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# Impact of Institutional Credit on Agricultural Output

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## Impact of Institutional Credit on Agricultural Output: A case study of Pakistan

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**Abstract.** *This paper looks at the role of credit to agricultural sector in Pakistan. It begins with an analysis of credit as indirect input to agricultural sector. It helps the farmers to buy modern and expensive inputs such as tractor, tubewell, seeds, fertilizers etc. the study covers the period from 1974 to 2008. The empirical findings show that there is a significant role of credit in agriculture sector.*

**Keywords:** Taccavi loans; farm mechanization; stationarity; cointegration; Granger causality.

**JEL Code:** .

**REL Code:** .

Agriculture sector has been predominant sector in Pakistan since independence. Agricultural output has been key source of growth in Pakistan's Gross Domestic Product (GDP) which grew about 3.6 percent a year for 25 years. The rate of economic growth in UDCs has been largely a function of the rate of growth in agriculture, which on average contributes nearly 50 percent towards their GDP (Afzal, 2004). In Pakistan's history, share of agricultural sector to GDP was 60 percent in 1949-1950 that decreased to 30 percent in 1978-79 and further to 20 percent in 2006-2007. But it is still the largest single component of total GDP. It absorbs nearly 43.1 percent of employed labour force. Agriculture sector has grown at an average rate of 4.1 percent per annum since 2002-2003 and experienced continuous variations from 6.5 percent to 1.1 percent from 2002-2003 to 2007-2008 as given in Table 1 (Ministry of Finance Division, 2009).

Agriculture sector has been also the great source of export earnings. Most of the economists are of the opinion that agriculture growth should be pursued within the framework of comprehensive national plan and should be integrated with the growth of other sectors. Agriculture sector is major source of food requirements of 67.5 percent rural population and 32.5 percent urban population besides provision of raw material to the industrial sector.

Table 1

**Agriculture growth rate**

Years	Growth in (percent)	Years	Growth in (percent)	Years	Growth in (percent)
1999-2000	6.1	2002-2003	4.1	2005-2006	6.3
2000-2001	-2.2	2003-2004	2.4	2006-2007	4.1
2001-2002	0.1	2004-2005	6.5	2007-2008	1.1

**Source:** Federal Bureau of Statistics.

The growth of agriculture sector in Pakistan always was low compared to developed economies. This growth has been the major component of the growth of industrial sector also. In USA, agriculture growth provided the necessary ignition to industrial development in the early period and agriculture was not sidelined as the industrial development picked up speed and momentum.

Therefore, this growth had required the use of chemical fertilizers, high yielding varieties of seeds, better irrigation, and mechanical equipments, which in turns had required the credit availability to the farmers.

The farmers in the use of modern methods of production, have to face the financial constraints in order to purchase these inputs. Agriculture credit, both by Agricultural Development Bank of Pakistan (ADBP) and commercial banks, expanded over the decade 1400 percent and 460 percent, respectively. Mechanization picked up great momentum as cumulative number of imported tractors increased by 462 percent. Pest control measures were substantially

strengthened as it was obvious from the import of pesticides which was reported increased more than 135 percent. Fertilizer consumption increased by 128 percent over the decade. Area irrigated by tubewell water increased from 2.56 million hectares in 1991 to 3.82 million hectares in 2007-2008 (Ministry of Finance Division, 2008).

### 1.1. Importance of credit

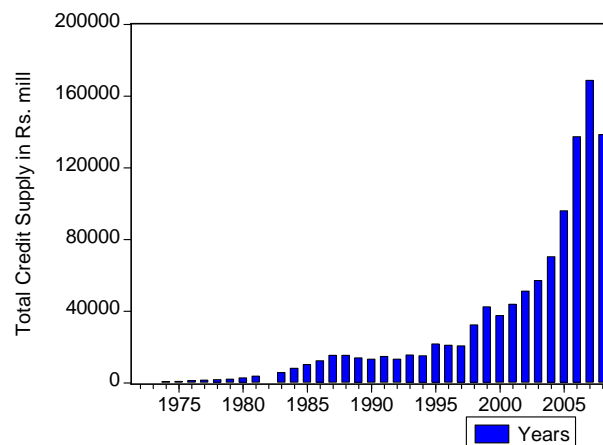
Small farmers, large farmers and non-farm population in agriculture sector all suffer from the problem of lacking in capital. After green revolution, and technological changes in this sector, the requirement of credit has increased to buy modern inputs. Large farmers also need the credit for the lumpy investment in this sector. Small farmers usually face cumbersome procedure and collateral problems in availing credit. These impediments had hardly hit the tenants and share croppers who did not own land. Other problems like providing credit to targeted farmers did not increase the number of farmers benefiting from this facility

Despite these problems, the role for financial institutions has been significant and emerged in the wake of technological changes in agriculture sector. In the past subsidized interest rate policy and share reserved for the poor farmers remained ineffective due to financial unsustainability in the loans portfolios. State Bank of Pakistan has introduced banking reforms and revised policies from time to time. Mandatory credit targets by Federal Bank for Cooperatives and by commercial banks were fixed for small farmers. Agriculture Development Bank of Pakistan established in 1961 has been playing its role to cater the need of poor farmers and non-farmers. Under the direction of government ADBP introduced special credit schemes, supervised Agricultural Credit System, and five loan windows. These loan windows provided Development Loans, Production Loans, Cottage Industry Loans, Agri-business Loans, and Off-farm Income Generating Loans. State Bank policy for giving subsidy on agriculture loans has been successful in the view of enabling the farmers to buy modern inputs and machinery and at the same time has been impediment in the efforts of Cooperative Societies and ADBP to mobilize deposits from their customers.

### 1.2. Impact of agricultural credit on production

In Pakistan not much work has been done in past to see the impact of credit on agricultural output. Some of the major studies in this regard done by Malik et al. (1985), Zuberi (1989), Sarfraz and Akhtar (1992), Sarfraz (1995), Iqbal et al. (2003), Afzal (2004).

The role of credit in agriculture sector has been significant. In modern agriculture, farming has become now complex and needs careful planning to achieve success, i.e. agriculture is no more a mode of life rather it has changed into commercial farming. Transformation of traditional agriculture sector to modern commercialization farming needs credit availability. Though there is a significant increase in borrowing from formal sources from 1985 onwards when mark-up free loans were made available to farmers. Rural credit reaches few rural households, and formal sources provide credit to only a small proportion of rural households. Only 32 percent of all rural households take loans, of these a mere 10 percent borrowing is from institutional sources. Not surprisingly, there is a positive correlation between wealth and access to source of credit. Richer households in the rural areas have better access to institutional sources, which are also cheaper, while poor households depend primarily on more expensive, non institutional credit.



**Figure 1.** Total credit supply by all institutions

The share of ZTBL in supply of total agricultural credit by institutions increased and was 29.9 percent during (July- March) 2008-2009. While the share of other institutions in total credit disbursement reduced as compared to ZTBL. The performance of commercial banks, however, in providing credit has surpassed the share of ZTBL was 48.9 percent of the total credit disbursed during July-March 2008-2009 (Ministry of Finance Division, 2009).

It was also found no consistency in facilitating short-term credit from 1985 to 2005 as well as in case of medium term credit. However, long term credit facility given to farmers has shown consistently declining trend in percentage terms from 74.4 in year 1983-1984 to 24.2 in year 2003. Further its

share in supply of total agricultural credit by institutions increased and was 29.9 percent in July-March 2008-2009 (Ministry of Finance Division, 2009). The reason behind this declining percentage from the year 1983-1984 to 2008-2009 is to focus more on targeted loans to small farmers.

Taccavi loans are provided through the Provincial Revenue Department of the Government. Provision of these loans is in the hands of provinces. In Punjab it grew at the rate of 41 percent from 1975-1976 to 2007-2008. But the situation for the rest of the provinces is entirely different. In Sindh loans are non-existent since 1993-1994. In NWFP, it was provided up till 1978-1979. In Balochistan, it has been showing non-continuous flow. The overall situation is showing declining trend from 1975-1976 till now. This kind of loans depends upon the support of federal government to the provincial governments (Ministry of Finance Division of Pakistan, 2009).

Sarwar et al. (1985) studied that there were two sources of the credit or cash for farmers, i.e. institutional and non-institutional. The non-institutional source was neither adequate nor reliable for the cash needs of the farmers. Other one source that is institutional credit that operates through its three major institutions, namely ADBP, commercial banks, and cooperatives. The credit advanced through these institutions increased since 1970s and the number of beneficiaries had also been reported to be growing till 1984-1985 but study shown its dissatisfaction regarding the rightness of these loan operations. Malik et al. (1989) studied the significance of institutional source of credit, which increased their credit facilities to the small farmers especially the credit from the ADBP, commercial banks, and cooperatives. While the non-institutional credit showed downward trend, especially loans from relatives and friends. Despite all the facts the results in this study showed, very little access of credit for small farmers. Khan et al. (1990) found that small farmers in Pakistan are 74 percent of the total number of farmers but the area they possess is only 34 percent of the total cultivable land. Malik et al. (1992) studied the disbursement of credit for improved seeds, water and tractors for the period of 1971 to 1987 and found these inputs grew at rates ranging from 3 percent to 15 percent per annum. The performance of disbursement of credit has been impressive that grew at the rate of 28 percent. This study also found the determinants of the probability of access to institutional credit.

Zuberi (1989) studied and estimated the production function for the agriculture sector and concluded that the impact of institutional credit comes through the financing of the seed and fertilizers. The role of financing fixed investment was insignificant. Shearer et al. (1990) pointed out that the type of farm has tended to emerge the liberalized agriculture sectors of Latin America is the capitalized family farm, large enough to overcome capital constraints but

small enough to have efficient labour supervision. Qureshi and Shah (1992) observed that the institutional credit affects agricultural output also through financing of capital investment. They found that the responsiveness of agriculture output is larger to institutional credit than that of output to fertilizer. Sarfraz and Akhtar (1992) attempted to review farm credit policy in Pakistan in relation to its impact on agricultural growth. This study found that credit is not significantly related to output but indirectly through buying inputs credit is impacting on output. This study also focused the role of commercial banks in providing loans to farmers. Udry (1994) concluded in the study the market imperfection and its failure in the agriculture sector regarding availability of credit to the farmers. This study analyzed the households in Northern Nigeria borrow more when they face an adverse shock and they lend more when they attain some positive shock. These two models of this paper analyzed Walrasian competitive model and, in second, imperfect market situation in rural credit market. Both models focused on the significance of credit payments to a farmers but a Pareto efficient risk-pooling equilibrium was not observed. Ebrahim (2000) focused the role of agriculture cooperatives in Indian's economic development as a means of encouraging large scale agriculture production while enhancing community cooperation and equity. Khandker and Faruquee (2002) described the character of cost effectiveness in providing of farm credit provided by Agriculture Development Bank of Pakistan. Dirk (2002) analyzed one of the bottlenecks of successful transformation in many sector, and particularly the agricultural sector in Central European post-socialist countries has been and continues to be the underdevelopment of the financial sector (OECD, 2001, Rother, 1999, World Bank, 1995). Now the phase of large macroeconomic changes is followed by one of adjustment and consolidation in the micro economic sphere, banks with their financial and governance potential could play a vital role in reorganizing the agricultural sector towards a long-term viable structure. Iqbal et al. (2003) used regression analysis approach with Cobb-Douglas production function to estimate the impact of institutional credit on agriculture production in Pakistan. The study suggested the growth of institutional credit and this credit especially should be provided to small farmers.

Sidhu and Vatta (2008) concluded that first the demand for agricultural credit in each state/region be assessed, depending on crop patterns, current inputs and capital requirements in relation to targeted output growth-rate. Waqar et al. (2008) attempted to focus on the constraints of agricultural credit and borrowing behavior of farmers in rural Punjab. This study found that despite the introduction of various agricultural credit programmes through institutional sources, the impact of credit policies has been limited.

## 2. Model, data and estimation

This study used annual data for the period 1972 to 2008. All the data were obtained from Ministry of Finance Division (2008), Statistical year Book of Pakistan (2008), Agriculture Statistics of Pakistan (2008), and World Development Indicators (2007). Following Iqbal et al. (2003) Aryectey (1997) and Mpuga (2004) attempted to characterize the rural financial markets, as formal and informal. Our objective is to study the impact of the credit on agricultural value added.

### 2.1. Variables of study

$Y_t$  = Agricultural out put (value added) measured in terms of million rupees;  
 $L_t$  = Cropped land in million hectares;  
 $La_t$  = Labour force in million;  
 $Cr_t$  = Credit disbursement from all institutions in million rupees;  
 $W_t$  = Water availability in million acre feet;  
 $D_t$  = Dummy variable for bad years (dummy=1 for years 1974-1975, 1983-1984, 1992-1993, 2000-2001; Else=0).

### 2.2. Specification of model

Conventionally, agricultural output function depends upon the inputs like land, labour, capital and quantities of other inputs such as water, fertilizer, pesticides etc. However, in this study agricultural output (value added) is used as dependent variable and output is assumed to be a function of availability of credit, labour force, cropped area, water and all those inputs which are purchased with the help of credit such as seeds, fertilizers, tractors and tubewells. But, instead of taking seeds, fertilizers, tractors and tubewells, only credit was taken as this is used to buy all these inputs. Based on the above discussion the model showing the impact of institutional credit on agricultural output has been developed as:

$$Y_t = f(L_t, La_t, Cr_t, W_t, D_t) + \mu_t \dots \dots \dots (1)$$

$$t = 1, 2, 3, \dots \dots \dots$$

In the above model, agricultural output was used as a dependent variable and it is assumed to be the function of cropped area, labour, agricultural credit, water, and dummy variable. While other inputs like improved seeds, fertilizers, tractors, and tubewells that may be purchased by using credit money were



dropped and agricultural credit was used as one of the explanatory variables. Agricultural credit, in fact, indirectly affects the agricultural output through purchasing these inputs. Therefore, this study has included credit as an explanatory variable in the model on the argument of Carter (1989) and Iqbal *et al.* (2003) and Afzal (2005). This credit affects the performance of agricultural output in these ways:

### 2.3. Methodology

Our study is based on time series data. Normally time series data have the problem of non stationarity. There are two approaches to check the problem of stationarity, i.e. traditional and modern approaches. In traditional approach correlogram is used to check the stationarity of data. In modern approach Augmented Dickey Fuller test (ADF) and Phillips Perron test (PP) are used. Since credit is being disbursed in buying the expensive inputs like tractors, tube wells, seeds, and fertilizers therefore; it was better justified to just see the long run impact and causality of credit, labour, cropped area and water with agriculture output.

### 2.4. Unit root test

This can be done by using the Augmented Dickey-Fuller (ADF) test for the presence of unit roots under the alternative hypothesis that the time series in question is stationary around the following specifications. A first specification includes the intercept but excludes the trend term. The second specification includes both the trend term and constant term.

ADF test for unit root is based on following regression equations.

*At constant*

$$(1-L)X_t = \alpha + \beta X_{t-1} + \sum_{i=1}^k \theta_i (1-L)x_{t-1} + \hat{\epsilon}_t \dots \dots \dots (2)$$

*At constant and trend*

$$(1-L)X_t = \alpha + \beta X_{t-1} + \gamma T + \sum_{i=1}^k \theta_i (1-L)x_{t-1} + \hat{\epsilon}_t \dots \dots \dots (3)$$

where

L is a lag operator, t denotes time trend, and  $\hat{\epsilon}_t$  is a white noise. For this purpose Schwartz criterion was used to choose the number of optimal lags (k). The null hypothesis is based on a test of  $\beta = 0$ ; i.e. the variable has a unit root. In addition, the estimated results of a unit root through Phillips- Perron (pp) test are included.

$H_0: \beta=0; (Y_t \text{ is Non-Stationary}) \text{ has a unit root}$

$H_a: \beta < 0; (Y_t \text{ is a Stationary}) \text{ has not a unit root}$

Reject the null hypothesis if the t-statistic is less than the critical value in real terms. If null hypothesis cannot be rejected, it implies that the time series is non-stationary at the level and therefore it requires taking first or higher order of differencing of the level data to establish stationary. The optimal lag length is also required to insure the residuals not to be correlated in the ADF regression.

## 2.5. ARDL model specification

There are several methods available to test for the existence of the long run equilibrium relationship among time series variables. The cointegration approach used by (Engle, Granger, 1987) to test the long run relationship, fully modified OLS procedure of (Phillips, Hansen's, 1990) maximum likelihood based on Johansen-Juselius (1990). This approach is used when variables in the model are integrated of same order and further extended by Pesaran. This test has a problem of low power and is not good for small sample. Therefore, the ARDL was approached by Pesaran and Shin (1990) and further extended by Pesaran et al. (2001). This is used for multivariate case, for several reasons. Firstly, the bounds testing procedure is simple as opposed to other multivariate cointegration techniques such as proposed by Johansen and Juselius (1990). The ARDL approach which requires the dependent variable or regressor to be integrated at I(1) is advantageous because the explanatory variables or regressands can either be purely integrated at I(1) or I(0) or a mix of both. Secondly, the bounds testing procedure does not require the pre-testing of the variables included in the model for unit roots unlike other techniques such as the Johansen approach. Thirdly, the test is relatively more efficient in small or finite sample data sizes as is the case in this study. The procedure will, however, crash in the presence of I(2) series. Following Pesaran et al. (2001), as summarised in Choong et al. (2005), we apply the bounds test procedure by modeling the long-run equation (4) as a general vector autoregressive (VAR) model of order  $p$ , in  $Z_t$ :

$$z_t = c_0 + \alpha T + \sum_{i=1}^p \beta z_{t-i} + \varepsilon_t, T=1,2,\dots,n \dots\dots\dots(4)$$

with  $c_0$  represents intercepts, and  $\alpha$  denotes  $(p+1)$ -vector of trend coefficients. Pesaran *et al.* (2001) further derived the following vector equilibrium correction model (VECM) corresponding to (4).

$$(1-L)z_t = c_o + \alpha T + \beta_1 z_{t-1} + \sum_{i=1}^{p-1} \gamma_i (1-L) z_{t-i} + \varepsilon_t, \dots\dots\dots(5)$$

$T=1,2,\dots\dots n$

where (p) is the order of autoregressive lags (n), (1-L) =Δ is a difference operator, (k +1)x(k+1)-matrices  $\beta=I_{k+1} + \sum_{i=1}^{p-1} \psi_i$  and  $\gamma_i = - \sum_{j=i+1}^{p-1} \psi_j$ ,  $i=1,2,\dots\dots\dots, p-1$  and contains the long run multipliers and short run dynamics coefficients of VECM.  $Z_t$  is the vector of variables  $Y_t$ , and  $X_t$  respectively.  $y_t$  is an I(1) dependent variable defined as  $Y_t$  and  $X_t = [L_t, La_t, Cr_t, W_t]$ . In model vector matrix of forcing I(0) and (1) regressors as already defined with multivariate identically and independently (*i.i.d*) zero mean error vector  $\varepsilon_t = (\varepsilon_{1t}, \varepsilon_{2t})$  and a homoskedastic process.

### 3. Result and discussion

The DF/ADF (Dickey Fuller) and (Augmented Dickey Fuller) DF/ADF unit root test are employed to test the stationarity of all variables in the models. Phillips and Perron (1988) have suggested a nonparametric test as an alternative to the ADF test. The aim of this is to consider autoregressive and/or hetroskedastic error terms in relation. The test statistic for the hypotheses  $\rho = 1$  is, however, rather adjusted by a non-parametric estimate of the variance of the estimated parametric  $\rho$  that takes the autocorrelation of the residual into account.

Table 2

DF/ADF (At level)			
Variables	Constant		Constant & trend
lnCr <sub>t</sub>	-3.6394***	(0)	-5.3099*** (0)
lnL <sub>t</sub>	-2.40566	(1)	-2.2217 (1)
lnY <sub>t</sub>	-1.22890	(1)	-5.09905*** (1)
lnLa <sub>t</sub>	-4.20905***	(0)	-0.743715 (0)
lnW <sub>t</sub>	-0.1856	(0)	-1.725371 (0)

**Source:** Author’s calculations.

**Notes:** The null hypothesis is that series is non-stationarity, or contains a unit root. The rejection of null hypothesis for DF/ADF test is based on the Mackinnon critical values and numbers in parentheses indicate number of lags (k) based on Schwarz information criterion (SIC).

\*\*\* Indicates the rejection of null hypothesis of non-stationary at 1%, 5%, 10% level of significance.

\*\* Indicates the rejection of null hypothesis of non-stationary at 5%, 10% level of significance.

\* Indicates the rejection of null hypothesis of non-stationary at 10% level of significance.

Table 3

Dickey Fuller/Augmented Dickey Fuller (At first difference)		
Variables	Constant	Constant & trend
$\ln Cr_t$	-4.64243*** (0)	-4.56701*** (0)
$\ln L_t$	-9.90560*** (0)	-10.3396*** (0)
$\ln Y_t$	-9.31607*** (0)	-9.20534*** (0)
$\ln La_t$	-3.57576** (0)	-4.4185*** (0)
$\ln W_t$	-5.40814*** (0)	-5.444206*** (0)

**Source:** Author's calculations.

**Notes:** The null hypothesis is that series is non-stationarity, or contains a unit root. The rejection of null hypothesis for DF/ADF test is based on the Mackinnon critical values and numbers in parentheses indicate number of lags (k) based on Schwarz information criterion (SIC).

\*\*\* Indicates the rejection of null hypothesis of non-stationary at 1%, 5%, 10% level of significance.

Table 4

Phillips Perron (At level )		
Variables	Constant	Constant & trend
$\ln Cr_t$	-4.44023***(2)	-4.9535***(3)
$\ln L_t$	-2.29203* (0)	-4.9462***(3)
$\ln Y_t$	4.38518*** (2)	-6.5040***(8)
$\ln La_t$	-4.2523*** (5)	-0.65904 (6)
$\ln W_t$	.394826 (6)	-1.75552 (3)

**Source:** Author's calculations.

\*\*\* Indicates the rejection of null hypothesis of non-stationary at 1%, 5%, 10% level of significance.

\* Indicates the rejection of null hypothesis of non-stationary at 10% level of significance.

Table 5

Phillips Perron (At first difference)		
Variables	Constant	Constant & trend
$\ln Cr_t$	-4.43760*** (0)	-4.6945*** (1)
$\ln L_t$	-17.812*** (20)	-28.303*** (29)
$\ln Y_t$	31.5291*** (29)	-30.38 *** (29)
$\ln La_t$	-3.5737** (0)	-4.3831*** (5)
$\ln W_t$	-5.389787** (6)	-5.570174*** (8)

**Source:** Author's calculation.

\*\*\* Indicates the rejection of null hypothesis of non-stationary at 1%, 5%, 10% level of significance.

\*\* Indicates the rejection of null hypothesis of non-stationary at 5%, 10% level of significance.

### 3.1. Cointegration results

The study was aimed to analyse the impact of credit on agricultural output. To this end, the study of the relationship among time series is essential in capturing the true impact. The cointegration is related with long run equilibrium between the two or more than two variables. The economic interpretation is that there should be link between two or more than two variables in the long run, even though series of observation of variables may deviate from the equilibrium. But they will move towards equilibrium in the long run (Harris, Sollis, 2003).

There are many approaches to conduct cointegration tests like Engle-Granger (1987), maximum likelihood based Johansen (1991, 1995) and Johansen – Juselius (1990) test.

By applying unit root test, we already had drawn the conclusion of the stationarity of variables on level and first difference. This is the justification of applying ARDL approach to cointegration, apart from this due to low power and other problems associated with Engle-Granger (1990), Johansen- Juselius (1990). The hypothesis of this study can be examined using F-statistic. The upper and lower bounds value for F-statistic in the model depends upon whether it contains trend or intercept or both or any one of them as specified by Pesaran et al. (2001). Moreover, whether they are taken as restricted intercept and trend or any one of them means that deviation of intercept and trend from its mean or unrestricted intercept and trend or any one of them means that no deviation of intercept and trend from its mean.

In this study, we have relatively small sample size of 37 observations with their critical values that deviates from the critical values reported in Pesaran et al. (2001). In the first step, the study calculated exact critical bounds values according to our sample sizes with seven regressors, for the F-statistic. In the second step study employed the model with an intercept and trend, which is the case (5) in Pesaran et al. (2001). If our calculated F-statistic falls outside the critical bounds, a conclusive decision can be made regarding cointegration. If calculated F-statistic is higher than upper bound of the critical values then the null hypotheses of no cointegration is rejected. If the calculated F-statistic is lower than the lower bound then null hypotheses of no cointegration is not rejected. If calculated F-statistic falls within upper and lower bound then it is inconclusive.

Table 6

Unrestricted intercept and unrestricted trend							
VARIABLES (when taken as a dependent)	F-Statistics	At 0.100		At 0.050		At 0.010	
		I(0)	I(1)	I(0)	I(1)	I(0)	I(1)
dlnY <sub>t</sub>	7.19***	2.38	3.45	2.69	3.83	3.34	4.63
dLL <sub>t</sub>	-----	2.38	3.45	2.69	3.83	3.34	4.63
dlnCr <sub>t</sub>	2.313	2.38	3.45	2.69	3.83	3.34	4.63
dlnLa <sub>t</sub>	3.77**	2.38	3.45	2.69	3.83	3.34	4.63
dlnWa <sub>t</sub>	4.406***	2.38	3.45	2.69	3.83	3.34	4.63

**Source:** Author's calculation.

\*\* Means at 5%, 10% significant levels reject the null hypotheses of no cointegration.

\*\*\* Means at 1%, 5%, 10% significant level reject the null hypotheses of no cointegration.

The above Table 6 depicts the (Wald) F-statistic values to consider whether there is long run relationship or not through cointegration approach. Among the variables, when agricultural value added, cropped area and labour were shown as a dependent variable then their relative F-statistic values were  $F_{Y_t}=7.19$ ,  $F_{La_t}=3.77$  and  $F_{Wa_t}=4.406$ , respectively. From these results it is clear that  $LY_t$  is a significant as its F-statistic values crosses the upper bound value at 5% and 10%. This shows the long run relationship is found and witnessed the cointegration when agricultural value added was a dependent variable. While labour and water also have cointegration as their F-Statistic crossed the upper bound and significant at 1%, 5% and 10%, while the F-Statistic for  $dLL_t$  is undefined due to its zero lag. On the other hand  $FCr_t=2.313$  falls with in upper and lower bond which shows no cointegration.

Table 7

**Estimated long run coefficients using the ARDL approach ARDL (1,0,1,3,2)  
selected based on Schwartz Bayesian criterion  
(Dependent variable is dlnY<sub>t</sub>)**

Regressor	Coefficient	Standard Error	T-Ratio	[Prob]
dlnL <sub>t</sub>	0.23386***	0.13420	1.7426	[0.000]
dlnCr <sub>t</sub>	0.1243	0.14430	0.855	[0.480]
dlnLa <sub>t</sub>	1.288***	0.2166	5.945	[0.000]
dlnW <sub>t</sub>	0.87795***	0.14893	5.8962	[0.000]
C	2.1156***	0.2457	8.6073	[0.002]
D <sub>t</sub>	-0.20688**	0.083882	-2.4663	[0.024]
T	0.081229**	0.034271	2.3702	[0.029]
R-Square 0.98062      Adjusted R Squared 0.96339      DW-statistic 2.0023				

**Source:** Author's calculation.

**Note:** \*, \*\* and \*\*\* denote rejection of the null hypothesis of insignificance at the 0.10, 0.05 and 0.01 level, respectively.

Table 7 presents the results for long-run coefficient estimated using the ARDL estimator. It is evident that land area (cropped area) is highly significant and showing to enhance the agricultural value added. The land as a basic input shows its coefficient 0.23386; this means 1% increase in cropped area will enhance the output almost by 0.23%. The agricultural credit is showing right positive relation with agricultural output as it is used to buy various inputs but indirectly affects the output. The credit is statistically insignificant with coefficient of 0.12431. This means 1% increase in credit will increase the agricultural output almost by 0.12%. The empirical results in this study are contradicted with the results carried out in most of the past studies such as Iqbal et al. (2003), Afzal (2005). Most of these studies in the past used OLS regression approach but this study followed ARDL approach to cointegration in order to estimate the short and long-run relationship in the model with desired variables. OLS regression approach gives spurious results in time series analysis because of stationarity problem in data. Therefore in the past studies of OLS regression approach results about the significance of credit were not much reliable. In this study the insignificant coefficient of credit is the result of many implications attached with the constraints and disbursement of this credit on the part of the poor farmers. These were discussed in detail in the next chapter. Labour in agricultural sector has a significant role as t-statistic is highly significant and the coefficient of labour shows that on average 1% increase in labour will increase the output by 1.2%. The significant and positive coefficient of water 0.87 shows that on average 1% increase in water increases the output by 0.87%. The negative coefficient of dummy variable shows that natural epidemics and bad weather conditions decreases output. In this model R square is 0.98 which explains that 0.98 percent variation in agricultural output is due to independent variables.

Table 8

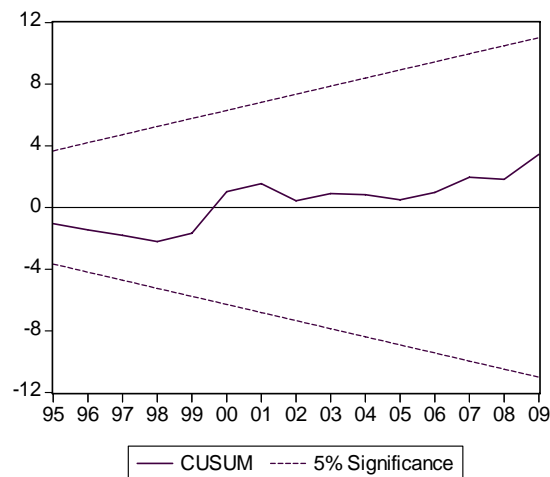
**Error correction representation for the selected ARDL model ARDL (1,0,1,3,2)  
selected based on Schwartz Bayesian criterion (Dependent variable is  $d\ln Y_t$ )**

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
$d\ln L_t$	0.058756*	0.038051	1.867[.0175]
$d\ln Cr_t$	0.015305*	0.00893	1.7138[.099]
$d\ln Cr_{t-1}$	0.01325**	0.00607	2.1822[.039]
$d\ln La_t$	1.3397***	0.35875	3.7343[.009]
$d\ln W_t$	0.10781*	0.05555	1.9406[.064]
$d\ln W_{t-1}$	0.28322***	0.06009	4.7129[.000]
$d\ln W_{t-2}$	0.071630	0.04680	1.5303[.139]
C	0.53153***	0.10821	4.912[.000]
$D_t$	0.26353**	.096154	2.7408[.012]
T	-0.10347	.045062	-2.2962[.032]
$ecm(-1)$	-1.1539	.11523	-10.0147[.000]

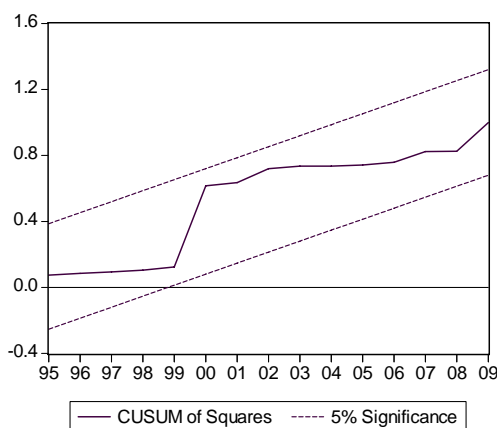
**Source:** Author's calculation.

**Note:** \*, \*\* and \*\*\* denote rejection of the null hypothesis of insignificance at the 0.10, 0.05 and 0.01 level respectively.

When cointegration is found in the long run equations through F-Statistic, then we find short-run analysis through error correction term Bannerjee et al. (1998). The coefficient of  $ECT_{t-1}$  measures the speed of adjustment of the model back to long-run equilibrium after disequilibrium which occurs due to shocks. The estimated coefficient of  $ECT_{t-1}$  (-1.1539) is highly significant and correct negative sign indicates the convergence or movement back to the equilibrium within a year Bannerjee et al. (1998). This implies that time period of adjustment is approximately nine months  $1/1.1539 = 0.86$ . The estimated coefficient of  $ECT_{t-1}$  (-1.1539) is highly significant also shows that cointegration is found in variables i.e. value added, labour, and water.



**Figure 2.** *CUSUM at 5% significance*



**Figure 3.** *CUSUM of SQUARE at 5% significance*



The structural stability of the equations is observed through the cumulative sum (CUSUM) and cumulative sum of squares test on recursive residuals. The diagnostic tests detect systematic changes in the regression coefficients as applied. Whereas the latter CUSUM and CUSUMQ detect sudden changes from the constancy of the regression coefficients. The results in Figure 2 and 3, show that the test statistics are within 5% confidence interval band. This suggests that estimated model is stable over time.

In the next step study analysis the impacts on agricultural output of those inputs which are bought by credit e.g. tubewells, tractors, fertilizers and seeds. This is represented in model form as

$$\ln Y_t = \beta_0 + \beta_1 \times \ln T w_t + \beta_2 \times \ln T r_t + \beta_3 \times \ln S d_t + \beta_4 \times \ln F r_t + \mu_{1t} \dots \dots \dots (6)$$

The objective of this model is to check that which variable has a greater impact on agricultural output as all these are bought against credit. The results of this estimation are given in the Table 9.

Table 9

When $\ln Y_t$ is Dependent variable				
Variables	Coefficient	Std. Error	t-Statistic	Prob.
$\ln T r_t$	0.074646***	0.0167713	4.450841	0.0001
$\ln T w_t$	0.018291***	0.245126	0.074618	0.0034
$\ln S d_t$	0.702684***	0.238666	2.944218	0.0059
$\ln F r_t$	0.015174	0.233262	0.065053	0.9485

Source: Author's calculation.

Note: \*, \*\* and \*\*\* means 10%, 5% and 1% level of significance respectively.

Table 3.5

Significance of Model		
R-Squared	Adj R-Squared	Durbin-watson
0.86	0.85	1.88202

From Table 9 it is obvious that tractors, tubewells and seeds are showing their significant impact on agricultural output. R-squared value is 0.85, which means 85 percent variation in the agricultural output is due to these variables. The coefficient of tractor show that one percent increase in tractor will lead to increase in output by 0.074 percent in million rupees and one percent increase in tubewell will increase the output by 0.018 percent in million rupees. These all inputs are bought by credit and showing significant impact on agricultural output. Therefore, study requires checking the causality between all these inputs and credit. For this Granger causality based on Toda Yamamoto (1995) was used. A new method has proposed by Toda and Yamamoto (1995), for causal

inference based on augmented level VAR with integrated and cointegrated processes. The advantage of using this procedure is that it is not necessary to pretest the variables for the integration and cointegration properties and therefore avoids the possible pretest biases.

This study requires two test procedures. First step includes determination of the lag length (k) and the maximum order of integration (d) of the variables in the system. Schwartz's Bayesian Information Criterion (BIC) is used to determine the appropriate lag structure of the VAR. Given VAR (k) selected, and the order of integration d(max) is determined, a levels VAR can then be estimated with a total of k+d(max) lags. In the second step Wald statistic is applied to the first k VAR coefficient matrix (but not all lagged coefficients) to make Granger causal inference.

Toda and Yamamoto (1995) augmented Granger causality test by estimating a two equation system using the Seemingly Unrelated Regressions (SUR) technique. Rambaldi and Doran (1996) showed that the Wald test improves efficiency when SUR models are used in the estimation. So, the model can be specified as follows:

$$Y_t = \alpha_1 + \sum_{i=1}^{k+d} \gamma_{1i} Y_{t-i} + \sum_{i=1}^{k+d} \gamma_{2i} X_{t-i} + \varepsilon_{yt} \dots \dots \dots (7)$$

$$X_t = \alpha_2 + \sum_{i=1}^{k+d} \delta_{1i} Y_{t-i} + \sum_{i=1}^{k+d} \delta_{2i} X_{t-i} + \varepsilon_{xt} \dots \dots \dots (8)$$

Where

k = Optimal lag order of VAR;

d = Maximal order of integration of the series in the system;

$\varepsilon_{yt}$  and  $\varepsilon_{xt}$  are error terms that are assumed to be white noise;

The results of Granger based Toda Yamamoto are given in the Table 11.

Table 11

**Causality Results**

Dependent variable	Independent variable	Chi-sq	df	Prob
lnTw <sub>t</sub> **	lnCr <sub>t</sub>	7.2040	3	0.022
lnTr <sub>t</sub> *	lnCr <sub>t</sub>	3.1907	3	0.075
lnSd <sub>t</sub>	lnCr <sub>t</sub>	0.6245	3	0.890
lnFr <sub>t</sub> **	lnCr <sub>t</sub>	9.5916	3	0.022

**Source:** Author's calculation.

\*\*,\* Means at 5%, 10% significant level and 10% significane level.

Results in the Table 11 show that tubewells, and fertilizers have strong causality with credit at 5% and 10% level of significance, while tractor has causality at 10% level of significance. Tractors and tubewells both have also greater impact on agricultural output, therefore credit also play its indirect role to enhance agricultural output as it has strong causality with tubewells, fertilizers and tractor. While rests of the variables that have no causality were excluded from table in order to summarize it.

#### 4. Conclusion

This study investigated the positive and significant role of credit when it is used indirectly. The study also shows that long run coefficient of cropped area is highly significant because the land is a basic input to agricultural sector. This shows as the intensity ratio of land increases it increases the output of this sector. The empirical results show in the Table 11 that directly credit has positive relation with agricultural output but has insignificant impact of credit on agricultural output and, practically, there is no sense of the direct use of credit. Credit always helps to buy various inputs for this sector, therefore it has indirect role.

The role of institutional credit is more important as it is a source of providing different agricultural inputs which has strong impact on productivity. Our study suggested that agricultural output is enhanced via three inputs tractors, tubewells, and seeds. While credit plays important role in providing tractors and tubewells to this sector. The study also shows that long run coefficient of cropped area is highly significant because the land is a basic input to agricultural sector. This shows as the intensity ratio of land increases it increases the output of this sector. The coefficients of labour and water are also highly significant and positive. These results are consistent with the previous studies.

#### 4.2. Policy recommendations

On the basis of above study it can be concluded that agriculture credit itself cannot play any direct role in enhancing the output rather indirectly helps in the growth of this sector through buying various modern inputs. Therefore, following policies are suggested.

- The base of agriculture credit should be enhanced to the large proportion of rural population; especially small farmers should be focused by commercial banks.

- Credit is like a capital input but this is used indirectly in agriculture sector. Therefore, it is suggested to increase its supply when land, water labour is increased, there will be rising demand for the use of machinery, seeds and fertilizers which can only be bought by credit.
- This is found that credit was given to either targeted groups or constraints for the poor farmers have been impediment in the way of its effective role. On these bases, study recommends to focus small farmers and to make easier conditions to avail credit from financial institutions.
- The supervised credit schemes by financial institutions provided credit to the small farmers in limited quantity as it was discussed in under the head of credit disbursed by size of holding. Therefore subsidized credit should be given more to the small size holding.
- To make the loan more productive special instructions and supervision should be carried out by loan issuing authorities.
- As study found that tubewell and tractor play their important role in enhancing agricultural output, therefore special loans should given to the farmers to buy these inputs or it should be directly given to the farmers on easy installments.

For the sustainable growth of agricultural sector as it contributes major proportion in total GDP of Pakistan, the credit must be link with the supply of and its disbursement for agricultural inputs. Credit itself cannot affect productivity, rather through the provisions of modern inputs.

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