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WHY AND FOR WHAT? AN EVIDENCE OF AGRICULTURE CREDIT DEMAND AMONG RICE FARMERS IN PAKISTAN

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Abstract

Credit is a crucial factor in agricultural development. This study explores the reality in the commonly practiced sources by farmers for acquiring agricultural credit, its uses and environmental and socio-economic determinants. A total of 236 rice farmers with agricultural credit activity at least last two years were randomly selected and interviewed in the Punjab province of Pakistan using a multistage cluster sampling technique. The collected data were analyzed using ordinary linear regression (OLS) regression and multivariate probit regression (MPR) models. The results indicate that 73.7% of farmers used informal sources to acquire agricultural credit, while 22.1% of farmers acquired loans through public and private institutional sources, and 4.2% of farmers used both sources simultaneously. The acquired agricultural credit amount was not completely invested in the agricultural sector: 64.8% was invested in the agricultural sector, while 25.5% and 9.7% of the credit was used to manage their livelihood and business activities, respectively. OLS indicates that socio-economic and environmental factors are responsible for agricultural credit demand. Moreover, the MPR results indicate that different factors are responsible for requesting credit from formal and informal institutes. The findings provide suggestions for sustainable development in the agricultural sector, tackling environmental issues and socio-economic development to reduce poverty. As an emerging economy, formal and informal credit policies should be revisited and the rules regarding environmental and institutional guidelines for farmers should be softened, which would probably support development of credit policies in developing countries.

Keywords: agriculture credit, socioeconomic and environmental factors, flood, rice farmers, multivariate probit model, OLS regression model

JEL Classification: D240, G2, Q140

Contents

1. INTRODUCTION

Creative actions require a time lag between when input is obtained and output is produced. If self-investment is not enough, then credit from formal or informal sources is essential to buy the necessary input. Contracts, written or oral, are used in the countryside in substantially different ways based on the characteristics of borrowers and lenders, as well as the input financed. For instance, interest free loans are often taken from relatives and friends, while conditional credit is taken from commercial banks, and no collateral is needed for loans taken from middlemen or commission agents, but these have a comparatively high interest rate. Such no-collateral loans are viewed with prejudice by policy makers and development experts, who believe such lenders take advantage of and exploit borrowers. Governments and non-governmental organization in developing countries are prioritizing solutions to such situations to help poor farmers by providing a credit supply to those who cannot supported by formal credit institutions.

Credit is crucial in the agricultural sector to enhance the productivity of crops and animals used as food for human beings (Akmal et al. 2012). Farmers usually obtain low crop production due to lack of capital, and credit is an capital alternative to enhance productivity in developing countries (Akmal et al. 2012; Sattar 2012). Numerous factors are involved in low productivity: a low dosage of fertilizer is caused by lack of capital, and this is one of the major factors involved in low productivity in developing countries like Pakistan (Sattar 2012). Poor farmers generally borrow capital, because their income and margins are low (Njeru, Mano, and Otsuka 2016). Credit is also important in the agricultural sector to make use of advanced technologies to enhance farm productivity. The demand for agricultural credit appears not just among small farmers, but also medium and large farmers as well, due to the low margins associated with agriculture (Das, Senapati, and John 2009). Duy (2015) indicated in his study that credit played a positive and significant role in rice production in the Mekong Delta.

Many studies have been carried out regarding the impact of credit on crop production; Martey et al. (2015), for example, studied the impact of credit on maize efficiency and found that credit had a positive effect on yield and production. They also found that credit eliminated the capital constraint of buying timely input in the agricultural sector, so input factors became more efficient thus providing maximum output. Farmers' credit investment in the agricultural sector allows superior decision-making regarding the input use of pesticide, fertilizer, and herbicides (Sossou, Noma, and Yabi 2014). Credit also has a positive and significant impact on production among small rice farmers in Malawi (Magreta et al. 2013), and the technical efficiency of rice farmers in Viet Nam was affected by deficiency of credit (Hùng, 2007). The availability of credit affects food security at both the regional and national levels (Rahman et al. 2014).

Farmers constrained from acquiring credit from formal sources such as banks tend to borrow money from informal sources such as relatives, neighbors and agents; as a result, they invest less and yield low agricultural production (Reyes et al. 2012). Formal credit is normally used in the agricultural sector and informal credit is used for household expenditures, as well as dwellings. In an overview of credit and subsidy policy, a recent study found that the supply of credit and subsidies to the agricultural sector has enhanced production (Hoda and Terway 2015), but the proportion of agricultural credit to small farmers still needs to be increased (Abdullah et al. 2015). Irrigation issues, small land holdings, and low yield are the main impetus for pursuing loans (Waqar 2002), while low education, large family size, and no availability of agricultural input are the primary allocating factors for borrowing (Oboh and Ekpebu 2011). Natural disaster shocks such as floods can affect the farm operators and the demand for credit increases after natural

disasters, such as the 1998 flood in Bangladesh (del Ninno, Dorosh, and Smith 2003; Dercon 2002).

2. BACKGROUND

2.1 Agricultural Background

Agriculture is the most important sector of Pakistan's economy, providing 42.5% of employment among total labor force and 21% of the country's gross domestic production (GDP; GOP 2017). Agriculture provides raw material to the country's industries and contributes more than 60% to exports. More than 60% of the country's population lives in rural areas, and their livelihood is associated directly or indirectly with the agricultural sector (GOP 2013). The agricultural sector therefore has a massive impact on the country's growth and provides employment to a large population (Bashir et al. 2007). The decreasing trend of the agricultural sector as a share of the country's GDP—from 45% in 1960 to 21.5% in 2015—in combination with the country's rapidly growing population has created an alarming situation for the government and policy makers. Daily newspapers in Pakistan report that the country will face food security issues in the coming years (Express 2017). Timely farm input and capital investment are crucial factors for creating development and growth in the agricultural sector (Akmal et al. 2012), and the majority of Pakistani farmers cannot afford the recommended quantity of input such as fertilizer and pesticide due to high prices and lack of capital, which results in very low yields far below that of their counterparts who are able to invest more capital (Shah et al. 2008).

Rice is a cash crop that is important in Pakistan's economy and feeds more than 2.7 billion people globally (more than half of the world population). More than 90% of production and consumption of rice takes place in Asia (Duy 2015; FAOSTAT 2017). Rice ranked on third among Pakistan's major crops, following cotton and wheat. Rice crops area occupy more than 11% of arable land in Pakistan; in 2013–2014, rice crops were cultivated on an area of 2789.2 thousand hectares, with a yield of 6798.1 tons. Average rice yields in Pakistan remain very low compared to those of other rice-growing countries (FAOSTAT 2017).

2.2 Credit-Receiving Cradles

Uncertainty is common in the agricultural sector, and credit is an important factor in overcoming those uncertainties and enhancing productivity. There are two types of credit accessible to farmers in Pakistan: formal (institutional) and informal (non-institutional). Formal sources of credit include commercial banks that give long-term loans. Farmers have to meet conditions to get bank loans, including documentation of their agricultural land or buildings and providing a certificate of good business reputation. Informal means of credit include friends, relatives, and middle men or commission agents (Akhtar 1986). Agents lend money to farmers for a short-time period when the need arises suddenly; farmers then sell their crop to the same commission agent or middlemen to fulfill the agreement, even if the agreement is verbal (Bashir et al. 2007). Farmers borrow money not only to cover costs in the agricultural sector, but also for other various reasons (Khan et al. 2011).

An FAO report found that the population growth rate in Asian countries will increase more than 52% on average by 2025, and the population in Pakistan will increase 87%, which

is the highest growth rate in Asian rice-growing consumptions countries. This will create an alarming situation as the state seeks to feed its population (Hossain 1995). Rice is produced in Pakistan on a large scale, but has been following a decreasing trend in yield for many years (FAOSTAT 2017). Capital has considerable power to increase rice yield and production.

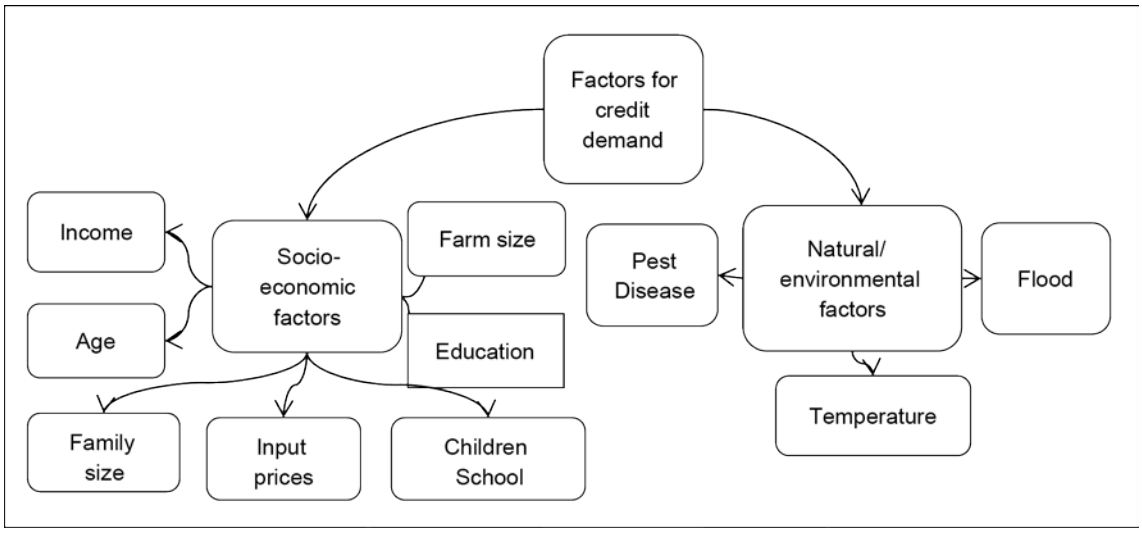
Several studies have been conducted on credit supply and its impact on the agricultural sector (Ashcraft 2005; Driscoll 2004; Kashyap and Stein 2000; Malik 1993; Peek and Rosengren 2000; Ramey 1993; Ruckes 2004; Zuberi 1989); however, little attention has been given to credit demand factors for rice-producing households, especially in Pakistan. To fill this gap, this study investigates the prompting socio-economic and environmental factors that create demand for agricultural credit, as well as how the credit is actually used—whether for agricultural or other purposes.

3. CONCEPTUAL MODEL

Farm credit can decrease economic inequities at the regional level, which strengthens farm wealth variations for development (REDDY 2011). It is also important in a sector where incomes usually have large seasonal fluctuations and to provide support during sporadic events such as ailments or weddings, which create a financial pressure on farmers (Ghosh, Mookherjee, and Ray 2000). Farmers obtain agricultural credit for survival and to increase farm income (Deressa et al. 2009). Accessing factors for agricultural credit such as age, family size, and income have been reviewed in previous studies (Abedullah, Khalid, and Kouser 2009; Amjad and Hasnu 2007; Nguyen and Le 2015; E. Saqib et al. 2018; Saqib et al. 2016; Sebatta et al. 2014). Education is an important factor for credit demand in agricultural sector (Abedullah et al. 2009; Chaudhary and Ishfaq 2003; Nguyen and Le 2015), and the literature also reveals the role of farming experience in credit markets (Nguyen and Le 2015). However, farmers in Pakistan often experience natural hazards such as flood, drought, heavy rains, pests and disease, and high input costs. During the last decade, the agricultural sector in Pakistan has experienced three enormous floods—in 2010, 2011, and 2014—that devastated farmers in the country and destroyed crops, fisheries, forestry, and livestock, as well as major infrastructure such as water channels, houses, personal items, stored fertilizers, and machinery (Amber Sayed 2014).

A consolidated conceptual model of factors affecting credit demand is shown in Figure 1. It is predicted that socio-economic and environmental factors are responsible for pushing farmers to seek credit. Farmers' income, age, farm size, family size, education, input prices, and school-going children are considered as pushing factors, while pest, disease, temperature, and natural disasters such as floods can generate momentous shocks in food supplies that can cause slow development and consequently strengthen demand for agricultural credit (Skees et al. 2005).

Figure 1: Conceptual Framework of Factors for Credit Demand



4. EXPECTED SIGNS OF THE USED VARIABLES IN THE MODEL

For the present study, the hypotheses are built and the expected signs for the variables are explained as follows (summary shown in Table 1). It is hypothesized that there is a negative relationship between credit demand and age means that the higher the age, the lower the demand for credit ($b_1 < 0$). It is also hypothesized that there is a positive relationship between credit demand and educational level, meaning that the higher educational level, the greater the demand for credit ($b_2 > 0$). There is expected to be a negative relationship between credit demand and income level, which means that the higher income, the lower the willingness to seek credit ($b_3 < 0$). A negative relationship is expected between credit demand and farm size: the bigger the farm, the lower the demand for credit ($b_4 < 0$). A positive relationship is expected between credit demand and household size: the bigger the household, the more loans are demanded ($b_5 > 0$). A positive relationship is also expected between credit demand and the number of dependent children: the higher the number of dependent children, the greater the demand for credit ($b_6 > 0$). There is probably a positive association between credit demand and input price risk: the higher the risk for input prices, the greater the demand for credit ($b_7 > 0$). Positive relationships are expected between credit demand and both disease and flood risk: the higher the risk of flood or disease, the greater the demand for credit ($b_8 > 0$; $b_9 > 0$). A positive association is expected between credit demand and temperature: the higher the temperature, the greater the demand for credit ($b_{10} < 0$). A positive relationship is expected between credit and both perceived flood and perceived disease risk ($b_{11} < 0$; $b_{12} < 0$). Finally, a positive relationship is expected between credit and mean annual temperature ($b_{13} < 0$).

Table 1: Expected Sign for the Estimation of Variables

Variables	Description of Variables	Expected Sign
	Socio-economic	
Age	Age (in years)	−
Educ.	Education (schooling years)	+
Inco.	Income (in Pakistani rupee)	−
Farmsz	Farm size (in acres)	−
Fmlysz	Family size (numbers of family members)	+
Dep.Child	Dependent children (less than 15 years)	+
Inpt. Price	Dummy: 1 = if respondent have inputs price risk, 0 = otherwise	+
	Sources of Credit	
Formal	Credit received from formal source = 1 otherwise = 0	+/−
Informal	Credit received from informal source = 1 otherwise = 0	+
Formal + informal	Credit received from formal + informal source = 1 otherwise = 0	+/−
	Environmental	
Flood risk	Dummy: 1 = if respondent have flood risk, 0 = otherwise	+
Disease risk	Dummy: 1 = if respondent have disease risk, 0 = otherwise	+
Temp	Temperature Annual average	+

5. MATERIALS AND METHODS

5.1 Study Area and Data Sampling

Traditionally, rice is cultivated in two provinces in Pakistan: Punjab and Sindh. The surface irrigation system has been improved and developed more in both provinces than elsewhere in the country. More than 85% of rice in Pakistan is produced in these two provinces; Punjab produces 100% Basmati rice due to its favorable climate and soil conditions, and five districts in this province—Gujranwala, Sialkot, Mandi Bahauddin, Sheikhupura, and Hafizabad districts—were selected for study as they produce rice as major crop. These districts produce about 70% of the total rice production at the national level (Abedullah et al. 2009). The total of 400 respondents interviewed using the multistage cluster sampling technique were further segregated into 236 respondents who had been involved in taking agricultural credit in the last two years.

5.2 Model Specification

5.2.1 Ordinary Least Squares Regression Model

The present study makes use of the decision making threshold theory following Hill and Kau (1973) and Pindyck and Rubinfeld (1998) to examine the prompting factors for rice farmers to pursue agricultural credit. The theory suggests that when farmers are confronted with the decision about an innovation—here, credit demand—then each farmer responds to a threshold that is dependent on a certain set of factors, such as respondent's socio-economic and environmental conditions. The collected data were therefore analyzed using the percentages technique (PT) to investigate the preferences regarding credit and uses of credit among rice farmers and a multiple linear regression (MLR) model using ordinary least squares (OLS) to analyze the impact of the factors on demand for credit. MLR is a statistical practice that is used to calculate the outcome of a

response variable for numerous descriptive variables. The following equation was developed for the regression model:

$$Y_i = a + b_1X_1 + b_2X_2 + b_3X_3 +, \ldots, + b_{13}X_{13} + e_i \quad (1)$$

where, Y_i is the dependent variable and represents the demand for credit, X_1 denotes age, X_2 indicates education level, X_3 is income level, X_4 denotes farm size, X_5 represents family size, X_6 denotes number of school-going children, X_7 denotes high prices of input risk, X_8 , denotes flood risk, X_9 is disease risk, while X_{10} indicates annual average temperature, X_{11} indicates formal sources of credit, X_{12} represents informal sources of credit, and X_{13} denotes both sources of lending credit; $b_1, b_2, b_3, \ldots, b_{13}$, are the coefficients of regression and e_i is the error term of the constant with a mean of zero.

5.2.2 Multivariate Probit Regression Model

Here a multivariate probit model (MPR) is considered with the probability of simultaneous relationships in the decision to take credit from the different sources considered: formal, informal and formal + informal (both) as follows:

$$\mathrm{Y_{ij}} = \mathrm{x'_{ij}}\beta_j + \varepsilon_{ij} \quad (2)$$

Therefore, Y_{ij} (j = 1, …, m) indicates the credit choice made (thus, m = 3) met by i^{th} farmer (i = 1, …, n), the vectors that affect the adoption decisions for credit borrow are observed by $\mathrm{x'_{ij}}$, which is a 1×k vector, the unidentified parameter β_j is a k×1 vector to be assessed, and e_{ij} is the unobserved error term. According to this description, each Y_{ij} is a dichotomous variable and, therefore, equation (2) is basically a part to be estimated of the m equations (in this case m = 3) to be assessed.

$$\left.\begin{aligned} Y_1^* &= \alpha_1 + X\beta_1 + \mathcal{E}_1 \\ Y_2^* &= \alpha_2 + X\beta_2 + \mathcal{E}_2 \\ Y_3^* &= \alpha_3 + X\beta_3 + \mathcal{E}_3 \end{aligned}\right\} \quad (3)$$

However, the three latent variables underlying each of the credit choices taken such that y_j = 1 if > 0 and 0 if not. If the vector of random errors ε_{ij} were *iid*, the estimation of the unidentified parameters of the model would be simple. However, as mentioned earlier, there is the likelihood of concurrent usage of risk management instruments, so it is probable that these choices are interrelated. The essentials of ε_{ij} probably experience stochastic dependence, which can be measured by assuming that ε_{ij} is multivariate normally (MN) distributed (Ashford and Sowden 1970). Therefore, in the MPR method, the error terms (across j=1,..., *m* possibilities) are expected to have MN distributions with a mean vector = 0. With the hypothesis of multivariate normality, the unidentified parameters in Eq. (3) can be assessed using SML (simulated maximum likelihood), which uses the GHK (Geweke-Hajivassiliour-Keane) simulator to assess the MN distribution.

6. RESULTS AND DISCUSSION

6.1 Descriptive Statistics of the Variables

Socioeconomic and environmental factors are the independent variables used in the present study to examine their influence on credit demand. The descriptive statistics of the used variables are shown in Table 2. The results indicate that average annual loan amount taken by rice farmers is Rs.131,520.9 (range: Rs.40,000–756,000). The average age of the household head is 45 years (range: 24–75). The mean education is 6.5 years, and the average annual income is Rs.187,252.2. The results indicate that the average farm size is 6.78 acres[1] (range: 2.47–25 acres). The average household size is 6 individuals (range: 4–14), while the average number of dependent children is 2.5 (maximum: 6). In this study, input price risk is valued as a dummy variable and the results show that the mean value is 0.57, which indicates positive risk for credit demand. Sources of credit (formal, informal, formal + informal) are also taken as dummy variables, where the informal average value is 0.74 and formal + informal is 0.04 on average (see Table 1). Flood is considered an environmental or natural risk and is used as a dummy variable, yielding a mean value of 0.35. Disease is used as dummy variable, with a mean value of 0.57. Temperature is an environmental variable, with an average value of 30.11 in the research area. In the agricultural system, farmers face numerous uncertainties, mostly due to environmental conditions (Akcaoz and Ozkan 2005; Ellis 1998, 2000).

Table 2: Descriptive Statistics of the Variables in the Model

Variables	Description of variables	Mean	SD	Min	Max
Dependent					
Cred.	Credit taken PKR	131,520.9	129,505.2	40,000	756,000
Independent	**Socio-economic**				
Age	Age (in years)	45	9.145	24	75
Educ.	Education (schooling years)	6.5	3.25	0	14
Inco.	Income (Pakistani rupee)	187,252.2	109,753.5	4,062	540,226
Farmsz	Farm size (acres)	6.78	5.26	1	25
Fmlysz	Family size (numbers of family members)	6	1.55	4	14
Dep.child	Dependent children (less than 15 years)	2.5	1.033	1	6
Inpt. Price risk	Input high prices risk dummy variable (1=yes, 0= otherwise)	0.57	0.49	0	1
	Sources of Credit				
Formal	Credit received from formal source = 1 otherwise = 0	0.20	0.41	0	1
Informal	Credit received from informal source = 1 otherwise = 0	0.74	0.44	0	1
Formal + informal	Credit received from formal + informal source = 1 otherwise = 0	0.04	0.20	0	1
	Environmental				
Flood risk	Flood risk dummy variable (1 = yes, 0 = otherwise)	0.35	0.47	0	1
Disease risk	Disease risk dummy variable (1 = yes, 0 = otherwise)	0.57	0.49	0	1
Temp	Average annual temperature	30.11	0.732	29	31.1

Source: Field survey, 2015–2016.

[1] 1 hectare = 2.47 acres.

6.2 Sources of Credit Practicing by the Framers

Information regarding the sources of loans taken was sought from the rice farmers during the survey. Respondents who had taken loans within the past two years were selected. The results in Table 3 illustrate the farmers' methods for acquiring credit. The results are somewhat surprising and reveal that only 22.1% of farmers sought loans from formal sources in 2015, while 20.3% of farmers used the same source for loans in 2014. In contrast, 73.7% of farmers sought loans from informal sources (i.e. middlemen / commission agents), while 4.2% used both sources (formal and informal) in 2015. In 2014, informal sources were used by 74.2% of farmers, while 5.5% used both formal and informal sources. There was a slight increase in taking credit from formal sources in 2015 compared to 2014, as was found in an earlier study (Malik and Nazli 1999). It is a challenge for small farmers to access formal credit due to security requirements, and the majority of farmers prefer informal credit sources (Khandker and Faruqee 2003; Rahman et al. 2014). There was significant variance in accessing formal and informal sources of credit. Large-scale farmers had greater access to agricultural credit from formal sources than small-scale farmers (Binswanger and Sillers 1983; Heltberg 1998; Rahman et al. 2014).

An earlier study revealed that farmers usual seek credit from informal sources (Kochar 1997), although the interest rate is higher. Farmers revealed that getting loans from commercial banks is complicated and security in the form of agricultural land or real estate documents has to be provided; our results are in line with those of an earlier study (Hassan et al. 2012). Additionally, 80% farmers seek loans from informal sources due to complicated banking procedures for the agricultural sector (Hussain 2012). Low education levels among farmers may be one reason for avoiding banks and complicated loan procedures. Farmers borrow money from informal sources to invest in the agricultural sector (Swain 2007). Only 5% African farmers get formal bank loans, for example, while 15% of Asian farmers have access to formal lending sources. A study in Ghana also found that farmers are changing their preferences for obtaining credit from formal to informal sources (Owusu-Antwi and Antwi 2010). Many farmers also feel that it is easy and convenient to get credit from informal sources, because they also have opportunity to sell their product to the same commission agents to return the loan, which is in line with a previous study (Hassan et al. 2012).

Table 3: Credit Sources Practicing by the Rice Farmers

	Formal (Banks)		Informal (Commission Agents)		Formal and Informal		Total	
Year	Number of Farmers	%	Number of Farmers	%	Number of Farmers	%	Number of Farmers	%
2015	52	22.1	174	73.7	10	4.2	236	100
2014	48	20.3	175	74.2	13	5.5	236	100

Source: Field survey, 2015–2016.

6.3 Household Credit Usage

Table 4 illustrates rice farmers' credit usage in the study area, revealing that around 65% of farmers are using loan for the agricultural sector, perhaps to purchase input and equipment. Without credit poor farmers are not able to produce crops and support their livelihood (Akmal et al. 2012; Bashir et al. 2007; Swain 2007). The results also indicate that more than 25% of farmers are taking loans for personal use, which suggests that

agricultural income alone is not sufficient to feed their family members. Klerk, Fraser, and Fullerton conducted a study in Botswana and found that agricultural loans are used to buy cars or pay school fees, rather than being used in the agricultural sector (De Klerk, Fraser, and Fullerton 2013). In another study, Katchova found that farmers do not use loans as proposed and spent the funds obtained on other personal activities rather than in the agricultural sector (Katchova 2005). In rural areas, households are generally poor and seek loans for personal use and sometimes to support a micro-business (Gonzalez-Vega 2003).

The results also revealed that nearly 10% farmers use loans for their own business. This indicates that they receive low income from the agricultural sector and are doing business to enhance their income. This may also be the result of excess leisure time due to well-managed farms; such farmers may want to spend their time wisely and enhancing their income. Agricultural credit is provided to farmers for investment and to enhance agricultural productivity, but farmers are using in different ways (Apurva 2016). Earlier studies found that agricultural credit was used for healthcare, education, festivals, consumption, and loan repayment (Chandio, Jiang, and Rehman 2018; Saqib et al. 2016).

Table 4: Household Credit Use

Type of Credit Use	Number of Farmers	Percentage
Agricultural use	153	64.8
Personal use	60	25.5
Business use	23	9.7
Total	236	100

Source: Field survey, 2015–2016.

6.4 Estimated Empirical Results of the OLS Regression

The estimated empirical results of the OLS regressions are shown in Table 5. Age is negatively but not significantly correlated with credit demand, which is in line with an earlier study investigating farmers in the United States (Katchova 2005). Hananu et al. (2015), however, found that age was found significantly and positively correlated with credit demand among farmers in Ghana. Education has a positive and significant effect on demand for credit, and well-educated farmers demand more credit, which is in line with the previous studies (Khan et al. 2011; Swain 2007). Getting credit from commercial banks is complicated for illiterate or less literate farmers due to the required preparation of different documents; this may be a reason for the effect of education on credit demand. A recent study revealed that education has a positive impact on agricultural credit demand in flood-prone areas (Saqib et al. 2018), while another study conducted in Ghana supports the present findings (Hananu et al. 2015). When education is compulsory to at least the primary level, there are better credit outcomes (Zuberi 1989).

Income has a negative and significant impact on credit demand: farmers with higher income do not like to get credit. Our findings are similar to previous studies (Hananu et al. 2015; Hoda and Terway 2015; Kochar 1997; Owusu-Antwi and Antwi 2010; Swain 2007). Farm size is negatively significant to credit demand, so farmers with less farming area have higher demand for credit. This may be due to the low income of such farmers and the capital required to purchase the agricultural input and equipment. This departs

from the findings of Hananu et al. (2015), who revealed that farm size had no effect on agricultural credit demand.

Household family size is also positive and highly significant for credit demand, perhaps due to the greater demands for providing food and for investment in the agricultural sector. Family labor is part of the condition of the agricultural sector in developing countries like Pakistan (Abedullah et al. 2009). The study results also reveal the number of dependent children has a positive and significant effect on credit demand. The presence of more children in the household pushes the need for credit, perhaps to feed the children, pay school fees, and cover other child-related costs.

Regarding risk factors, the results demonstrate that input price risk has a positive and significant effect on credit demand. Farmers facing high input price risk—that is, small farmers—do not have enough money to purchase input for crops, so they require more credit. This is in line with Hoda and Terway (2015), who found that input price as positively significant and 100% covered by credit in India. Formal sources of credit were highly significant and informal sources were significant, but not as much as formal. Formal and informal credit sources were both positive but not significant. This shows that there is demand for formal sources of credit in the agricultural sector but, due to the documentation demands, farmers do not like get loans from banks. and prefer informal sources.

Concerning environmental variables, floods have a positive and significant impact on credit demand. Floods are always considered a substantial risk to farmers in Pakistan and each year floods damage thousands of acres of crops. Ninno et al. (2003) conducted a study after the flood in 1998 and revealed that demand for credit increased after the flood, while another study found that farmers facing natural disaster risks that damage crops need credit to overcome the loss of income (Iqbal et al. 2016). Natural hazards such as floods, heavy rains, and storms in Pakistan challenge farmers; floods in 2010, 2011, and 2014, for example, damaged a huge agricultural production area and priority was not given to credit policy to assist farmers seeking agricultural credit to invigorate crop production and buy agricultural input (NDMA 2017; Saqib et al. 2016). Disease risk also has a positive significant impact on credit demand, which shows that if disease risk is increased in the rice area, credit demand increases. Pests and disease cause low production and low income, which increase the demand for credit (Saqib et al. 2016).

Temperature has a significant and positive effect on credit demand. The agricultural sector remains risky due to climate change, so credit is helpful for small farmers in developing countries (Abedullah et al. 2009). High temperature can affect rice crops and cause water to evaporate, which results in the need for more water for irrigation. As water is very scarce resource in the agricultural sector, more capital is needed if more water is required. In a recent study, Shakoor et al. (2015) revealed that increasing temperatures would cause decreasing rice output in Pakistan, so the use of credit for input in the agricultural sector—especially scarce resources—is necessary (Abedullah et al. 2009; Sidhu, Vatta, and Kaur 2008; Swain 2007).

Table 5: Estimated Results of the OLS Regression

	Estimation of the Variables		
Independent Variables	**Coeff.**	**SE**	**P values**
Socio-economic factors			
Age	−0.8731	0.1841	0.4617
Education	0.9121*	0.4072	0.0190
Income	−0.3479***	0.0768	0.0000
Farm size	−1.52829**	0.4601	0.0010
Family size	3.0968**	1.0953	0.0051
Dependent children	1.8015***	0.4190	0.0000
Input price risk	0.2022*	0.4762	0.0671
Sources of credit			
Informal	2.8964*	1.6740	0.0850
Formal + informal	3.3251	2.0407	0.1047
Environmental factors			
Flood risk	0.3970*	0.1984	0.0266
Disease risk	1.2976**	0.4852	0.0081
Temperature	169.090**	13.5116	0.0000
Constant	−570.790***	46.0826	0.0000
Adjusted R-squared Value		0.6798	

***Indicates significant at the 1% level, **significant at 5% and *significant at 10%.

6.5 MPR Estimates

The parameter estimates of MPR for the factors affecting credit demand for rice farmers in Pakistan are shown in Table 6. The results indicate that education, income, farm size, dependent children, input price risk, flood risk, and borrowed amount were the influencing factors for demanding credit. Education was positive and significant for seeking formal credit. Income has a negative impact on seeking credit from informal sources. Farm size was positive and significant for seeking formal credit, which is supported by the results of earlier studies (Chandio et al. 2018; Saqib et al. 2016). Dependent children were positively significant for informal credit sources, while having no impact on formal sources. Input price risk was also positively significant for informal credit sources. Flood risk was positive and significant for both formal and informal credit demand. Our results are in line with previous studies (Chandio et al. 2018; Sebopetji and Belete 2009). Borrowed amount was highly significant and positive for formal credit and highly significant for informal credit (Chandio et al. 2018). None of the instrumental variables was found to be significant for the rice farmers seeking credit from both sectors in the study area.

Table 6: Multivariate Probit Regression Estimates

	Formal		Informal		Formal + Informal	
Characteristics	**Coefficient**	**SE**	**Coefficient**	**SE**	**Coefficient**	**SE**
Age	−0.0901	0.1218	−0.1116	0.1402	−0.0092	0.0675
Education	0.0215*	0.0406	0.0118	0.0467	−0.0150	0.0225
Income	−0.0026*	0.0078	−0.0081*	0.0091	−0.0061	0.0043
Farm size	0.0659*	0.0387	0.0923*	0.0446	0.0340	0.0214
Family size	0.0073	0.1017	−0.1120	0.1172	0.0049	0.0564
Dependent children	0.0171	0.0442	0.0036*	0.0509	0.0036	0.0245
Input price risk	−0.0328	0.0487	0.0659*	0.0561	−0.0298	0.0270
Flood risk	0.0983*	0.0506	0.1032*	0.0582	0.0261	0.0280
Disease risk	−0.0346	0.0505	0.0318	0.0582	−0.0154	0.0280
Temperature	2.1201*	0.3378	1.8703	1.5401	0.9516	0.7413
Borrowed amount (credit)	0.0334***	0.0054	−0.0269**	.0062	−0.0039	0.0029
Constant	6.6453***	4.6117	−4.7045**	5.3160	−3.1260	2.5588
# Adjusted R2 Value	0.2087		0.1366		0.0450	

***Indicates significant at the 1% level, **significant at 5% and *significant at 10%.

The adjusted R square for the model was highly significant for formal and informal credit demand.

7. SUMMARY AND CONCLUSION

The present study analyzed the factors influencing agricultural credit demand, the sources used for obtaining credit, and the usage of agricultural loans among rice farmers in the Punjab province of Pakistan. The results give an empirical overview of demand for agricultural credit and the sources used to take out loans by rice-producing households. Surprisingly, most farmers prefer to take credit from informal sources, rather than formal ones, although they end up paying more interest. Very few farmers take loan from formal sources due to the complicated bank procedures. Farmers getting agricultural credit are not using it for the intended purpose. Among the respondents, 64% of the credit is used as proposed (in the agricultural sector) while 25% is used for their personal requirements, and 9% is used to run a part-time business. The regression results demonstrate that education, family size, dependent children, high input price risk, flood risk, disease risk, and temperature have positive and significant impacts on agricultural credit demand in the research area. Income and farm size are negatively significant to agricultural credit demand.

Based on these results, the government and other concerned authorities should revise agricultural credit policies and make the procedures for providing credit to farmers easier. No-interest loan schemes could change farmers' opinions and increase reliance on government institutes and the banking sector. To ensure food security, to enlarge agricultural productivity, and for better credit outcomes, the government should categorize credit schemes for agriculture and business separately. Education should also be promoted in the study area so that farmers gain greater advantages that would improve their standard of living. Improvement of rural credit system would increase household income and reduce poverty. The government should also provide off-farm employment to rice farmers. Crop insurance policies should be introduced to overcome the numerous uncertainties of the sector. In the view of the environmental factors, the government should make policies regarding environmentally friendly practices and provide funds for environmental research and sustainable development. Further studies should be conducted to clarify the impact of agricultural credit on rice production.

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