Effect of Agricultural Credit on the Growth of Agricultural Sector in Nepal

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Abstract

Purpose – The research aims to examine the effect of agricultural credit on agricultural GDP growth in Nepal.

Design/methodology/approach – Utilizing secondary data from the Ministry of Finance, Nepal Rastra Bank, and the Department of Hydrology and Meteorology spanning from 1990 to 2023, the research employed econometric techniques to explore the relationship. The research used unit root tests, co-integration analysis using the ARDL bounds test, and diagnostic tests to assess the validity of the model.

Findings and Conclusion – The findings revealed a consistent decline in the relative contribution of agricultural GDP to the total GDP, indicative of a transition towards a more diversified economy. While agricultural GDP displayed fluctuations in growth rates, the sector exhibited a pattern of modest growth overall. Agricultural credit experienced fluctuations, with notable growth in the early 2010s, although a slight decline was observed in fiscal year 2022/23. Long-run relationships indicate significant positive impacts of cultivation area on agricultural GDP. The error correction model underscores the sector's ability to adjust to shocks, emphasizing long-term stability.

Implications – The findings of the research provide valuable insights into the dynamics of agricultural GDP, the role of agricultural credit and the factors influencing agricultural productivity and growth. These insights can inform agricultural policies and investment decisions aimed at promoting sustainable agricultural development and economic growth.

Originality/value – The research is novel in its kind that it examines the agricultural credit performance on agricultural GDP growth in Nepal which is early research in the domain. Policymakers can use the research results to improve the effectiveness of agricultural credit and increase agricultural GDP in the country.

Keywords – Agricultural credit, ARDL bounds test, Correlation analysis, GDP growth, Hydrology, Meteorology

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1. Introduction

In developing countries, agriculture is one of the most important sectors. It provides the majority of the world's population with food, jobs, and income. Over many centuries and generations, agriculture has been recognized as one of the earliest sources of income of the human species (Asaleye et al., 2018). One of the major problems of developing countries is inadequacy of agricultural credit. Borrowed funds or agricultural credit, which includes bank and trade credit, are two possible forms of it. As the primary source of credit for various economic sectors, the banking sector is an essential component of financial systems across countries (Ngong et al., 2023). The World Bank (2018) states that bank credit encourages leading technology firms and makes it easier for farmers to purchase and use new technology. Zabatantou et al. (2023) stated credit is integral to the modernization of agriculture and the promotion of farmer participation in these processes. Consequently, credit is a crucial component of the growth plan for the agriculture industry (Mohsin et al., 2011).

There are two opposing theories aimed to explain how agricultural credit affects the growth of agricultural GDP. The agricultural credit function was pointed out in the Keynesian approach to agricultural credit policy, which depends on heavy state intervention. The Neoclassical approach, on the other hand, was centered on private financing. These models assessed rural and agricultural underdevelopment as a consequence of impoverished peasants' incapacity to save and invest. Afterwards, credit was employed as a development tool to support technical advancement, agricultural productivity, and innovation funding.

The agriculture industry in Nepal is the second largest contributor to GDP revenues. It is the largest sector in Nepal in terms of employment, GDP, export revenue, and provision of raw materials to the country's manufacturing industries. It is also essential to the country's economic growth (Dahal & Thapa, 2020). Agriculture accounts for the majority of exports; the main exportable commodities are cardamom, ginger, lentils, tea, and coffee (Dumre et al. 2020). In 2021/22, the share of the GDP that goes toward agriculture, industry, and services is 23.95 percent, 14.29 percent, and 61.76 percent respectively (NRB, 2021). As per the Economic Survey 2018/19, the agricultural sector provides livelihood to around 60.4% of the people and accounts for 27.7% of the country's GDP. In addition, workers leave agriculture to work in other industries. Just 27% of the country's GDP is resulting from agriculture, which employs about 60.4% of the entire population. By the end of the periodic plan, that percentage is predicted to decrease to 22.3% (GoN, 2020).

Due to the reliance of a sizable section of the population, industries, and commerce on agriculture, Nepal's future development is heavily reliant on the growth of its Agri-GDP. Thus, the key to Nepal's economic development which is dependent on a number of variables is the sector's growth in agriculture. Additionally, Dumre et al. (2020) proposed that the following factors are important for agricultural growth – institutional (land holdings, agricultural credit), technological (high yielding varieties or improved seed, fertilizers and pesticides), socioeconomic (population, poverty, and literacy), and infrastructural (irrigated area, farm mechanization, electricity, storage, transportation, agricultural market).

In recent years, the share of agricultural GDP that comes from inputs has decreased, making up less than one-third of GDP (MoF, 2018). The availability and application of agri-inputs, such as agricultural loans, irrigation, chemical fertilizers, better seeds, land cultivation, rainfall, and chemical pesticides, are major factors in the agricultural sector's growth. The growth of agriculture is also supported by better access to seeds, fertilizer application, sufficient irrigation systems, and ideal weather (MoF, 2018). Therefore, the objective of the research was to analyze the effect of agricultural credit on agricultural GDP growth in Nepal. The focus areas of the research were agricultural credit, irrigation, chemical fertilizers, better seeds, land cultivation, rainfall are considering independent factors, while agricultural GDP was the dependent variable. Moreover, agricultural credit was a major source of credit used to fund loan and other agricultural-related transactions. Based on the planting, harvesting, and selling cycles, these financing options were made to specifically address the financial needs of farmers. Thus, agricultural finance can be used in a wide range of other ways, such as for labor, tractors with deferred payments, storage facilities, etc. This research offers enhanced comprehension of how economic policies might enhance the growth and productivity of agriculture in Nepal. It can help policymakers understand how agricultural credit functions within the larger framework of economic development and how important it is for promoting agricultural growth. The results give academics, bank officials, and policymakers in Nepal empirical support (Rawat & KC, 2024).

2. Literature Review and Hypotheses Development

The academic study of economic growth was formally started in 1940 by American economist Domar and British economist Harrod. Economic growth indicates the expansion of a country's production capacity and is commonly quantified by GDP growth (Duwal & Acharya, 2023). A large amount of research indicates that agriculture is the main driver of economic growth (Ismail & Kabuga, 2017). Iyoha and Oriakhi (2004) conducted research to determine the causes of Nigeria's economic expansion. Their results demonstrate that agriculture, which contributes more to GDP growth than one might expect, is one of the primary drivers of economic expansion. The use of improved seeds, fertilizer, insecticides, tube wells, tractors, hired labor, and crop timing are important elements that impact agricultural productivity (Ahmad et al., 2018).

The availability of financing has a significant impact on the agricultural sector of any country (Chakraborty & Shukla, 2020). An analysis of cross-country data by Seven et al. (2020) shows that agricultural credits positively impact agricultural output; doubling agricultural credits boosts agricultural productivity by roughly 4-5 percent. Rahman et al. (2014) state that because loans allow farmers to purchase a variety of high-yield seeds, fertilizers, and pesticides, they can contribute to an increase in agricultural output. Akudugu (2016) also examined how Ghana's agricultural productivity, farm size, and access to financing are related. The findings showed that a number of formal and informal lending types and agricultural productivity were positively and significantly correlated.

The effect of agricultural credit on agricultural GDP growth is debatable, despite the fact that 40% of the world's population depends on agriculture (WB, 2022). Numerous empirical investigations have adopted various methods to analyze the effect of agricultural credit on agricultural GDP growth. In various countries, the findings of these investigations have been contradictory. Studies (Joao and de Castro, 2023; Azad et al., 2022; Ammani, 2012; Nwokoro, 2017; Udokaet et al., 2016) demonstrate that bank credit has a major favorable impact on agricultural growth. Further, research (Dhrifi, 2014; Olorunsola et al., 2017) suggests that bank loan negatively impact agricultural productivity. Certain research findings suggest a reciprocal relationship between bank loans and the expansion of agriculture (Chi et al., 2020; Tamga, 2017). Joao and de Castro (2023) examined causal relationship between agricultural credit and agricultural GDP growth, time series data were fitted into the ARDL test using a variety of econometric techniques, including the ADF stationarity test, Granger causality, the ordinary least squares method, and a vector error correction model (VECM), and it was found that agricultural credit had a 14.41% effect on agricultural GDP. Agricultural credit and agricultural GDP appear to be positively correlated, according to Granger causation. On the other hand, there is a unidirectional causal relationship between agricultural credit and GDP growth.

Azad et al. (2022) used the Johansen co-integration approach to study the effect of agricultural credit on agricultural growth in Bangladesh. The test findings show that the use of fertilizer and credit distributed to the agricultural sector both greatly boost agricultural output over time. Nwokoro (2017) observed that credit from banks had a favorable impact on agricultural GDP using an error correction model and OLS on data from 1980 to 2014. Udoka et al. (2016)'s examination of the impact of commercial bank credit on agricultural output from 1970 to 2014, there was a strong positive connection between agricultural output and commercial bank credit to Nigeria's agricultural sector. The same findings were reached by Ogbuabor and Nwosu (2017) when they looked at the impact of agricultural lending from deposit money banks on agricultural output in Nigeria. Dhrifi (2014) used the system generalized method of moment as an estimating methodology to examine the impact of financial development on agricultural productivity in Africa. The study found that the coefficient of financial development, as measured by domestic lending to the private sector, was considerably negative in the absence of institutional quality, indicating that the financial system had no positive impact on agricultural output in African countries.

Olorunsolaet al. (2017) studied on the relationship between credit to agriculture, and agricultural output in Nigeria was investigated using a nonlinear autoregressive distributed lag model on a time series data set spanning from 1992Q1 to 2015Q4, indicated that while there was no indication of asymmetry in the short-term relationship between loans and the rise of agricultural output, there were distinct equilibrium relationships over the long term. They also emphasized the necessity to look at the ways in which agricultural output is impacted by the various aspects of agricultural finance (production, processing, and marketing). Furthermore, Obilor (2013) assessed the effect of agricultural credit on agricultural growth from 1984 to 2007 and found that there was no discernible increase in agricultural growth in Nigeria as a result of commercial banks' credit to the agricultural sector. Chi et al. (2020) investigated the long-term causal relationship between agricultural productivity and banking sector development in the CEMAC countries from 1990 to 2018, using vector error correction model approaches and autoregressive distributed lag techniques. The findings demonstrated a long-term correlation between agricultural productivity and the banking sector in the CEMAC region. The results showed a two-way causal relationship between GDP's agriculture value added (AGRVA) and domestic bank credit to the private sector (DCPSB). This implied that the expansion of the banking industry and agricultural productivity operated in mutualism across the CEMAC region.

Tamga (2017) conducted research in Cameroon to determine whether the growth of the banking industry has an impact on the country's agricultural output between 1965 and 2014. Granger causality and cointegration were used to demonstrate the findings, which indicated a bidirectional relationship between the development of the banking sector and that of agriculture.

In the context of Nepal, there is inadequate literature available; however, this study attempts to review the current literature. Neupane (2023) found that there is a long-term cooperative relationship between the agriculture labor force, gross fixed capital formation, total food crops, and total cash crops, as well as a positive short-term correlation between these variables and capital expenditure and total food crops. The one lag time allows for the correction of the disequilibrium at a 0.07 percent adjustment speed. The analysis comes to the conclusion that government spending and Nepal's agricultural growth are related. Thus, over time, there is a relationship between government spending and the growth of agriculture. The research, however, did not examine how agricultural credit affected agricultural GDP growth.

Chaudhary and Mishra (2021) suggested increasing the rate of economic growth make poverty reduction much simpler. The GDP contribution of the agriculture sector is steadily declining annually, while the GDP contribution of the non-agricultural sector is rising in terms of economic growth. Ghimire and Dhakal (2021) conducted a study on the effects of the use of agricultural inputs in the agricultural production sector using time series data spanning 30 years (1990 to 2019) and found that during the course of the study period, the growth rate of various agricultural inputs such as government expenditure, cultivated area, irrigated area, population engaged in agriculture, fertilizer consumption, pesticide application, and improved seed use had increased significantly and was trending upward. Additionally, it was shown that the application of pesticides, the irrigated area, and the cultivated area were statistically significant and had a substantial impact on the increase of the agricultural GDP. Dahal and Thapa (2020) applied a descriptive and analytical research design to compare the loan disbursement conditions in the manufacturing and agriculture sectors. The findings of the Johansen Co-integration test show that commercial banks credit more to the manufacturing sector than to the agricultural sector, and that there is no long-term link between commercial bank loans and agricultural output in Nepal. However, the least-squares method points to a positive causal relationship between loans for agriculture and industry expansion.

The study conducted by Dumre et al. (2020) tries to examine the correlation between economic growth and agricultural expansion, as well as identify the elements that impact Nepal's economic growth. The findings indicate a high positive association ($r = 0.750$) between economic growth and agricultural growth, although agriculture's percentage of GDP and employment in the country is dropping while secondary sectors such as manufacturing, services, and industry are growing. The most significant factors influencing agricultural growth are institutional (land holdings and agricultural credit), infrastructural (irrigated areas, farm mechanization, electricity, storage, transportation, agricultural market), technological (high-yielding varieties or improved seed, fertilizers, and pesticides), and socioeconomic (population, poverty, and literacy). Nevertheless, the research solely establishes the correlation between economic expansion and agricultural expansion; the influence of precipitation on agricultural GDP growth remains unexplored.

Sharma (2014) used time series data from the Nepalese economy covering the years 2002–2012 to examine the effect of agricultural lending from commercial banks on GDP growth. According to this report, Nepal's agricultural GDP has been positively and considerably benefited by agricultural financing. However, there hasn't been any discernible effect on agricultural GDP from the usage of fertilizer or improved seeds. It is advised that the financial services system be expanded and strengthened in rural areas, and that loans for agriculture be made easier. The following hypotheses were developed based on related previous empirical studies conducted in different countries concerning the issue under investigation;

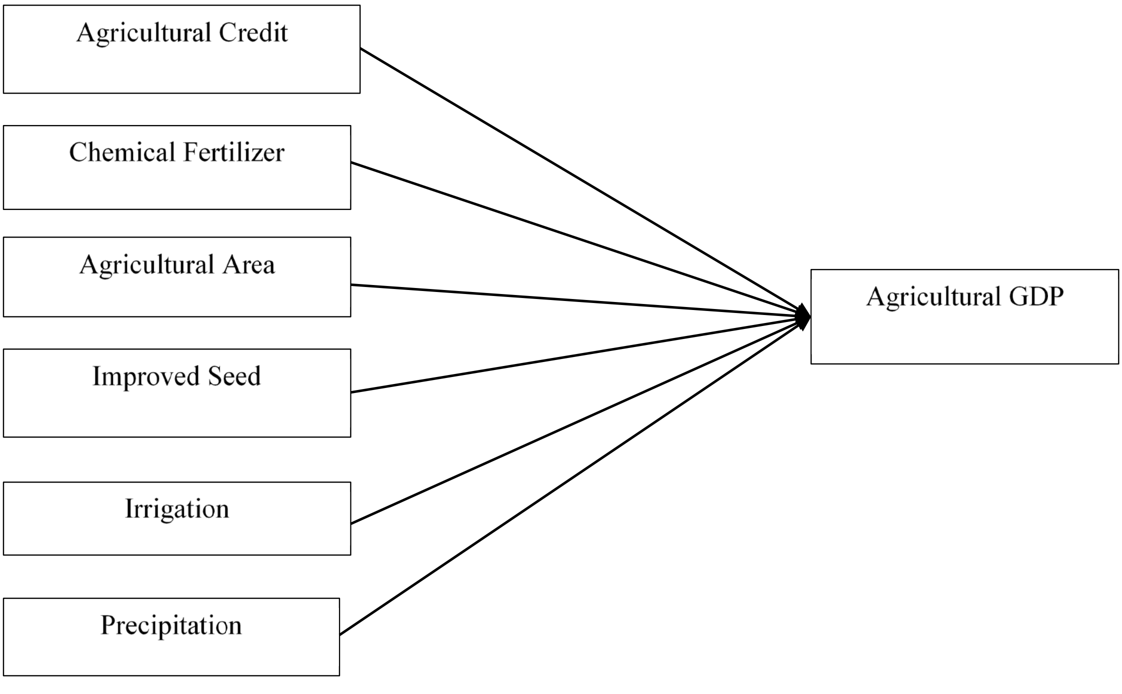
H1: There is significant positive relation between agricultural credit and agricultural GDP growth.

Conceptual Framework

The paper proposed a conceptual framework by considering agricultural credit, chemical fertilizer, agricultural area, improved seed, irrigation, precipitation as independent variables, and agricultural GDP growth as dependent variable in order to see the effect of independent variables on dependent variable. Agricultural growth depends on agricultural credit, land, irrigated area, improved seed and fertilizers (Dumre et al., 2020). Similarly, Reddy and Dutta (2018) concluded that variables such as rainfall and seeds have a statistically significant impact on agricultural GDP. In this research; however, agricultural credit is considered as a major variable and chemical fertilizer, agricultural area, improved seed, irrigation, precipitation are considered as supporting variables because agricultural credit not only boosts output but also advanced the agriculture process as a whole. Agricultural credit has increased application of fertilizer and pesticides, irrigation and mechanization of agricultural production. Literature of (Hussain & Thapa, 2012; Rahman et al., 2014; Saqib et al., 2016; Abdallah, 2016) explain that agricultural credit has a positive and significant impact on agricultural output.

Figure 1

Conceptual Framework



3. Research Methods

The research used descriptive and explanatory research design. To examine the effect of agricultural credit on growth of Nepal's agricultural GDP, the research has used the annual secondary time series data covering the years from 1990 to 2023. The year 1990 was taken because the privatization began from 1990 in Nepal. The time series data was collected from the Ministry of Finance (MoF), Nepal Rastra Bank (NRB), and the Department of Hydrology and Meteorology (DoHM). Every data set was rebased on the same base year, which is 2010/11. By dividing nominal data by the GDP deflator, real data can be obtained. In order to facilitate the analysis and handle any potential econometric problems that might surface, the data were also converted into logarithmic form. The summary of the variables and their respective sources are presented in the Table 1.

Table 1

Variables Description and Sources of Data

Variables	Description	Expected Sign	Data Source
Dependent Variable			
Agricultural GDP (AGGDP)	Log transformation of value of TR in 10 million.		MOF's macroeconomic dashboard retrieved from https://data.mof.gov.np/data.aspx#
Independent Variable			
Agricultural Credit (AGCRE)	Log transformation of value of AGCRE in 10 million.	+	Ministry of Finance (MOF)
Chemical Fertilizer (CHEMFERRT)	Log transformation of value of CHEMFERRT in metric Tons.	+	Ministry of Finance (MOF)
Agricultural Area (CULTAREA)	Log transformation of CULTAREA in thousand hector.	+	Statistical information of Nepalese agriculture
Improved Seed (IMPSEED)	Log transformation of value of IMPSEED in in metric Tons.	+	Ministry of Finance (MOF)
Irrigation (IRRIG)	Log transformation of IRRIG in hector.	+	Ministry of Finance (MOF)
Precipitation (PRECI)	Log transformation of PRECI in millimeter.	+	Department of Hydrology and Meteorology (MOHD)

Specification of the Model

In this study, economic growth, represented by agricultural gross domestic product (AGGDP), serves as the dependent variable. The independent variables encompass agricultural credits disbursed by banking and financial institutions in Nepal (AGCRE), the annual usage of chemical fertilizers in Nepal (CHEMFERT), cultivation area (CULTAREA), the annual usage of improved seeds in Nepal (IMPSEEDS), the area of irrigated land in Nepal (IRRIG), and annual rainfall in Nepal (PRECI). The mathematical model was used to examine the effect of agricultural credit on agricultural GDP is presented as

AGGDP = f (AGCRE, CHEMFERT, CULTAREA, IMPSEEDS, IRRIG, PRECI) ………… (1)

The unit root test is necessary for the econometric model to be applied. Given that some variables exhibit stationarity at the level while others are stationary at the first difference, the study employs techniques such as the autoregressive distributed lag model (ARDL).

Methods of Analysis

In order to analyze the descriptive statistics of the variables, this study makes use of many statistical methods, including mean, standard deviation, median, minimum, maximum, kurtosis, skewness and Jarque-Bera test. For empirical analysis, the ADF test, ARDL limits testing technique to cointegration, and ECM are used. Additionally, CUSUM and CUSUMSQ statistics are used to assess the model stability. The normalcy test, Breusch-Pagan-Godfrey test for heteroscedasticity, Breusch-Godfrey LM test for serial autocorrelation, and Ramsey's RESET test are also used in a diagnostic test. Microsoft Excel is utilized for basic statistical calculations, Eviews-10 software is used for data analysis, and Microfit 5.0 is used for data analysis.

4. Results and Analysis

Descriptive Statistics

The Table 2 presents a detailed summary of mean values for various significant agricultural variables, providing insights into their average levels within the dataset. These mean values serve as central indicators of the typical magnitude or scale of each agricultural metric, facilitating an understanding of their overall patterns and trends.

Table 2

Descriptive Statistics

Variables	Mean	Median	Maximum	Minimum	Std. Dev.
AGGDP	42861.12	41127.92	55838.89	29453.73	8212.67
AGCRED	10296.82	8939.1	23502.35	1419.2	7400.83
CHEMFERT	132196.6	72719	400541	3157	131442.5
CULTAREA	3031	3058.31	3216.94	2651.31	138.92
IMPSEEDS	10116.29	3669	33998	1794	12223.08
IRRIG	25363.48	25372	49015	3005	12289.1
PRECI	1683.49	1674	2104.4	1355.1	165.49

Source: Output of Eviews10

The mean values presented in the Table 2 indicated that the mean value of agricultural GDP, agricultural credit, chemical fertilizers, cultivation area, improved seeds, irrigation, and annual precipitation are within the maximum and minimum values. Which offer a comprehensive overview of various agricultural variables, shedding light on their average levels within the dataset.

Unit Root Test

The results of the Augmented Dickey-Fuller test for the time series are presented in the following Table 2, where the lag length was determined using the Schwarz Information Criterion.

Table 3

Augmented Dickey-Fuller Unit Root Test Result

Variables	Stationary at	Significance level				t-stat	Prob
		includes	1%	5%	10%		
lnAGGDP	1st difference	intercept	-6.257	- 3.662	-2.96	-2.619	0
lnAGCRED	1st difference	none	-5.275	-2.642	-1.952	-1.61	0
lnCHEMFERT	1st difference	none	-6.94	-2.642	-1.952	-1.61	0
lnCULTAREA	1st difference	trend and intercept	-8.493	-4.297	-3.568	-3.218	0
lnIMPSEEDS	1st difference	none	-3.055	-2.644	-1.952	-1.61	0.004
lnIRRIG	Level	trend and intercept	-4.331	-4.285	-3.563	-3.215	0.009
lnPRECI	Level	intercept	-4.41	-3.654	-2.957	-2.617	0.001

Source: Output of Eviews10

Table 3 presents the results of Augmented Dickey-Fuller Unit Root Test, as it is found that agricultural GDP, agricultural credit, chemical fertilizer, cultivation area, and improved seeds become stationary after taking the first difference, with the exceptions of irrigation and precipitation which are stationary at the level. The p-values for all variables are very low, indicating strong evidence against the null hypothesis of a unit root. This means that these variables do not require further differencing for stationarity, which is crucial for accurate time series modeling and analysis. Based on ADF test results, the ARDL model is used as econometric model for the study.

ARDL Model for Cointegration Test

The ARDL model expressed by the given equation combines short-term dynamics and long-term equilibrium while preserving critical long-term information. The model generated in the first phase is used to calculate the long-run coefficients, which are obtained by dividing the coefficients of the lagged dependent variables by the coefficients of the one-period lagged explanatory variables (multiplied by a negative sign). Akinboade et al. (2008) stated that this calculation allows the relationship between the dependent variable and the explanatory factors to be established over an extended period of time, capturing persistent equilibrium dynamics.

The fundamental model employed for estimating the determinants of economic growth in the Nepalese economy is specified as:

$$lnAGGDPt = a+b1 \ln AGCREt + b2 \ln CHEMFERTt + b3 \ lnCULTAREAt + b4 \ln IMPSEEDSt + b5 \ln IRRIGt + b6 \ln PRECIt + error$$

Where,

ln $AGGDP_t$	Agricultural gross domestic product expressed in logarithm
ln $AGCRE_t$	Agricultural credits provided by the banking and financial institutions
ln $CHEMFERT_t$	Chemical fertilizer in metric ton
In CULTAREA	Cultivation area in hector
ln $IMPSEEDS_t$	Improved seeds in metric tons
ln $IRRIG_t$	Irrigation land area in hectare
ln $PRECI_t$	Annual precipitation millimeters

Following Pesaran et al. (2001), ARDL representation of unrestricted version is specified below in equation (3.16)

$$\Delta lnAGGDPt = \mu + \sum_{i=0}^{m} \eta_i \Delta lnAGCREC_{t-1} + \sum_{i=0}^{n} \omega_i \Delta \ln CHEMFERTt\text{-}i + \sum_{i=0}^{p} \varphi_i \Delta \ln CULTAREA_{t-i} + \sum_{i=0}^{q} \pi_i \Delta \ln IMPSEEDS_{t-i} + \sum_{i=0}^{r} \alpha_i \Delta \ln IMPSEEDS_{t-i} + \sum_{i=0}^{s} \beta_i \Delta \ln IMPSEEDS_{t-i} + \theta_1 \ln GDP_{t-1} + \theta_2 \ln AGCRE_{t-i} + \theta_3 \ln CHEMFERT_{t-i} + \theta_4 \ln CULTAREA_{t-i} + \theta_5 \ln IMPSEEDS_{t-i} + \theta_5 \ln IRRIG_{t-i} + \theta_5 \ln PRECI_{t-i} + u_t$$

Where Δ denotes first difference operator, μ is the intercept term, and ut is the usual white noise residuals. As such, coefficients (θ1 to θ5) signify the long-run relationship while the remaining terms denoted by the summation sign (coefficients ηi, ωi, ϕi, πi) represent the short-run dynamics of the model.

The selected ARDL model is ARDL (1, 2, 1, 0, 2, 2, 0), which specifies the lag structure for the variables in the model. This indicates the number of lags used for each variable to capture their dynamic relationships with ln AGGDP.

Table 4

Autoregressive Distributed Lag Estimates

AGGDP = f(AGCRE, CHEMFERT, CULTAREA, IMPSEEDS, IRRIG, PRECI)

Variables	Coefficient	Std. Error	t-statistic	Prob.
AGGDP(-1)	0.649	0.077	8.432	0
AGCRED	-0.007	0.013	-0.557	0.586
AGCRED(-1)	0.026	0.014	1.807	0.09
AGCRED(-2)	-0.023	0.012	-1.886	0.078
CHEMFERT	0.032	0.008	3.884	0.001
CHEMFERT(-1)	-0.032	0.008	-4.021	0.001
CULTAREA	0.988	0.241	4.109	0.001
IMPSEEDS	0.028	0.017	1.716	0.105
IMPSEEDS(-1)	-0.055	0.02	-2.765	0.014
IMPSEEDS(-2)	0.047	0.015	3.107	0.007
IRRIG	-0.002	0.01	-0.174	0.864
IRRIG(-1)	-0.004	0.009	-0.404	0.692
IRRIG(-2)	-0.016	0.01	-1.488	0.156
PRECI	-0.014	0.065	-0.21	0.836
C	-3.997	1.487	-2.688	0.016
R-squared	0.992	Akaike info crit.	-4.38	
Adjusted R-squared	0.984	Schwarz crit.	-3.686	
F-statistic	134.907	Hannan-Quinn crit.	-4.154	
Prob(F-statistic)	0	Durbin-Watson stat.	1.908	

Source: Output of Eviews10

Table 4 presents the results of Autoregressive Distributed Lag Estimates as it is found that the model has an R-squared value of 0.992, indicating that 99.2% of the variation in lnAGGDP is explained by the independent variables. The adjusted R-squared value is 0.984, which accounts for the number of predictors in the model. The F-statistic is 134.907 with a p-value of 0.000, indicating the overall significance of the model. The Durbin-Watson statistic is 1.908, which suggests no severe autocorrelation problem in the residuals. Akaike info criteria, Schwarz criteria, Hannan-Quinn criteria provide measures of model fit, with lower values indicating a better model fit.

Existence of a Level Relationship

The Table 5 presents the results of testing for the existence of a level relationship among the variables in an Autoregressive Distributed Lag (ARDL) model.

Table 5

Testing for Existence of a Level Relationship among the Variables in the ARDL Model

Test Statistic	Value	Sig.	I(0)	I(1)
F-statistic	7.421	10%	1.99	2.94
K	6	5%	2.27	3.28
		2.50%	2.55	3.61
K	6	1%	2.88	3.99

Source: Output of Eviews10

Table 5 presents the results of Testing for Existence of a Level Relationship among the variables in the ARDL Model as it is found that the calculated value of the F-statistic is 7.421, which is greater than the values of I(0) i.e. 1.99 and I(1) i.e. 2.94 for all level of significance showing that there exists a level relationship among the variables in the ARDL model.

Long-run Relationships

The Table 6 provides insights into the estimated long-run coefficients obtained through the ARDL approach for various variables influencing Agricultural Gross Domestic Product (AGGDP). Each variable's coefficient represents the expected impact on AGGDP, considering other factors in the model.

Table 6

Estimated Long-run Coefficients using ARDL Approach

Variables	Coefficient	Std. Error	t-Statistic	Prob.
lnAGCRED	-0.0114	0.023	-0.489	0.631
lnCHEMFERT	0.0001	0.021	-0.005	0.996
lnCULTAREA	2.8135	0.409	6.878	0
lnIMPSEEDS	0.0583	0.031	1.9	0.076
lnIRRIG	-0.0592	0.045	-1.308	0.209
lnPRECI	-0.0388	0.186	-0.208	0.838
C	-11.3792	3.708	-3.069	0.007

Source: Output of Eviews10

Table 6 presents the results of Estimated Long-run Coefficients using ARDL Approach, as it is found that certain variables such as cultivation area exhibit significant impacts on AGGDP, others such as agricultural credit, chemical fertilizers, improved seeds, irrigated land, and annual precipitation show less pronounced or statistically insignificant effects, highlighting the complexity of factors influencing agricultural output.

Error Correction Regression Model

The results from Error Correction Model (ECM) regression offer a comprehensive view of the dynamic relationship between the variables under study, capturing both short-term impacts and the adjustment process toward long-term equilibrium. The selected model is ARDL (1, 2, 1, 0, 2, 2, 0), which specifies the lag structure for the dependent and independent variables.

Table 7

ARDL Error Correction Regression

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(lnAGCRED)	-0.007	0.008	-0.871	0.396
D(lnAGCRED(-1))	0.023	0.008	2.894	0.011
D(lnCHEMFERT)	0.032	0.006	5.689	0
D(lnIMPSEEDS)	0.028	0.011	2.585	0.02
D(lnIMPSEEDS(-1))	-0.047	0.011	-4.061	0.001
D(lnIRRIG)	-0.002	0.005	-0.342	0.737
D(lnIRRIG(-1))	0.016	0.006	2.835	0.012
CointEq(-1)*	-0.351	0.038	-9.238	0

Source: Output of Eviews10

Table 7 presents the results of ARDL Error Correction Regression, as it is found that the ARDL Error Correction Model provides detailed insights into both the immediate and lagged effects of agricultural credit, chemical fertilizers, improved seeds, and irrigation on the agricultural GDP. The model also effectively captures the speed at which deviations from long-term equilibrium are corrected, offering a nuanced understanding of the dynamics at play in the system. The error correction term is -0.351, which is highly significant with a p-value of 0.000. The negative sign of the coefficient indicates that approximately 35.1% of any deviation from the long-term equilibrium is corrected in each period.

Diagnostic and Residual Test

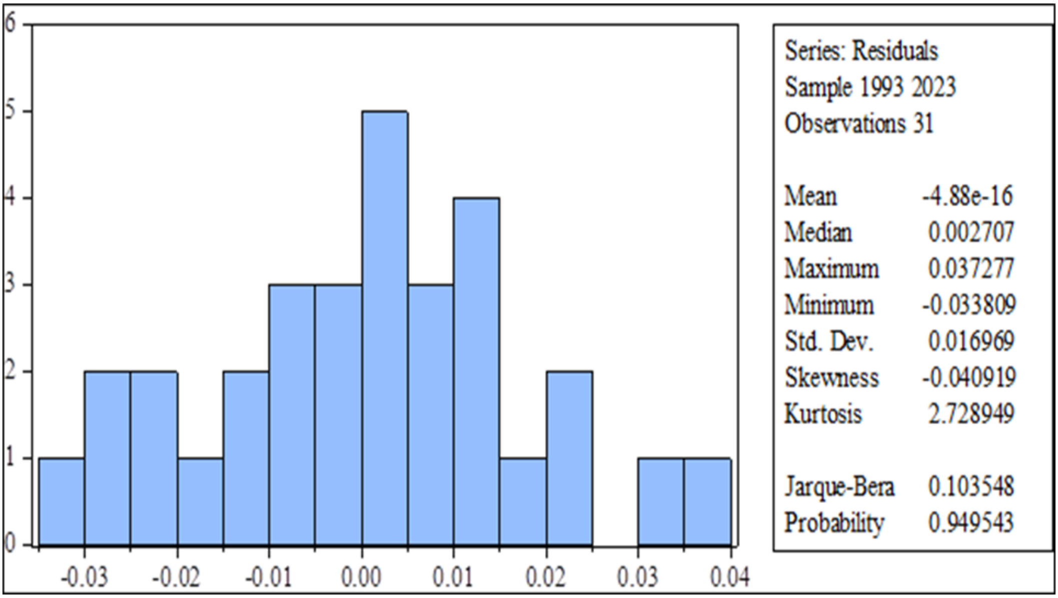
Diagnostic and residual tests of the ARDL model are essential steps in validating the robustness and reliability of the model's estimates. These tests help ensure that the underlying assumptions of the ARDL model are not violated, thereby enhancing the credibility of the results. Diagnostic tests typically include checks for serial correlation, heteroscedasticity, normality of residuals, and functional form specification. Residual tests, such as the CUSUM and CUSUMSQ tests, assess the stability of the model over time by examining the cumulative sum of recursive residuals and their squares.

Normality Test

The figure 2 presents the outcomes of a normality test conducted on a set of residuals, a key step in statistical analysis to assess if the data conform to a normal distribution.

Figure 2

Normality Test



Source: Output of Eviews10

From figure 2, the "Skewness" value of -0.040919 suggests a negligible deviation from a symmetric distribution, while the "Kurtosis" of 2.728949 indicates a distribution slightly more peaked than a normal distribution, with heavier tails. The figure 2 includes results from the Jarque-Bera test, a statistical test for normality. The Jarque-Bera test statistic of 0.103548, accompanied by a high p-value of 0.949543, indicates that the residuals do not significantly depart from a normal distribution. Consequently, there is no substantial evidence to reject the null hypothesis, suggesting that the residuals are normally distributed.

Breusch Godfrey Serial Correlation LM Test

Table 8 presents the findings from the Breusch-Godfrey Serial Correlation LM Test, a crucial statistical examination used to scrutinize whether there exists serial correlation, also known as autocorrelation, within the residuals of a regression model. Autocorrelation arises when the errors of a regression model exhibit correlation with each other over time, contravening the assumption of error independence.

Table 8

Breusch-Godfrey Serial Correlation LM Test

F-statistic	0.055	Prob. F (1,15)	0.817
Obs*R-squared	0.114	Prob. Chi-Square (1)	0.736

Source: Output of Eviews10

Table 8 presents the results of the Breusch-Godfrey Serial Correlation LM Test, as it is found that there is weak evidence to suggest the existence of serial correlation in the residuals of the regression model under consideration. The low F-statistic and high p-values imply that the null hypothesis of no serial correlation cannot be confidently rejected. Therefore, it is reasonable to conclude that the assumption of no serial correlation holds for the regression model, ensuring the robustness of subsequent analyses reliant on this assumption.

Breusch Pagan Godfrey Heteroscedasticity Test

Table 9 provides the outcomes of the Breusch-Pagan-Godfrey Heteroscedasticity Test, an important statistical examination employed to assess the presence of heteroscedasticity within the residuals of a regression model. Heteroscedasticity refers to the situation where the variability of the errors in a regression model changes across different levels of the independent variables, contrary to the assumption of homoscedasticity, where the error variance remains constant.

Table 9

Breusch-Pagan-Godfrey Heteroscedasticity Test

F-statistic	0.852	Prob. F (14,16)	0.615
Obs*R-squared	13.237	Prob. Chi-Square (14)	0.508
Scaled explained SS	3.048	Prob. Chi-Square (14)	0.999

Source: Output of Eviews10

Table 9 presents the results of the Breusch-Pagan-Godfrey Heteroscedasticity Test, as it is found that there is weak evidence to suggest the presence of heteroscedasticity in the residuals of the regression model. The low F-statistic and high p-values imply that the null hypothesis of no heteroscedasticity cannot be confidently rejected. Therefore, it is reasonable to conclude that the assumption of homoscedasticity holds for the regression model, ensuring the validity of subsequent analyses relying on this assumption.

Ramsey RESET Test

Table 10 outlines the outcomes of Ramsey's RESET (Regression Specification Error Test), a diagnostic tool utilized to identify potential misspecifications in a regression model. This test is crucial for assessing whether the model's functional form is correctly specified, thus guarding against the omission of relevant variables or incorrect functional forms that could compromise the model's accuracy.

Table 10

Ramsey's RESET Test

Statistics	Value	df	Probability
t-statistic	0.18107	15	0.8587
F-statistic	0.03279	(1, 15)	0.8587

Source: Output of Eviews10

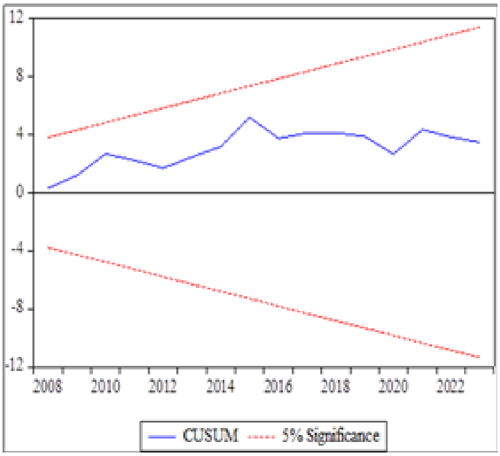
Table 10 presents the results of Ramsey's RESET test, as it is suggested that there is no substantial evidence of misspecification in the regression model. Both the t-statistics and the F-statistics yield low values, while their associated probabilities are high, indicating weak evidence against the null hypothesis of no misspecification. Thus, it can be reasonably inferred that the functional form of the regression model is correctly specified, and the model adequately captures the relationship between the dependent and independent variables.

CUSUM and CUSUMSQ Test

To evaluate the stability of the ARDL model, two techniques – the Cumulative Sum of Recursive Residuals (CUSUM) and the CUSUM of Squares (CUSUMSQ), plotted over time are utilized. The CUSUM method entails computing the cumulative sum of residuals throughout the model to detect any deviations or shifts from stability. The CUSUM test was employed to identify parameter instability within a model by examining the cumulative sum of recursive residuals. This method involves plotting the cumulative sum alongside 5% critical lines. If the cumulative sum falls outside the range defined by these critical lines, it signifies the presence of parameter instability within the model.

Figure 3

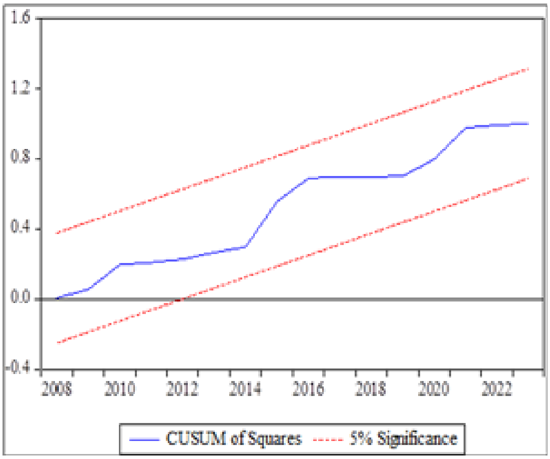
Plot of Cumulative Sum of Recursive Residuals



Source: Output of Eviews10

Figure 4

Plot of Cumulative Sum of Square of Recursive



Source: Output of Eviews10

Figures 3 and 4 depict the cumulative sum of recursive residuals and the cumulative sum of squared recursive residuals respectively. These visuals distinctly show that both the CUSUM curves and the CUSUMSQ curve consistently fall within the confines delineated by the 5% critical lines. This observation suggests the parameter space of the ARDL model of co-integration remains stable, indicating that the model is not mis-specified.

5. Discussion and Conclusion

The estimated long-run coefficients and the error correction model underscore the significant positive impacts of variables such as cultivation area on agricultural GDP. These findings are consistent with literature such as Isola et al. (2019), which found no long-term relationship between bank credit and agricultural productivity in Nigeria. However, the error correction model highlights the system's ability to adjust back to equilibrium aftershocks, emphasizing the stability of relationships among variables over time.

Overall, the discussions drawn from the findings and the literature provide valuable insights into the dynamics of agricultural GDP, the role of agricultural credit and the factors influencing agricultural productivity and growth. These insights can inform agricultural policies and investment decisions aimed at promoting sustainable agricultural development and economic growth.

In conclusion, long-run relationships, as estimated through the ARDL approach, highlight significant positive impacts of cultivation area on agricultural GDP, while other variables such as agricultural credit, chemical fertilizers, improved seeds, irrigated land, and annual precipitation exhibit statistically insignificant effects. The Error Correction Model underscores the long-term stability of relationships among variables, providing insights into both immediate and lagged effects on agricultural GDP, and emphasizing the model's ability to adjust back to equilibrium aftershocks. This study does not include other factors that are influencing the growth of the agricultural GDP, such as subsidies, the price of agricultural commodities, climate, temperature, winds, labor, agricultural wages, pesticides, availability and consumption of agricultural inputs, soil type, land topography, biotic factors (diseases, pests, and soil microorganisms), socioeconomic factors (demand for agricultural products), and government interventions, support, and programs.

6. Implications

This research is important because it can help policymakers understand how agricultural credit functions within the larger framework of economic development and how important it is for promoting agricultural growth. Research on the agriculture sector provides decision-makers with relevant information about the challenges the sector faces, allowing them to set priorities and assign resources accordingly. As a result, this helps achieve long-term economic goals as well as allocative and technological efficiency. The farm industry's sole remaining survival strategy is an uncertain future. In this context, the current research could offer a basis on which decision-makers could work to maximize the agricultural sector's capacity to increase exports, support industry, and quicken the rate of general economic development with a high level of technical and allocative efficiency.

The research findings may also be useful in identifying the causes of the sluggish increase in credit to the agricultural sector and in bringing attention to specific legislative concerns that might promote this form of financing. Through a variety of economic strategies, including as loan programs aimed at the agricultural and developing sectors, the Nepal Rastra Bank (NRB), the central bank of Nepal, itself is closely monitoring how to distribute resources to the productive sector. In this situation, it will be advantageous for the NRB and economic policymakers to offer the appropriate instruments and strategies to accomplish the aforementioned objectives.

7. Limitations and Direction for the Future Research

Credit from commercial banks is taken into consideration for research, but credit from other financial institutions, such as finance companies, cooperative societies, and rural development banks, has not. Furthermore, as the regression equation under consideration shows, multicollinearity may arise between independent variables. Agricultural credit provided by commercial banks is the capital injected into the agriculture sector; this same cash may be used to purchase irrigation, chemical fertilizer, and seeds. This research does not include other factors that may influence the growth of the agricultural GDP, such as subsidies, the price of agricultural commodities, climate, temperature, winds, labor, agricultural wages, pesticides, availability and consumption of agricultural inputs, soil type, land topography, biotic factors (diseases, pests, and soil microorganisms), socioeconomic factors (demand for agricultural products), and government interventions, support, and programs.

In the future, the researchers could focus on three major avenues – first, Impact of Specific Agricultural Policies: Delve deeper into the direct impact of specific agricultural policies on agricultural GDP and lending dynamics. Analyze how changes in policies, such as subsidy programs or market regulations influence agricultural credit accessibility and sectoral growth, providing insights for more targeted policy interventions. Second, Climate Change Resilience: Investigate the resilience of agricultural GDP and lending practices to climate change-induced shocks. Assess adaptation strategies, risk mitigation measures, and the integration of climate-smart agricultural practices to enhance the sector's ability to withstand environmental challenges. Third, Technological Innovation and Financial Inclusion: Explore the intersection of technological innovation and financial inclusion in agriculture. Examine the role of digital finance solutions, precision agriculture, and other agri-tech advancements in improving access to credit, enhancing productivity, and fostering sustainable agricultural development.

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