# RELATIONSHIP BETWEEN AGRICULTURAL GROWTH AND COMMERCIAL BANK LENDING IN AGRICULTURE SECTOR IN NEPALESE CONTEXT

A THESIS

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# DECLARATION

I, SUPRABHA THAPALIYA, declare that this thesis entitled "RELATIONSHIP BETWEEN AGRICULTURAL GROWTH AND COMMERCIAL BANK LENDING IN AGRICULTURE SECTOR IN NEPALESE CONTEXT" submitted to Central Department of Economics is my own original work unless otherwise indicated or acknowledged in the thesis. The thesis does not contain materials which has been accepted or submitted for any other degree at the University or other institution. All sources of information have been specifically acknowledged by references to the author(s) or institution(s).

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# LETTER OF RECOMMENDATION

This thesis entitled "RELATIONSHIP BETWEEN AGRICULTURAL GROWTH AND COMMERCIAL BANK LENDING IN AGRICULTURE SECTOR IN NEPALESE CONTEXT" has been prepared by Ms. Suprabha Thapaliya under my guidance and supervision. I, hereby, recommend it in partial fulfilment of the requirements for the Degree of MASTER OF ARTS in ECONOMICS for final examination.

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## APPROVAL SHEET

We clarify that this thesis entitled "RELATIONSHIP BETWEEN AGRICULTURAL GROWTH AND COMMERCIAL BANK LENDING IN AGRICULTURE SECTOR IN NEPALESE CONTEXT" submitted by Ms. Suprabha Thapaliya to the Central Department of Economics, Faculty of Humanities and Social Sciences, Tribhuvan University, in the partial fulfilment of the requirements for the degree of MASTER OF ARTS in ECONOMICS have found satisfactory in scope and quality. Therefore, we accept this thesis as a part of the said degree.

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# ABBREVIATIONS

| **Abbreviations** | **Full form** |
|---|---|
| ADB | Agriculture Development Bank |
| ADF Test | Augmented Dickey Fuller Test |
| AGDP | Agriculture GDP/growth |
| AIC | Akaike Information Criterion |
| ARDL | Autoregressive Distributed Lag |
| BFIs | Bank and Financial Institutions |
| CBS | Central Bureau of Statistics |
| CBs | Commercial Banks |
| CUSUM | Cumulative Sums |
| CUSUMSQ | Cumulative Sum of Squares |
| ECM | Error Correction Model |
| F.Y. | Fiscal Year |
| FAO | Food and Agriculture Organization of the United Nations |
| FER | Fertilizer use and supply |
| GDP | Gross Domestic Product |
| IRI | Irrigation Supply |
| LDCBS | Lending Distribution by Commercial Banks |
| LM test | Lagrange Multiplier test |
| MA | Moving Average |
| MoF | Ministry of Finance |
| NRB | Nepal Rastra Bank |
| OLS | Ordinary Least Square |
| SBC | Schwarz Bayesian criterion |
| SD | Standard Deviation |
| SEED | Seed use and supply |

# ABSTRACT

The World Bank has noted that in least developed countries, the agriculture sector can account for more than a quarter of GDP and is crucial for economic growth. In Nepal, the shift in national priorities towards the industrial and service sectors has resulted in a relative lack of development in the agriculture sector. However, it has been observed globally that the development of the agriculture sector can lead to overall economic development. As a result, it is important to examine whether the agriculture sector in Nepal is growing through lending from commercial banks.

This study examines short term and long term effect of agricultural credit on agriculture growth in Nepal during the period of 1987-2021 using time series data. The variables considered are agricultural growth (AGDP), lending on agriculture by commercial banks (LDCBS), fertilizer supply (FER), seed supply (SEED) and irrigation supply (IRI). The regression results from ARDL cointegration test shows that lending has significant and positive long-run relationship with AGDP whereas ECM suggests that LDCBS is insignificant in short-run. The findings suggest that credit has enabled the increased use of purchased inputs and changes in the input mix, support to the evolution of agriculture over the longer horizon but it has not contributed to short-term growth in agricultural GDP. Thus, on the basis of the acquired result and few existing researches in context of Nepal, it can be said that lending towards agriculture sector is beneficial in Nepal. Solicitous plans, programs and actions are duly needed to transform agriculture sector. It is advisable for both the government and the NRB to consider revisiting current policies, increase credit flow to the agriculture sector, and investing more in actual farmers to ensure that they have access to the necessary services and facilities to drive agricultural transformation.

*Keywords:* Agricultural Productivity, Agricultural credit, Commercial Bank.

# CHAPTER-I

# INTRODUCTION

## 1.1 Background of the Study

Agriculture is crucial to economic growth, as it accounts for a significant portion of GDP in many countries. In the least developed nations, it can account for more than 25% of GDP (World Bank, 2022). In addition to providing employment and income for many people, agriculture can also contribute to economic growth by increasing food production, improving food security, and driving exports of agricultural products. Food systems that are healthy, sustainable, and inclusive are essential for addressing global development challenges, such as poverty, malnutrition, and environmental degradation. A healthy food system is one that provides people with access to affordable, nutritious, and culturally appropriate foods, while also ensuring that the production and distribution of these foods is environmentally and socially sustainable. Agricultural development plays a key role in achieving these goals. It is one of the most effective ways to reduce severe poverty, as growth in the agriculture sector is often more effective at improving incomes among the poorest than growth in other industries.

Agriculture is an important sector for many poor countries, as it is often a major source of employment and income for a large portion of the population. When the agriculture sector grows, it can lead to an increase in income for those who depend on it for their livelihoods. This can be particularly beneficial for small-scale farmers and rural communities, who may be more vulnerable to poverty and economic insecurity. Growth in the agriculture sector can also have broader economic benefits for a country. It can lead to increased food production, which can help to improve food security and reduce malnutrition. It can also lead to increased exports of agricultural products, which can bring in much-needed foreign currency and stimulate economic growth. Agriculture is a major source of income and employment in Nepal, in 2018 with approximately 60.4% of the population working in the sector (Ministry of Finance, 2021). This sector not only provides income for the population, but also helps drive growth and stability in the rest of the Nepalese economy.

Agricultural transformation is also crucial for developing countries to reach high-income status and achieve other important development goals. Many countries have been able to transition from poverty to high-income status by undergoing an economic transformation that starts with agriculture and drives growth in other sectors. For instance, China's GDP per capita in current US dollars increased from $155 to $8,123 between 1978 and 2016, which can be attributed to this type of transformation (Lin, 2018).

In fiscal year 2011/12, the contribution of agriculture sector (agriculture, forest and fisheries) to GDP was 32.7 percent. It has been gradually decreasing in recent years and is estimated to be 25.8 percent in fiscal year 2020/21 (Ministry of Finance, 2021). By mid 2010s, Nepal's economy was in a phase of structural transformation, with the service sector growing and the agriculture sector declining. Modernizing and commercializing agriculture by increasing production and productivity through the proper provision of agricultural inputs such as improved seeds, fertilizers, irrigation, agricultural credit, technology, and skilled human resources is a challenging task, but rewarding as it can take the country to a  high-growth path. The share of population depending on the agricultural sector has been gradually declining due to the modernization and commercialization of agriculture as well as the expansion of services in non-agriculture sectors. According to the Nepal Labor Force Survey of 2008 (FNCCI, 2021), 73.9 percent of the population was engaged in agriculture sector, but in 2018 the proportion has decreased to 60.4 percent.

Most Nepalese people live in rural areas, and agriculture is their primary source of income. The growth and development of the Nepalese economy are largely dependent on the growth and development of the agriculture sector, as the majority of Nepalese industries are agriculture-based, and the export sector is dominated by agricultural commodities. The agriculture sector in Nepal is still primarily based on subsistence farming, which leads to low productivity and production of agricultural commodities. Based on sufficient number of researches in literature review, it can be concluded that credit is one of the major factors that influence agriculture sector growth. This will enhance commercialization in farming, advanced technology, trained farmers, improved farming practices and hence uplift the living standard of people, improve agriculture sector and overall economic growth.

If more farmers are able to access credit at affordable rates and have markets to sell their products, it creates a ecosystem with sufficient money to invest in improved agricultural practices, improved efficiency of farmers (Baffoe, Akiyama, Matsuda, & Masafumi, 2014) resulting in higher yields and reduced losses. In the long run, it is a self-sustaining cycle that drives progress and supports the agricultural sector. To fully realize the agricultural sector's potential, programs are being implemented to increase production and productivity, improve food security, and create employment through modern and commercial farming systems by optimizing the use of agricultural land through land use policies and scientific land reform (Ministry of Finance, 2021).

In Nepal, the major formal institutions that provide agricultural credit are the Nepal Rastra Bank (NRB) licensed banks and financial institutions such as commercial banks, microfinance institutions, and cooperatives (Pandey, 2022), microcredit banks and rural development banks (Bhatta, 2014). The Agriculture Development Bank has been the main financial institution providing credit to the agriculture sector in Nepal since its establishment in 1968 (Shrestha, 2022). According to the Nepal Rastra Bank's directives and monetary policy (2022), commercial banks are required to invest at least 12% of their total lending in the agriculture sector by mid-July 2022. In the third quarter of the current fiscal year 2021-22, commercial banks have lent a total of Rs. 490.15 billion (around $4.1 billion) to the agriculture sector, which accounts for 12.28% of their total credit (Ministry of Finance, 2021). As per economic survey 2020/21, out of total annual growth rate of GDP in FY 2019/20, agriculture, forestry and fisheries contributed 2.23 percent at constant price of FY 2010/11. As of mid-March of the fiscal year 2020/21, loan investment in livestock and vegetable farming had increased by 27.9% to Rs. 20.31 billion compared to the same period in the previous fiscal year. During the same period, banks and financial institutions disbursed Rs. 290.75 billion in agricultural credit, with 36.7% going towards livestock farming and services, 17.1% towards agriculture farming services, and 43.9% towards other agriculture-related services. The share of savings, and reserve funds of small farmers' groups had increased by 27.7% in 2021. Credit investment through the Small Farmers Development Program increased by 5.2% to Rs. 12.880 billion compared to the same period in the previous fiscal year, and debt recovery increased by 9.3%. Overall, agriculture sector experienced improvement in various aspect of credit mobilization.

Farmer-level transformation means to increase yields, reduce post-harvest losses, improve market access, and increase product margins. In Nepal, there are a large number of smallholder farmers who are not officially recorded in data. These farmers, who are often illiterate and have low bargaining power, need guidance and training in farming practices and business skills. For them, agricultural credit and guidance by the bank and financial institutions or lenders can play a crucial role in improving their access to inputs and technologies that can increase their crop yields and overall farm productivity. However, the current availability of agricultural credit in Nepal is limited, with most of it being disbursed for financing capital items like tractors and threshers, rather than inputs like irrigation systems, fertilizers, pesticides, and improved seeds (Bhatta, 2014). As a result, farmers often struggle to obtain the credit they need to finance the inputs required for agricultural production and are forced to pay high interest rates to microcredit banks and rural development banks. To address this issue, there is a need for the expansion of financial intermediation services and the provision of more affordable credit to farmers. This could involve reducing interest rates, increasing the reach of financial services, and providing technical know-how to farmers on how to use credit to enhance farm productivity through better inputs and practices.

## 1.2 Statement of the Problem

The agriculture sector plays a crucial role in economic development, as it has contributed significantly to the prosperity of developed countries. In fact, the history of countries such as England, the United States, China, the Republic of Korea, Taipei, and Japan shows that agricultural development often precedes industrial development, or helps to drive it (Praburaj, 2018; Briones & Felipe, 2013). Developing countries like Nepal should not view agricultural and industrial development as mutually exclusive; rather, a strong agriculture sector can lead to increased income and investment, which can in turn drive growth in the industrial and service sectors, as well as the external sector. In short, the agriculture sector is the backbone of the economic system for developing economies and should be a key focus for policy makers. One key roadblock in agricultural transformation is insufficient credit for farmers (Bhatta, 2014), which cause them unable to invest in the agricultural inputs in the first hand, thereby, reducing farm productivity.

Furthermore, the literature review indicates varying associations between credit disbursement in the agriculture sector and growth in agriculture sector. Some studies have found a positive correlation, while others have found inconclusive or mixed results. Additionally, some research suggests a long-term relationship, while others suggest a both long-run and short-run relationship. Few papers are found which depicts positive association between the variables in Nepal using different time periods and research methods. Thus**,** more investigation is needed to determine the co-integration between these two variables in the context of Nepal by extending the sample period. This study is concerned with the relationship between agricultural sector growth and lending by the commercial banks to agriculture sector since magnitude and sign of this relationship is an important predictor of Nepal's agricultural transformation and, ultimately, national development.

## 1.3 Objectives of the Study

The general objective of this study is to find relationship between agriculture sector growth (AGDP) and lending distribution by commercial banks to agriculture sector (LDCBS). The specific objectives of this study are:

a. To analyze the nature and trend of agriculture sector growth and agricultural lending distribution by commercial banks in Nepal.
b. To explore empirically the relationship of agricultural output growth to agricultural credit along with control variables viz. fertilizer supply, seed supply, irrigation supply in Nepal.

## 1.4 Significance of the Study

It is important to prioritize the development of the agriculture sector in order to build a prosperous Nepal, as the success of other sectors such as industry and services depends on the foundation provided by a strong agriculture sector. There are many aspects of the agriculture sector that need to be improved, from basic problems like input availability to government policies and strategies. Availability of credit is one of the main factor that needs investment of the government and financial institutions. A case study done by Bhatta (2014) reveals that the credit flow is not accessible easily and is not enough as per the demand. To determine whether lending from formal institutions is effectively contributing to the development of the agriculture sector, it is important to evaluate whether these loans are achieving their primary objective of supporting the growth of the agriculture sector. The results of this study can point out if this is the case or not. If it is not the case, we can explore other areas of the agriculture sector that may benefit from targeted investment and support. Thus, the results of this study are important to policy making institutions of Nepal that concerns lending on agriculture sector and development of agriculture sector.

## 1.5 Limitations of the Study

The purpose of this study is to assess the impact of formal credit from commercial banks on agriculture in Nepal. It is important to note that the scope of this study is limited to credit provided by commercial banks and does not include the contributions of other financial institutions, the government, personal investment, or credit from the informal sector to the agricultural sector. Thus, this study does not examine the total amount of lending to the agricultural sector which comes through formal or informal sector or the government. Moreover, multicollinearity may occur between independent variables as in the considered regression equation, agricultural lending by commercial banks is the capital induced to agriculture sector and the same capital can be expend for supply of fertilizer, seed and irrigation.

## 1.6 Organization of the Study

This research is organized and described into five chapters. They are as follows:

**Chapter I: Introduction**

This chapter presents an overview of the research topic and the structure of the study. It includes the background of the study, a description of the research problem, the specific objectives of the study, the significance of the study, any limitations or constraints on the research and organization of the study.

**Chapter II: Literature Review**

This chapter presents previous research findings on the topic from sources such as academic journals, papers, books and similar works. It also includes a theoretical review, an empirical review of past research in both a national and international context, and an identification of any research gaps.

**Chapter III: Research Methodology**

This chapter describes the methods used to conduct the research and gather data. It includes information on the research design, conceptual framework, nature and sources of data, tools and methods of data collection, data organizing and processing, model specification, specification of tools and methods of data analysis, and definition of the variables.

### Chapter IV: Results and Discussions

This chapter presents the main findings of the study. It includes the presentation of data and analysis of the results using visual representations such as line charts and bar graphs, as well as results from statistical tools used to test the hypotheses. The results of these tests are used to interpret the findings of the research.

### Chapter V: Summary and Conclusions

This chapter is divided into three part which includes summary of major findings, conclusions and recommendations for further improvement.

# CHAPTER-II

# REVIEW OF LITERATURE

## 2.1 Introduction

There is difference of opinion in the literature about the effect of bank credit on agricultural productivity. Some research suggests that bank credit has a positive impact on agricultural productivity (Das, Senapati & John, 2009; Hegde & Reddy, 2008; Khan, Fatima & Jhamshed, 2017; Misra, Chavan & Verma, 2016), while other studies suggest that it has a negative impact (Dhrifi, 2014; Ikenna, 2012). Additionally, some studies have found a bidirectional relationship between bank credit and agricultural productivity (Tamga, 2017). There are also studies that have found an inverted U-shaped effect of bank credit on agricultural productivity (Zakaria, Jun, & Khan, 2019). Hence, this study investigates the relationship of bank credit on agricultural productivity in the Nepal from 1987 to 2021 AD.

## 2.2 Empirical review

In this section, we discuss various papers related to research objectives of the study in national and international contexts.

### 2.2.1 International Context

In their paper "Agricultural Credit-led Agricultural Growth: A VECM Approach," Khan, Fatima, and Jamshed (2017) examine the relationship between Agricultural GDP and Agricultural credit, as well as the relationship between Agriculture credit and economic growth in the long run. Using time series data from 1980 to 2011, the authors apply the Johansen Co-integration test to analyze the long-term association between agriculture gross domestic product (AGDP) and Agriculture Credit. They also use a Vector Error Correction Model to examine the long-run and short-run causality. The findings suggest that Agricultural GDP is highly responsive to increases in agricultural credit in India over the period of study. There is a positive, long-term association between India's agricultural GDP and agricultural credit. Additionally, the study found evidence of a unidirectional Granger causality running from agriculture credit to agricultural growth, but not the other way around.

According to a study by Narayanan (2015), titled "The Productivity of Agricultural Credit in India," credit can be seen as fulfilling two roles in the agriculture sector. It helps to maintain productivity levels through the support of certain types of mechanization, and it also contributes to the growth of agricultural GDP through the purchase of various inputs such as fertilizers and tractors. The study, which covered the period from 1995-96 to 2011-12, found that all inputs were highly responsive to an increase in institutional credit to agriculture during this time. In addition to inputs, the study also considered factors such as prices, rainfall, and public expenditure on agriculture, as well as credit flow. The findings indicated that while all inputs were responsive to increased credit, the agricultural GDP was not affected by credit flow to the sector. Credit seems to be playing its part of only supporting the purchase of inputs.

The authors of the study "Has bank credit really impacted agricultural productivity in the Central African Economic and Monetary Community?" argue that commercial banks should increase lending to the private sector in order to benefit both the agricultural sector and the banking sector (Ngong, Onyejiaku, Fonchamnyo, & Onwumere, 2022). The study looks at the relationship between bank loans and agricultural productivity in the Central African Economic and Monetary Community (CEMAC) from 1990 to 2019. Agricultural value added (AGRVA) is used as a proxy for agricultural productivity, while domestic credit to the private sector by banks (DCPSB), broad money supply, land, inflation (INF), physical capital (PHKAP), and labor supply are all explanatory variables. The results of the co-integration test suggest a long-term relationship between these variables. The impact of bank credit on agricultural productivity is not conclusive, as some results show positive effects, some show negative effects, and others show a U-shaped relationship.

A study by Sagbo and Yoko (2021) examined the effects of agricultural loans provided by microfinance institutions in Benin, a developing country. The survey, which took place in October 2017 and involved 750 agricultural households in rural and urban areas, found that agricultural loans have a significant positive impact on the net farm income, food security, and food quality of the recipients. Additionally, agricultural loans were found to have a positive impact on women's empowerment and helped to alleviate food insecurity. In particular, loans from FECECAM, a major microfinance institution in Benin, greatly improved the income and living conditions of the lowest income group. However, the success of these loans was largely attributed to

FECECAM's effective monitoring and implementation system. Overall, the results of the study suggest that agricultural loans have the potential to improve the conditions of farmers and reduce poverty, particularly in rural areas.

In a study conducted by Akram, Hussain, Ahmad, and Hussain ( 2013), the relationship between agriculture credit and production efficiency was examined using a sample of 152 farmers from the Sargodha District of Punjab Province. The Cobb-Douglas model was applied using logarithms and standard linear regression, and it was found that the high technical efficiency of credit users was due to their timely access to farm inputs through credit availability. However, the study also found that farmers were misallocating their resources, suggesting that in addition to credit, farmers also need extension services to achieve economic efficiency.

In a study conducted by Hegde and Reddy (2017), the impact of agricultural credit on agriculture production in India was analyzed using dynamic panel data analysis. The study found that direct agricultural credit has a positive and statistically significant impact on agriculture output, with an immediate effect. Indirect agricultural credit was also found to have a positive and statistically significant impact on agriculture output, but with a year lag. This suggests that both direct and indirect agricultural credit can play a role in improving agriculture production in India, but the effects may not be immediate in the case of indirect credit.

Sidhu, Vatta, and Kaur (2008) conducted a study on the dynamics of institutional agricultural credit and growth in Punjab, India. The study found that there was a strong relationship between the use of variable inputs and production credit disbursement. The contribution of institutional credit to the promotion of modern production inputs and private capital investments was also found to be significantly positive. The study analyzed data from 1981-1982 to 2003-2004 and developed a simultaneous four-equation model to estimate the contribution of institutional credit to the use of production inputs, private investments, and agricultural growth. The model was estimated using the three-stage least squares method. Overall, the results of the study suggest that institutional agricultural credit can have a positive impact on the use of modern inputs, private investments, and agricultural growth in Punjab.

The research study by Misra, Chavan, and Verma (2016) examined the connection between agricultural credit and agricultural production/productivity in India during the

2000s. They discovered that agricultural credit had a favorable and significant impact on agricultural growth. Direct agricultural credit was found to have a larger impact on agricultural production/productivity and therefore should be promoted. The study used a state-level panel model and supports the policy of prioritizing agriculture as a loan sector in India. It also highlights the need for continued policy support for the industry in order to achieve a more sustainable and high-growth path.

Das, Senapati, and John (2009) on "Impact of agricultural credit on agriculture production: An empirical analysis in India" found that direct agricultural credit has immediate positive effect on productivity while indirect credit effects productivity with a year lag. This study examines the role of direct and indirect agriculture credit in the agriculture production taking care of the regional disparities in agriculture, credit disbursement and agriculture production in an econometric framework using dynamic panel data analysis.

In their study "Impact of Institutional Credit on Aggregate Agricultural Production in India during Post Reform Period," Izhar and Tariq (2009) examine the effect of institutional credit on agricultural production in India by estimating a Cobb Douglas agricultural production function using time series data for the pre and post reform periods. The model, which covers the period from 1972 to 2005, suggests that institutional credit has a significant impact on aggregate agricultural production in India.

In the study "Impact of financial development on agricultural productivity in South Asia," Zakaria, Jun, and Khan (2019) investigate the link between financial development and agricultural productivity in South Asia using data from 1973 to 2015. They discovered that there is a U-shaped relationship between these two, with agricultural productivity initially rising as financial development increases but eventually declining as financial development continues to rise.

The purpose of the research by Baffoe, Matsuda, Nagao and Akiyama (2014) was to investigate the relationship between credit and agricultural productivity using empirical data in Ghana. To do so, 109 farming households were surveyed and divided into two groups: those who had borrowed money and those who had not. The findings showed that the study community had limited access to credit also that the households who did not borrow money tend to spend more on variable inputs than those who did borrow, but this higher expenditure did not result in higher yield or income productivity. In contrast, households who borrowed money spent less, but achieved higher productivity. We suggest that this difference in productivity may be due to the technical advice provided by lending institutions to the borrowed households, which makes them more technically efficient and may be the pressure to pay loan directed them to be efficient.

The research by Baffoe, Matsuda, Nagao, and Akiyama (2014) aimed to explore the connection between credit availability and agricultural productivity in Ghana using empirical data. To do so, they surveyed 109 farming households and divided them into two groups: those who had borrowed money and those who had not. The results showed that the study community had limited access to credit. Households that did not borrow money tended to spend more on variable inputs than those that did borrow, but this higher expenditure did not correspond with higher yield or income productivity. The researchers suggest that this difference in productivity may be due to the technical advice provided by lending institutions to the borrowed households, which may have made them more technically efficient. Additionally, the pressure to pay back their loans may have motivated them to be more efficient in their farming practices. Furthermore, the research observed that the household borrowed money for non-farm purposes and to purchase agricultural inputs. Using agricultural credit for non-farm activities can be detrimental to the growth of the agriculture sector.

### 2.2.2 Nepalese Context

In “Agricultural credit flow of commercial banks and impact on agricultural production in Nepal,” Rimal (2014) seeks to determine the effect of commercial banks' agricultural credit on agricultural production in Nepal. To do so, the author estimates a Cobb Douglas Production Function using time series data from 2002 to 2012. The model shows that the coefficient of the natural logarithm of agricultural credit per cultivated area, a key explanatory variable, is positive and has a significant impact on Nepal's agricultural productivity. The study concludes that the flow of agricultural credit from commercial banks has a positive effect on agricultural productivity and plays a crucial role in boosting agricultural GDP in Nepal, a predominantly agricultural country.

The study "Agricultural Credit and Its Impact on Farm Productivity: A Case Study of Kailali District" (Bhatta, 2014) found that agricultural credit has helped improve the agricultural productivity of farmers in Kailali District. The study used primary data sources collected by the Nepal Rastra Bank Dhangadhi office and was based on a survey of 100 farmers, 50 of whom were agricultural credit users and 50 of whom were non-users. The study showed that farmers who used credit facilities had higher levels of technical efficiency, while those who did not use credit facilities had lower levels of technical efficiency. Thus, the study suggests that extending agricultural credit services to increase farmers' access to better inputs and mechanized production techniques would help farmers achieve higher levels of technical efficiency.

## 2.3 Research Gaps

The agriculture sector plays a significant role in the economic growth of developing economies, and agricultural credit is a key factor that directly impacts agricultural production in case of Nepal (Bhatta, 2014). However, there are relatively few published papers on this topic. There is a lack of research on the trend and status of growth in the agriculture sector and the relationship between agricultural lending and agricultural growth in Nepal. It would be helpful to analyze the amount of credit flowing into the agriculture sector to assess the impact of lending on this sector in Nepal. Examining the relationship between agricultural lending and growth in the agriculture sector could shed light on whether or not lending towards this sector is beneficial in Nepal.

Few papers have been published on the topic of agricultural credit in Nepal. Dhakal's (2019) "Agricultural credit and insurance in Nepal: Coverage, issues, and opportunities" discusses the status and challenges of agricultural credit in Nepal and highlights the potential for agricultural credit to support growth and development in the agriculture sector. Rimal's (2014) "Agricultural credit flow of commercial banks and impact on agricultural production in Nepal" assesses the impact of commercial banks' agricultural credit on agricultural production in Nepal using Cobb-Douglas production function for period of ten years (2002-2012) using time series data. Bhatta's (2014) "Agricultural Credit and its Impact on Farm Productivity: Case Study of Kailali District" investigates issues related to the procurement and use of agricultural credit, examines the factors that influence lending decisions, and evaluates the impact of agricultural credit on farm productivity in Kailali district using data from 2010 to 2014.

Unlike Rimal's study, this paper uses long-term data of 34 years ranging from 1987 to 2021 using ARDL approach to find cointegration between Nepal's agricultural output and credit disbursement. Except these papers, there are relatively few academic studies that have focused on the impact of agricultural credit on the Nepalese economy, despite it's importance as a major influencing factor for agriculture sector and overall economic growth and development. This represents a significant gap in the research.

# CHAPTER-III

# RESEARCH METHODOLOGY

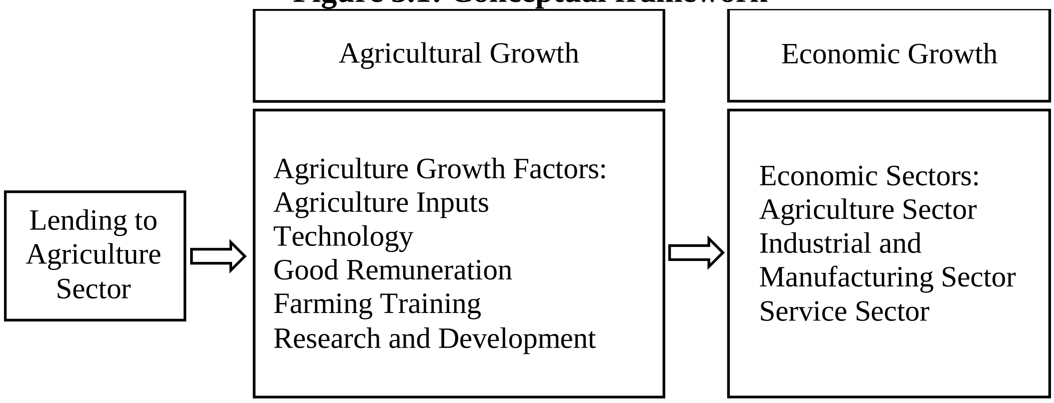
## 3.1 Research Design

This study is based on the descriptive as well as the empirical research design. For descriptive analysis, the study presents summary statistics of all the variables including mean, median, standard deviation, skewness, kurtosis and Jarque-Bera test. Similarly, this study analyzed the nature and trend of the agriculture GDP as well as the lending made by commercial banks on agriculture sector using tables, charts and percentages. Moreover, different econometric tools and techniques such as Augmented Dickey-Fuller test for the unit root test of the variables; Autoregressive Distributed Lag bounds testing approach to cointegration test for identifying the long-term relationship between the variables; Error Correction Model to estimate the short-run relationship test to are employed.

## 3.2 Conceptual Framework

The conceptual framework of this research is developed depending upon the empirical literature review and researcher's own intuition. It is outlined in figure 3.1.

**Figure 3.1: Conceptual framework**




*Source*: Author's creation

Figure 3.1 illustrates the central concept of this research paper. LDCBS is shown to be a key factor in driving agricultural growth, which in turn leads to economic growth. One of the major problem in development in Nepal is inadequacy of capital. If capital were more readily available, it would lead to improvements in all aspects of the agricultural sector and contribute to overall growth in the sector. Appendix-4 is showing the effect of agricultural growth in other economic sectors and ultimately growth of all sectors jointly leading to economic growth. The economic transformation involves a shift in the relative contribution of a country's different sectors to its overall GDP, moving from traditional technology to modern technology, and from agriculture to industry and manufacturing, reaching a high-income service economy which ultimately helps overall economic growth and development of a country. Focusing solely on the industrial and service sector while ignoring the agriculture sector may not lead to this vision, as the development of other sectors depends on the growth of the agriculture sector. Therefore, modernizing the agriculture sector is the first step towards economic growth and prosperity. Thus, agriculture sector growth and role of it's determinants matters much in a developing country like Nepal. Therefore, the paper serves to find the significance of lending on AGDP.

The research utilizes econometric techniques such as unit root and cointegration tests to analyze the data. The data for this study is obtained primarily from Nepal Rastra Bank, the central bank of Nepal, which is a reliable source. The research will use the autoregressive distributed lag bounds testing approach to cointegration and error correction model to examine the relationship between agricultural growth (AGDP) and lending to the agricultural sector by commercial banks (LDCBS) in the long run and short run, respectively. While there may be other factors that influence the relationship being studied, the variables included in the model are believed to be sufficient to test the hypothesis.

In today's world, governments must prioritize improving productivity in order to meet the needs of a growing population, compete in the global market, and efficiently use limited resources. Productivity is a key factor in the success and development of countries, and by analyzing and measuring productivity, we can identify areas for improvement and work towards higher production and long-term economic growth. According to production and supply theories, there are two main ways to increase production in a sector: using more production factors and using more advanced technologies. However, in Nepal and other developing countries, the inadequate supply of irrigation, limited availability and affordability of agricultural inputs, and poor agricultural infrastructure can restrict the way of increasing production in the long run. These challenges must be addressed in order to improve productivity and drive economic growth.

## 3.3 Nature and Sources of Data

The data for AGDP in this study was obtained from the Ministry of Finance and originally reported in 10 million units. The author modified the data to be reported in million rupees. The data for LDCBS was collected from two sources: Economic Survey 2002 for the period from 1987 to 2002 by MoF, and the "Loan to the BFIs (Sector-wise)" report provided by Nepal Rastra Bank for the period from 2003 to 2021. In both sources, data are reported in million rupees, and the data collection was conducted in mid-July. The data for irrigation, fertilizer and seed is obtained from the "Agricultural inputs" report from Nepal Rastra Bank and is measured in hectares for irrigation and metric ton for fertilizer and seed.

The analysis includes two core variables: AGDP and LDCBS, and three control variables: FER, SEED and IRI. The study utilizes annual time series data spanning 35 years, from fiscal year 1986/87 to fiscal year 2020/21. This time frame was selected due to the limited availability of data for all variables beyond this period.

## 3.4 Tools and Method of Data Collection

Data and information are abstracted from secondary sources. The major variables were extracted from Nepal Rastra Bank, Economic Survey and Ministry of Finance. Other statistical data and information are obtained from various issues of Economic Survey, Banking and Financial Statistics, Agriculture Census 2078, Ministry of Finance, Central Bureau of Statistics, Ministry of Agriculture and Livestock Development and Statistical Information on Nepalese Agriculture, National Accounts, Monetary Policy, Ministry of Agricultural Development, Government of Nepal.

**Table 3.1: Table showing information related to variables**

| Variables | Abbreviation | Unit | Data Sources |
|---|---|---|---|
| Agriculture GDP | AGDP | In Million Rupees | MoF |
| Lending by commercial banks | LDCBS | In Million Rupees | Economic Survey and NRB |
| Fertilizer | FER | In metric ton | NRB |
| Seed | SEED | In metric ton | NRB |
| Irrigation | IRI | In Hectares | NRB |

*Source*: Author’s Compilation

## 3.5 Data Organizing and Processing

The collected data and information are organized and processed in a way that allows the study to achieve its objectives and test the hypotheses. The AGDP and LDCBS are the core variables. These variables are converted into real terms to adjust the inflation, as RAGDP and RLDCBS, using constant 2010/11 base year prices. To do this, the GDP deflator is calculated by dividing the value of nominal GDP by the value of real GDP in Nepal. The nominal data is then divided by the deflator to obtain the real data series. Real series are calculated using deflator. For the GDP Deflator, the author manually calculated using data available in current macroeconomic and financial situation released by NRB. Deflator is calculated by dividing nominal GDP by real GDP. The real terms were further transformed into natural log form as: LRAGDP and LRLDCBS. FER, SEED, and IRI were converted into natural log form because they are not measured in price and do not need to be adjusted for inflation.

## 3.6 Model Specification

This section presents the possible variables that are considered in the context of Nepal's economic growth, as determined by existing empirical and theoretical studies. In order to select the most relevant determinants of AGDP for Nepal, a variety of variables were collected from various published papers and articles. The final selection of variables was based on the availability of data in order to find the best fit variables that can explain AGDP in Nepal.

Generally, factors affecting agriculture performance and hence affecting AGDP were found to be: availability of capital to the farmers, government interventions like subsidy, agriculture commodity price, irrigation, climate (temperature, rainfall and winds), labor, agriculture wage, affordability of agricultural inputs (machineries, fertilizers, seeds, feeds, and pesticides), availability and consumption of agricultural inputs, nature of soil, land topography, Biotic factors (pests, diseases and soil microorganisms), socio-economic factor (Market demand for agricultural products) and Government interventions, support and programs. Timely availability of credit is especially crucial for small and marginal farmers (Golait, 2007).

Sriram (2007) recognizes that establishing the causation of credit-agricultural productivity is particularly challenging due to the large number of intervening factors.

Thus, due to lack of data availability and with the intention of making the model simple, production function is considered where AGDP is agriculture growth measured in million rupees, LDCBS denotes lending of commercial banks on agriculture sector measured in million rupees, FER is fertilizer supply measured in metric ton, SEED represents seed supply measured in metric ton and IRI means irrigation supply measured in hectares.

The model is carried out by using time series data of 35 years ranging from 1986/87 to 2020/21. AGDP is the dependent variable and LDCBS, FER, SEED, IRI are independent variables.

$$AGDP_t = f(LDCBS_t, FER_t, SEED_t, IRI_t) \quad (1)$$

Where,

AGDP = Agricultural Growth

LDCBS = Lending to Agriculture Sector by Commercial Banks

FER = Fertilizer Supply

SEED = Seed Supply

IRI = Irrigation Supply

AGDP and LDCBS variable are converted into real form namely RAGDP and RLDCBS. Again, RAGDP, RLDCBS, FER, SEED and IRI variables are converted into log form as LRAGDP, LRLDCBS, LFER, LSEED and LIRI respectively.

$$LRAGDP_t = f(LRLDCBS_t, LFER_t, LSEED_t, LIRI_t) \quad (2)$$

The explicit form of the above model (2) shows the linear relationship between the dependent and explanatory variables which can be expressed in equation (3) as;

$$LRAGDP_t = \beta_0 + \beta_1 LRLDCBS_t + \beta_2 LFER_t + \beta_3 LSEED_t + \beta_4 LIRI_t + U_t \quad (3)$$

Where, $LRAGDP$ is dependent variable and $LRLDCB$, $LFER$, $LSEED$, $LIRI$ are independent variables, and $U$ is error term for a time period $t$. Where $LRAGDP$ is log of RAGDP, $LRLDCBS$ is log of LDCBS, $LFER$ is log of FER, $LSEED$ is log of SEED, $LIRI$ is log of IRI, and $t$ represents the time period. Here, $\beta_0$ is intercept, $\beta_1$, $\beta_2$, $\beta_3$ and $\beta_4$ is regression coefficients. All the $\beta_1$, $\beta_2$, $\beta_3$ and $\beta_4$ are expected to have positive influence on dependent variable because they contribute to increased efficiency and agricultural activities.

## 3.7 Definition of the Variables

This section discusses a short description of the variables used in this study for descriptive statistics as well as empirical analysis. The variables are described below:

**a. Agricultural Growth (AGDP)**

AGDP, or agriculture gross domestic product, refers to the production from agriculture and allied activities across the country on an annual basis. It represents an increase in agricultural production and productivity in Nepal and is an important indicator of growth in the volume of production. The dependent variable in this study is AGDP, which is expressed in millions of rupees. To eliminate the effect of inflation, agricultural performance is measured using real agricultural growth (RAGDP).

**b. Lending Distribution by Commercial Banks (LDCBS)**

LDCBS, or lending distribution by commercial banks to the agriculture sector, represents the capital input in the basic agriculture production function. This variable provides insight into commercial banks funding on agriculture industry. The aim of this research is to examine the impact of lending behavior by commercial banks on the growth of the agriculture sector. Therefore, in this study, LDCBS serves as the main independent variable and is expressed in millions of rupees. It is expected to have a positive relationship with AGDP. In order to eliminate the impact of inflation, the nominal form of the LDCBS is converted into real terms (RLDCBS).

**c. Fertilizer Use and Supply (FER)**

Fertilizer is measured in metric ton which is explained as the total fertilizer used by Nepalese economy during a year. It serves as control variable in the regression. The relationship between FER and the dependent variable is expected to be positive.

**d. Seed Use and Supply (SEED)**

Seed is quantity of seed measured in metric ton consumed by Nepalese economy in a year. It also serves as control variable in the regression. Theoretically, it should have positive relationship with the dependent variable.

**e. Irrigation Supply (IRI)**

Irrigation supply is a factor that influences agricultural production. Land productivity can be measured by the irrigation supplied, which serves as a proxy variable for the land input in the basic agriculture production function (which is relatively constant). Irrigation supply is measured in hectares. Theoretically, the relationship between irrigation supply and agricultural production should be positive.

## 3.8 Specification of Tools and Method of Data Analysis

This study concerns different statistical tools such as mean, standard deviation, median, minimum, maximum, skewness, kurtosis, Jarque-Bera test for analyzing descriptive statistics of the variables. The tables, bar lines, line charts are used to analyze the nature and trend of lending by commercial banks in agriculture sector and agricultural growth. The ADF test, ARDL bounds testing approach to cointegration, ECM are employed for empirical analysis. Moreover, CUSUM and CUSUMSQ statistics are applied to check the stability of the model. Similarly, a diagnostic test is done using the Breusch-Godfrey LM test for serial autocorrelation, Ramsey's RESET test, normality test and KB test for heteroscedasticity. The study uses Eviews-10 software, Microfit-5.0 for data analysis and Microsoft Excel is used for simple statistical calculations.

### 3.8.1 Stationary (Unit Root) Test

A stationary time series has a constant variance and it always returns to the long-run mean. This empirical study is based on the annual time series analysis. Firstly, we need to check whether the data series are stationary or not because it is the most important property of time series econometrics which shows the ability of the data series to explain the long-term and short-term information. Generally, it is assumed that statistical properties should not change over time. But in most cases, the macroeconomic time series are non-stationary. If we apply the regression model in non-stationary data it gives a spurious relationship which makes hypothetical test results unreliable (Gujarati, 2021). Hence, to avoid the spurious relationship among the variables, detecting the stationarity or non-stationarity of time series is crucial. Various methods are often used for testing stationarity of the variables and some of them are graphical analysis, the correlogram test, Augmented Dickey-Fuller test, Phillip-Peron test. However, this study employed the Augmented Dickey-Fuller test for checking the stationarity of the variables.

### 3.8.2 Augmented Dickey-Fuller (ADF) Test

The Augmented Dickey-Fuller test is the most common and popular method of testing the stationarity property (unit root) of a single time series. For this, Dickey and Fuller

(1981) have proposed the tau statistics popularly known as T-statistics. While conducting the Dickey-Fuller test (1979), it was assumed that the error term $(U_t)$ was uncorrelated. However if $(U_t)$ is correlated, for that case Dickey and Fuller have developed another test, known as the Augmented Dickey-Fuller test (1981). There are three possible forms of the ADF test which are as follows;

The equation for no intercept and no trend is,

$$\Delta Y_t = \gamma Y_{t-1} + \sum_{i=1}^{k} c_i \Delta Y_{t-i} + U_t \tag{4}$$

The equation for the intercept with no trend is,

$$\Delta Y_t = \alpha_1 + \gamma Y_{t-1} + \sum_{i=1}^{k} c_i \Delta Y_{t-i} + U_t \tag{5}$$

The equation for both intercept and trend is,

$$\Delta Y_t = \alpha_1 + \varphi_t + \gamma Y_{t-1} + \sum_{i=1}^{k} \delta_i \Delta Y_{t-i} + U_t \tag{6}$$

Where, $\Delta Y_t$= first difference.

The null hypothesis of ADF is $\gamma = 0$ against the alternative hypothesis of $\gamma < 0$. If we do not reject the null hypothesis, the series is non-stationary whereas rejection means the series is stationary. If the series is stationary without any differencing, it is said to be integrated of order 0 and denoted by I(0). Similarly, if the series is stationary after a first difference is said to be integrated of order 1 and written as I(1).

### 3.8.3 Cointegration Test

After checking unit root tests, the next step is to test for the existence of cointegration between the variables. Cointegration is a statistical property that refers to the long-term relationship between two or more time series variables. It is important to test for cointegration when building an econometric model, as it can affect the interpretation of the results and the accuracy of the model. There are several commonly used tools for testing for cointegration in econometrics, including the Johansen Cointegration Test, the Engle-Granger Cointegration Test, and the Auto-Regressive Distributed Lag bounds testing approach. The ARDL bounds testing approach is particularly useful when the variables being analyzed are integrated at different orders, such as if they are purely I(0) or purely I(1). This approach can be used to test for the existence of a long-term relationship between the variables, even if the direction of that relationship is not clear. In this study, the ARDL bounds testing approach is used to test for a long-term relationship between agriculture GDP and lending to agriculture by commercial banks. If the result of the test indicates that there is a cointegration between these two variables, it suggests that there is a long-term relationship between them.

### 3.8.4 ARDL Approach to Cointegration

Engle and Granger (1987) were the first to introduce a residual-based approach to cointegration, which involved tests and estimation procedures to evaluate the existence of a long-run relationship between non-stationary variables within a dynamic framework. However, this approach had some limitations, and Johansen (1988) and Johansen and Juselius (1990) proposed a new procedure based on maximum likelihood that was applicable only to time series with the same order of integration. A more advanced technique known as the autoregressive distributed lag (ARDL) model was later developed by Pesaran and Shin (1999) and Pesaran et al. (2001). This model is based on ordinary least squares and can be applied to time series with different orders of integration which means data series can be I(0), I(1), or mutually integrated. However, the ARDL model cannot be used if the variables are integrated of order two i.e. I(2).

An alternative approach known as the ECM can be used to determine cointegrating relationships in small samples. This procedure involves a linear transformation that integrates short-run dynamics with long-run equilibrium without losing long-run information and helps to avoid problems such as spurious relationships resulting from non-stationary time series. Importantly, level data rather than first difference data should be used when testing for cointegration among variables.

Following the ARDL approach proposed by Pesaran and Shin (1999), the existence of a long-run relationship between the four variables of interest could be tested using equation (7) as;

$$\begin{aligned}\Delta LRAGDP_t = \alpha_0 &+ \sum_{j=1}^{p} b_j \, \Delta LRAGDP_{t-j} + \sum_{j=0}^{q_1} c_j \, \Delta LRLDCBS_{t-j} \\ &+ \sum_{j=2}^{q_2} d_j \, \Delta LFER_{t-j} + \sum_{j=0}^{q_3} e_j \, \Delta LSEED_{t-j} \\ &+ \sum_{j=0}^{q_4} f_j \, \Delta LIRI_{t-j} + \gamma_1 \, LRAGDP_{t-1} + \gamma_2 \, LRLDCBS_{t-1} \\ &+ \gamma_3 \, LFER_{t-1} + \gamma_4 \, LSEED_{t-1} + \gamma_5 \, LIRI_{t-1} + U_t \end{aligned} \quad (7)$$

Here, all the variables are as previously defined. $\alpha_0$ is intercept. $\gamma_1$, $\gamma_2$, $\gamma_3$, $\gamma_4$ and $\gamma_5$ are the respective long-run coefficients while $b_j$, $c_j$, $d_j$, $e_j$ and $f_j$ represents the short-run dynamics and $U_t$ is the random disturbance term. To test whether the long-run equilibrium relationship exists between AGDP, LDCBS, FER, SEED and IRI bounds test (F-version) for cointegration is carried out as proposed by Pesaran and Shin (1999). To test the long-run level relationship between the variables, the hypotheses for the bounds test are:

Null hypothesis ($H_0$): $\gamma_1 = \gamma_2 = \gamma_3 = \gamma_4 = \gamma_5 = 0$; No cointegration exists.

Alternative Hypothesis ($H_1$): ): $\gamma_1 \neq \gamma_2 \neq \gamma_3 \neq \gamma_4 \neq \gamma_5 \neq 0$; Cointegration exists.

If the calculated F-statistic is larger than the upper critical value provided by Pesaran et al. (2001), we reject the null hypothesis of no cointegration. If the F-statistic is less than the lower critical value, we cannot reject the null hypothesis. If the F-statistic falls within the range of the lower and upper critical values, the results are inconclusive.

After calculating the F-statistic, the next step is to estimate the long-term relationship based on the appropriate lag selection criteria. There are several techniques available for selecting the lag length, such as adjusted $R^2$, likelihood ratio test statistic (LR), final prediction error (FPE), Akaike information criterion (AIC), Schwarz Bayesian criterion (SBC), and Hannan–Quinn information criterion (HQ) (Ozcicek & Mcmillin, 1999). In this study, the AIC criterion is used to select the lag length because it has the smallest number as compared to other model which minimizes the number of lags used, helps to avoid unnecessary loss of degrees of freedom and provides smallest residual value for model.

### 3.7.5 Error Correction Model (ECM)

Based on the long-run coefficients of the ARDL model, the estimation of dynamic error correction will be carried out using this equation which shows the dynamics of short-run adjustments towards the long-run equilibrium.

$$\Delta LRAGDP_t = \delta_0 + \sum_{j=1}^{p} \delta_{1j} \, \Delta \, LRAGDP_{t-j} + \sum_{j=0}^{q_1} \delta_{2j} \, \Delta \, LRLDCBS_{t-j} + \sum_{j=2}^{q_2} \delta_{3j} \, \Delta \, LFER_{t-j} + \sum_{j=0}^{q_3} \delta_{4j} \, \Delta \, LSEED_{t-j} + \sum_{j=0}^{q_4} \delta_{5j} \, \Delta \, LIRI_{t-j} + \delta_6 \, ECM_{t-1} + V_t \quad (8)$$

The coefficients $\delta_{1j}$, $\delta_{2j}$, $\delta_{3j}$, $\delta_{4j}$ and $\delta_{5j}$ show the respective short-run dynamics of the model and $\delta_6$ indicates the speed of adjustment towards the long-run equilibrium. The error term must be white noise (independently and identically distributed). A positive coefficient indicates a divergence, while a negative coefficient indicates convergence towards equilibrium. The term ECM is derived as the error term from the corresponding long-run model equation (7) and $ECM_{t-1}$ is a one-period lag residual of ECM. $V_t$ is white noise error term and $\delta_0$ is the constant.

For the diagnostic tests of the model, various formal tests are carried out, such as Lagrange Multiplier (LM) test for serial correlation, Ramsey RESET test for functional form misspecification, Jarque-Bera test for the normality, and KB test for heteroscedasticity. Similarly, for the stability test of the model, CUSUM and CUSUMSQ tests are carried out.

## CHAPTER-IV

## RESULTS AND DISCUSSIONS

This section presents an analysis of the trend of agricultural production in Nepal, as well as descriptive statistics for all the variables used in the study. Graphs and tables are used to analyze the trend of AGDP and LDCBS. Descriptive statistics are calculated using tools such as mean, standard deviation, median, skewness, kurtosis and Jarque-Bera test. The empirical analysis of the hypothesis is conducted using econometric techniques such as stationary test, cointegration test, and diagnostic tests. These operations are performed using EViews-10 and Microfit-5.0.

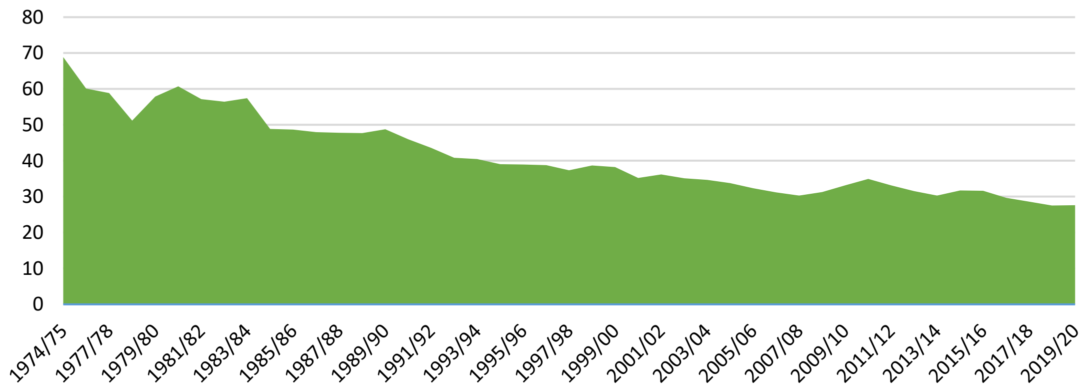
## 4.1 Trends and Patterns of Agricultural Lending and Growth

This section discusses the trends and patterns of key variables which includes contribution of AGDP in total GDP, growth rate of AGDP, five years moving average of growth rate of AGDP and LDCBS.

**a. Contribution of AGDP in Total GDP**

The data in Figure 4.1 shows that the annual contribution of AGDP to total GDP in Nepal has been steadily declining. In FY 1986/87, AGDP accounted for 47.95 percent of total GDP. By FY 2019/20, that percentage had dropped to 27.65 percent. Between FY 1974/75 and FY 2019/20, the contribution of the agriculture sector to total GDP decreased by approximately 41 percent, from a high of 68.88 percent in FY 1974/75 to a low of 27.65 percent in FY 2019/20. Additionally, the contribution of agriculture to real GDP fell from 36.6 percent in FY 2000/01 to 33.1 percent in FY 2015/16,

**Figure 4.1: Contribution of AGDP in total GDP**



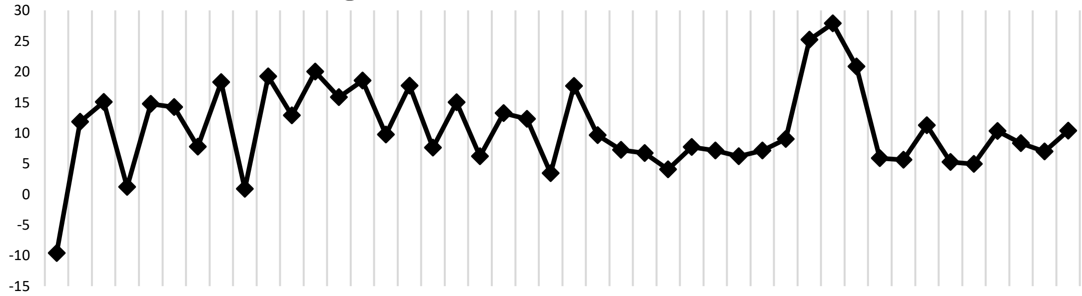

*Source*: Author's derivation based on Appendix-3

indicating a continuing trend of decreasing share of agriculture in GDP.

**b. Growth Rate of AGDP**

The figure below displays the growth rate of AGDP over a 43-year period ranging from FY 1976/77 to 2019/20. The data depicted in the chart illustrates that the annual growth rate of AGDP is fluctuating. According to the table, the percentage change in AGDP was 12.85 percent in fiscal year 1986/87 and 10.34 percent in fiscal year 2019/20. The agriculture sector experienced its highest growth rate of 27.85% in fiscal year 2009/10 and its lowest growth rate of 0.85% in fiscal year 1984/85. In fiscal year 2008/09, AGDP (agriculture gross domestic product) showed significant growth.

**Figure 4.2: Growth rate of AGDP**



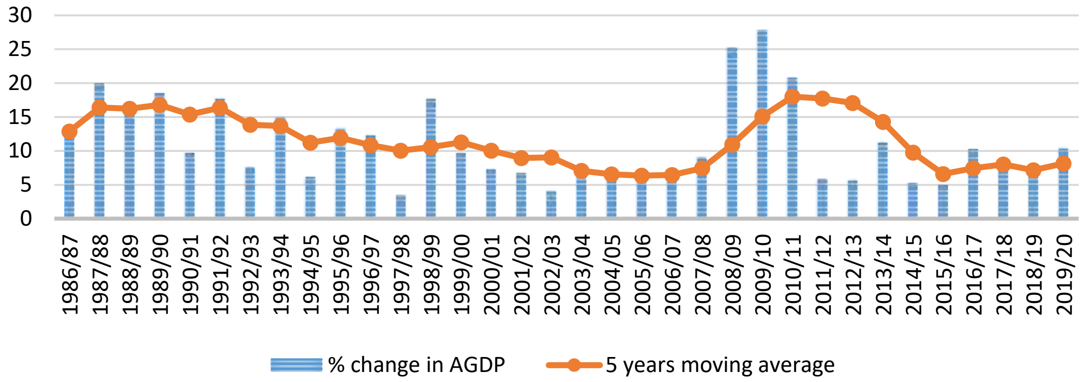

*Source*: Author's derivation based on Appendix-3

This growth was likely due to the implementation of various policies and programs such as the Agriculture Business Promotion Policy 2063 (2006), One Village, One Product Program, Bird-flu Control Program 2064 (2007), Cooperative Farming Program 2065 (2008), and Cooperative Stores Operation Rules 2065 (2009), which aimed to support the national economy and had a positive impact on agricultural growth in the following years.

**c. Five Years Moving Average of Growth Rate of AGDP**

Figure 4.3 illustrates the five year moving average of the AGDP growth rate. It is used to smooth out short-term fluctuations and provides a visual representation to show long-term trend of the AGDP's percentage change. The average AGDP growth appears to be decreasing from FY 1991/92, then begins to rise starting in FY 2007/08, reaching its highest point in FY 2010/11 with an average of 18%. Afterwards, the growth rate declines again, reaching its lowest point in FY 2015/16 at an average of 7%.

**Figure 4.3: Five years moving average of growth rate of AGDP**

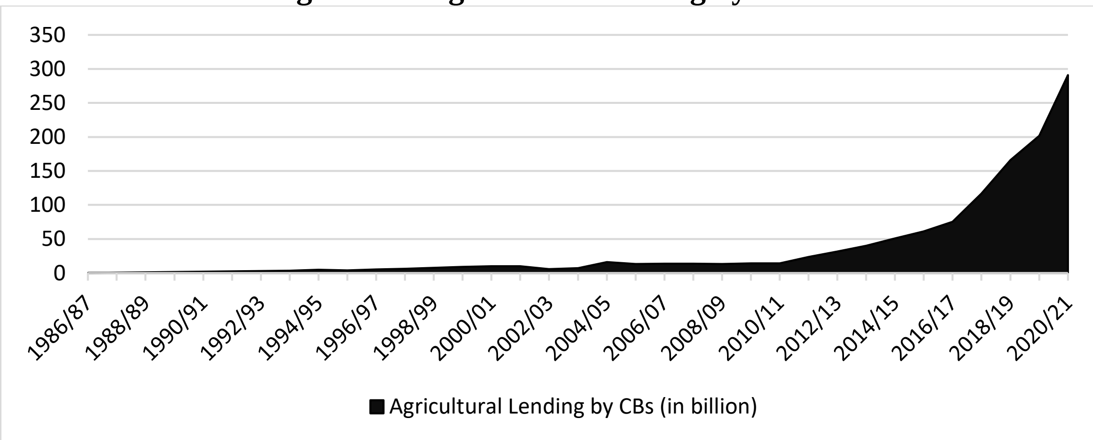



*Source*: Author's derivation based on Appendix-3

### d. Agricultural Lending by Commercial Banks

Figure 4.4 demonstrates that the trend of annual agricultural credit provided by commercial banks in Nepal has been steadily increasing, but the growth has been slow until FY 2012/13. After that point, the growth rate accelerates significantly. One possible reason for this is that before FY 2012/13, the data did not include credit provided by the ADB to the agriculture sector due to data unavailability.

**Figure 4.4: Agricultural lending by CBs**



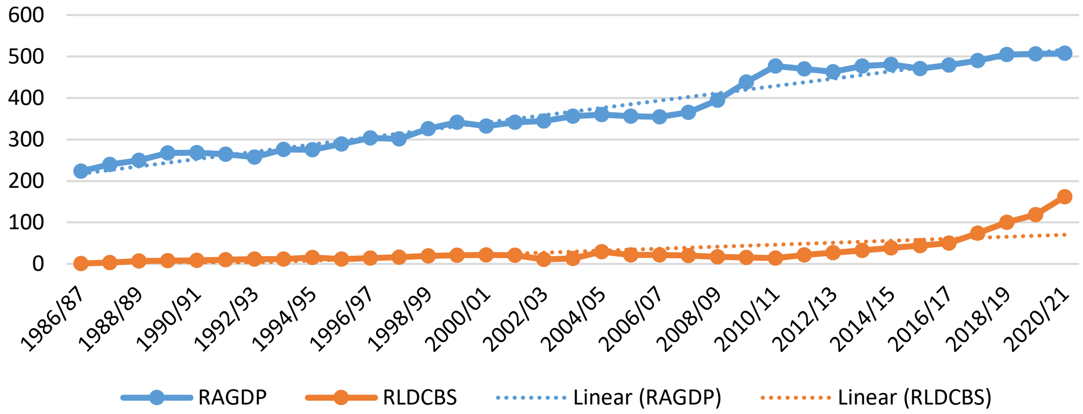

*Note*: Credit figures relate to the credit from commercial banks only. But it includes credit from the Agricultural Development Bank Limited before its upgrading to commercial bank too.

*Source*: Author's derivation based on Appendix-1

### e. Trend of AGDP and LDCBS

The graph in Figure 4.5 illustrates the trend of both AGDP and LDCBS in real terms, measured in billions of rupees. The trend of AGDP appears to follow a linear pattern. There were some small declines in AGDP, which may be attributed adverse climatic condition on agriculture sector, the earthquake of 2015, and the lockdown due to the coronavirus pandemic. AGDP experienced an increasing trend for four consecutive years, during the fiscal year 2006/2007, even though LDCBS had been decreasing. This may be due to the data structure, as the data does not include the ADB as a major source of credit. Additionally, from the fiscal year 2016/2017, LDCBS seems to be increasing exponentially, while AGDP is decreasing in trend. This may be due to the growth of the primary sector, such as favorable monsoon conditions, the commercialization of agriculture, an increase in the production of forest-based materials for reconstruction, and quarrying.

**Figure 4.5: Trend of AGDP and LDCBS**




*Source*: Author's derivation based on Appendix-1

## 4.2 Descriptive statistics of the variables

Table 4.1 presents the descriptive statistics of the variables which summarizes the basic features of a dataset. It consists of three basic categories of measures i.e. measures of central tendency, variability and frequency distribution. Here, all the dataset considered have 35 observations. Mean and median describes the middle value of data series. Maximum is higher limit excluding outliers in the dataset which is 911,916 and 290,976 for AGDP and LDCBS. Similarly, minimum is lower limit excluding outliers in the dataset which is 30,623 and 153 for AGDP and LDCBS. The average value of AGDP and LDCBS are 310,961 and 35,437 respectively. The values of SD measures variability in dataset in relation to its mean. Here, the values of SD indicate that the variables are close to the mean which shows the data are consistent except LDCBS and IRI.

Likewise, the skewness and kurtosis of the variables depict the degree of asymmetry of the distribution. Skewness assesses the extent to which a variable's distribution is symmetrical. A normal distribution has zero skew which means the distribution of data is bell-shaped. Based on the dataset, it appears that all of the distributions are positively skewed, meaning that they are not normally distributed. This is evident in the fact that the mean for all of the variables is greater than the median or the value of skewness is greater than zero, and the distributions are right-tailed in shape. Positively skewed distributions tend to have a long tail extending towards higher values, and a shorter tail extending towards lower values. Kurtosis measures occurrence of outliers of the distribution. It is measured in terms of normal distribution. Generally, normal distribution has a kurtosis value of 3 which means the outliers are neither highly frequent nor highly infrequent. Thus, FER is mesokurtic with kurtosis value of 3 approximately. IRI and AGDP has kurtosis value of less than 3 which means the distribution of dataset is platykurtic that means the outliers are infrequent. Similarly, LDCBS and SEED has kurtosis value of more than 3 which means the distribution of dataset is leptokurtic that means there are a lot of outliers.

**Table 4.1 Descriptive statistics of variables**

| **Variables** | **AGDP** | **LDCBS** | **FER** | **SEED** | **IRI** |
|---|---|---|---|---|---|
| Mean | 310961 | 35437 | 112060 | 5458 | 459977 |
| Median | 186125 | 10156 | 56839 | 3380 | 33833 |
| Maximum | 911916 | 290976 | 400541 | 34614 | 1509427 |
| Minimum | 30623 | 153 | 3157 | 1794 | 11326 |
| SD | 277784 | 64091 | 124378 | 7440 | 648124 |
| Skewness | 0.86 | 2.67 | 1.24 | 3.28 | 0.81 |
| Kurtosis | 2.31 | 9.66 | 2.97 | 12.80 | 1.68 |
| Jarque-Bera<br>(Probability) | 4.97<br>0.08 | 106.2<br>0 | 9.0<br>0.01 | 202.8<br>0 | 6.4<br>0.04 |
| Observations | 35 | 35 | 35 | 35 | 35 |

*Source*: Author’s computation using Eviews-10

The Jarque-Bera test is a goodness-of-fit test that measures if dataset has skewness and kurtosis that are similar to a normal distribution. A normal distribution has Jarque-Bera statistics of positive and close to zero and the p-value is larger than 5 percent of significance level. The probability value of Jarque-Bera statistics relates to a null hypothesis that the data is following a normal distribution. Importantly, if the test statistic is large and the p-value is less than 5 percent then the data does not follow a normal distribution. Here, the AGDP dataset has Jarque-Bera statistics of positive and close to zero and the p-value is greater than 5 percent which means the null hypothesis which is accepted indicating normal distribution. While LDCBS, FER, SEED, and IRI do not follow normal distribution since the p-value is less than 5% and the Jarque-Bera statistics are distant from zero.

## 4.3 Correlation Matrix

The correlation matrix helps to clarify the direction and degree of relationships between variables in the model. Table 4.2 shows the correlation matrix for the variables in log form at levels and first differences respectively. A strong significant correlation exists when the correlation value is greater than 5 percent. As shown in the table, there is a strong and significant positive correlation between LRAGDP, LRLDCBS and LIRI in the level form. The correlation between LRAGDP and LRLDCBS is positive and strong in level form whereas the correlation between them in first difference form is negative and uncorrelated.

**Table 4.2 Correlation matrix (at level and first difference)**

| | **LRAGDP** | **LRLDCBS** | **LFER** | **LSEED** | **LIRI** |
|---|---|---|---|---|---|
| LRAGDP | 1 | | | | |
| LRLDCBS | 0.83 | 1 | | | |
| LFER | -0.26 | -0.09 | 1 | | |
| LSEED | -0.48 | -0.31 | 0.48 | 1 | |
| LIRI | 0.77 | 0.63 | 0.29 | -0.16 | 1 |
| | **DLRAGDP** | **DLRLDCBS** | **DLFER** | **DLSEED** | **DLIRI** |
| DLRAGDP | 1 | | | | |
| DLRLDCBS | -0.01 | 1 | | | |
| DLFER | 0.13 | 0.08 | 1 | | |
| DLSEED | 0.09 | 0.06 | -0.04 | 1 | |
| DLIRI | 0.32 | -0.15 | -0.08 | -0.06 | 1 |

*Source*: Author’s computation using Eviews-10

## 4.4 Stationarity of the variables

ADF test is a common statistical test used to test stationarity of given time series. It is essential to confirm that all the variables used in the model are integrated of order zero or one i.e. I(0) or I(1) or mutually integrated. If the variables are integrated of order more than one, the ARDL approach to cointegration cannot be applicable for time series econometrics. To detect the unit root in the dependent as well as explanatory time series variables used in this study, the Augmented Dickey-Fuller (ADF) test is carried out at level and first difference form with intercept as well as trend and intercept.

Table 4.3 presents the results of the ADF test in levels and in the first differences of the data to test the null hypothesis ($H_0$) that there is a unit root (non-stationarity) against the alternative hypothesis ($H_1$) that there is no unit root (stationarity) in the series. To detect the unit root, we check the probability value and compare the ADF statistics (t-stat.) with that of critical values for each variable. Here, if the p-value is less than 5 percent ($p < 0.05$), we reject the null hypothesis. Similarly, if the absolute value of ADF statistics is found greater than that of absolute critical values, then the variable is considered to have no unit root which means the variable is stationary.

**Table 4.3 ADF for unit test**

| **Variables** | | **Level** | | **First Difference** | | **Decision** |
|---|---|---|---|---|---|---|
| | | **Intercept** | **Trend & Intercept** | **Intercept** | **Trend & Intercept** | |
| LRAGDP | t-statistics | -1.337 | -2.998 | -4.669* | -4.623* | I(1) |
| | p-value | 0.600 | 0.147 | 0.0007 | 0.0041 | |
| LRLDCBS | t-statistics | -1.337 | -2.998 | -4.669* | -4.623* | I(1) |
| | p-value | 0.600 | 0.147 | 0.0007 | 0.0041 | |
| LFER | t-statistics | -1.635 | -1.406 | -6.978* | -7.120* | I(1) |
| | p-value | 0.453 | 0.840 | 0 | 0 | |
| LSEED | t-statistics | -2.516 | -2.166 | -13.064* | -13.155* | I(1) |
| | p-value | 0.120 | 0.491 | 0 | 0 | |
| LIRI | t-statistics | -0.646 | -1.811 | -5.836* | -5.851* | I(1) |
| | p-value | 0.846 | 0.676 | 0 | 0 | |

*Note*:

* denotes rejection of $H_0$ at 5 percent level of significance

The p-values are based on MacKinnon (1996) one-sided p-values

*Source*: Author's computation using E-views 10

As shown in the Table 4.3, since the p-value is not less than 5 percent all the variables are non-stationary at level with intercept as well as intercept and trend but stationary at first difference. It means all the variables are integrated of order one, that is, I(1). Therefore, the null hypothesis that there is a unit root is rejected at first difference as the absolute values of ADF t-statistics are greater than the critical values at a 5 percent level of significance for every variable. Hence, it can be concluded that all the variables are non-stationary in levels, however after transforming them into the first difference they become stationary. Thus, we can further proceed with the ARDL bounds testing approach to cointegration.

## 4.5 Lag Length Selection

The selection of appropriate lag order for the ARDL model is essential to identify the cointegration among the variables. The optimal lags selected by different criteria based on the VAR lag selection approach are presented in the given table. From the Table 4.4, it is observed that LR, FPE, AIC and HQ statistics for lag 2 are significant at the 5 percent level, and SBC statistics for lag 1 are significant at the 5 percent level of significance.

**Table 4.4: VAR lag order selection criteria**

Endogenous variables: LRAGDP LRLDCBS LFER LSEED LIRI

Exogenous Variable: C

Included observations: 33

| Lag | LogL | LR | FPE | AIC | SBC | HQ |
|---|---|---|---|---|---|---|
| 0 | -12.92 | NA | 2.04E-06 | 1.09 | 1.31 | 1.16 |
| 1 | 169.14 | 297.9 | 1.53E-10 | -8.43 | -7.07* | -7.98 |
| 2 | 202.08 | 43.92* | 1.06e-10* | -8.91* | -6.42 | -8.07* |

*Note:*

* indicates lag order selection by the criterion

LR: sequential modified LR Test statistics (each test at 5% level)

FPE: Final Prediction Error

AIC: Akaike information criterion

SBC: Schwarz Bayesian criterion

HQ: Hannan-Quinn information criterion

*Source*: Author’s computation using E-views 10

We can select the order of lags by either the Akaike Information Criterion (AIC) or the Schwarz Bayesian Criterion (SBC) as they are frequently used in most of the research papers with time-series data. While selecting lag order, we need to select the regression that gives us least residual value considering negative sign of the number given by different lag selection criteria. Additionally, we can consider the lag selection criteria that yields the highest adjusted R-squared value. Among these, AIC has the smallest digit i.e. -8.91, which is a cause for concern because the premise is that the smaller the residual value, the better the model.

As per VAR Lag Order Selection Criteria in the above table, lag 2 is selected based on AIC criteria for each variable in their autoregressive distributed lag structures and lag 1 is chosen based on the SBC criterion. The AIC criterion with lag 2 is employed as it uses minimum acceptable lag in comparison to SBC criterion to avoid unnecessary loss of degrees of freedom.

## 4.6 Cointegration Results

Following the Auto Regressive Distributed Lag modeling proposed by Pesaran and Shin (1999), the bounds tests (F-statistics) has been applied to justify the existence of the cointegration or long-run relationship among the variables in the system. The F-statistics are compared with the upper and lower critical values and if F-statistics is found greater than the upper bound, it means there is a cointegrating relationship among the variables.

**Table 4.5: Bounds test (F-version) results**

| **Variables** | **F-statistics** | **Critical Values Finite Sample (n=35)** | | | **Lag Option** |
|---|---|---|---|---|---|
| | | | I(0) | I(1) | |
| F(LRAGDP \| LRLDCBS, LIRI, LLBR) | 4.24 | 10% | 2.46 | 3.46 | (1,0,2,0,0) |
| | | 5% | 2.94 | 4.08 | |
| | | 1% | 4.09 | 5.53 | |

*Source*: Author’s computation using E-views 10

Table 4.5 presents the F-statistics if 4.24 which lies above the upper bounds critical values of standard significance level of 5 percent which is 4.08. Thus, it rejects the null hypothesis of no cointegration. Thus, it can be concluded that there is a long-run relationship between the variables used in the system. This result is also supported by the statistically negative coefficient obtained from ECM(t-1), which is considered more efficient for testing cointegration.

## 4.7 ARDL Regression results

After identifying the cointegration among underlying variables, the next step is to estimate the long-run and short-run coefficients using the ARDL model. ARDL models are typically estimated using standard least squares techniques. Table 4.6 presents the autoregressive distributed lag based regression estimates with the overall significance of the model. Based on the AIC lag selection criteria, maximum lag for dependent variable is 1 and independent variable is 2. AIC selected appropriate lag length for each of the variable as ARDL(1, 0, 2, 0, 0). As shown in the table below, LRAGDP(-1) is significant as the p-value is less than 0.05. It means AGDP of a year lag period has positive and significant relationship with AGDP. All the independent variables are insignificant as shown by the p-value. Alternatively, if the t-statistic value is 2 or more in absolute value then the model is significant. In this basis, LRAGDP(-1) is significant.

**Table 4.6: Autoregressive distributed lag estimates**

ARDL(1,0,2,0,0) selected based on AIC
Dependent Variable: LRAGDP
Included 34 observations used for estimation from 1987 to 2021

| Regressor | Coefficient | Standard Error | T-Ratio | Probability |
|---|---|---|---|---|
| LRAGDP(-1) | 0.747 | 0.114 | 6.559 | 0.00 |
| LRLDCBS | 0.028 | 0.021 | 1.294 | 0.20 |
| LFER | 0.005 | 0.010 | 0.487 | 0.63 |
| LFER(-1) | -0.013 | 0.012 | -1.073 | 0.29 |
| LFER(-2) | -0.022 | 0.012 | -1.828 | 0.07 |
| LSEED | 0.011 | 0.013 | 0.867 | 0.39 |
| LIRI | 0.016 | 0.009 | 1.796 | 0.08 |
| C | 1.717 | 1.340 | 2.264 | 0.32 |
| R-squared = 0.98<br>Adjusted R-squared = 0.98 | | D-W stat = 1.75 | F-statistic F(7,25) = 253.29<br>Probability(F-statistic) = 0 | |

**Diagnostics Tests**

| Test Statistics | LM-Version | F-Version |
|---|---|---|
| A. Serial Correlation | CHSQ(1) = 0.509 (0.475) | 0.376 (0.545) |
| B. Functional Form | CHSQ(1) = 0.876 (0.349) | 0.655 (0.426) |
| C. Normality | CHSQ(2) = 1.962 (0.375) | Not applicable |
| D. Heteroscedasticity | CHSQ(1) = 1.471 (0.225) | 1.447 (0.238) |

*Note*:

A: Lagrange multiplier test of residual serial correlation;
B: Ramsey's RESET test using the square of the fitted values;
C: Based on a test of skewness and kurtosis of residuals;
D: Based on the regression of squared residuals on squared fitted values.

*Source*: Author's computation using Microfit-5.0

An R-Squared value of 0.98 indicates that the independent variables used in the model explain 98 percent of the variance in AGDP. However, a value of 0.9 or higher suggests that there may be issues with the model, such as a small number of observations, a large number of predictor variables, data that is in a time series or aggregated format, or the exclusion of important independent variables. Similarly, the general perception about DW-statistics is that it should be greater than the R-squared value and be around 2. In this study, it is found 1.75 and indicates that there is no autocorrelation in the model. Additionally, this is also confirmed by the LM test for serial correlation. Microfit uses LM test to test serial correlation with the help of chi-square and F-statistics. The null hypothesis for serial correlation is that there is no correlation. It is accepted because the p-value of both the statistics is greater than 0.05 so null hypothesis cannot be rejected.

The F-Test of overall significance in regression determines if the linear regression model fits a dataset than a model with no predictor variables. The null hypothesis is that the model with no independent variables fits the data as well as your model and alternative hypothesis is that the model fits the data better than the intercept-only model. The overall F-statistic is significant because the p-value is less than 0.05 indicating that R-squared does not equal to zero, and the correlation between the model and dependent variable is statistically significant.

The diagnostic test signifies that the model passes all of the tests. The null hypothesis of no serial correlation, the null hypothesis of no misspecification of functional form, the normality of residuals, and the null hypothesis of no heteroscedasticity are accepted. The null hypothesis for Ramsey RESET test is that the model has no omitted variables. The alternative hypothesis is that the model is suffering from an omitted variable problem. The p-value of LM-test and F-test statistics is greater than 0.05 so null hypothesis cannot be rejected which means that the model has omitted variables. Normality test checks if the underlying residuals are normally distributed or not. The null hypothesis is that the residuals are normally distributed, against the alternative hypothesis that they are not normally-distributed. The p-value of LM-test statistics is greater than 0.05 so null hypothesis cannot be rejected which proves that the residuals are normally distributed. Similarly, the results of the heteroscedasticity test suggest that we cannot reject the null hypothesis, indicating that the data is likely homoscedastic.

## 4.8 Long-run Coefficients

The long-run coefficients are estimated using the ARDL based regression model. The long-run relationship between AGDP and LDCBS along with the FER, SEED and IRI is presented on the table below. The estimated long-run model of the corresponding ARDL(1,0,2,0,0) is:

$$LRAGDP = 12.033 + 0.111 * LRLDCBS - 0.121 * LFER + 0.044 * LSEED + 0.064 * LIRI \quad (1)$$

As shown in Table 4.7, the correlation of LRLDCBS and LIRI with LRAGDP is positive and statistically significant, while the correlation between LFER is negative and statistically significant. The long-run coefficient of LRLDCBS is 0.11 means that when LDCBS is increased by 1 percent, AGDP is increased by 0.11 percent in long-run with the assumption that other variables remaining constant. Similarly, the coefficient of LSEED and LIRI is 0.04 and 0.06 respectively indicating the effect made on AGDP is positive. However, the correlation between LSEED and LRAGDP is not statistically significant in long-run. The mechanism is increased lending leads to an increase in consumption capacity through increased income which increases the economic activities on agriculture sector. From these results, it could be concluded that AGDP and LDCBS are cointegrated with each other and LDCBS has positive and significant long-run effects on LDCBS.

**Table 4.7: Estimated long run coefficients using the ARDL model**

ARDL(1, 0, 2, 0, 0) selected based on AIC
Dependent Variable: LRAGDP
33 observations used for estimation from 1989 to 2021

| Regressor | Coefficient | Standard Error | T-Ratio | Probability |
|---|---|---|---|---|
| LRLDCBS | 0.111* | 0.053 | 2.095 | 0.046 |
| LFER | -0.121* | 0.032 | -3.737 | 0.001 |
| LSEED | 0.044 | 0.061 | 0.729 | 0.472 |
| LIRI | 0.064* | 0.023 | 2.731 | 0.011 |
| C | 12.033 | 0.518 | 23.219 | 0 |

*Note*: * shows the significance of coefficient at 5 percent significance level

*Source*: Author's computation using Microfit-5.0

## 4.9 Error Correction Model

ECM is a short-run model that incorporates a mechanism which restores a variable to its long-term relationship from a disequilibrium position. Thus, to check the short-run relationship between AGDP and other explanatory variables, the error correction version of the ARDL model is employed and the result obtained is presented in table below. The estimated error correction model of the corresponding ARDL(1, 0, 2, 0, 0) is:

$$\Delta LRAGDP = 0.028 * \Delta LRLDCBS + 0.005 * \Delta LFER + 0.011 * \Delta LSEED + 0.016 * \Delta LIRI - 0.252 * ECM_{t-1} \quad (2)$$

As reported in the Table 4.8, short-run coefficients show the dynamic adjustment of respective variables, and both all the coefficients are insignificant. The short-run coefficient of ΔLRLDCBS is insignificant at a 5 percent level of significance. Although the variable may seem insignificant, it is not necessarily the case that it has no effect on the dependent variable i.e. AGDP.

**Table 4.8: Error correction representation for selected ARDL model**

ARDL(1, 0, 2, 0, 0) selected based on AIC
Dependent Variable: D(LRAGDP)
33 observations used for estimation from 1989 to 2021

| Regressor | Coefficient | Standard Error | T-Ratio | Probability |
|---|---|---|---|---|
| D(LRLDCBS) | 0.028 | 0.021 | 1.294 | 0.207 |
| D(LFER) | 0.005 | 0.010 | 0.487 | 0.630 |
| D(LFER1) | 0.022 | 0.012 | 1.828 | 0.079 |
| D(LSEED) | 0.011 | 0.013 | 0.867 | 0.394 |
| D(LIRI) | 0.016 | 0.009 | 1.796 | 0.084 |
| ECM(-1) | -0.252* | 0.114 | -2.212 | 0.036 |
| $R^2$ = 0.360 | $\bar{R}^2$ = 0.181 | D-W stat = 1.75 | F-stat (6, 26) = 2.352<br>Prob (F-statistic) = 0.060 | |
| ECM = LRAGDP - 0.111*LRLDCBS + 0.121*LFER - 0.044*LSEED - 0.064*LIRI - 12.033 | | | | |

*Note:*

* shows the significance of coefficient at 5 percent significance level
Where,
dLFER = LFER - LFER(-1)
dLFER1 = LFER(-1) - LFER(-2)

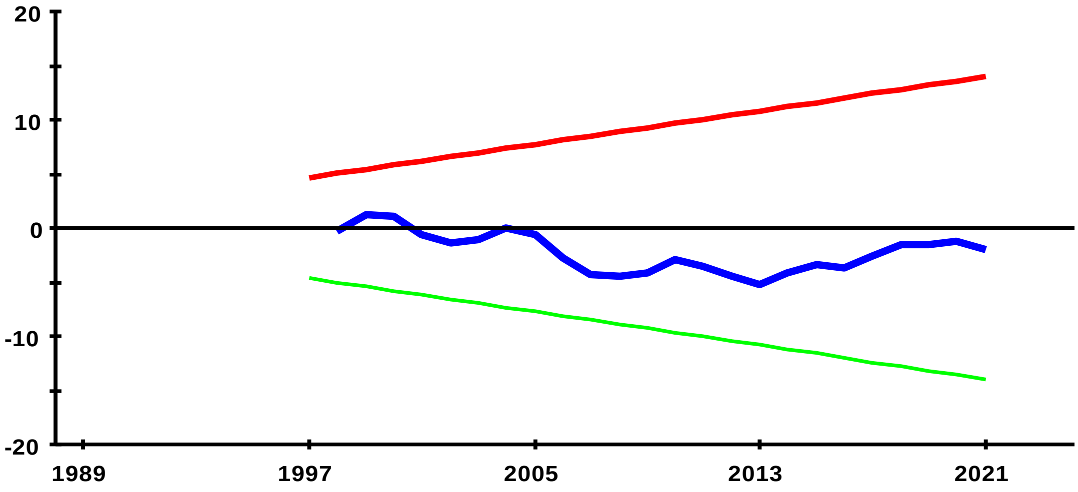
*Source*: Author’s computation using Microfit-5.0

There are several reasons why a variable may appear insignificant in the data. For example, the sample size may be too small, or the random variation may be too large to detect a significant effect on AGDP. Additionally, the variable may be correlated with other variables, making it difficult to determine the individual contribution of each variable to the overall effect. It is important to note that insignificant data does not necessarily mean that an effect does not exist; it simply means that the data do not provide evidence of the effect.

The error correction term $ECM_{t-1}$ indicates the speed of adjustment resorting the equilibrium in the dynamic model, which is one period lag of Error Correction Model, i.e. $ECM_{t-1} = ECM_t - ECM_{t-1}$. The term ECM is generated using long-run coefficients of the model, $ECM = LRAGDP - 0.111 * LRLDCBS + 0.121 * LFER - 0.044 * LSEED - 0.064 * LIRI - 12.033$. The error correction coefficient has negative sign and is highly significant (p-value < 0.05) as shown by the probability value of being zero. This helps to reinforce the existence of cointegration as provided by the F-test. Specifically, the estimated value of $ECM_{t-1}$ is $-0.252$ and is statistically significant at 5 percent level of significance. The absolute value of $ECM_{t-1}$ indicates the speed of adjustment towards long-run equilibrium through a series of partial short-run adjustments. Hence, it shows that short-run disequilibrium on the system converges to the equilibrium at a speed of 25.2 percent per annum. The main variable, LDCBS, is insignificant in short-run. Likewise, the value of R-squared is 0.36, which means approximately 36 percent of the total variation in the agricultural growth is explained by the independent variables, and the remaining 74 percent is due to error.

## 4.10 Stability Test

**Figure 4.6: Plot of CUSUM statistics**

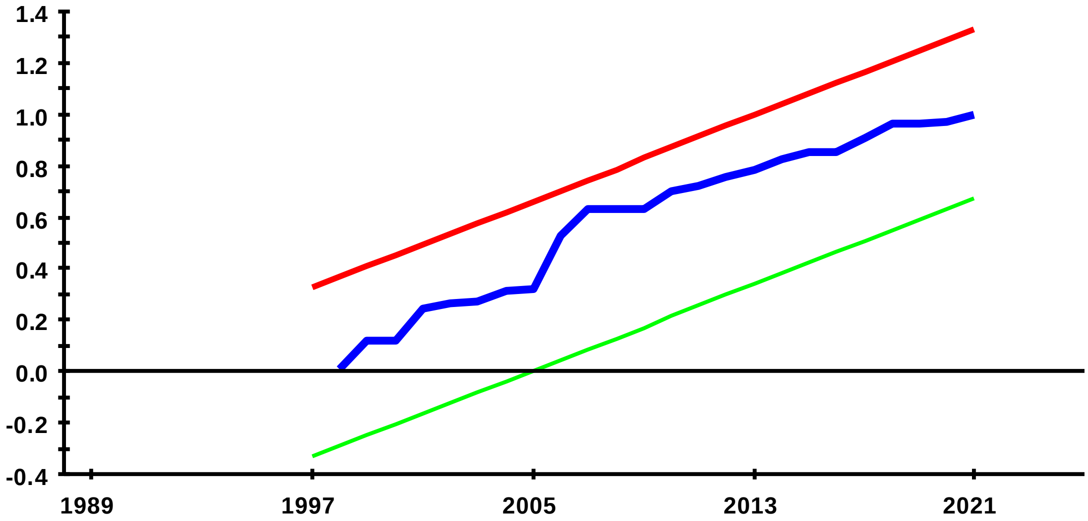



*Source*: Author's computation using E-views 10

The stability diagnostics examine whether the parameters of the estimated model are stable or not. The CUSUM and the CUSUMSQ tests proposed by Brown, Durbin, and Evans (1975) have been applied to test the stability of the model. The CUSUM test makes use of the cumulative sum of recursive residuals based on the first set of n observations and is updated recursively and plotted against breakpoints. The red and green straight lines represent critical bounds at 5 percent significance level. If the plot of CUSUM statistics stays within the critical bounds of 5 percent significance level represented by a pair of red and green straight lines drawn at 5 percent level of significance, the null hypothesis that all coefficients in the error correction model are stable cannot be rejected.

Figure 4.6 presents the plot of the CUSUM of the recursive residuals and the result indicates the absence of instability of coefficients during the study period which means that the parameters used in the model are stable over the period. If either of the lines is crossed, the null hypothesis of stability of coefficients can be rejected at the 5 percent level of significance. Also, a similar procedure is used to carry out the CUSUMSQ test, which is based on the squared recursive residuals. Similarly, Figure 4.7 provides the plot of the CUSUMSQ of the recursive residuals. The result indicates the absence of instability in coefficients over a certain period [1987 to 2021].

**Figure 4.7: Plot of CUSUMSQ statistics**




*Source*: Author's computation using E-views 10

## 4.11 Discussion

Similar to the study of Rimal (2014), this paper finds significant positive relationship between agricultural growth and lending on agriculture sector by commercial banks in Nepal. However, this paper does not identify a short-term relationship. The primary difference lies in the methodology employed; while Rimal (2014) utilized a Cobb Douglas Production Function and analyzed a decade of time series data from 2002 to 2012, this paper examines a broader time frame of 35 years starting from FY 1986/87.

The literature review indicates that the correlation between agricultural sector growth and lending by commercial banks can differ in both the short and long term, depending on various factors. These factors may include the effectiveness of credit utilization, the availability and accessibility of bank credit, the economic climate of the country, the efficiency and oversight of financial institutions, the availability of agricultural inputs, the effectiveness of agriculture-related organizations, the level of government priority given to the agriculture sector, as well as the availability of non-agricultural resources such as training and information.

# CHAPTER-V

# SUMMARY AND CONCLUSIONS

## 5.1 Major Findings

The goal of this study is to investigate the relationship between AGDP and LDCBS in the context of the Nepalese economy. To achieve this, a dataset covering 35 years from fiscal year 1986/87 to 2020/21 (2044 to 2078 B.S.) is used. Graphs, tables, and trend lines are used to analyze the trend of agricultural growth. The ADF test is also applied to determine the stationarity of the time-series data. The and ECM methods are used to identify the long-term and short-term relationships between the variables, respectively. The main findings of the study are as follows:

1. The trend of agricultural growth shows that it is increasing over the years whereas contribution of agriculture sector to GDP is decreasing. Annual growth rate of AGDP over the study period is between 5 to 10 percent.
2. The trend of lending behavior of commercial banks to agriculture sector shows an exponential growth in recent years.
3. The trend of AGDP and LDCBS appears to be increasing. However, lending appears to have grown at an exponential rate over the previous five years, but agricultural growth has not.
4. The results of the ADF test shows that all the variables have unit root in the level form but stationary after first differencing which means that all the variables are integrated of order one.
5. After running the lag length structure, outputs disclose that our optimal results will be reached on lag 2. The model of ARDL(1, 0, 2, 0, 0) has been selected as the best model based on the AIC lag selection criteria.
6. Similarly, the ARDL bounds testing approach to cointegration shows that all the independent variables are insignificant. However, F-statistics is greater than upper critical bounds at the standard 5 percent level of significance.
7. The long-run model, based on ARDL regression, confirms significant and positive effects of LDCBS and IRI on AGDP. However, FER shows negative and significant relationship with AGDP in long-run. SEED is insignificant.

8. The outcome of ECM indicates that the LDCBS is insignificant in the short-run. The coefficient of $ECM_{t-1}$ is found negative and statistically significant at 5 percent level which indicates that the short-run disequilibrium on the system converging into the equilibrium at a speed of 25.2 percent per annum.
9. The CUSUM and the CUSUMSQ tests concludes that the coefficients are stable.

## 5.2 Conclusions

Our results show decreasing contribution of agriculture sector to GDP despite increasing trend of AGDP over the study period whereas the contribution of AGDP to the economy is decreasing due to the expansion of services in non-agriculture sectors, and the national priority has shifted towards the industrial and service sectors. However, the data shows that lending to the agriculture sector has significantly increased when credit from the ADB is included in total lending by commercial banks. This increase in lending may be due to changes in the national priority, with a greater focus on the agriculture sector through priority sector lending, as well as the development of the financial sector, which has made credit more accessible.

According to the specific objective of this study, the analysis confirms the existence of cointegration between AGDP and LDCBS. The long-run model shows a significant and positive relationship between the two variables over the study period, while the relationship is not significant in the short-run. On the basis of this result and few existing researches in context of Nepal, it can be said that lending towards agriculture sector is beneficial in Nepal. These findings suggest that while credit has enabled the increased use of purchased inputs and changes in the input mix, supporting the evolution of agriculture over the longer horizon, it has not contributed to short-term growth in agricultural GDP.

The relationship between agricultural lending and agriculture sector growth in Nepal appears to be positive but very small. This may be due to several factors, including a potentially small sample size and issues with credit distribution and expenditure in the country. Many real farmers in Nepal may not have access to credit due to illiteracy and perceived risk of debt repayment (Bhatta, 2014). Additionally, credit investments may not be spent where they are intended, possibly due to weak monitoring of banks and financial institutions. All of these factors could contribute to the low observed relationship between agricultural lending and agriculture sector growth in Nepal.

Additionally, the credit flow considered does not accurately reflect the total credit flow to the agriculture sector in Nepal as a whole, as it only takes into account credit from commercial banks. This means that other sources of credit, such as microfinance institutions or government programs, are not being considered in the analysis. This could potentially affect the relationship between agricultural lending and agriculture sector growth, as these additional sources of credit may have a different impact on the sector.

## 5.3 Recommendations

The results of the study support the Nepalese government and NRB's efforts to provide more credit to farmers. The negative result observed in the short-term may be due to the insufficient amount of credit provided for seed, technology, and training extension to make an immediate impact. Data from 2006 to 2009 demonstrates that the efforts made to develop the agriculture sector through the implementation of various plans and programs such as Agriculture Business Promotion Policy 2063, One Village, One Product Program, Bird-flu Control Program 2064, Cooperative Farming Program 2065, Cooperative Stores Operation Rules 2065 were effective. Such solicitous plans, programs and actions are duly needed to transform agriculture sector. However, the positive long-term result suggests that credit has transformed agriculture sector in Nepal. Therefore, the government and the NRB should consider updating current policies such as priority sector lending by identifying real farmers and increasing the credit available for agricultural transformation. This could be achieved by providing credit directly when purchasing farm inputs to real farmers. Additionally, the data found in public domain does not provide whole picture of lending and growth of agriculture sector. Therefore, it is necessary for the relevant authority to prioritize the collection, organization and dissemination of data.

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# APPENDICES

## APPENDIX-1

**Time Series Data from 1986/87 to 2020/21**

| AD | LRAGDP | LRLDCBS | LFER | LSEED | LIRI |
|---|---|---|---|---|---|
| 1986/87 | 12.317 | 7.020 | 10.716 | 7.788 | 10.507 |
| 1987/88 | 12.388 | 8.192 | 10.900 | 7.844 | 10.452 |
| 1988/89 | 12.428 | 8.824 | 10.948 | 7.625 | 10.884 |
| 1989/90 | 12.497 | 9.002 | 11.117 | 7.781 | 10.153 |
| 1990/91 | 12.499 | 9.101 | 11.194 | 7.730 | 10.012 |
| 1991/92 | 12.486 | 9.198 | 11.343 | 7.675 | 10.429 |
| 1992/93 | 12.459 | 9.355 | 11.331 | 7.529 | 10.322 |
| 1993/94 | 12.528 | 9.361 | 11.209 | 8.182 | 10.421 |
| 1994/95 | 12.527 | 9.671 | 11.410 | 8.212 | 10.141 |
| 1995/96 | 12.576 | 9.381 | 11.158 | 8.115 | 10.790 |
| 1996/97 | 12.623 | 9.564 | 11.069 | 8.275 | 10.374 |
| 1997/98 | 12.616 | 9.700 | 10.758 | 7.709 | 9.973 |
| 1998/99 | 12.694 | 9.871 | 10.729 | 7.492 | 10.800 |
| 1999/00 | 12.741 | 9.946 | 10.525 | 7.857 | 10.483 |
| 2000/01 | 12.715 | 9.970 | 10.070 | 7.546 | 10.298 |
| 2001/02 | 12.741 | 9.947 | 9.889 | 7.884 | 9.775 |
| 2002/03 | 12.750 | 9.320 | 10.570 | 7.627 | 9.378 |
| 2003/04 | 12.784 | 9.499 | 9.368 | 7.692 | 9.454 |
| 2004/05 | 12.793 | 10.285 | 9.823 | 7.919 | 9.335 |
| 2005/06 | 12.782 | 9.998 | 9.004 | 8.165 | 9.820 |
| 2006/07 | 12.778 | 9.984 | 9.453 | 8.126 | 10.202 |
| 2007/08 | 12.809 | 9.930 | 8.097 | 8.238 | 9.718 |
| 2008/09 | 12.887 | 9.745 | 8.057 | 8.281 | 10.160 |
| 2009/10 | 12.991 | 9.670 | 10.650 | 8.375 | 10.333 |
| 2010/11 | 13.075 | 9.558 | 10.296 | 8.341 | 14.062 |
| 2011/12 | 13.060 | 9.986 | 10.729 | 7.761 | 14.087 |
| 2012/13 | 13.046 | 10.216 | 12.084 | 8.208 | 14.102 |
| 2013/14 | 13.075 | 10.383 | 12.355 | 8.894 | 14.116 |
| 2014/15 | 13.084 | 10.570 | 12.607 | 9.122 | 14.130 |
| 2015/16 | 13.063 | 10.688 | 12.464 | 9.432 | 14.146 |
| 2016/17 | 13.081 | 10.818 | 12.692 | 9.081 | 14.176 |
| 2017/18 | 13.102 | 11.211 | 12.790 | 8.382 | 14.203 |
| 2018/19 | 13.132 | 11.520 | 12.752 | 10.452 | 14.205 |
| 2019/20 | 13.136 | 11.683 | 12.901 | 8.270 | 14.213 |
| 2020/21 | 13.138 | 11.995 | 12.839 | 10.402 | 14.227 |

**APPENDIX-2**

LIST OF LITERATURE REVIEWS WITH THEIR RESULT

| POSITIVE RESULTS | |
|---|---|
| Akram et al (2013) | Credit users were highly efficient |
| Baffoe et al. (2014) | Farmers who had access to credit had larger average profit |
| Bahsi and Cetin (2020) | Agricultural credit significantly and positively impacted agricultural output |
| Chandio et al. (2016) | Formal credit had a positively significant impact on agricultural output |
| Chisasa and Makina (2013) | Bank credit had a significantly positive impact on agricultural output |
| Das, Senapati, John (2009) | Direct agricultural credit has immediate positive effect on productivity |
| Girabi and Mwakaje (2013) | Agricultural credit beneficiaries had higher agricultural productivity |
| Hassan (2017) | Significantly positive relationship between agricultural growth and capital, bank credit and liquid liability |
| Hegde and Reddy (2017) | Direct agriculture credit has a positive and statistically significant impact on agriculture output |
| Ibe (2014) | Commercial bank credit to agricultural sector significantly affected agricultural productivity in Nigeria |
| Izhar and Tariq (2009) | Institutional credit has significant impact on aggregate agricultural production in India |
| Khan, Fatima, Jamshed (2017) | Long-run positive association between the India's agricultural GDP and agricultural credit |
| Kumar et al. (2017) | Formal credit played a significant role in enhancing net farm income and per capita monthly household expenditure for the farmers in India |
| Misra, Chavan & Verma (2016) | There is favorable and significant impact of agricultural credit on agricultural growth |
| Mubaraq (2021) | ACGSF significantly and positively affected real agricultural GDP |
| NRB, Dhangadhi Office, 2014 | Agricultural credit has helped enhance the agricultural productivity of the farmers in Kailali District. |
| Ogbanje et al. (2010) | Commercial banks' loan had a significantly positive effect on agricultural GDP |
| Ogbuabor and Nwosu (2017) | Bank credit had a significantly positive long-run effect on agricultural productivity and negligibly impact in the short run |
| Okafor (2020) | Banks credit and ACGSF significantly and positively affected agricultural output |
| Onoja (2017) | Credit to agriculture contributed positively to agricultural productivity through direct crop inputs but negatively through agricultural value added as ratio of GDP |
| Osabohien et al. (2020) | Bank credit had a short-run and long-run significant positive effect on agricultural performance |

| | |
|---|---|
| Owuor and Shem (2012) | Significantly positive impact of agricultural credit on food production |
| Rehman et al. (2017) | Food production and loan disbursement had a significantly positive impact on AGDP |
| Reuben et al. (2020) | ACGSF significantly and positively affected Nigerian agricultural output |
| Rimal (2014) | Commercial banks agricultural credit flow has a favourable influence on agricultural productivity |
| Sagbo (2019) | Farm loans have a significant positive impact on sampled recipients' net farm income |
| Sekyi et al. (2019) | Informal credit has a positive influence on rural agricultural productivity |
| Sidhu et al. 2008 | Relationship between use of variable inputs and production credit disbursement has been found highly significant |
| Nnamocha and Eke (2015) | Bank credit had a long-run effect on agricultural output |

INCONCLUSIVE/INSIGNIFICANT/NEGATIVE RESULTS

| | |
|---|---|
| Narayanan (2015) | GDP of agriculture is not sensitive to credit flow to agriculture sector |
| Ngong et al. (2022) | Impact of bank credit on agricultural productivity are not conclusive |
| Zakaria et al. (2019) | Financial development has an inverted U-shaped effect on agricultural productivity |

## APPENDIX-3

DATA TABLE FOR TRENDS AND PATTERNS

| Fiscal Year | Contribution of AGDP in Total GDP (in %) | AGDP Growth rate |
|---|---|---|
| 1974/75 | 68.88 | - |
| 1976/77 | 60.12 | -9.62 |
| 1977/78 | 58.88 | 11.81 |
| 1978/79 | 51.15 | 15.06 |
| 1979/80 | 57.9 | 1.16 |
| 1980/81 | 60.75 | 14.72 |
| 1981/82 | 57.17 | 14.22 |
| 1982/83 | 56.42 | 7.72 |
| 1983/84 | 57.44 | 18.28 |
| 1984/85 | 48.86 | 0.85 |
| 1985/86 | 48.69 | 19.22 |
| 1986/87 | 47.95 | 12.85 |
| 1987/88 | 47.79 | 20.02 |
| 1988/89 | 47.69 | 15.83 |
| 1989/90 | 48.8 | 18.55 |
| 1990/91 | 46 | 9.7 |
| 1991/92 | 43.59 | 17.68 |
| 1992/93 | 40.87 | 7.57 |
| 1993/94 | 40.44 | 14.98 |
| 1994/95 | 39.04 | 6.18 |
| 1995/96 | 38.93 | 13.24 |
| 1996/97 | 38.78 | 12.27 |
| 1997/98 | 37.39 | 3.41 |
| 1998/99 | 38.7 | 17.67 |
| 1999/00 | 38.24 | 9.64 |
| 2000/01 | 35.25 | 7.23 |
| 2001/02 | 36.15 | 6.72 |
| 2002/03 | 35.11 | 4.04 |
| 2003/04 | 34.68 | 7.71 |
| 2004/05 | 33.82 | 7.12 |
| 2005/06 | 32.37 | 6.19 |
| 2006/07 | 31.16 | 7.14 |
| 2007/08 | 30.31 | 8.98 |
| 2008/09 | 31.32 | 25.23 |
| 2009/10 | 33.18 | 27.85 |
| 2010/11 | 34.98 | 20.82 |
| 2011/12 | 33.15 | 5.88 |
| 2012/13 | 31.53 | 5.58 |
| 2013/14 | 30.27 | 11.24 |
| 2014/15 | 31.74 | 5.26 |
| 2015/16 | 31.61 | 4.93 |
| 2016/17 | 29.65 | 10.28 |

| | | |
|---|---|---|
| 2017/18 | 28.57 | 8.31 |
| 2018/19 | 27.51 | 6.94 |
| 2019/20 | 27.65 | 10.34 |
| 2020/21 | 25.8 | - |

Source: Macroeconomic Indicators Dashboard, MoF

**APPENDIX-4**

Regression Results for Different Models

| Model Number | Model Functions: | ECM table: | | | | |
|---|---|---|---|---|---|---|
| | | R-squared | F-stat [lower-upper] | Coineq(-1) (prob.) | Overall F-stat (prob.) | DW -stat |
| MODEL 1 | AGDP=f(LDCBS,PCI,IRI,FER,SEED,LBR) | 0.537 | 2.21 [2.45-3.61] | -0.0425 (0.002) | 4.312 (0.0027) | 1.753 |
| MODEL 2 | AGDP=f(LDCBS,IRI,FER,SEED,LBR) | 0.496 | 3.671 [3.12-4.25] | -0.460 [0] | 9.862 [0.0001] | 1.749 |
| MODEL 3 | AGDP=f(LDCBS,PCI,FER,SEED,LBR) | 0.5014 | 3.64 [3.12-4.25] | -0.454 [0] | 10.059 [0.000095] | 1.6439 |
| MODEL 4 | AGDP=f(LDCBS,PCI,IRI,SEED,LBR) | 0.5057 | 3.71 [3.12-4.25] | -0.472 [0] | 10.232 [0.000084] | 1.6099 |
| MODEL 5 | AGDP=f(LDCBS,PCI,IRI,FER,LBR) | 0.537 | 3.255 [3.12-4.25] | -0.486 [0] | 8.4358 [0.00012] | 1.673 |
| MODEL 6 | AGDP=f(LDCBS,PCI,IRI,FER,SEED) | 0.527 | 2.864 [3.12-4.25] | -0.37 [0.0001] | 8.097 [0.00016] | 1.739 |
| MODEL 7 | AGDP=f(LDCBS,PCI,IRI,LBR) | 0.48 | 2.99 [2.86-4.01] | -0.420 (0.0003) | 5.18 (0.0017) | 1.652 |
| MODEL 8 | AGDP=f(LDCBS,FER,IRI,LBR) | 0.481 | 4.292 [3.47-4.57] | -0.518 [0] | 9.274 [0.000170] | 1.77 |
| MODEL 9 | AGDP=f(LDCBS,SEED,IRI,LBR) | 0.445 | 4.068 [3.47-4.57] | -0.4308 [0] | 12.450 [0.000107] | 1.675 |
| MODEL 10 | AGDP=f(LDCBS,LBR,FER,SEED) | 0.439 | 3.472 [3.47-4.57] | -0.488 [0.00001] | 7.838 [0.00052] | 1.6085 |
| MODEL 11 | AGDP=f(LDCBS,FER,SEED,IRI) | 0.36 | 4.24 [2.56-3.49] | -0.252 [0.036] | not shown | 1.75 |
| MODEL 12 | AGDP=f(LDCBS,FER,LBR,PCI) | 0.498 | 4.501 [3.47-4.57] | -0.484 [0] | 9.957 [0.0001] | 1.65 |
| MODEL 13 | AGDP=f(LDCBS,FER,PCI,IRI) | 0.52 | 3.46 [3.47-4.57] | -0.412 [0.00001] | 7.888 [0.00019] | 1.77 |
| MODEL 14 | AGDP=f(LDCBS,PCI,SEED,LBR) | 0.493 | 4.389 [3.47-4.57] | -0.418 [0] | 9.726 [0.00012] | 1.629 |
| MODEL 15 | AGDP=f(LDCBS,PCI,IRI,SEED) | 0.486 | 3.4007 [3.47-4.57] | -0.3377 [0.0002] | 9.482 [0.000146] | 1.69 |
| MODEL 16 | AGDP=f(LDCBS,PCI,FER,SEED) | 0.446 | 4.087 [3.47-4.57] | -0.343 [0] | 12.504 [0.0001] | 1.66 |
| MODEL 17 | AGDP=f(LDCBS,IRI,LBR) | 0.42 | 5.45 [3.23-4.35] | -0.457 [0] | 24.08 [0.000026] | 1.72 |
| MODEL 18 | AGDP=f(LDCBS,PCI,LBR) | 0.489 | 5.61 [4.01-5.07] | -0.451 [0] | 9.587 [0.000135] | 1.63 |
| MODEL 19 | AGDP=f(LDCBS, IRI) | 0.43 | 4.63 [4.87-5.85] | -0.437 (0.0006) | 7.623 (0.0006) | 1.67 |
| MODEL 20 | AGDP=f(LDCBS,LBR) | 0.346 | 4.710 [4.87-5.85] | -0.372 (0.0005) | 8.208 (0.001) | 1.561 |

| Model Number | Model Function: | Bounds Test: | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | F-stat [lower-upper] (5% sig. level) (N=35) | LONG RUN COEFFICIENTS: | | | | | |
| | | | LRLDCBS [prob.] | LRPCI [prob.] | LIRI [prob.] | LLBR [prob.] | LRFER [prob.] | LRSEED [prob.] |
| MODEL 1 | AGDP=f(LDCBS,PCI,IRI,FER,SEED,LBR) | 2.21 [2.864-4.324] | -0.099 (0.28) | -0.023 (0.58) | 0.026 (0.24) | 1.505 (0.03) | -0.003 (0.92) | 0.018 (0.77) |
| MODEL 2 | AGDP=f(LDCBS,IRI,FER,SEED,LBR) | 3.671 [3.673-5.002] | -0.0881 [0.1251] | - | 0.0408 [0.0445] | 1.256 [0.1732] | -0.0148 [0.5397] | 0.0242 [0.457] |
| MODEL 3 | AGDP=f(LDCBS,PCI,FER,SEED,LBR) | 3.6469 [3.673-5.002] | -0.047 [0.036] | -0.0206 [0.09] | - | 0.2235 [0.5040] | 0.0058 [0.522] | 0.004 [0.72] |
| MODEL 4 | AGDP=f(LDCBS,PCI,IRI,SEED,LBR) | 3.714 [3.673-5.002] | -0.0912 [0.147] | -0.0369 [0.283] | 0.01515 [0.3951] | 0.626 [0.45] | - | 0.0114 [0.697] |
| MODEL 5 | AGDP=f(LDCBS,PCI,IRI,FER,LBR) | 3.255 [3.673-5.002] | -0.0705 [0.17] | -0.037 [0.27] | -0.0066 [0.79] | 0.1503 [0.85] | 0.015 [0.42] | - |
| MODEL 6 | AGDP=f(LDCBS,PCI,IRI,FER,SEED) | 2.864 [3.673-5.002] | -0.084 [0.22] | -0.047 [0.294] | 0.0066 [0.793] | - | -0.0189 [0.53] | 0.018 [0.614] |
| MODEL 7 | AGDP=f(LDCBS,PCI,IRI,LBR) | 2.997 [2.86-4.01] | -0.091 [0.20] | -0.020 [0.57] | 0.029 [0.02] | 1.44 [0.005] | - | - |
| MODEL 8 | AGDP=f(LDCBS,FER,IRI,LBR) | 4.292 [4.036-5.304] | -0.0727 [0.1117] | - | 0.0358 [0.0318] | 0.9442 [0.1773] | -0.01096 [0.5991] | - |
| MODEL 9 | AGDP=f(LDCBS,SEED,IRI,LBR) | 4.068 [4.036-5.304] | -0.1217 [0.03] | - | 0.033 [0.04] | 1.280 [0.17] | - | 0.0212 [0.53] |
| MODEL 10 | AGDP=f(LDCBS,LBR,FER,SEED) | 3.47 [4.036-5.304] | -0.090 [0.14] | - | - | 0.645 [0.41] | 0.026 [0.11] | 0.011 [0.70] |
| MODEL 11 | AGDP=f(LDCBS,FER,SEED,IRI) | 4.243 [2.947-4.088] | 0.028 [0.20] | - | 0.016 [0.08] | - | 0.005 [0.63] | 0.115 [0.39] |
| MODEL 12 | AGDP=f(LDCBS,FER,LBR,PCI) | 4.501 [3.47-4.57] | -0.093 [0.07] | -0.042 [0.14] | - | 0.379 [0.56] | 0.012 [0.46] | - |
| MODEL 13 | AGDP=f(LDCBS,FER,PCI,IRI) | 3.463 [4.036-5.304] | -0.0748 [0.2005] | -0.0419 [0.26] | 0.0074 [0.74] | - | -0.013 [0.58] | - |
| MODEL 14 | AGDP=f(LDCBS,PCI,SEED,LBR) | 4.389 [4.036-5.304] | -0.101 [0.16] | -0.057 [0.08] | - | 0.2127 [0.7] | - | 0.013 [0.69] |
| MODEL 15 | AGDP=f(LDCBS,PCI,IRI,SEED) | 3.4007 [4.036-5.304] | -0.134 [0.10] | -0.059 [0.26] | -0.0066 [0.75] | - | - | 0.015 [0.69] |
| MODEL 16 | AGDP=f(LDCBS,PCI,FER,SEED) | 4.08 [4.036-5.304] | -0.015 [0.03] | -0.065 [0.17] | - | - | -0.0059 [0.77] | 0.014 [0.70] |
| MODEL 17 | AGDP=f(LDCBS,IRI,LBR) | 5.456 [3.615-4.913] | -0.107 [0.0047] | - | 0.0368 [0.0001] | 1.3465 [0] | - | - |
| MODEL 18 | AGDP=f(LDCBS,PCI,LBR) | 5.61 [4.568-5.795] | -0.087 [0.10] | -0.054 [0.059] | - | 0.071 [0.88] | - | - |
| MODEL 19 | AGDP=f(LDCBS, IRI) | 4.630 [5.457-6.57] | -0.075 (0.044) | - | 0.010 (0.301) | - | - | - |
| MODEL 20 | AGDP=f(LDCBS,LBR) | 4.710 [5.457-6.57] | -0.102 (0.04) | - | - | -0.103 (0.85) | - | - |