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Impact of Agricultural Credit by Commercial Banks on Agricultural GDP

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Abstract

The farming sector in India has always been an essential and significant part of the country's economy. Agriculture has long been a significant employer of over 43% of the workforce and a large contributor to the nation's Gross Domestic Product (GDP), (14.39%) but it has also experienced difficulties including exploitation and uneven regulations. Despite these challenges, agriculture remains essential for the country's development, especially as it shifts towards a more business-oriented approach that requires access to capital. When looking at what factors influence agricultural productivity growth in India, attention to credit, inputs and policies can be signalled. Credit has been a crucial component in supporting agriculture for centuries and its importance has only increased as financial institutions have taken over from traditional non-institutional players such as moneylenders, friends and relatives. A significant factor in agriculture's expansion, especially in spurring the Green Revolution, has been institutional financing. Institutional lending to the agricultural industry and allied fields has grown significantly over time. Based on regression analysis, this study examines the relationship between direct institutional credit and agriculture and allied services GDP by analysing data covering 19 years (1992-2011) using a Multi Linear Regression model to find determinants of agricultural development. The research has found that a strong correlation exists between credit and agricultural output along with other inputs like seeds, fertilisers, pesticides, tractors, power tillers and electricity. This has been reinforced by government interventions such as offering subsidies, providing extension services and developing infrastructure. Nonetheless, a nagging problem of climate change markets is out of control and gaps in the execution of policies continue to cross the horizons. For India to manage these changes, it will be necessary for the country to shift and take positive measures that will ensure sustainable agricultural growth in rural communities.

Keywords: Agricultural Productivity, Agriculture and Allied Services, Direct Institutional Credit, GDP, Green Revolution, Multi Linear Regression Schedule Commercial Banks

1. Introduction

While the agricultural sector plays a crucial role in India's economic growth, its interconnectedness with other industries and its ability to uplift rural communities highlights its even greater importance. It continues to be the most crucial sector of the Indian economy. It appropriates 14.39% of the Indian GDP (down from 52% in 1950–51). According to Agricultural Statistics at Glance (2018), the sector employs more than 43% of the population inclusive of the largest share of women workers (71%) in rural areas (Gulati & Juneja, 2021). Primarily agrarian, the Indian economy depends heavily on rural areas (Reddy & Dutta, 2018). In developing nations, agriculture appears to have a greater economic significance than the wealthy nations (Arendonk, 2015). Historically, India has relied heavily on agriculture for sustenance. For centuries, agriculture contributed significantly to the nation's economic output. India was renowned for its agricultural products, such as spices, cotton and sugar, attracting global trade. However, following the 13th century, political instability and a lack of consistent agricultural policies led to a decline in the

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sector. The arrival of European colonisers exacerbated this trend, with policies designed to exploit agrarian resources.

The agricultural sector faced significant challenges at the time of India's independence. After independence, many of the country's largest industries, including sugar, jute, textiles, food processing, dairy and others, remained interconnected with agriculture, relying on it for raw materials. Agriculture is the backbone of the economy, providing raw materials for various industries and driving economic growth (Golait, 2007). It emphasizes that the development of basic industries and other non-agricultural sectors depends on the agriculture sector. By providing the raw ingredients for other industries, agricultural products effectively create demand for industrial goods and stimulate the economy. India launched the Green Revolution in the 1960s to produce more food and reduce hunger and poverty. Using age-old tools like bullock carts and wooden ploughs, Indian agriculture remained virtually unaltered for millennia before the Green Revolution. Due to this, the food produced was not enough and in the middle of the 1960s, there was almost a famine. To tackle this issue, High-Yielding Varieties (HYVs) of rice, such as IR-8, were released by the International Rice Research Institute (IRRI)) (Raeboline *et al*., 2019). Agricultural credit was instrumental in driving the Green Revolution. Credit to the agricultural sector, particularly to small and marginal farmers, was mostly provided by the National Bank for Agriculture and Rural Development (NABARD) and Regional Rural Banks (RRBs) (Suryavamshi, 2015). This helped to reduce the reliance on lenders in rural areas (Table 1). However, the high rate of loan defaults had negative implications for lending practices and the reputation of these financial institutions.

Proper availability of finance is one of the key drivers of progress in any sector. (Athar *et al*., 2021). Agricultural credit has played the role of this key driver in supporting farm production in India (Mohan, 2006). Financial institutions are essential for mobilising resources and directing them towards productive investments. The financial sector has an important role in monetising the rural economy, which can amplify its impact. Consequently, financial institutions are indispensable for the development of any industry, including agriculture. Agriculture is a vital sector of the Indian economy, contributing to economic growth, price stability and poverty reduction. Therefore, it is essential to increase the flow of agricultural loans, enhance land productivity and improve the potential and efficiency of water resources for agricultural growth. (Sidhu & Gill, 2006).

However, the expansion of the farming industry is increasingly dependent on financial institutions since 86.2% of farmers are small and marginal farmers who are unable to save and invest owing to low-income levels and possess just 47.3% of cropland (Chintala, 2021). Additionally, according to the World Bank, a large portion of India's population, around 66.46%, lives in rural areas which represent the biggest consumer market and can create revenue and employment through multiplier effects.

Direct lending has historically been the primary source of agricultural financing. This encompasses both short-term lending for seasonal agricultural operations and long-term financing for capital investments. Since the 1960s, the Indian government has implemented numerous measures to improve the flow of institutional credit to the farming sector. With the advent of new agricultural technologies in the mid-1970s, it became obvious that a more efficient system of agricultural finance was needed (Nagaraju, 2018). Regarding the impact of the greater availability of bank credit on India's agricultural growth after 1969, economists are largely in agreement (Ramakumar & Chavan, 2000). There was a surge in the number of village-level cooperative societies because of the strengthening of the cooperative credit system. Commercial banks had to boost their presence in rural areas as an outcome of nationalisation, even though their early involvement in agricultural lending was restricted. Regional Rural Banks were set up in 1975 to serve the low-income rural areas' credit needs. Launched in 1982, the National Bank for Agriculture and Rural Development (NABARD) was created to solve the deficiencies in institutional agricultural lending.

These developments spurred agricultural progress, with direct agricultural advances growing by 13.63%

annually from 1970-71 to 2012-13. After a slowdown in the 1990s, agricultural credit growth in India rebounded after 2000. A significant increase in the number of bank branches and a rapid acceleration in credit volume were key factors contributing to this resurgence. The RBI is notable for being one of the first central banks in the world to have shown a strong interest in agriculture and agricultural loan issues, and this dedication is still present today (Godara et al., 2014). When evaluating growth in a financial system dominated by financial institutions, credit is the most crucial component (Nagaraju, 2018).

Previous studies on agricultural productivity in India have highlighted the importance of credit, inputs, and government policies (Rehman *et al*., 2017; Mohapatra *et al*., 2017; Rao, 2012; Das *et al*., 2009). However, these studies have often focused on specific aspects or limited periods. This research aims to provide a comprehensive analysis by examining the interplay of these factors and their impact on agricultural growth. Building upon the findings of Yadav and Sharma, (2015); Godara, (2014) and Saleem *et al*., (2011), the study investigates the role of credit in enhancing productivity and the impact of other inputs along with credit in promoting agriculture.

The purpose of the current study is to assess how direct institutional credit from commercial banks on agricultural GDP from 1992 to 2011. The research also analyses the statistical significance of credit in conjunction with integrating additional farm inputs, such as pesticides, fertilizers and seeds, on agricultural GDP. The primary objectives of this study are to analyse the growth trends of the agriculture and allied services sector in terms of GDP, investigate the dynamics of direct institutional credit provided to this sector through priority sector lending by commercial banks, and assess the correlation between these two variables. Additionally, the study aims to evaluate the impact of other relevant variables (such as seeds, fertilizers, pesticides, electricity, power tillers and tractors) along with credit on the growth of the agriculture and allied services sector. By examining these factors, the study seeks to provide a more comprehensive understanding of the determinants of agricultural sector growth in India.

To achieve the above objectives the study employs a multi-linear regression model, analysing the impact of outstanding institutional credit on the growth of agriculture and allied services. Secondary data is obtained from various central agencies, Reserve Bank of India (RBI) and Niti Ayog, spanning a period of 19 years from 1992 to 2011. The study controls for various agricultural inputs, including seeds, fertilizers, pesticides and mechanisation, to isolate the specific effect of credit on productivity. The regression equation is as follows:

Agriculture GDP = β1+ β 2 Credit+ β3 Seeds+ β4 Fertilizers+ β 5 Pesticides + β6

Tractors + β7 Power Tillers + β8 Electricity + μ.

β1 = Constant or intercept (When the value of all the independent variables is zero, the value of agriculture GDP) and μ is all the other variables that have not been included as independent variables. The study period of 1992-2011, using data from the 2011 Census, can be considered a valid way to analyse the impact of credit, seeds, fertilizers, etc. on agricultural GDP in India. The Census is a comprehensive source of data on the population and economic characteristics of the country and is conducted every 10 years. The most recent census conducted in India was in 2011, so the data from that census would be the most up-to-date and accurate available for the study period. However, it's important to note that the study period of 1992-2011 is a 19-year span, which is a considerable period and may not accurately reflect the current scenario. It's also important to consider any changes in policy or other factors that may have occurred during the study period that could have influenced the results.

2. Financial Reach by Formal Institutions

The role of financial inclusion in promoting agricultural productivity is vital. Integrating farmers into the formal financial system enhances their access to institutional credit, which in turn has an extremely beneficial impact on agricultural output. The critical role of financial inclusion in improving access to credit and financial services for farmers, particularly small and marginal

farmers who are often excluded from formal credit channels is well demonstrated by many. Some authors have highlighted the elasticity of bank credit to GDP in several Indian states, suggesting that credit availability is a strong driver of agricultural growth at the regional level (Das *et al*., 2009).

Despite owning a substantial portion of agricultural land in India, small and marginal farmers contribute a relatively small fraction (less than 10%) to total agricultural investment. In contrast, medium and large farmers contribute significantly more, with medium farmers contributing 25.8% and large farmers contributing 47.3%. Over a third of all farmers' investments come from non-institutional sources, while the remaining 64% is borrowed from financial institutions (Table 1). Small and marginal farmers tend to rely more on unofficial sources, while medium and large farms benefit from subsidised loans from formal institutions. To address the growing number of women, renters and labourers involved in agriculture, credit policies should strive for greater inclusivity (Chand *et al*., 2021). The table shows the increase in institutional loans to agriculture and related activities.

3. Literature Review

The role of agricultural credit in driving agricultural productivity has been a subject of extensive scholarly inquiry, particularly within the context of developing economies where agriculture serves as a cornerstone of economic growth. The role of agricultural credit in fostering agricultural productivity has been widely examined in the literature. In India, where agriculture remains a vital sector, the availability of institutional credit to farmers has been a critical factor in enabling access to modern inputs, technologies, and other resources necessary for enhancing agricultural output. This literature review explores the historical context of agricultural credit in India, examines empirical evidence on its impact on agricultural productivity, and discusses the challenges and opportunities associated with providing effective credit to farmers.

The history of agricultural credit in India is rooted in colonial-era policies that limited access to formal financial institutions for rural farmers. The All-India Rural Credit Survey Report (1954), also known as the Gorwala Committee Report, was one of the first comprehensive efforts to assess rural credit in post-independence India. It identified the entrenched role of local moneylenders, despite the expansion of cooperative societies. The report underscored that the cooperative movement, intended to provide a sustainable alternative to non-institutional lenders, failed due to poorly structured credit programs and lack of adequate supervision.

Following this, India undertook significant reforms, including the establishment of RRBs in 1975 and the NABARD in 1982. These institutions were designed to extend institutional credit to rural areas, but challenges persisted, particularly in reaching marginalised farmers. In addition, various policy interventions such as the Agricultural Debt Waiver and Debt Relief Scheme (2008) aimed to alleviate farmers' debt burdens but often led to moral hazard issues, undermining long-term financial discipline.

Numerous empirical studies highlight the complex relationship between agricultural credit and productivity.

Table 1. Growth in institutional credit to agriculture and allied activities

Sources of Credit	1951	1961	1971	1981	1991	2002	2013
Non-Institutional	92.7%	81.3%	68.3%	36.8%	30.6%	38.9%	36%
(a) Money Lenders	69.7%	49.2%	36.1%	16.1%	17.5%	26.8%	29.6%
Institutional	7.3%	18.7%	31.7%	63.2%	66.3%	61.1%	64%
(a) Cooperative Societies / Banks	3.3%	2.6%	22%	29.8%	35.2%	30.2%	28.9%
(b) Commercial Banks	0.9%	0.6%	2.4%	28.8%	35.2%	26.3%	30.7%
Unspecified	-	-	-	-	3.1%	4.6%	4.4%
Total	100%	100%	100%	100%	100%	100%	100%

Source: All India Debt and Investment Survey, Various Issues, NSSO

NABARD's Research Study (2023), employs Institutional Theory to analyse the agricultural credit landscape in India. The study emphasises the role of institutional frameworks in shaping the effectiveness of credit delivery systems and their impact on agricultural productivity. It highlights how various rural financial institutions, including cooperatives and RRBs, serve as critical conduits for credit flow to farmers. The research assesses how these institutions' structures and governance affect their ability to provide timely and adequate credit, offering policy recommendations to strengthen institutional frameworks and enhance credit access. The study investigates the relationship between institutional credit availability and agricultural productivity, demonstrating that stronger institutions lead to better credit outcomes, positively affecting farmers' productivity and income levels. The research incorporates empirical data to illustrate the effectiveness of different institutional arrangements in facilitating agricultural credit, aligning with institutional theory's focus on the importance of context-specific institutional characteristics.

Gulati and Juneja (2020) provided a detailed examination of the transformative impact of mechanisation in Indian agriculture, driven by access to long-term credit. Their study utilised Ordinary Least Squares (OLS) regression models to analyse data across states, demonstrating that access to credit for mechanisation, particularly for tractors and irrigation infrastructure, significantly boosted productivity in food grains, especially in Punjab and Haryana.

Reddy and Dutta (2018) Investigated the relationship between agricultural inputs and agricultural GDP in India from 1980-1981 to 2015-2016 using Simple Regression Analysis. To enhance predictive accuracy, minimise error terms and mitigate omitted variable bias, the authors incorporated a wide range of control variables. Their findings indicate that factors such as net irrigated areas and fertilizers are not statistically significant, suggesting they have no discernible impact on agricultural GDP during this period. Conversely, the study identifies several variables such as seeds, electricity, rainfall and pesticides, as statistically significant contributors to agricultural GDP. The results conclude that these factors play a substantial role in influencing agricultural output, with both seeds and rainfall positively affecting agricultural GDP.

Mohapatra *et al*., (2017), in their article, examine the background and significance of agricultural finance in India, evaluating advancements in the agriculture sector while investigating the sources and levels of investment. The authors argue that agricultural financing is as crucial as any other production input. Their study explores both institutional and non-institutional sources of credit, emphasising the essential role of institutional frameworks in facilitating agricultural finance. Based on the literature reviewed, the authors conclude that there has been an increase in institutional credit disbursement and outstanding debt for agricultural and related sectors. Additionally, both the proportion of long-term loans and the ratio of agricultural credit to agricultural GDP are on the rise. The study aims to contribute to ongoing discussions regarding the importance of agricultural financing in developing countries and highlights the role of institutional structures in enabling farmers to access credit effectively.

Khan *et al*., (2017) present a comprehensive analysis of the complex interplay between rural development and agricultural credit in India. Utilising a Vector Error Correction Model (VECM), they investigate both short- and long-term causal relationships between these two critical variables. Their findings indicate a robust correlation between agricultural financing and agricultural growth, revealing that India's agricultural GDP has consistently shown a positive association with agricultural credit. Notably, the study concludes that while agricultural GDP does not drive agricultural credit, it is the latter that significantly influences agricultural growth in the short term. This underscores the potential of agricultural financing as a vital driver for expansion in the sector, particularly in developing nations. Enhanced access to financial resources can substantially support improvements in agricultural output and foster economic growth within rural communities. They reiterate the necessity of addressing the supply side of agricultural lending, emphasising that equitable access to affordable credit is essential for fostering inclusive growth and alleviating poverty. The study advocates for comprehensive lending policies

that prioritise the needs of small and marginal farmers. The implications of this research are significant for both financial institutions and policymakers, as it emphasises how strategic agricultural financing can stimulate economic development and promote growth in rural areas.

Singariya and Naval's (2016) study provides a comprehensive examination of the interconnections among various sectors of the Indian economy using time series data from 1950-51 to 2011-12. Employing multiple econometric techniques like stationarity tests, Johansen's cointegration test and the VECM they elucidate the dynamic relationships between these sectors and their impact on India's economic growth. Notably, it identifies reciprocal causal relationships between GDP and the agricultural, industrial and services sectors, highlighting their interdependence. A significant contribution of this study is its assertion that the agricultural sector plays a pivotal role in shaping overall economic growth. Furthermore, it reveals that GDP has a substantial long-term influence on agriculture, suggesting that broader economic advancements create favourable conditions for agricultural success. This long-term effect is likely linked to improvements in infrastructure, technology adoption, and increased investments driven by overall economic development, which collectively enhance agricultural productivity. Overall, Singariya and Naval's analysis deepens our understanding of inter-sectoral linkages within India's economy and underscores the critical role of agriculture in facilitating economic growth through its interactions with other sectors

Yadav and Sharma (2015), in their research article, provide a thorough review of 110 studies on agricultural credit in developing economies, spanning the years 1995 to 2015. It underscores the vital importance of financing for small and marginal farmers, who often struggle to obtain timely access to institutional credit. The authors organise the literature according to various factors, such as geographical focus, methodology, and key themes, including determinants of credit access, gender-related issues, repayment challenges and the effects of credit on agricultural productivity. Despite increasing attention from policymakers and researchers due to concerns about food security and population growth, the continued reliance on non-institutional credit sources remains a significant obstacle for many farmers. The study calls for effective policy interventions to enhance credit access for vulnerable groups and suggests future research directions, including the sustainability of microfinance institutions and the integration of various credit sources. Overall, the literature emphasises the importance of addressing the constraints within agricultural credit systems to boost productivity and improve livelihoods in developing economies.

The research conducted by Narayanan (2016) explores the relationship between formal agricultural credit and agricultural GDP in India. Published in an agricultural economics journal, this study focuses on the influence of credit on agricultural growth during a period marked by slow growth in agricultural GDP and declining profitability in traditional crop sectors. Despite significant policy interventions including increased credit access, debt forgiveness and lowered interest rates, the effects of these measures on the sector's growth remain inadequately understood. The findings indicate that a 10% increase in institutional credit flow is associated with a 2.1% rise in agricultural GDP. However, there is limited evidence to support the claim that lending has a substantial impact on agricultural GDP. The data suggests that factors other than labour and fertilizers, such as the sectoral mix and output prices, exert a greater influence on agricultural GDP. These results imply that while credit may facilitate the use of purchased inputs and modify input composition, it has not had a corresponding effect on agricultural GDP in India.

The study conducted by Das *et al*., (2009) provides valuable insights into the relationship between agricultural finance and agricultural production, which is characterised by volatility. Utilising dynamic panel data analysis with instrumental variables, they reveal that agricultural output is positively and significantly influenced by direct loans for agriculture, with effects observed almost immediately. This finding aligns with existing literature, which suggests that access to credit enables farmers to obtain essential inputs such as seeds,

fertilizers, and machinery, all of which are critical for enhancing productivity. By facilitating the acquisition of these inputs, direct credit alleviates liquidity constraints faced by farmers, leading to improved yields and agricultural practices. Additionally, they emphasise the role of indirect agricultural credit, consistent with the perspective that such credit often supports investments in agricultural infrastructure and input supply chains, which may take longer to manifest in increased productivity. Overall, the empirical evidence presented enhances our understanding of the crucial role that agricultural finance plays in boosting agricultural output in India.

Gulati and Bathla (2002) applied the Institutional Credit Theory to analyse the dynamics of agricultural credit systems in India. Focusing on RFIs, they examined factors influencing credit availability, default rates, and Non-Performing Assets (NPAs). The authors evaluated the performance of various RFIs, finding that despite significant growth in deposits and loans, defaults had also increased. They identified several internal and external factors contributing to defaults, including natural calamities, inadequate income generation, high transaction costs and poor operational efficiency of RFIs. Consistent with the Institutional Credit Theory, these findings highlight the impact of institutional dynamics on credit outcomes. To address these challenges, the study proposed policy measures aimed at revitalising RFIs and strengthening institutional frameworks to improve credit management and loan recovery rates. Through a temporal analysis of deposits, loans and defaults across Indian states, the authors provided empirical evidence supporting the importance of institutional factors in shaping agricultural credit systems. Overall, the work demonstrates the applicability of the Institutional Credit Theory in understanding the complexities of agricultural credit in India and underscores the need for robust institutional frameworks to support sustainable agricultural financing.

Binswanger and Khandker, (1995) in their study, applying the Supply-Led Credit Theory, examined the impact of credit on agricultural productivity in rural India. Their findings revealed a significant positive correlation between increased credit supply and investment in agricultural assets, leading to notable productivity gains in both agricultural and non-farm sectors. The study highlighted the particularly strong impact of credit on non-farm activities, suggesting a substantial undersupply of credit in rural areas. This undersupply hinders farmers' ability to invest and improve productivity. The study emphasised the effectiveness of targeting credit to poorer farmers as a strategy for increasing incomes and reducing poverty. The study's empirical evidence strongly supports the Supply-Led Credit Theory, demonstrating that expanding access to credit can stimulate investment and foster productivity growth in rural economies. The results underscore the importance of implementing supply-led credit policies to promote agricultural development and alleviate poverty in rural regions. By addressing credit constraints faced by farmers, policymakers can unlock significant productivity potential and enhance rural livelihoods.

4. International Comparisons and Global Context

The relationship between agricultural credit and productivity is not unique to India. It has been explored across several developing nations with varying outcomes. For instance, a study by Rehman *et al*., (2017) examines the correlation between Pakistan's agricultural GDP and variables such as crop acreage, fertilizer usage, credit distribution and water availability. Econometric methods such as the Cobb-Douglas Production Function, the Johansen co-integration test and the Phillips-Perron (P-P) and Augmented Dickey-Fuller (ADF) tests are used in the data analysis. Based on the findings, the Annual Gross Domestic Product (AGDP) is positively impacted by fertilizer use, better seed distribution and credit distribution and water availability has a small but negative impact. The report makes finance and policy recommendations for enhancing Pakistan's irrigation systems and water availability.

A case study by Arendonk (2015) contrasts the contribution of agriculture to GDP and employment in two affluent nations, the United States and the

Netherlands and two emerging nations, China and Indonesia. The study analyses the historical growth of agriculture in these countries and finds that the proportion of employment and GDP share of agriculture is declining. The author concludes that agribusiness is more important to the economy than primary agriculture, which is losing ground to it. This research offers a valuable perspective on how agriculture has changed in these countries in the face of economic globalisation and contributes to the ongoing discourse on the development of the agricultural sector. Top of Form

Saleem *et al*., (2011) explain that agriculture, a cornerstone of food security, livelihood, and ecological stability, is intrinsically linked to a nation's sovereignty. Pakistan, facing rising population density and dwindling agricultural land due to fragmentation and urbanisation, urgently needs to adopt advanced production technologies to meet domestic food demands. To facilitate this transition, the Pakistani government has been providing loans to small-scale farmers to support the adoption of capital-intensive agricultural technologies. This study aimed to investigate the impact of credit on the AAGDP in the D.I. Khan region. Data on credit disbursement from various formal sources for different agricultural inputs and AGDP of major crops were analysed using a Cobb-Douglas regression model. The results revealed that credit allocated for seeds, fertilisers and pesticides, irrigation and tractors had a significant positive correlation with AGDP, with coefficients of 0.87, 0.58, and 0.42, respectively. Overall, credit contributed to over 80% of the variation in AGDP, with a significant F-statistic of 10.752 ($p < 0.001$). Among the individual inputs, credit for seeds, fertilisers, and pesticides played a more prominent role in driving AGDP. In conclusion, the availability of credit has been instrumental in enhancing agricultural production in Pakistan.

Williamson's (1985) Institutional Credit Theory has profoundly influenced subsequent studies on agricultural credit systems by emphasising the critical role of institutions in determining credit availability and allocation. His focus on transaction costs has led researchers to examine how these costs associated with lending, monitoring and enforcing contracts affect farmers' access to credit and their investment behaviours. This perspective has enriched the understanding of various governance structures, such as cooperatives, microfinance institutions and formal banks and their effectiveness in supplying credit to agricultural sectors. Empirical studies inspired by Williamson's framework have provided evidence supporting the notion that stronger institutions lead to better credit outcomes and improved agricultural productivity. Overall, Williamson's Institutional Credit Theory has established a foundational understanding of the interplay between institutional dynamics and agricultural credit systems, guiding both academic research and policy formulation in this critical area of economic development.

Mellor (1966) applied the Supply-Led Credit Theory to examine the role of credit in enhancing agricultural productivity and fostering economic growth in developing countries. He argued that increasing access to credit is essential for enabling farmers to invest in critical agricultural inputs, such as seeds, fertilisers and machinery, which are necessary for improving output. Mellor emphasised the interconnectedness between agriculture and other economic sectors, asserting that agricultural growth could stimulate demand in non-farm sectors, thereby creating a multiplier effect that benefits the overall economy. Mellor believed that government investment in agricultural research and extension services would enhance the effectiveness of credit supply and complement private sector efforts. His empirical research demonstrated that access to credit could lead to substantial improvements in agricultural productivity, reinforcing the need for policies prioritizing credit access. His Supply-Led Credit Theory provided a robust framework for understanding how credit can catalyse agricultural transformation and drive economic development in developing nations. His insights continue to influence contemporary agricultural policy and development strategies.

5. Theoretical Framework

The theoretical foundations of agricultural credit and its influence on productivity can be elucidated

through various economic models. These models provide insights into the dynamics of credit markets, investment behaviour, and productivity improvements within the agricultural sector. This study employs two key frameworks: the Supply-Led Credit Theory and the Institutional Credit Theory. A detailed explanation of these theories is provided below.

The Supply-Led Credit Theory states that the availability of credit is a crucial driver of economic growth, particularly in the agricultural sector. This theory emphasises that increasing the supply of productive credit enables farmers and businesses to invest in essential inputs, such as modern technology and high-quality materials, which can significantly enhance productivity. By facilitating access to financial resources, credit acts as a catalyst for investment, leading to improved economic activity and growth. This theory underscores the pivotal role of financial access in transforming agricultural practices and fostering broader economic development.

The Institutional Credit Theory emphasises the importance of credit institutions and their policies in shaping the availability and allocation of credit within an economy. This theory posits that the structure, regulations and practices of credit institutions, such as banks and financial intermediaries, have a direct impact on economic growth and development. By emphasising the institutional framework within which credit operates, the Institutional Credit Theory provides a comprehensive perspective on the relationship between credit and economic outcomes. It highlights the importance of strengthening credit institutions and improving their policies to foster sustainable economic growth and development.

The examinations of the literature analysed in these inquiries accentuate the significance of both the above theories.

6. Growth of Agriculture in India

In 1950-51, the shares of Agriculture and allied sectors, Industry, and Services in India's total GDP were 51.81%, 14.16%, and 33.25%, respectively. By 2013-14, the Agriculture share declined to 18.20%, while the Services sector increased to 57.03%, and the Industry sector rose to 24.77% (Mandi et al., 2022). A key component in the growth of the Indian economy is agriculture. The nation's economy draws enormously from agriculture. At 2011–12 prices, Agriculture and Allied Gross Value Added (GVA) made up 14.4% of total GVA in 2018–19. In 2020–21, it continued to grow at a rate of 3% despite the pandemic (Pocket Book of Agricultural Statistics, 2020). The share of India's agricultural exports in the world agricultural trade in 2019-20 was 11.4 per cent. Agricultural exports as a percentage of agricultural GDP were 9.90% during 2015-16. Agriculture is the prime sector of the country's rural economy and rural employment proves that the total workforce of the country is dependent on it. Hence agricultural development is essential for economic development through rural development and poverty alleviation through employment generation.

Figure 1 depicts the trends in India's GDP and Annual Average Growth Rate of Agricultural and Allied Gross

Table 2. Table showing total GDP and GDP of agriculture and allied activity

Year	Total GDP (Rs in Cr) at 2004-05 price	AAGDP (Rs Cr at 2004-05 Prices)
1992	1367171.036	390200.7204
1993	1440503.925	416152.9968
1994	1522343.645	429980.5409
1995	1619694.475	450258.3378
1996	1737740.933	447127.3445
1997	1876319.275	491483.7151
1998	1957031.948	478932.5586
1999	2087828.107	509203.2729
2000	2246275.52	522794.5567
2001	2342774.224	522754.7294
2002	2472051.974	554157.0743
2003	2570689.825	517559.2416
2004	2777813.093	564391.0096
2005	2971464	565426
2006	3253072.966	594487
2007	3564363.838	619190
2008	3896636.409	655080
2009	4158675.948	655689
2010	4516071	660987
2011	4937006	713477

Source: RBI Database and Unit in Rs. Cr.

Domestic Product (AAGDP) from 1991-92 to 2010-11 (Table 2). Both GDP and AAGDP have exhibited a steady upward trajectory over the period. This suggests a consistent growth in the Indian economy. However, there are noticeable fluctuations in the AAGDP, indicating periods of accelerated or decelerated growth. For instance, the AAGDP experienced a significant increase between 1996-97 and 1997-98, followed by a slight dip. Overall, the chart reveals a positive trend in India's economic growth, with GDP steadily increasing and AAGDP fluctuating but generally maintaining an upward direction (Figure 1).

The relationship between GDP and AAGDP is also evident in the chart. As GDP increases, AAGDP tends to follow a similar trend, suggesting a strong correlation between the two. This indicates that the overall economic growth is driving the growth rate of the economy. However, there are instances where AAGDP fluctuates more significantly than GDP, suggesting factors other than overall economic growth are influencing the growth rate. A major factor in the nation's economic transition is agriculture. Throughout the many stages of economic development, from high mass consumption to traditional society, agriculture plays a major role. Early industrialisation requires the participation of agriculture to supply food, raw materials, and financial surplus (including foreign exchange) for investment (Johnston & Mellor, 1961).

7. Short Term and Medium/ Long Term Credit by Commercial Banks to Agriculture and Allied sector

Credit supply is an important determinant of investment in agriculture (Ramakumar, 2011). A vital component of agricultural output and a significant force behind economic change is agricultural financing. In India, it has been essential for boosting agricultural output. There is a major loss of GDP when huge portions of the population are left out of fundamental banking services (Yadav & Sharma, 2015). Three categories exist for agricultural financing: crop loans, or short-term credit; medium-term credit; and long-term credit. One-month loans with short terms are used to pay for supplies like seeds, fertiliser, labour, cattle feed, etc. Loans with terms varying from 15 months to 5 years are available for costs associated with making improvements to the property, drilling wells and buying farm equipment, livestock and tools. Extended financing, lasting more than five years, is offered for projects that need significant capital outlays. Only land development banks provide long-term financing. Enough financing must be available to support the expansion of the

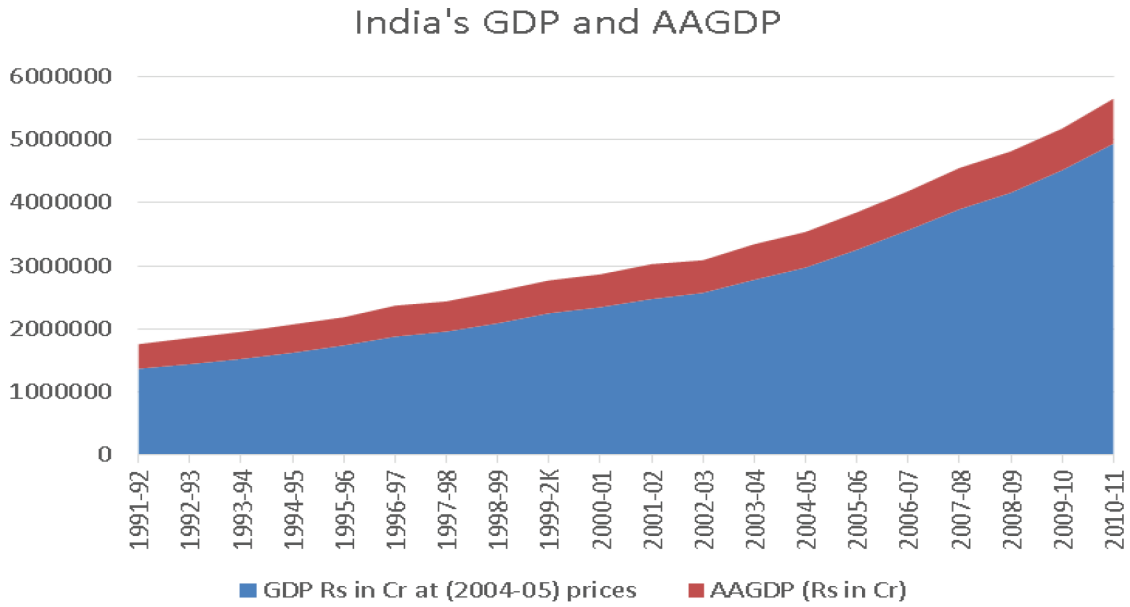

Figure 1. Chart showing the share of agricultural and allied sectors in India's GDP.
Source: Handbook of Indian Statistics, RBI Database

agricultural industry, both in terms of cost and quality (Nagaraju, 2018).

The Indian rural credit delivery system is a complex web that includes non-banking financial institutions, cooperatives, commercial banks, regional rural banks, self-help organisations and unofficial lending sources. These organisations are essential to rural development in addition to acting as financial middlemen. Data analysis reveals a growth rate of 4.70% in production credit from 2012 to 2021, while medium and long-term credit witnessed a growth rate of 16.38%. Regional rural banks have been the dominant players in production credit during this period, with a growth rate of 10.30%. Cooperatives, while closely following the production credit supply, exhibited negative growth in medium and long-term credit. Commercial banks have emerged as the leading providers of medium and long-term credit, with a growth rate of 17.08% (Pocket Book of Agriculture Statistics, 2019).

8. Policy Initiatives for Increasing the Flow of Credit

Formal financial institutions have prioritised lending to the agricultural sector since the 1980s to make sure that impoverished areas and communities are not left out of the process of rural and agricultural development (Nagaraju, 2018). The primary policy innovation post-nationalisation was the introduction of the priority sector credit, a pivotal move in the farming and rural arena as the cooperative framework failed to attain its goals. The financial arena possessed the capability to fulfil the credit needs of agriculturists, thus, farming was designated a priority sector, entailing a duty on banking entities to furnish loans for farming and related endeavours (Gulati & Juneja, 2019). To increase the amount of credit available to agriculture, the Indian government has launched several initiatives. The Self Help Group (SHG) - Bank linkage program, a cooperative approach including SHGs, banks, and Non- Governmental Organisations (NGOs), was the subject of a 1992–1993 NABARD pilot study. To provide farmers with easy access to loans, the Kisan credit card was launched. The Ground Level Credit program was implemented by the Union Government in 2003–2004. Under this policy, banks were expected to reach annual targets for agricultural and allied activities in the Union Budget, with goals broken down by region, agency and loan category. The Interest Subvention Scheme was implemented in 2006-07, offering farmers a short-term crop loan of up to Rs 3 lakh for one year at a subsidised interest rate of 7 per cent per annum, reducing to 4 per cent with timely repayment.

To mitigate the debt burden on farmers, the Indian government implemented the Agriculture Debt Waiver and Debt Relief Scheme in 2008. In addition to offering other farmers a 25% rebate and a one-time settlement opportunity, this initiative completely erased the debt of small farmers. To encourage prompt repayment of debts, the government launched the Prompt Repayment Incentive in 2010. Based on the recommendations of the Internal Working Committee, the priority sector lending rules were updated in 2015. The difference between direct and indirect agricultural credit was removed in this version, and lending to small and marginal farmers was given an 8% target. Financing for agricultural operations replaced the previous focus of financing the agriculture industry (Internal Committee on Agriculture Credit, 2019).

9. Agriculture Inputs in India

India, the seventh-largest country worldwide, possesses a total land area of 328 million hectares. Approximately 50% of this land is arable, with 42.6% currently utilised for agricultural purposes. Irrigation, covering 48.7% of the cultivated area, contributing significantly to the Indian economy was valued at USD 524.7 billion in fiscal year 2017-18. Access to irrigation water substantially impacts crop yield. In India, crop intensity increased from 123.1% in 1980-1981 to 143.6% in 2015-2016. Fertiliser consumption, Nitrogen, Phosphorus and Potassium (NPK) rose from 2.17 kg/ha in 1960-1961 to 134 kg/ha in 2018-2019. From 1971 to 2011, the total workforce expanded from 180.7 million to 481.7 million, with a corresponding increase in agricultural workers from 125.7 million to 263.1 million (Chand *et al*., 2021).

India's vast agricultural sector encompasses 166 million hectares of farmable land. Mechanisation is vital for enhancing production efficiency, reducing labour costs and improving crop quality, thereby contributing significantly to the country's agricultural output. Farm mechanisation in India has surged, leading to the development of innovative agricultural tools. In India, 88% of farm power comes from tractors, diesel engine pump sets, electric pump sets and power tillers. This country had a shift from traditional to mechanical procedures between the mid-20th century and 2013–2014 (Gulati & Juneja, 2020). This has significantly boosted productivity, contributed positively to employment growth and supported food production for the growing population. The availability of farm power, from various sources like tractors and power tillers, has increased notably over the years, contributing to India's agricultural modernisation. The overall effect of agricultural mechanisation on the agriculture sector in India has been substantial. It has led to increased productivity and production, reduced drudgery, enhanced efficiency and facilitated sustainable multi-cropping and timely planting of crops. Additionally, it has positively impacted employment growth in rural areas by providing opportunities for various professionals (Dhruw *et al*., 2024).

Agricultural growth plays a pivotal role in economic development. It stimulates other sectors through forward linkages (providing inputs like food and raw materials), backward linkages (demanding industrial products), inter-sectoral transfers (contributing taxes and labour) and foreign exchange earnings from exports. These interconnected effects highlight agriculture's crucial role in driving overall economic growth. Fertilisers, net irrigated areas, pesticides, power, rainfall and seeds are used as variables in a regression analysis to examine how important agricultural inputs affect GDP performance. The results of this study showed that whereas pesticides, electricity, rainfall and seeds have statistically significant effects, fertilisers and net designated areas have less impact. (Reddy & Dutta, 2018). While all other agriculture inputs are used as variables, we have selected GDP as the dependent variable and credit (short and long), seeds, fertiliser, pesticides, tractors, power tillers and electricity consumption as the independent variables.

Agricultural investment, measured by Gross Capital Formation in Agriculture (GCFA), has witnessed a significant increase in India. GCFA encompasses investments in fixed assets such as land, structures and equipment, as well as other forms of capital. The Indian government has implemented various initiatives and programs to enhance the agriculture industry, leading to a surge in GCFA. These efforts have resulted in a higher allocation of resources from both government and private sectors towards agriculture, as evidenced by the increased share of GCFA in the Gross Domestic Product of Agriculture (GDPA). The GCFA as a percentage of GDPA has risen from 7.8% in 1980-1981 to 13.7% in 2017-2018 (Chand *et al*., 2021).

The mechanisation of agriculture, marked by the substitution of manual labour and animal power with machinery, has been a pivotal factor in the transformation of Indian agriculture from traditional to industrialised practices. The reliance on human and animal labour in agriculture and related activities has significantly declined from 97.4% in 1951 to 66% in 1971 and 12% in 2013-14 (most recent data available). Concurrently, the utilisation of mechanical and electrical sources has witnessed a substantial increase from 2.6% in 1951 to 34% in 1971 and 88% in 2013-14. Tractors have played a dominant role, accounting for nearly half of the total farm power at 48% in 2013-14 (Chand *et al*., 2021). In the early 1950s, the utilisation of pesticides was scarce, yet by the mid-1960s it experienced a remarkable surge. The consumption of pesticides in 1970-1971 was approximately 24.3 thousand tons, while in 2014-2015, it had escalated to 57.4 thousand tons.

10. Evaluating the Applicability of Supply-Led Credit Theory and Institutional Credit Theory

Based on the study objectives, the following hypotheses have been formulated to evaluate the applicability of Supply-Led Credit Theory and Institutional Credit Theory.

Hypothesis

- H0: There is no significant relationship between the independent variable credit and dependent variable GDP
- H1: There is a significant relationship between the independent variable credit and dependent variable GDP

The Multi Linear Regression Model is used to test the above hypothesis to describe the relationship between the independent (direct institutional credit to agricultural and allied services (short-term and long-term) and dependent variables (AAGDP). (Table 3). The output is a summary of a linear regression analysis (Table 4) the Multiple R (0.899) indicates a strong positive correlation between credit and AAGDP, with an R-squared value of 0.808, explaining 80.8% of the variance in AAGDP. Based on the given summary output (Table 4), the results of the hypothesis test indicate that there is a significant relationship between the "credit" and the "AAGDP". The P-value (7.07859E-08) is less than the level of significance (usually set at 0.05), which indicates that there is evidence to support the alternative hypothesis (H1) rather than the null hypothesis (H0). This implies that, for the duration of the study, there is a substantial link between credit and AAGDP.

Adjusted R Square: Like R Square, but adjusted for the number of independent variables, a value of 0.798 indicates that credit along with other variables explains 79.8% of the variation in GDP.

The values of R squared (0.8085) and adjusted R squared (0.7978) justify that further hypothesis testing is required to find out other variables impacting the GDP. A test is applied using seeds, fertilisers, pesticides, tractors, power tillers and electricity consumption is considered along with the credit. The following hypothesis is set for the purpose.

Both theories would seem to hold in this scenario. The high R-squared and significant P-value imply that credit, especially institutional credit, has a substantial effect on AAGDP. This suggests that as credit supply increases, agricultural output also increases, aligning with both theories.

Table 3. Table showing AAGDP and direct institutional credit by scheduled commercial banks to agriculture and allied services*

Year	Credit o/s (Rs in Cr)	AAGDP (Rs Cr at 2004-05 Prices)
1992	16981	390201
1993	18288	416153
1994	19113	429981
1995	20920	450258
1996	23427	447127
1997	26327	491484
1998	28445	478933
1999	29819	509203
2000	33442	522795
2001	38270	522755
2002	45106	554157
2003	53804	517559
2004	68103	564391
2005	95519	565426
2006	135603	594487
2007	169018	619190
2008	202796	655080
2009	256119	655689
2010	315436	660987
2011	357584	713477

Source: RBI Database. Unit in Rs. Cr.

Table 4. Regression statistics

Measurement	Multiple R	R Square	Adj. R Square	Std. Error	Observation
Value	0.8991	0.8085	0.79781	40828.74	20

Anova:

Source	df	SS	MS	F	Significance F
Regression	1	1.27E+11	1.27E+11	75.9708532	7.08E-08
Residual	18	3.00E+10	1.67E+09		
Total	19	1.57E+11			

Coefficient:

Variables	Coefficient	Std. Error	t Stat	P-Value	Lower 95%	Upper 95%
Intercept	5E+05	12534.266	36.9475219	2.00E-18	436776.566	489443.599
Credit (Short and Long)	0.766	0.0878992	8.71612604	7.08E-08	0.58147113	0.95080985

11. Implications for Theories in the Expanded Hypothesis

The initial regression (Table 4) strongly supports both the Supply-led credit theory and the Institutional credit theory, showing a strong and significant relationship between credit and AAGDP. The value of Multiple R of 0.899 indicates a strong positive correlation between credit and Agricultural GDP (AAGDP), implying that as credit increases, AAGDP tends to increase as well.

While the Supply-Led Credit theory suggests that credit supply boosts economic output, the insignificance of credit (Table 5) in the expanded model suggests that the effect of credit diminishes when combined with other variables such as seeds, fertilisers, etc. Therefore, in this multi-factor environment, the supply-led credit theory is only partially supported. The insignificance of credit (P-value = 0.3612) suggests that institutional credit alone does not drive AAGDP significantly when other inputs (like seeds and fertilisers) are considered. This indicates that institutional credit's impact is context-dependent and may require complementary inputs to drive significant growth.

Hypothesis

- H0: There is no significant relationship between the independent variables (credit, seed, fertilisers, pesticides, tractors, power tillers, electricity) and the dependent variable (AAGDP).
- H1: There is a significant relationship between the independent variables (credit, seed, fertiliser, pesticides, tractors, power tillers, electricity) and the dependent variable (AAGDP).

The summary output (Table 5) shows the results of a regression analysis of AAGDP as the dependent variable and credit (short and long), seeds, fertiliser, pesticides, tractors, power tillers, and electricity consumption as the independent variables. The Multiple R-values of 0.9891 indicate a strong positive relationship between the independent and dependent variables. The R-squared value of 0.9784 suggests that 97.8% of the variation in AAGDP can be explained by the independent variables. The summary output also indicates that there is a significant relationship between the independent variables and the dependent variable. However, the P-value for credit (0.3612) indicates that the credit alone is not statistically significant when considering these other variables.

The coefficients table shows the relationship between the independent variables (credit, seed, fertilisers, pesticides, tractors, power tillers and electricity) and the dependent variable (AAGDP) in a multiple linear regression model. The values in the table can be interpreted as follows:

Agriculture GDP = β1+ β 2 Credit+ β3 Seeds+ β4 Fertilisers+ β 5 Pesticides + β6

Tractors + β7 Power Tillers + β8 Electricity + μ

Based on the above outcome the following regression equation is formed to get the required agricultural GDP:

Agriculture GDP = 451129.7 + 0.349888 * Credit (Short and Long) - 770.855 * Seeds + 614.3656 * Total N+P+K (Lakh Tonne) – 2224.54 * (Consumption of Pesticides (000's Tonne)) + 8.156734* Tractors + 4193.605 * Power Tillers + 0.916424* (Electricity Consumption (GWH)) + μ

However, in the expanded model (Table 5), the significance of credit diminishes, indicating that credit alone is not the primary driver of AAGDP when other factors (e.g., seeds, and fertilisers) are considered. This suggests that institutional credit must be supplemented with other agricultural inputs to drive growth effectively, making institutional credit theory less dominant in a multi-variable context.

Table 5. Regression statistics

Measurement	Multiple R	R Square	Adj. R Square	Std. Error	Observation
Value	0.9891	0.9784	0.9657	16809	20

Anova:

Source	df	SS	MS	F	Significance F
Regression	7	1.53257E+11	2.19E+10	77.48	4.89137E-09
Residual	12	3.39E+09	2.83E+08		
Total	19	1.57E+11			

Coefficient:

GDP	Coefficient	Std. Error	t Stat	P-Value	Lower 95%	Upper 95%	Lower 95%	Upper 95%
Intercept	451129.74	201125.17	2.24	0.05	12915.65	889343.84	12915.65	889343.84
Credit (Short and Long)	0.3499	0.3686	0.9493	0.3612	-0.4532	1.1529	-0.4532	1.15
Seeds	-770.8553	497.6329	-1.549	0.1473	-1855.10	313.39	-1855.10	313.39
Total NPK (Lakh tonne)	614.37	859.22	0.7150	0.4883	-1257.72	2486.45	-1257.72	2486.45
Consumption-Pesticides (000's Tonne)	-2224.54	1296.61	-1.72	0.11	-5049.61	600.52	-5049.61	600.52
Tractors	8.16	180.64	0.045	0.97	-385.43	401.75	-385.43	401.75
Power Tillers	4193.61	2959.73	1.42	0.18	-2255.08	10642.29	-2255.08	10642.29
Electricity Consumption (GWH)	0.92	0.78	1.17	0.26	-0.79	2.62	-0.79	2.62

12. Conclusion

The summary results of the linear regression analysis (Table 4) reveal a strong correlation of 0.899 between the variables, indicating a significant relationship between credit and AAGDP during the study period. This finding supports the validity of both theories in this context. The high R-squared value and significant P-value suggest that credit, particularly institutional credit, exerts a substantial and meaningful impact on AAGDP. Therefore, as the supply of credit increases, agricultural output is likely to rise, which aligns with the predictions of both theories.

The regression analysis (Table 5), as evidenced by the high R-squared values (0.989 and 0.9778), demonstrates a strong correlation between the independent variables (credit, seeds, fertilisers, pesticides, tractors, power tillers and electricity) and the dependent variable (AAGDP). However, the study suggests that while credit may not directly drive AAGDP growth in the agricultural sector, other factors such as efficient input utilisation (fertilisers, seeds), sustainable practices (pesticides) and mechanisation play crucial roles. While the Supply-Led Credit Theory asserts that an increase in credit supply leads to enhanced economic output, the insignificance of credit in the expanded model (as indicated in Table 5) implies that its effect is diminished when analysed alongside other variables such as seeds and fertilisers. Therefore, in this multi-factor framework, the support for the Supply-Led Credit Theory is only partial. The lack of significance of credit (P-value = 0.3612) suggests that institutional credit does not have a meaningful impact on agricultural GDP (AAGDP) when other inputs are considered. This finding indicates that the influence of institutional credit is context-dependent and may require the presence of complementary inputs to drive significant growth.

The negative coefficient for seeds (-770.8553) (Table 5) suggests that increased seed usage might be associated with lower AAGDP due to factors like overproduction or inefficient use of seeds. In contrast, the positive coefficient for fertilisers (614.37) indicates that increased fertiliser use is correlated with higher AAGDP, potentially attributed to improved crop yields or increased productivity. The negative coefficient for pesticides (-2224.54) suggests a potential link between increased pesticide use and lower AAGDP, possibly due to environmental damage or health risks. As the economy develops, there might be a shift towards more sustainable agricultural practices that reduce pesticide dependence, supporting policies aimed at promoting organic farming or stricter pesticide regulations. The positive coefficients for tractors (8.16) and power tillers (4193.61) highlight the association between increased mechanisation and higher AAGDP, potentially due to enhanced efficiency or reduced labour costs. Similarly, the positive coefficient for electricity consumption (0.92) suggests a correlation with higher AAGDP, possibly attributed to increased industrial activity or improved agricultural practices.

To enhance agricultural productivity and ensure sustainable growth, policy interventions should focus on promoting efficient input use, supporting mechanization, investing in rural infrastructure and addressing environmental concerns. Specifically, policies could provide training and education to farmers

on the effective use of fertilisers, seeds and pesticides. Government subsidies or incentives for the purchase of tractors and power tillers could encourage mechanisation. Investments in rural infrastructure, such as electricity and irrigation, can help improve agricultural productivity and boost AAGDP. Finally, policies should address the environmental impacts of agricultural practices, such as pesticide use, to ensure sustainable growth.

The 2011 data and findings, while valuable, may have limitations due to time lag, data quality, policy changes and the evolving economic context. Despite these limitations, the 2011 data can still provide valuable insights for current research by serving as a baseline for understanding historical trends and informing the development of theoretical frameworks and hypotheses. The findings might also remain relevant for policymakers seeking to understand long-term trends and potential challenges in the agricultural sector. Furthermore, the 2011 data can be used as a benchmark to assess the impact of recent policy changes and economic developments on the agricultural sector. Additionally, the insights gained from the 2011 analysis can help identify areas where further research is needed to address the evolving challenges and opportunities in agriculture. The government has initiated many policy changes to address the above challenges in this decade. The NITI Aayog report projects a significant increase in demand for agricultural inputs in India by 2047-48. This has paved the way for further research to analyse the implications of the above policies.

While credit plays a role in driving agricultural growth, it must be supplemented by other inputs such as fertilisers, modern machinery and infrastructure to have a more meaningful impact on agricultural GDP. To better understand the factors influencing AAGDP, future studies should consider additional variables such as net sown area, irrigation facilities, cropping intensity, agricultural product prices and market infrastructure. These could provide a more comprehensive view of the interplay between credit and agricultural productivity.

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