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Suman Chandolia and Chitra Choudhary

Research Journal of Agricultural Sciences
An International Journal

P- ISSN: 0976-1675
E- ISSN: 2249-4538

Volume: 12
Issue: 05

Res Jr of Agril Sci (2021) 12: 1621–1625

CARAS

Res. Jr. of Agril. Sci. (Sep-Oct 2021) 12(5): 1621–1625
www.rjas.org

Full Length Research Article

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Suman Chandolia[1] and Chitra Choudhary*[2]

Received: 17 Jun 2021 | Revised accepted: 22 Aug 2021 | Published online: 20 Sep 2021
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A B S T R A C T

The objective of the study is to examine the impact of Agricultural Credit on Agricultural Gross Domestic Product in India and also tries to investigate the relationship between both of them. The study is based on secondary data ranging from the period of 1982 to 2019, congregated from the various reports of RBI. Various statistical tools such as Ordinary Least Square Method, Johansen Cointegration Test, VECM and Granger Causality test have been applied. Double log specification of the model shows that one per cent increase in agricultural credit will significantly raise agricultural GDP by 0.24 per cent. Error correction term is negative which indicate that there is a convergence between the variables and the existence of long-run causality. Agricultural credit only has a long-run relationship with agricultural GDP and has an influential impact in the long run only. Further, it is also found that agricultural credit granger causes agricultural GDP but vice-versa does not exist. The findings comprehend that the ability of credit to induce agricultural GDP growth is limited. Hence, adequate attention should be given to building other capabilities required to promote agricultural growth. This may include productivity increases, expansion of infrastructure, higher public expenditure on agriculture and allied activities, effective extension services, sound institutions, and export competitiveness. The impact of credit on agricultural growth would be more effective in the presence of these non-credit growth ingredients. The weak contribution of credit to agricultural growth also emphasizes the need for proper targeting of agricultural credit to achieve the desired impact on agricultural growth.

***Key words*:** Agricultural credit, Gross domestic product, Agricultural growth, Vector error correction model, Ordinary least squares

Agricultural credit plays an important role in the growth of agricultural output. Reiterating its importance regarding the contribution to employment and Gross Domestic Product (GDP), the agricultural credit policies are designed in such a way that it helps in the development of the farm sector and facilitates the adoption of new technologies. Agricultural finance as the economic study of the acquisition and use of capital in agriculture [1]. It deals with the supply of and demand for funds in the agricultural sector of an economy. Agricultural Credit is the amount of investment funds made available for agricultural production from resources outside the farm sector. Agricultural finance is considered a separate field of study dealing with lending and borrowing by organizations and farmers. Indian agriculture and allied sector comprise crop, livestock, forestry and fisheries. According to the Agriculture Census 2015-16, the total number of operational holdings in the country was 146 million hectares and the total operated area was 157.14 million hectares. The average size of small and marginal holdings is around 1.08 hectares. The small and marginal farmers account for 86.21 per cent of total holdings and their share in the operated area is at 47.34 per cent in 2015-16. In India agricultural production depends upon millions of small farmers. These farmers have inadequate money with them. So, the role of agricultural credit becomes important. The main sources of agricultural finance in India are divided into Institutional and Non-institutional credit sources. Non-institutional credit comprises Traders and Commission Agents, Landlords, Money Lenders and Family Members. (i) Traders and Commission Agents advance loans to farmers for productive purposes against their crop with no legal formalities. They charge a huge amount of rate of interest on the loan and a commission on all the sales and purchases. They are very exploitative towards farmers. (ii) Landlords give loans to small farmers and tenants for crop production and day-to-day financial needs. (iii) Money Lenders are easily approachable by the farmers. They meet the demand for both productive and unproductive purposes.

* Chitra Choudhary
✉ chitrachoudhary33@gmail.com

1-2 Department of Economics, University of Rajasthan, Jaipur - 302 004, Rajasthan, India

They charge a huge rate of interest. In the 1950s, agricultural credit was traditionally met from non-institutional sources mainly by the local money lenders. As the development of institutional sources has taken with special emphasis on commercial bank development and other government measures the share of non-institutional sources began to decrease. Institutional credit comprises Co-operative Banks, Commercial Banks, Regional Rural Banks, Micro Finance Institutions and NABARD.

The share of agriculture in the gross domestic product (GDP) has reached almost 18 per cent for the first time in the last 17 years, making it the sole bright spot in GDP performance during 2020-21 [2]. The resilience of the farming community in the face of adversities made agriculture the only sector to have a positive growth of 3.4 per cent at constant prices in 2020-21 when other sectors had declining growth. In 2019-20, India's agricultural and allied exports amounted to approximately Rs. 252 thousand crores. The top agriculture and related products exported from India were marine products, basmati rice, buffalo meat, spices, non-basmati rice, cotton raw, oil meals, sugar, castor oil and tea. The agricultural credit flow target for the year 2019-20 was Rs. 13,50,000 cones and the total credit flow was Rs.13,92,469.81 crores. The agriculture credit flow target for 2020-21 is fixed at Rs. 15,00,000 crores.

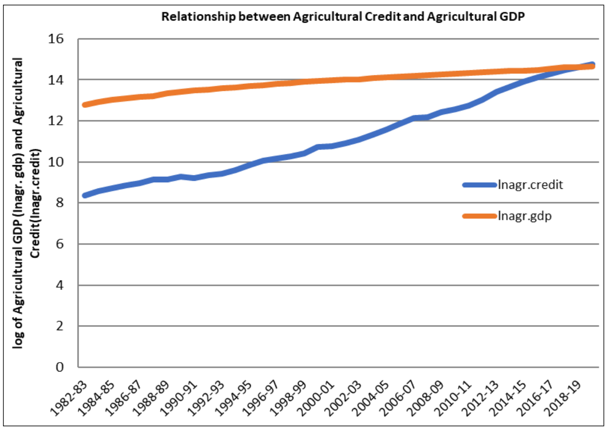

Fig 1 Trends in India's agricultural GDP and credit
Source: Various Reports of RBI and National Account Statistics (CSO)

The above (Fig 1) shows the trends in agricultural GDP and credit. It is clear from the figure that over the years the share of agricultural credit (direct institutional credit) has been rising from 1982 to 2019 from the log value of 8 to 14.7, showing the importance of credit in agriculture. However, the rise in agricultural GDP is not that high as the agricultural credit. It increased from value 12.77 to 14.65 only. It also shows that an increase in agricultural credit does not lead to an increase in agricultural GDP to the same extent, as many factors contribute to growth in agricultural GDP and credit is only one of them.

Table 1 Growth patterns in agricultural GDP and credit

Growth rates	Agricultural GDP	Agricultural credit
1982-2000	6.39 (29.18)	12.6 (26.14)
2001-2019	3.57 (57.06)	22.2 (55.83)
1982-2019	4.62 (34.32)	17.68 (41.24)

Above (Table 1) shows that the growth rates of agricultural GDP and credit are rising from 1982 to 2019 however, the growth rate of agricultural credit is greater than the agricultural GDP. From 1982 to 2000, the agricultural GDP grew by 6.39 per cent while the growth in agricultural credit gets doubled i.e., 12.6 per cent. After the twenties, agricultural GDP fell as revealed by the growth rate of 3.57 per cent, on the other hand, agricultural credit rose by 22.2 per cent. This rise in agricultural credit is due to the measures taken by the government of India and the RBI to increase institutional credit flow and bringing more farmers (small and marginal farmers) under it. As per the RBI guidelines under Priority Sector lending SCBs (domestic) are required to lend 18 per cent of the Adjusted Net Bank Credit (ANBC) or Credit Equivalent to Off-Balance Sheet Exposure (CEOBE), whichever is higher, towards agriculture. A sub-target of 10 per cent is also prescribed for the small and marginal farmers. Various schemes like Interest Subvention Schemes, Kisan Credit Card (KCC), Joint Liability Groups (JLGs) and much more help in the rise of direct institutional credit. Agricultural GDP on the other hand had not risen much due to the low level of investments in agriculture, low level of technology, the small size of landholdings, inadequate finance and marketing services for the farm products, insufficient irrigation facilities, etc.

The paper is broadly structured into four sections. The first section briefly introduces the topic and presents the trend and growth patterns in the agricultural GDP and credit. The second section deals with the review of the literature followed by the data sources and methodology. The third section examines the impact of agricultural credit on agricultural GDP and also investigates the relationship between both. The fourth section concludes the results and suggests some policy measures.

MATERIALS AND METHODS

The study is based on secondary data. Time series data of Agricultural GDP and Agricultural Credit collaborates from the RBI Database and National Account Statistics (CSO) from the period of 1982 to 2019. Firstly, the conversion exercise of agricultural GDP data is carried out concerning the base year 2011-12. Then unit root test is applied, which is the pre-requisite to analyse the time-series data. The Ordinary Least Squares (OLS) method is applied to evaluate the impact of credit on agricultural GDP. Further, the Johansen Cointegration test is used to find out the long-run relationship between both variables. After confirming the long-run association, the VECM model helps in comprehending the long-run as well as the short-run dynamics among the variables. Lastly, the Granger Causality test helps in identifying the direction of the relationship between the two selected variables.

Base conversion method

$Y^{*}_{1980-81} = Y_{1980-81} + (E_1 - E_0)^{*}(\frac{1}{32})$ For 1980-81 and

For $Y^{*}_{1990-91} = Y_{1990-91} + (E_1 - E_0)^{*}(\frac{11}{32})$

Where superscript ''indicates new series

It may be noted from (Fig 2) that the difference has been redistributed by sliding back up to the year 1980–1981 shown as inline, indicating a declining weight backwards for the new economic activities in the production basket. In the next step, we compute the price deflator with 2011-12 by simple splicing and then divide the nominal series by this deflator to get real SDP at 2011-12 prices. Exercise of Base Conversion is carried out using the above-discussed formula:

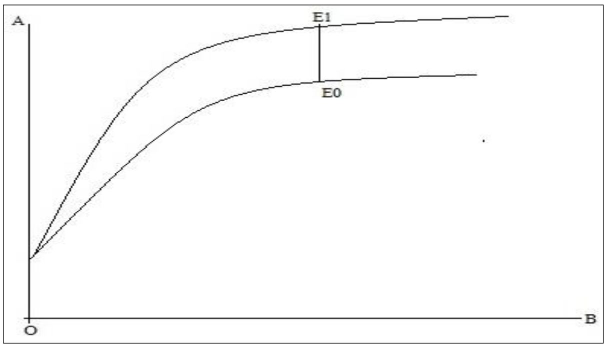

Fig 2 Shift in production function with change in base year
Source: Bhanumurthy and Singh [3]

Stationarity of time series - variables is checked through the unit root test i.e., the ADF test.

Given time series data, Augmented Dickey-Fuller (ADF) considers three differential form autoregressive equations to detect the presence of a unit root:

Y_t is a random walk:

$$\Delta Y_t = \gamma Y_{t-1} + \sum_{j=1}^{p}(\partial_j \Delta Y_{t-j}) + \varepsilon_t$$

Y_t is a random walk with drift:

$$\Delta Y_t = \alpha + \gamma Y_{t-1} + \sum_{j=1}^{p}(\partial_j \Delta Y_{t-j}) + \varepsilon_t$$

Y_t is a random walk with drift around a stochastic trend:

$$\Delta Y_t = \alpha + \beta t + \gamma Y_{t-1} + \sum_{j=1}^{p}(\partial_j \Delta Y_{t-j}) + \varepsilon_t$$

Where;

t is the time or trend variable

α is the intercept constant called a drift

β is the coefficient on the time trend

γ is the coefficient presenting process root, i.e., the focus of testing

p is the lag order of the first difference autoregressive process

ε_t is an independent identically distributed residual term

The difference between the three equations concerns the presence of the deterministic elements α (a drift term) and β_t (a linear time trend). The focus of testing is whether the coefficient γ equal zero that infers the original series has a unit root.

Vector error correction model (VECM) - is a VAR model that is designed to analyse non-stationary data having a cointegration relationship. The VECM with the cointegration rank $r \leq k$ is as follows:

$$\Delta Y_t = C + \prod Y_{t-1} + \sum_{i=1}^{p-1} \tau_i \Delta Y_{t-1} + \varepsilon_t$$

Where;

Δ: Operator differencing, where $\Delta Y_t = Y_t - Y_{t-1}$

Y_{t-1}: Vector Variable endogenous with the 1st lag

ε_t: Vector Residual

C = Vector Intercept

Π: Matrix coefficient of cointegration

(Π = αβ'; α = vector adjustment, matrix of order (k × r) and β = vector cointegration (long – run parameter) matrix (k × r))

r = Matrix with order (k × r) of the coefficient endogenous of the ith variable.

The short-run relationship among the variables is further tested with the aid of Wald test. When the Wald test is used to test the point significance of several coefficients then the Wald statistics is given in quadratic form as:

$$W = \widehat{\beta_2} var^{-1}(\widehat{\beta_2})\widehat{\beta_2},$$

Where, $\widehat{\beta_2}$ is the maximum likelihood estimator of β_2 and $var(\widehat{\beta_2})$ is its variance-covariance matrix.

The VAR model is a natural framework for examining Granger causality. Thus, the model of Y_t is a linear function of its past values, plus the past values of X. That is if we consider two-time series, $\{Y_t\}$ and $\{X_t\}$ and the lagged equation thus formed:

$$Y_t = \sum_{i=1}^{k} \alpha_i Y_{t-i} + \sum_{i=1}^{k} \beta_i X_{t-i} + u_t$$

Then if $\beta_i = 0$ (i = 1,2 …,k), X_t fails to Granger Cause Y_t. The lag length k is, to some extent arbitrary. If X Granger causes Y, then some or all of the lagged X values have non-zero effects on the Y_t, $\beta_i \neq 0$ (i = 1. 2 … k).

RESULTS AND DISCUSSION

Firstly, unit root test has been undertaken to do further econometric exercise on the data. Data in (Table 2) shows the results of the test, indicating that all the variables are non-stationary at the level and stationary at the first difference when Akaike Information Criterion is applied at both intercepts and the trend.

Table 2 Augmented dickey- fuller unit root test results

Variables	Level / first difference	Without trend (p-value)	With trend (p-value)
LnAGRGDP	Level	0.213	0.113
	First difference	0.0000	0.000
LnAGRCREDIT	Level	0.99	0.86
	First difference	0.0014	0.0014

To examine the impact of agricultural credit on agricultural GDP, Ordinary Least Square (OLS) is applied. The double log specification of the model gives the elasticity value i.e., a one per cent increase in agricultural credit will significantly raise agricultural GDP by 0.24 per cent [4-5]. The value of R square reveals that 90 per cent of the variation in regress and can be explained with the help of a regressor (Table 3).

Table 3 Ordinary least square regression results

Independent variables / Dependent variables	Agricultural GDP
Agricultural credit	0.2498 (0.000)
R-Square value	0.9072
F-Value	352.073

Cointegration test

Since all the variables are integrated at the first difference, therefore, cointegration is applied to the variables. Given a set of I (1) variables $\{X_{it} \ldots X_{kt}\}$. If there exists a linear combination of all variables with vector β so that,

$$\beta_1 x_{1t} + \cdots + \beta_k x_{kt} = \beta' x_t$$ … Trend stationary

$\beta_j \neq 0, j = 1, \ldots, k.$ Then the x's are cointegrated of order C(1, 1)

Cointegration is tested using the Johansen cointegration test also known as Johansen and Juselius (JJ) test. It has two test statistics to check cointegration among the variables namely, trace test and maximum Eigenvalue test. Trace test has a null hypothesis that there are at most *r* cointegration vectors and maximum Eigenvalue has a null hypothesis that there are r+1 cointegration vectors versus there are r cointegration vectors.

The following (Table 4) presents the long-term association between the agricultural GDP and credit during the period 1982-2019 based on Trace test and Maximum Eigen Values. The results show that agricultural GDP and credit are cointegrated at a 5 per cent level. That is, there exists a long-run relationship among the variables [6].

Table 4 Johansen test of cointegration

Hypothesized No. of CE(s)	Trace statistic	5 % critical value	Max-Eigen statistic	5% critical value
None (r=0)*	23.30311	15.49471	23.29929	14.26460
At most 1	0.003817	3.841466	0.003817	3.841466

*Denotes rejection of the hypothesis at the 0.05 level
Note: Trace and Max-Eigen Statistic values indicate that there is one cointegration equation

VECM ties the short-run behaviour of agricultural GDP to its long-run values and also helps in finding the speed of adjustment of variables. The error correction term is negative which indicate that there is a convergence between the variables and the existence of long-run causality. It means that if there is any deviation in the long-run relationship among variables then there is an error correction mechanism and negative sign express that the system will go back to the long-run equilibrium with 11.6 per cent speed.

D(LNAGR_GDP) = C(1)*(LNAGR_GDP(-1) - 0.145019504823*LNAGR_CREDIT(-1) - 12.306799856) + C(2)*D(LNAGR_GDP(-1)) + C(3)*D(LNAGR_GDP(-2)) + C(4)*D(LNAGR_CREDIT(-1)) + C(5) *D(LNAGR_CREDIT(-2)) + C(6) ……………. Eq. (1)

Table 5 VECM results

	Coefficient	Std. Error	t-Statistic	Prob.
C (1)	-0.116289	0.027024	-4.303162	0.0002
C (2)	-0.405432	0.169459	-2.392507	0.0234
C (3)	-0.187259	0.156164	-1.199115	0.2402
C (4)	0.013876	0.045812	0.302887	0.7641
C (5)	-0.023057	0.044013	-0.523873	0.6043
C (6)	0.077458	0.017992	4.305027	0.0002
R-squared	0.4757610		F-statistic	5.263658
Durbin-Watson stat	2.176247		Prob(F-statistic)	0.001468

The model summary results (Table 5) state that the value of R square is 47.57 per cent reflecting that 48 per cent of the variation in agricultural GDP is explained by the explanatory variable i.e., agricultural credit. F- statistics also reveal the robustness of the model [7]. Moreover, to check the reliability of the model, diagnostic tests are applied for testing Normality, Serial Correlation and Heteroscedasticity of the residual term. The results given in (Table 6) show no evidence of autocorrelation and satisfies the normality assumption of the given error term. Although, Breusch-Pagan-Godfrey's Heteroscedasticity test shows that the given error term is not homoscedastic and independent of the regressor. However, the model can be said to be statistically fit.

Table 6 Residual diagnostic test for VEC model

	H_o	Df	Probability
VEC Residual Normality Tests	Residuals are multivariate normal	0.25 (Jarque-Bera Value)	0.88137
VEC Residual Serial Correlation LM Tests	No serial correlation at lag order h	2,27	0.1165
VEC Residual Heteroscedasticity Test	Residuals are homoscedastic	6,28	0.0087

If p> 0.05, we accept H_o

Table 7 WALD test results

Test Statistic	Value	Df	Probability
F-statistic	0.156495	(2, 29)	0.8559
Chi-square	0.312990	2	0.8551
Null Hypothesis: C(4)=C(5)=0			
Null Hypothesis Summary:			
Normalized Restriction (= 0)		Value	Std. Err.
C (4)		0.013876	0.045812
C (5)		-0.023057	0.044013

Restrictions are linear in coefficients

The results revealed in (Table 8) that agricultural credit granger cause agricultural GDP but agricultural GDP does not granger cause agricultural credit. Therefore, it can be concluded that there exists a unidirectional causality running from agricultural credit to agricultural GDP at 10 per cent level of significance [9].

In the equation produced under the Vector error correction model (VECM), the coefficients of the explanatory variable, namely agricultural credit are tested for their short-run impact on the agricultural GDP function using the Wald test. The results of the Wald test as shown in (Table 7) indicate that agricultural credit does not have any short-run impact on the agricultural GDP of India [8]. Thus, it can be concluded that agricultural credit only has a long-run relationship with agricultural GDP and has an influential impact in the long-run period only.

Table 8 Granger causality test

Null hypothesis	Obs	F-Statistic	Prob.
LNAGR_CREDIT does not Granger Cause LNAGR_GDP	36	2.57932	0.0920
LNAGR_GDP does not Granger Cause LNAGR_CREDIT	36	1.70906	0.1977

If $p > 0.05$, we accept H_o

CONCLUSION

It is evident from the analysis that there is a continuous rise in the growth of agricultural credit and GDP from 1982 to 2019. However, growth in agricultural credit is four times higher than the growth of later one. At the same time share of agricultural GDP in total GDP is declining. The analysis also concludes that agricultural credit only has a long-run relationship with agricultural GDP. Further, it is also found that agricultural credit granger causes agricultural GDP but vice-versa does not exist. The above results comprehend that the ability of credit to induce agricultural GDP growth is limited. Hence, adequate attention should be given to building other capabilities required to promote agricultural growth. This may include productivity increases, expansion of infrastructure, higher public expenditure on agriculture and allied activities, effective extension services, sound institutions, and export competitiveness. The impact of credit on agricultural growth would be more effective in the presence of these non-credit growth ingredients. The weak contribution of credit to agricultural growth also emphasizes the need for proper targeting of agricultural credit to achieve the desired impact on agricultural growth.

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