a regressor (i.e. plantation cost) had negative impact on rice productivity. For a 1% increase in the agricultural credit amount, there was 4.4% rise in the amount of rice productivity in the regression outcome for formal source beneficiaries. While it was 19.5% in the model for semi-formal source beneficiaries. Thus, this study emphasized more on semi-formal credit sources, unlike the existing literature that focuses more on flourishing formal sources of credit for agricultural financing.

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Introduction

Agriculture is dominated by crop cultivation, particularly rice, which is the staple food of Bangladesh. It has a great challenge to maintain sustainable food security for 180 million people in the country. The population size is increasing day by day, but the country is losing by 8000 hectares of cropland every year from its original 13 million hectares of arable land (BBS, 2019). Among the countries total cultivated area, about 80% is covered by rice

cultivation (BBS, 2018). Therefore, there are fewer alternatives except for increasing rice productivity, which necessarily requires the intensification of rice farming systems through adopting irrigation and fertilizer-intensive high-yielding varieties (HYVs) of rice in place of the traditional method of cultivation. HYV technology is associated with a significant increase in rice production costs as it is capital intensive. Adopting this technology is not affordable for small and marginal rice farmers who depend on agricultural credit for financing the farm expenses (Alauddin & Biswas, 2014). Thus, rural credit seems to be a vital instrument to promote up-to-date technology for greater rice productivity.

The importance of agricultural credit for higher rice productivity in rural economies is well supported by empirical evidence. Credit can raise rice production because it is a key tool that enables rice farmers to obtain some sort of control on working capital, fixed capital, and consumer goods (Sharmin, 2016). The availability of credit raises agricultural production, which is shown by many researchers (Rahman *et al.*, 2011; Elahi *et al.*, 2009). Saha and Dutta (2013) demonstrated the positive effects of adequate credit supplies on agricultural production growth and firm's incomes, as has been shown in many nations. An empirical analysis in India shows a positive and statistically significant impact on agricultural production of farm credit from any sources, but the marginal impact of traditional credit sources is more effective (Das *et al.*, 2009). Another study in Pakistan reveals the positive relationship between conventional credit sources and rice production (Iqbal *et al.*, 2003). According to Miah (2016), the farmers who use semi-formal agricultural credit get 1.21 times higher yields in rice production than those who do not use agricultural credit in Bangladesh.

In Bangladesh, the sources of agricultural credit can be divided into three: formal sources of credit, semi-formal sources of credit, informal credit sources. These agricultural financing sources might have a distinct other than the combined effect on rice production and its productivity in the study area, which is prominent for rice cultivation. This area has the facility to make agricultural financing from both formal and semi-formal sources. However, most of the researchers in the existing literature discussed the average contribution of credit in agriculture. Occasionally, they pay attention to the role of formal and semi-formal agricultural credit sources for increasing rice production. There's some space in the research on finding a separate marginal effect of formal and semi-formal agricultural credit on rice production in Bangladesh. Therefore, this study attempts to show whether any positive change in agricultural financing either from formal or semi-formal credit sources can play a diverse role in increasing rice productivity in the study area.

The specific objectives of the study are: to determine the socioeconomic profile characteristics of the rice farmers, and to estimate the effect of agricultural credit received from either of formal or semi-formal credit sources on rice productivity.

Methodology

The study was carried out in the Dinajpur district, which is popular for rice production in Bangladesh. The Boro rice farmers were considered for the study among the three types (Aus, Aman, and Boro) of rice farmers in the study area. Boro is the irrigated rice from December to early February, which is to be harvested during the dry seasons, from April to

June (Shelly *et al.*, 2016). Both qualitative and quantitative methods were used for the study. For data collection, both primary and secondary methods were used. The primary data was collected using field survey immediately after the Boro harvesting period during July 2019. As the source of secondary, data provided by Bangladesh Bureau of Statistics (BBS) for various years was used. Three types of Boro rice farmers comprise the population of the study viz. (i) non-beneficiaries who did not borrow any credit, (ii) beneficiaries who borrowed credit from formal financial institutions and (iii) beneficiaries who borrowed credit from semi-formal financial institutions within two years of data collection for rice production.

The multistage sampling design was followed for selection of the sample farmers from the population. At the first stage, two upazilas were randomly chosen from a total of 13 upazilas of Dinajpur district. After that, two unions are chosen from each upazilas using a simple random sampling process. At the third stage, two villages are randomly chosen from every selected union. Thus, a total of eight villages were selected. Finally, thirty farmers from each villages consisting of three types of farmers (ten farmers who did not borrow any credit, ten farmers who borrowed credit from formal financial institution and ten farmers who borrowed credit from semi-formal financial institution) were selected from eight villages. Therefore, a total of 240 farmers constitute the sample of the study.

For determining the socioeconomic profile characteristics of the rice farmers, age, gender, marital status, education, family size, occupation, farm size, and farming experience of rice farming was considered. For estimating the effects of agricultural credit received from the formal or semi-formal credit sources on rice productivity, conventional inputs of production (cost for seed, fertilizer, irrigation, pesticide, tillage, plantation, harvesting, and weeding) was used along with amount of credit received from different sources of financing.

Both descriptive and inferential analysis was performed in the study. In the descriptive analysis, the frequency and percentage was presented along with the respective categories of the socioeconomic characteristics of types of farmers. For the purpose of inferential analysis, agricultural productivity is assumed to be measured as the ratio of agricultural outputs to agricultural inputs. Such productivity could be compared to a variety of inputs. However, this type of measurement captures the partial productivity (Preckel, 2003). In this study, rice productivity is assumed as the amount of Boro rice produced in each bigha in the March-June season. Here, bigha is a local unit of land area measurement in Bangladesh which is equivalent to 33 decimals or 0.33 acre.

The marginal effect of agricultural credit from both formal, semi-formal financial credit source on rice productivity was estimated by using OLS regression model utilizing the Cobb-Douglas Production Function following the study of Ekwere and Edem (2014). The formal financial institutions as a source of credit include the private commercial banks, state-owned banks, and specialized government banks, etc. and the semi-formal sources of credit comprise autonomous credit institutions like Bangladesh Rural Development Board (BRDB), Palli Karma Sahayak Foundation (PKSF), and various Non-Government Organizations (NGOs). The same model was also estimated for the respondents who did not take any credit for rice production. The production function is:

$$Y = \alpha X_1^{b_1} X_2^{b_2} X_3^{b_3} X_4^{b_4} X_5^{b_5} X_6^{b_6} X_7^{b_7} X_8^{b_8} X_9^{b_9} e_i^{\mu_i} \dots\dots\dots (i)$$

Equation (i) can be written in the linear form, as follows:

$$\ln Y = \ln a + b_1 \ln x_1 + b_2 \ln x_2 + b_3 \ln x_3 + b_4 \ln x_4 + b_5 \ln x_5 + b_6 \ln x_6 + b_7 \ln x_7 + b_8 \ln x_8 + b_9 \ln x_9 + u_i \dots\dots\dots(ii)$$

Here, \ln = natural logarithm; Y = amount of rice production (kilogram/per unit of area or bigha); α = constant factor; X_1 = Amount of credit invested per unit area; X_2 = cost of seeds (Tk per bigha); X_3 = cost of chemical fertilizer (Tk/ bigha); X_4 = cost of irrigation (Tk/ bigha); X_5 = cost of pesticide (Tk in a bigha); X_6 = Tillage cost ; X_7 = plantation cost (Tk in a bigha); X_8 = Harvesting cost; X_9 = weeding cost; μ_i = Disturbance term and $b_1, b_2, b_3, \dots, b_9$ = co-efficient of respective variables needs to be estimated.

The null hypothesis considered for the study is, (H_0): $b_1=0$ (agricultural credit does not affect the productivity of rice in the study area), whereas the alternative hypothesis is, (H_1): $b_1 \neq 0$ (agricultural credit can affect the rice productivity). The t statistics have been used to test the hypothesis.

Results & Discussion

Socioeconomic profile of the farmers

The findings of the socio-economic characteristics along with their suitable categories are presented in Table 1. Findings in Table 1 reveal that 46 to 60 years old farmers consist of the majority of the formal credit beneficiaries which is 43.7% of the total, and among the semi-formal sector beneficiaries, the greater part (52.5%) belongs to the age group 31 to 45 years. In contrast, the majority (48.8%) of the non-beneficiary respondents are in the age range of 31-45 years. It indicates that the majority of the formal credit borrowers are in the middle age category ranging from 46 to 60 years old (43.7%). However, the majority of the semi-formal beneficiaries and also non-borrowers are young-aged farmers ranging from 31 to 45 years old.

It was also found that 98.8 % of the formal source credit beneficiaries and 75% of the semi-formal source credit beneficiaries are male, whereas 73.8% are male among the non-beneficiaries of credit. This indicates that majority of the respondents involved in rice farming are male. Findings reveal that every credit beneficiary of the formal sector is married. Among the semi-formal credit beneficiaries, 96.2% are married and 92.5% of non-beneficiaries are married.

On the issue of education, the majorities (48.8%) of the formal sector farmers have received secondary level education, and the highest 45% of semi-formal sector credit beneficiaries and 47.5% of the non-beneficiaries have completed primary level. As people having higher education prefer to work in the official job sector, a very low percentage of highly educated respondents are found engaged in rice production in the study. It is noteworthy that none of the formal source credit beneficiaries and very few (3.8%) of the

semi-formal source credit beneficiaries are illiterate, but 22.5% of the non-beneficiary respondents are illiterate.

Table 1 Distribution of different types of farmers based on their socioeconomic profile characteristics

Characteristics (measurement unit)	Categories	Beneficiaries of formal credit source		Beneficiaries of semi-formal credit source		Non-Beneficiaries- (didn't borrow any credit)	
		No.	%	No.	%	No.	%
Age range (years)	16-30	9	11.2	30	37.5	16	20
	31-45	33	41.3	42	52.5	39	48.8
	46-60	35	43.7	7	8.8	18	22.5
	Above 60	3	3.8	1	1.2	7	8.8
Gender	Male	79	98.8	60	75	59	73.8
	Female	1	1.2	20	25	21	26.3
Marital status	Married	80	100	77	96.2	74	92.5
	Unmarried	0	0	1	1.2	4	5
	Divorced/others	0	0	2	2.5	2	2.5
Education	Illiterate	0	0	3	3.8	18	22.5
	Primary education	23	28.8	36	45	38	47.5
	Secondary education	39	48.8	28	35	16	20
	HSC	10	12.5	6	7.5	8	10
	Degree & above	8	10	7	8.8	0	0
Family size (number of members)	1-4	36	45	43	53.8	36	45
	5-8	42	52.5	36	45	39	48.8
	> 8	2	2.5	1	1.2	5	6.2
Occupation	Only farmer	57	71.2	55	68.8	54	67.5
	Farming and business	11	13.8	5	6.2	6	7.5
	Farming and day laborers	10	12.5	9	11.2	15	18.8
	Farmers and others	2	2.5	11	13.8	5	6.2
Farm size (bigha*)	1-4	12	15	52	65	56	70
	5-10	33	41.2	22	27.5	14	17.5
	11-15	18	22.5	5	6.2	9	11.2
	> 16	17	21.2	1	1.2	1	1.2
Rice farming experience (years)	≤5	1	1.2	3	3.8	4	5
	6-10	4	5	2	2.5	3	3.8
	11-15	2	2.5	19	23.8	15	18.8
	16-20	16	20	23	28.8	16	20
	>20	57	71.2	33	41.2	42	52.5
Total		80	100	80	100	80	100

Source: Field Survey-2019

Note: * bigha is a local land area measurement unit which is equivalent to 33 decimals or 0.33 acre.

It is clear regarding family size, the majorities (52.5%) of the formal source beneficiaries have a family size of 5 to 8 members, but major (53.8%) semi-formal source beneficiaries belong to the family size of 1-4. Whereas the highest, 48.8% of non-beneficiaries have a family size of 5-8. Semi-formal source credit beneficiaries' average family size is smaller than that of formal sector beneficiaries and also non-beneficiaries.

Findings show that the majority of the respondents are farmers in both formal and semi-formal credit sources, accounting for 71.2 percent and 68.8 percent, respectively. While, the majority of non-beneficiaries' (67.5 percent) occupation is farming.

With regard to farm size, the majority of formal source credit beneficiaries (41.2%) have a farm size of 5 to 10 bighas (~ 1.65 to 3.3 acres). However, the majority of semi-formal source beneficiaries (65 %) do have farm size of 1 to 4 bighas (~ 0.33 to 1.32 acres). On the other hand, 70% of the non-beneficiaries have a total of 1 to 4 bighas (~ 0.33 to 1.32 acres) farm size. The average farm size of the formal source beneficiaries is larger than that of non-beneficiaries and semi-formal source credit beneficiaries.

In terms of agricultural experience, 71.2% of formal source recipients have over twenty years of rice farming experience, while 41.2% of the semi-formal beneficiaries have more than 20 years of rice farming experience. Similarly, the majority (52.5%) of the non-beneficiaries have experience of more than 20 years. The results indicate that the young or less experienced farmers are smaller in both types of the beneficiary of credit and non-beneficiaries. They are most likely employed in jobs other than farming.

Effects of agricultural credit on rice productivity

The results of Cobb-Douglas Production function (equation ii) for formal source credit beneficiaries (model 1), semi-formal source credit beneficiaries (model 2), and non-beneficiary of credit (model 3) are presented in Table 2.

The regression results of formal source beneficiaries (model 1) shows that the independent variables have explained a 75.5% variation in the dependent variable. Out of nine regressors, three variables, namely agricultural credit, fertilizer, and tillage have significant positive effect on productivity of rice at 1% level of significance, whereas seed is positively significant at 5% level of significance, and plantation is significant at 10% level of significance to affect rice productivity. While the rest four variables (irrigation, pesticides, harvesting, and weeding) have no statistically significant effect at 10% level of significance. The regression model's coefficient represents the elasticity of the amount of rice production concerning independent variables: agricultural credit, fertilizer, seed, pesticides, irrigation, and pesticide, harvesting, and weeding. The findings indicate that a percent increase in the agricultural credit amount, seeds, fertilizer, tillage cost, and plantation cost will bring to 4.4%, 4.3%, 37.5%, 9.4%, and 11.9 % rise in the amount of rice productivity.

Considering model 2 of Table 2, the coefficient of determination (R^2) for the semi-formal sector indicates that the independent variables have described 83% variation in rice productivity. Six variables out of nine regressors, namely agricultural credit amount, cost of seed, fertilizer, pesticides, tillage, and plantation, are significant to affect the amount of rice productivity at different levels of significance. The findings of the regression result for semi-

formal source beneficiaries indicate that a percent increase in the agricultural loan amount, cost of seeds, fertilizer, pesticides, and tillage will 19.5%, 9.1%, 24.2%, 3.1%, and 9.9% increase in the amount of rice productivity at different levels of significance. But it will decrease the rice productivity by 18.8% with a one percent increase of plantation cost.

Again, the results of model 3 of Table 2 for credit non-beneficiaries show that the independent variables describe 64% variation of the dependent variable. The regression results also indicate that a one percent increase in the cost of seeds, fertilizer, tillage, and plantation will bring to 3.9%, 23.4%, 8.7%, and 14.5% increase in the amount of rice productivity at various levels of significance.

Table 2 Regression outcome of the predicted factors affecting rice productivity

Dependent variable = Amount of rice production per bigha			
	Formal source credit beneficiaries (1)	Semi-formal source credit beneficiaries (2)	Non-beneficiaries of credit(3)
Variables	Coefficients	Coefficients	Coefficients
X ₁ (Credit)	0.044*** (0.016)	0.195*** (0.022)	-
X ₂ (Seed)	0.043** (0.025)	0.091*** (0.032)	0.039* (0.027)
X ₃ (Fertilizer)	0.375*** (0.122)	0.242*** (0.049)	0.234** (0.133)
X ₄ (Irrigation)	0.016 (0.034)	-0.005 (0.039)	0.012 (0.026)
X ₅ (Pesticide)	0.011 (0.044)	0.031* (0.020)	0.019 (0.031)
X ₆ (Tillage)	0.094*** (0.033)	0.099** (0.047)	0.087** (0.046)
X ₇ (Plantation)	0.119* (0.091)	-0.188*** (0.067)	0.145** (0.081)
X ₈ (Harvesting)	-0.020 (0.021)	0.037 (0.042)	0.019 (0.027)
X ₉ (Weeding)	0.026 (0.032)	-0.015 (0.020)	0.023 (0.021)
Constant	-1.658*** (0.566)	-0.256 (0.695)	-1.240 (0.454)
Sample Size	80	80	80
R ²	0.755	0.830	0.640

Source: Author's calculation from E-views 7

Note: Standard errors are shown in parentheses, *** p<0.01, ** p<0.05, * p<0.1

It is clear from the regression result that a one percent increase in formal source credit amount will bring to a rise of 4.4% in the productivity of rice. In contrast, a percentage increase in the semi-formal source credit amount will contribute to 19.5% in rice productivity. So, it can be said based on the coefficient of 'credit amount' in both models of the formal source of credit beneficiaries and semi-formal source credit beneficiaries that the rice farmers' access to credit has a significant marginal impact on their rice productivity. In comparison to the non-beneficiaries, both types of credit beneficiaries are better off in terms of productivity change. But the marginal contribution of the credit in the semi-formal sector is larger than that of the formal sector (Table 2).

There are various reasons for having the larger marginal effect of rice productivity of semi-formal source beneficiaries than that of formal source beneficiaries and non-beneficiaries. Semi-formal credit sources like Palli Karma Sahayak Foundation (PKSF) and numerous NGOs monitor farmers' activities and provide various support, training, and information for the effective use of loans and inputs in producing rice. Besides, semi-formal beneficiaries get agricultural loans easily and use their smaller credit more properly in rice production. On the other hand, formal source credit beneficiaries receive a larger amount of loans but generally don't get proper support, training, and information for effective use of loans and inputs; in some cases, they use their loan improperly. Non-beneficiaries, in some cases, might receive a loan from the informal sector at a higher cost. Also, they don't get proper support, training, and information to use inputs effectively. Therefore productivity of semi-formal source loans is higher than that of formal source loans and non-beneficiaries. Shelly and Nosaka *et al.* (2016) showed similar issues in the analysis of problems of rice cultivation and barriers of formal source agricultural financing. They proposed making more formal credit flexible as well as giving more incentives to the NGO sector that provide all post-loan services to rural poor farmers. In real life, the credit does not directly influence rice farmers' productivity, as the regression result shows. But, it indirectly affects the productivity of output through a change in inputs used (Alauddin & Biswas, 2014).

Conclusion

The purpose of this research is to find out how agricultural financing affects rice productivity. The findings show that the overall condition related to the socio-economic status of the formal source credit recipients concerning education, farm size, and occupation is healthier than that of the beneficiaries of semi-formal sources. But, the socio-economic situation of the semi-formal source beneficiaries is better than that of non-beneficiaries regarding education, farm size, and occupation. NGOs, a source of semi-formal sources of credit, are contributing to the distribution of agricultural credit through their stronger network over the whole country. It has become popular in many South-Asian countries, including Bangladesh.

The study outcome indicated that a rise in the amount of credit will bring positive change in rice productivity and the marginal contribution of the semi-formal sector is more than that of formal sources of credit on rice production. The most available, informal credit is less effective for HYV technology promotion since it offers a smaller amount of loans with the highest interest rate. Formal sources of credit provide a larger amount of agricultural loans to

the rich farmer with a lower interest rate. It is less available for poor rice farmers because of the government or institution's many regulations. Semi-formal sources of credit posit the in-between situation of formal and informal sources of credit. Semiformal credit sources like Palli Karma Sahayak Foundation (PKSF) and numerous NGOs monitor farmers' activities and provide various support, training, and information for the effective use of loans and inputs in producing rice. Besides, a semi-formal beneficiary uses their smaller credit more properly in rice production. On the other hand, formal source credit beneficiaries receive a larger amount of loans but generally don't get proper support, training, and information for effective use of loans and inputs; they may misuse their loan in some instances. Non-beneficiaries, in some cases, might receive a loan from the informal sector at a higher cost. Also, they don't have proper support, training, and information to use inputs effectively. Therefore the productivity of semiformal source credit borrowers is higher than that of formal source credit borrowers and credit non-beneficiaries. The following suggestions for consideration are based on the findings of this research.

- All formal and semi-formal agricultural loan providers should take necessary measures like regular and systematic supervision of loan usages so that borrowers could properly utilize their loans.
- Institutional and semi-institutional credit supplying agencies should be stronger enough to provide good services to rice farmers.
- The government should provide adequate incentives and support (i.e. subsidy to input cost and flexible rules in loan disbursement) to rice farmers to produce rice at a lower cost and earn higher profits from rice production.
- The government can provide proper incentives (e.g. subsidized interest, flexible policy support for a quick agricultural loan from NGOs, and promoting reward for the performance of NGOs) to semi-formal lenders who are efficient and devoted to agricultural financing in rural areas.
- It is important to increase rice productivity by giving concentration on rice production and providing adequate semi-formal loans to marginal rice farmers.

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