Research Journal of Humanities and Social Sciences
(An Open Access International Peer Reviewed Journal)
ISSN: 2945-3968

Research Article

Is the Agriculture Productivity in India Determined by Government Expenditure? Shreds of Evidence from Standard

Nisar Ahmed[1], Mohammad Rehan[2], Mohammad Afsar Alam[3], Nazim Khan[4], Muzafar Husain[5]
[1]Assistant Professor, Department of Geography, B N Jalan College, Sisai (Ranchi University)
[2]Assistant Professor, Department of Adult and Continuing Education and Extension, Jamia Millia Islamia, New Delhi,
[3]Associate professor, Department of Geography, Jamia Millia Islamia, New Delhi, India
ORCID ID: https://orcid.org/0000-0001-5989-6399
[4]Department of Geography, Zakia Afaque Islamia, College, Siwan (Affiliated to Jai Prakash University, Chapra), Bihar, India, ORCID ID: https://orcid.org/0000-0003-4490-6085
[5] TGT (Social Sciences), SBV Madanpur Khadar, New Delhi

Abstract: This study is a gentle attempt to analyse the role of governmental expenditure tostimulate the cultivational productivity in India from 1990-1991 to 2020-2021. The data is obtained from the various sources of the National Statistical Account, Government of India and World Bank. The Autoregressive Distributed Lag (ARDL) model has been used to achieve the goal. The model of Dynamic Ordinary Least Square (DOLS)is used in this study to test the resilience of the ARDL model. The results received from the ARDL model indicate that both the short- and long-run outcomes display that the increased government expenditure on agriculture sectors has evidently stimulated India's agricultural productivity. Furthermore, the agricultural labour force, gross cropped area and the economic growth have shown a few positive and number of significant impacts on agricultural productivity. In this regard, the results that we got from this study, would require sincere commitment, engagement and proper strategies on behalf of the Government of India to nurture agricultural productivity in aiming to meet the growing demand for food, reduce dependence on imports, increase rural incomes and create employment opportunities in the agricultural sector. The study recommends that the government should prioritize this issue very fast and work out a national productivity in policy to increase the share of government expenditure in agriculture. Unmistakably, such an analysis will allow the policymakers to set up well-planned environmental and fiscal policies to manage the desired outcomes. The pertinent emphases of future research are also available in this study.
Keywords: Government Expenditure; Agricultural Labour Force; Gross Cropped Area; Economic Growth; Agricultural Productivity and ARDL model.

How to cite this article: Ahmed N, Rehan M , Alam MF, Khan N, Husain M. Is the Agriculture Productivity in India Determined by Government Expenditure? Shreds of Evidence from Standard ARDL Modelling. **Research Journal of Humanities and Social Sciences.2026 April 28, 5(2):12-29**
Source of support: Nil.
Conflict of interest: None
DOI: doi.org/10.58924/rjhss.v5.iss2.p2

1. Introduction

In most emerging economies, the agricultural sector is considered a key driver of economic growth. Consequently, the sector undergoes periodic structural and size-related changes to adapt to the evolving economic landscape (Anwar et al., 2015; Sertoglu et al., 2017; Hongdou et al., 2018; Gokmenoglu et al., 2018; Ullah et al., 2018; Bansal et al., 2021; Aman, 2023).

Since the early 19th century, India's agricultural sector has witnessed significant shifts in its size, structure, and output composition (Onder et al., 2011; Awokuse et al., 2015; Liu et al., 2017; Agboola et al., 2022). Over the years, the sector has played a substantial role in driving India's economic growth, contributing significantly to the country's GDP (Patra et al., 2017; Cagliarini et al., 2011; Mohammed et al., 2020; Baig et al., 2020).

Research Journal of Humanities and Social Sciences
(An Open Access International Peer Reviewed Journal)
ISSN: 2945-3968

Received: 10-02-2026
Revised: 12-02-2026
Accepted 27-03-2026
Published: 28-04-2026

For centuries, agriculture has been the backbone of India's economy, supporting millions of livelihoods and ensuring food security (Ceesay et al., 2022). Even in the present scenario, it remains a crucial sector for India's overall development and economic progress (Aman et al., 2023). Given its continued importance, the government and policymakers must prioritize agricultural development to ensure its sustainability and growth.

Contributions of Agriculture to India's Economic Development

1. **Employment Generation**: Agriculture has long been India's largest employment provider, engaging nearly 50% of the workforce. This is especially vital in a country where job creation in other sectors remains a challenge.
2. **Food Security**: Consistent agricultural production ensures a stable food supply for the nation. With India's population projected to reach 1.5 billion by 2030, ensuring adequate food production is of paramount importance.
3. **Exports and Foreign Exchange**: Agriculture significantly contributes to India's export economy. The country is the world's largest producer of spices, pulses, and millets, and ranks second in wheat, rice, and fruit production. Agricultural exports generate substantial foreign exchange earnings.
4. **Rural Development**: Agriculture is the foundation of rural India, and its growth is integral to reducing poverty and inequality in rural areas. Strengthening the sector can drive overall national development.
5. **Climate Change:**The agricultural sector plays a crucial role in mitigating climate change. India, being highly vulnerable to its effects, can benefit from adopting sustainable farming practices that help reduce greenhouse gas emissions, conserve biodiversity, and protect natural resources.

Plans, Policies and Programme to Promote Agriculture Productivity in India

The Government of India has introduced several plans and policies to support the agricultural sector, with substantial expenditure allocated at different phases. Below are some major initiatives along with their respective budget allocations:

1. **Green Revolution**: Launched in the mid-1960s, the Green Revolution aimed to enhance agricultural productivity and food production in India. During its initial phase, the government allocated approximately ₹50 crores (500 million) to this initiative.
2. **Rashtriya Krishi Vikas Yojana (RKVY)**: Introduced in 2007, RKVY provides financial assistance to state governments for agriculture and allied activities. During the 12th Five-Year Plan (2012-2017), the government allocated ₹7,118 crores (71.18 billion) for this scheme.
3. **Pradhan Mantri Fasal Bima Yojana (PMFBY)**: Launched in 2016, this scheme offers crop insurance to farmers. For the fiscal year 2022-23, the government allocated ₹16,000 crores (160 billion) to support PMFBY.
4. **Soil Health Card Scheme**: Introduced in 2015, this scheme aims to provide soil health cards to farmers, helping them assess soil quality and enhance productivity. For the fiscal year 2022-23, the government allocated ₹568.54 crores (5.68 billion) to this initiative.
5. **National Agriculture Market (eNAM)**: Launched in 2016, eNAM is a nationwide electronic trading platform for agricultural commodities, designed to improve market accessibility for farmers. In the fiscal year 2022-23, the government allocated ₹218 crores (2.18 billion) for this program.

These initiatives highlight the Indian government's ongoing commitment to agricultural growth and development. Over the years, the government has steadily increased its expenditure in this sector to ensure its sustainability and expansion.

Agriculture Development and Budget Allocation under Different Five-Year Plans in India

Major Budget Allocations for Agricultural Development in India's Five-Year Plans:

1. **First Five-Year Plan (1951-1956)**: The primary focus was on developing irrigation facilities, enhancing agricultural research, and increasing food production. Approximately ₹210 crores (2.1 billion) were allocated for agricultural development.
2. **Second Five-Year Plan (1956-1961)**: This plan aimed to initiate the Green Revolution by introducing high-yielding seed varieties, chemical fertilizers, and pesticides. A budget of around ₹427 crores (4.27 billion) was allocated to agricultural development.
3. **Third Five-Year Plan (1961-1966)**: Efforts were made to further boost food production and implement rural development programs. A total of ₹807 crores (8.07 billion) was allocated for agriculture.
4. **Fourth Five-Year Plan (1969-1974)**: This plan focused on enhancing small farmers' productivity and promoting modern agricultural technologies. Around ₹1,424 crores (14.24 billion) were allocated for agricultural development.
5. **Fifth Five-Year Plan (1974-1979)**: To sustain agricultural growth, the plan emphasized agro-based industries and rural employment. An allocation of ₹3,059 crores (30.59 billion) was made for agricultural development.
6. **Sixth Five-Year Plan (1980-1985)**: The focus was on sustainable agriculture and rural development. Around ₹7,367 crores (73.67 billion) were allocated to support these initiatives.
7. **Seventh Five-Year Plan (1985-1990)**: This plan aimed to promote technology transfer in agriculture and improve rural infrastructure. A budget of ₹12,537 crores (125.37 billion) was allocated for agricultural development.
8. **Eighth Five-Year Plan (1992-1997)**: The objective was to increase agricultural productivity and boost agricultural exports. Around ₹29,754 crores (297.54 billion) were allocated for agriculture.
9. **Ninth Five-Year Plan (1997-2002)**: The concept of sustainable agriculture was emphasized to improve rural infrastructure. Approximately ₹59,215 crores (592.15 billion) were allocated for agricultural development.
10. **Tenth Five-Year Plan (2002-2007)**: The focus was on agricultural diversification and improving productivity. Around ₹124,717 crores (1.24 trillion) were allocated for agricultural development.
11. **Eleventh Five-Year Plan (2007-2012)**: This plan continued efforts to promote agricultural growth and enhance rural livelihoods. A total of ₹281,300 crores (2.81 trillion) was allocated to the agricultural sector.
12. **Twelfth Five-Year Plan (2012-2017)**: The primary objectives included promoting sustainable agriculture, improving agricultural infrastructure, and increasing productivity. Approximately ₹457,000 crores (4.57 trillion) were allocated for agricultural development.

These budget allocations highlight the Indian government's ongoing commitment to strengthening agricultural development and fostering rural growth.

The study explores the effects of government expenditure on agriculture, agricultural productivity, economic growth, environmental sustainability, and population growth in India. It specifically examines the symmetric relationship between government spending on agriculture and agricultural productivity in the country. To ensure robust results, various control variables are incorporated into the model. The study aims to quantify how agricultural spending impacts productivity in India.The study is organized into five sections.Among them, Section II reviews the existing literature on the topic. Section III outlines the data sources, model specification, and the time-series econometric methods used for analysis. Section IV presents the empirical results and discusses their implications. Finally, Section V concludes with the findings and provides policy recommendations.

2. Literature Review

Government funding for agriculture plays a crucial role in promoting agricultural growth, shaping its distributional effects, and creating supportive policies. These relationships are thoroughly documented in research (Benin, 2011). However, to achieve these outcomes, several factors must be considered: adequate public expenditure, appropriate allocation of funds (such as for irrigation, subsidies for inputs, infrastructure, schooling, and healthcare), proper geographical distribution of resources to enhance distributional results and impacts, and a suitable balance between capital inflows and outflows (Ngobeni &Muchopa, 2022).

Evidence from Wagner (1876) suggests that public spending is an endogenous variable used to boost the economy rather than a driver of growth. Wagner (1876) also proposed that during economic development, the rate of public expenditure increases more rapidly than the rate of economic growth. Contrary to Keynesian theory, the causal relationship between public spending and economic growth flows from economic growth to public expenditure. This paper concurs with (Lencucha et al. 2020), asserting that developing the agricultural sector and its contribution to economic growth necessitates appropriate measures, such as government spending through fiscal policy, considering the evidence and understanding that sectoral growth contributes to overall economic growth. Increasing government expenditure on vital sectors like agriculture ultimately stimulates economic activity and job creation (Ernawati et al. 2021). The Keynesian school of thought, which posits that government spending plays a crucial role in fostering economic growth, can be used to justify increased government expenditure (Dynan and Sheiner, 2018). Keynesian theory supports the notion that rising government spending leads to increased domestic economic activity (Babatunde, 2018). Furthermore, government spending is considered the primary catalyst for economic development (Keynes, 1936) and is employed to address issues of economic stagnation. In contrast to Wagner's thesis, Keynesian theory considers government spending as an external tool that authorities employ to consistently manage economic growth (Selvanathan et al. 2021). Despite Moreno-Dodson's (2008) assertion that government spending may be ineffective, Keynes (1936) emphasized that increased government expenditure through fiscal policy would stimulate economic activity. The Maputo declaration on African agricultural funding exemplifies this principle, recommending that countries allocate up to 10% of their total budget to agriculture (Fontan Sers and Mughal, 2019). Furthermore, Makin (2015) supports the Keynesian Hypothesis by showing that higher government spending enhances a nation's output value. Atayi et al. (2020) define government expenditure in agriculture as all expenses incurred by the government in the agricultural sector. These expenses encompass extension services, crop gene banks, livestock, and agricultural research and development (Mogues and Anson, 2018).According to Rajesh et. al. (2020), government expenditure on agricultural resources and auxiliary services has more than tripled over the last eleven years, which is expected to indirectly boost rural earnings and narrow the urban-rural divide. The research identified disparities in the distribution of public funds for agriculture across different states, aiming to achieve fair growth in India's agricultural sector. The study also emphasizes the uneven allocation of public agricultural spending among states, indicating that future considerations are necessary to promote inclusive development in Indian agriculture.

Government spending plays a crucial role in driving economic growth, a principle strongly supported by the Keynesian school of thought, which advocates for increased public expenditure (Dynan & Sheiner, 2018).

Investment in crop husbandry has been shown to have a significant positive effect on Gross State Domestic Product (GSDP) growth. Conversely, public spending on forestry, dairy, and irrigation appears to have a negative impact. Despite the benefits of crop husbandry for economic growth, the state's shrinking landholdings necessitate stronger linkages with other sectors to sustain progress (De, U. K., 2018).

To alleviate rural poverty, the Indian government should prioritize increased investment in agricultural research and rural road development. These sectors not only enhance productivity more effectively than other public expenditures but also yield the highest impact on poverty reduction per rupee spent. In comparison, other investments—such as irrigation, soil and water conservation, healthcare, and rural community development—have relatively modest effects. However, government spending on education ranks third in terms of its positive influence on rural poverty alleviation and productivity growth (Fan et al., 2000).

Research also indicates that public investment is more effective than input subsidies in fostering agricultural development. Additionally, findings support the "crowding-in" hypothesis, which suggests that government and private investments complement each other in India's agricultural sector (Zafar & Tarique, 2023).

Dastagiri (2010) examines trends in government expenditure on animal husbandry, dairy farming, and overall agricultural investment in India. His study assesses the impact of such spending on livestock GDP growth and poverty reduction while proposing policy recommendations to boost investment in the livestock sector.

Similarly, De U. K. (2018) highlights that public expenditure on agriculture and allied sectors falls under economic services, covering multiple areas such as crop husbandry, soil and water conservation, animal husbandry, fisheries, forestry, agricultural research, education, and irrigation.

Selvaraj (1993) explores the declining share of agriculture in public finance, attributing it to planned advancements in agriculture, industrialization, and economic reforms. This trend, he argues, could negatively affect agricultural performance. He underscores the importance of government spending in shaping policies that support the sector's growth.
Another study analysing the impact of agricultural expenditure on economic growth, using descriptive statistics and econometric techniques, concludes that the current level and pattern of government spending in agriculture are insufficient to drive the desired economic growth. Instead, it recommends a sustained increase in domestic investment as a more effective strategy for economic prosperity (Megbowon et al., 2022).

A study utilizing secondary data and regression analysis examined the impact of government expenditure on agriculture and the Agricultural Credit Guarantee Scheme Fund on economic growth. The findings indicate that both variables have a positive and significant effect, with the explanatory variables collectively accounting for 71.3% of economic growth. The researchers recommend that the government diversify the economy and enhance the development of non-oil sectors, particularly agriculture. Additionally, collaboration with the private sector is advised to allocate funds for agricultural financing and to educate farmers on the availability of credit facilities (Agbana& Lubo, 2022).

Government spending on education has been found to significantly contribute to both short- and long-term economic growth. However, public expenditure on agriculture negatively affects long-term economic growth, while its short-term impact, though negative, remains considerable. Investment spending has a minor positive influence on economic growth in the long run but exerts a substantial negative effect in the short term. The study further suggests that prioritizing government expenditure in education can create favorable conditions for higher labor force participation, ultimately leading to greater economic growth (Mulugeta Emeru, G., 2023).

Ngobeni and Muchopa (2022) assert that government spending on agriculture can substantially enhance agricultural production. They also highlight the significance of additional factors, such as rainfall and population growth, in driving increased agricultural output.

Ramakumar et. al. (2022) use their analyses to draw the main conclusion so that in relation to the size of the sector in the aspect of the overall economy, the state spending on agriculture has been historicallyless. As a percentage of total public spending, this public spending on agriculture is likewise decreasing. Due to the substantial decline in union spending on agriculture as a part of agricultural Gross Value Added (GVA) proportion, the overall public expenditure on agriculture (Union + States) as a percentage of agricultural GVA has decreased between 2010–11 and 2019–20. Furthermore, state governments now shoulder most of the public spending on agriculture instead of the union government. This phenomenon has been occurredduring the GST regime and other such centralising policies are slowly but surely it has acted against the ethos ofIndia's overall federal structure.Furthermore, Gross Capital Formation and Foreign Direct Investment have a significant positive relationship with economic growth in both the short- and long-run, while population growth shows a significant negative relationship with economic growth. The paper recommends to increase thepublic expenditure on profitable projects to promote economic growth (Poku et. al. 2022).Chandio, A. A. et. al.(2016) find a long-run relationship between government expenditure on agriculture, agricultural outputsand economic growth in Pakistan. The Regression analysis reveals that agricultural outputs and government expenditure have a significant influence on economic growth. In general, the agricultural sector faces various challenges which are inadequate funding, underdeveloped agriculture marketing, poor infrastructure, shortage of irrigation and so on. Government expenditure on agriculture should be increased to boost agricultural productivity and drive economic growth. Studies indicate a statistically significant relationship between government spending on agriculture and economic growth in the assessed countries, highlighting the crucial role of public investment in the sector, particularly in Africa. The research suggests that policymakers should implement relevant policies to support agricultural development and allocate greater funding to the sector, given its substantial contribution to economic growth (Olumba, C. C. et al., 2020).

Hypotheses:
Hypothesis H1- For India, there is a positive effect of government expenditure on the Agricultural productivity
Hypothesis H2- For India, there is a positive effect of economic growth (GDP) on the Agricultural productivity

Hypothesis H3-For India, here are some positive effects of Agricultural Labour Force (ALE) onAgricultural productivity
Hypothesis H4-For India, there is a positive effect of Gross Cropped Area (GCA) on Agriculturalproductivity

The previously discussed literature highlights the connection between government expenditure and agricultural productivity. This study aims to analyze the impact of government spending on enhancing agricultural productivity in India. Using time-series data from the Indian economy, it examines trends and relationships over the period from 1990-1991 to 2020-2021.

3. Data and Methodology

This section outlines the data sources, model-building process, and linear time series modeling approach used in the study. Data on agricultural productivity, government expenditure on agriculture, the agricultural labor force, and gross cultivated area were obtained from various editions of the National Statistical Accounts (GOI) and the Economic Survey of India for the period 1990-1991 to 2020-2021. Economic growth data was sourced from the World Development Indicators (World Bank).Given that this study examines the symmetric effects of government expenditure on agricultural productivity in India, additional control variables have been incorporated into the model to ensure robust and reliable results. Table 1 presents details on the data sources, relevant proxies, and variable descriptions.
The study period is from 1990-1991 to 2020-2021 and we have used Eviews-12 (University Edition) software to analyse time series data.

Table 1: Description of Variables and data sources.

Names of variables	Variable description	Data sources
Government Agriculture Expenditure(GAE)	It includes the expenditure incurred by the government of India on agriculture out of the total government expenditure.	National Statistical Accounts (Government of India), Economic Survey of India and various budgetary reports of Government of India.
Gross Cropped Area (GCA)	It is also known as the total sown area, which includes the total area of India that is sown once or more than a year.	National Statistical Accounts (Government of India), Economic Survey of India and various budgetaryreports of Government of India.
Agricultural Productivity (AGRP)	It is calculated as the value additive proportion from farming, hunting livestock production, forestryand fishing.	World Bank national accounts dataand OECD National Accounts data files.
Economic Growth (EG)	It is the total output growth of an economy proxies by the GDP per capita.	World Bank national accounts dataand OECD National Accounts data files.
Agricultural Labour Force (ALF)	It is the sum of labour force engaged in agriculture-related activities out of the total working population of India.	National Statistical Accounts (Government of India), Economic Survey of India and various Budgetary Reports of government of India.

Note: Compiled from different sources and shown respectively in Data Sources.

Data, empirical model and methodological strategy

To empirically analyse the role of government expenditure in stimulating agriculture productivity in India, the present research uses time-series data that covers the period 1990-1991 to 2020-2021, we have resorted to a neo-classical model popularly known as the Cobb-Douglas production function model as:

$$AGRP_T = \beta 1 + \beta 2GAE_T + \beta 3GCA_T + \beta 4ALF_T + \beta 4EG_T + \nu_T$$
(1)

Where, $AGRP_T$ represents agricultural productivity. GAE_T, GCA_T, ALF_TandEG_T represents government agriculture expenditure, gross cropped area, agriculture labour forceand economic growth respectively at time T.

Unit Root Test

The stationarity test reveals that agricultural productivity, government expenditure on agriculture, the agricultural labor force, gross cropped area, and economic growth are all integrated at I(1), meaning they are stationary at the first difference. To assess the stationary level of these series, Equations 2 and 3 were estimated using the Augmented Dickey-Fuller (ADF) and Phillips & Perron (PP) tests.The ARDL method is suitable for series that are a mixture of I(0) and I(1) variables, but not I(2). Therefore, the authors have chosen to proceed with this method, as recommended by Ullah et al. (2021). It is also noted that structural breaks in the series can weaken or impair stationarity (Wang et al., 2023).Stationarity tests, such as ADF and PP, are fundamental for addressing the unit root issue in the series. These tests were applied to both the level and first-differenced forms of all variables. The lag length in the ADF test was incorporated to address autocorrelation and enhance robustness.The ADF equation is presented as follows:

$$\Delta T_t = \varphi_0 + \varphi T_t + \sum_{i=k}^{OP} w_i \Delta T_{t-1} + \varepsilon_t$$
(2)

Where Δ denotes the operator of the first difference, T_t shows the time dimension, φ_0 explores the intercept term, OP illustrates the maximum lag length on the explained seriesand the term ε shows the white noise random error term. The ADF unit root approach of the stationary provides the increasing the statistical distribution of ADF. Moreover, the PP test equation is presented in Eq. 3as follows:

$$\Delta T_t = \pi + S^* T_{t-1} + \varepsilon_t \quad (3)$$

The Philip and Perron Unit Root Test is also the stationary approach linked with statistics by calculating the S^* test statistics coefficient value.

Autoregressive Distributed Lag Model (ARDL) of Cointegration

To examine the relationship between agricultural productivity, government agricultural expenditure, the agricultural labor force, gross cropped area, and economic growth, various time series econometric models are available. However, this study relies on the Autoregressive Distributed Lag (ARDL) model, which is an Ordinary Least Squares (OLS) regression developed by Pesaran and Shin in 1991.The ARDL model offers several advantages over earlier models. It combines both endogenous and exogenous variables, allowing for a more comprehensive analysis. Moreover, the ARDL model can determine both short-run and long-run coefficients, and it does not require the variables to have the same order of integration, making it more flexible and robust for time series analysis.The standard form of the auto-regressive distributive lag (ARDL) model is:

$$y_t = \beta_0 + \beta_1 y_{t-1} + \beta_1 y_{t-2} + \cdots \beta_p y_{t-p} + a_0 x_t + a_0 x_{t-1} + \cdots + a_q x_{t-q} + \varepsilon_t \quad (4)$$

Where ε_t is the white noise error term?

Equation (1) can be represented in ARDL form as:

$$\ln AGRP_t = \alpha_1 + \sum_{i=1}^{p} \alpha_2 \ln AGRP_{t-j} + \sum_{i=1}^{q} \alpha_3 \ln GAE_{t-i} + \sum_{i=1}^{r} \alpha_4 \ln GCA_{t-i} + \sum_{i=1}^{s} \alpha_5 \ln ALF_{t-i} + \sum_{i=1}^{u} \alpha_6 \ln EG_{t-i} + \varrho_1 \ln AGRP_{t-1} + \varrho_2 \ln GAE_{t-1} + \varrho_3 \ln GCA_{t-1} + \varrho_4 \ln ALF_{t-1} + \varrho_5 \ln EG_{t-1} + v_{1t} \quad (5)$$

Where, p, q, r, sand u are the suitable lag length, α_1, α_2, α_3, α_4, α_5&, $\alpha_6$are the short-run coefficients, while ϱ_1, ϱ_2, ϱ_3, $\varrho_4$and ϱ_5 show the long-run coefficients of independent variables. The error term is represented by ν.

Dynamic Ordinary Least Square (DOLS) Model

The Dynamic Ordinary Least Squares (DOLS) is a robust single-equation approach developed by Stock and Watson (1993) that addresses regressor endogeneity. It does so by incorporating first differenced regressor leads and lags, as well as correcting for autocorrelation errors using the Generalized Least Squares (GLS) technique. The DOLS method offers advantages over Ordinary Least Squares (OLS) and maximum likelihood procedures, particularly in its ability to handle endogeneity and provide more reliable estimates when dealing with time series data.

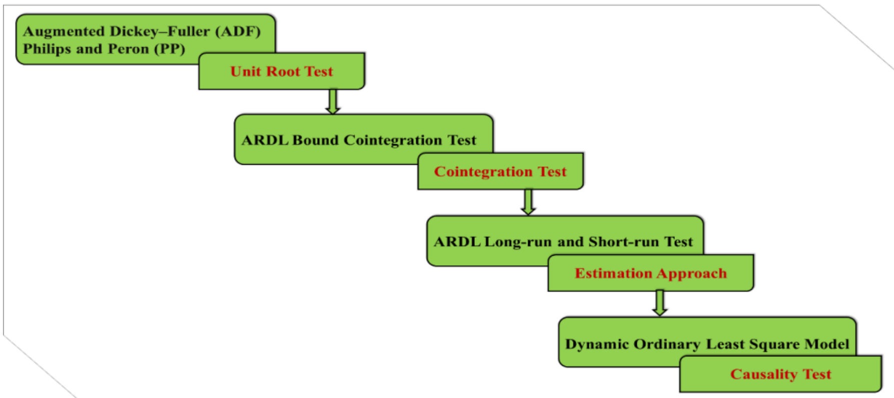

Figure 1. Graphical Presentation of Methodological Strategy

4. Results and Discussion

Table 1 provides the descriptive statistics for the variables used in this study. It reveals that agricultural productivity has the highest average value at 19.7467 units, while economic growth has the lowest average at 4.55554 units. Similarly, agricultural productivity also has the highest median value at 18.71757 units, whereas the gross cropped area has the lowest median value at 2.01445 units. These findings highlight the relationship between government spending on agriculture and its impact on economic growth and agricultural productivity in India. Increased government expenditure in the agricultural sector seems to positively affect agricultural productivity.Historical context, such as during the 3rd Five-Year Plan (1961-1966), also reinforces this idea. During this period, the government focused on boosting the agricultural sector, especially after the setbacks caused by the India-China War, which had slowed agricultural development. In response, the government increased its spending in agriculture, leading to a rise in productivity. The descriptive statistics in Table 2 further indicate stable variation in the variables, as the standard deviations are lower than the mean values, suggesting consistent data trends.

Table 2: Descriptive Statistics

	AGRP	GAE	GCA	EG	ALF
Mean	19.76467	7.57556	3.17544	4.55755	6.68658
Median	18.71757	5.01647	2.01445	4.57656	5.55758
Maximum	17.66271	4.54597	1.97434	5.45576	4.03972
Minimum	15.03163	2.68130	0.98175	3.78543	3.95754
Standard Deviations	3.99079	0.55456	1.39781	0.47546	1.47547
Skewness	0.72608	0.35457	0.45548	-0.00145	-0.15754
Kurtosis	1.93902	1.57555	1.57655	1.74544	1.64755
Jarque-Bera	4.03532	3.08141	3.08141	1.99555	1.45545
Probability	0.13245	0.24756	0.21765	0.35743	0.23276
Sum	599.16941	135.01016	28.01016	136.42541	38.75757
Sum of Squared Deviations	461.86730	41.58914	6.58975	4.72546	31.68766
Observations	30	30	30	30	30

Note: Calculated by Authors

AGRP: Agricultural Productivity; GAE: Government Agriculture Expenditure; GCA: Gross Cropped Area; EG: Economic Growth and ALF: Agricultural Labour Force

According to ADF and PP unit-root tests are employed to check the stationarity properties of variables of interest. However, all the selected variables are following the stationary property at the first integration order I(1). Moreover, the results are mentioned in Table 3.

Table 3. Unit Root Test Results

Variables	ADF-Test		PP-Test		OI
	Level	First Difference	Level	First Difference	
AGRP	-0.6436	-7.3455***	-0.5432	-6.5757***	I(1)
GAE	-0.5777	-5.4857***	-1.1745	-6. 7675***	I(1)
ALF	-0.4654	-4.4523***	-1.4554	-4.4756***	I(1)
GCA	-0.7876	-6.7866***	-08675	-6.6867***	I(1)
EG	-1.5557	-1.3249***	-1.5244	-1.7876***	I(1)

Note: OI: Order of integration; AGRP: Agricultural Productivity; GAE: Government Agriculture Expenditure; ALF: Agriculture Labour Force; GCA:Gross Cropped Area; EG: Economic Growth.
*** denotes the significance level of 1%.

The results of the ARDL Cointegration bound test are presented in Table 4. The F-test value of 7.8737 is significant at the 1% level, leading to the rejection of the null hypothesis of no cointegration. This supports the acceptance of the alternative hypothesis, indicating the presence of a long-run relationship between government expenditure on agriculture, agricultural productivity, the agricultural labor force, gross cropped area, and economic growth in India.

Table 4: Results of ARDL Bound Test

	Lower bound	Upper bound	F-statistic value	Remarks
Sig.	I(0)	I(1)	7.8737***	Cointegration exists
10%	5.33	6.43		
5%	4.42	5.35		
2.5%	3.46	4.95		
1%	2.76	3.45		

Note:Calculated by Authors
***denotes the significance level of 1%.

Table 5: Results of ARDL Model (Long-Run)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GAE	0.2545	0.2655	0.9585	0.0000
ALF	0.4764	0.3216	1.4811	0.0063
GCA	0.5321	0.3865	1.3766	0.0012
EG	0.5674	0.2585	2.1947	0.0340
Constant	0.7454	1.5754	0.4731	0.0001

Note: Compiled by Authors

After establishing the long-run relationship, the short-run and long-run coefficients for all the independent variables were estimated, as shown in Table 5. The standard ARDL results in the long run indicate a significantly positive relationship between agricultural productivity and government expenditure on agriculture in India. This suggests that increased government spending on agriculture improves the productivity of the sector. Specifically, a one-unit increase in government spending on agriculture results in a 0.25 unit increase in agricultural productivity.These findings align with studies by Selvaraj, K.N. (1993), Benin (2011), Lencucha et al. (2020), and Ernawati et al. (2021). Additionally, the control variables—agricultural labor force, gross cropped area, and economic growth—also positively influence agricultural productivity. A 1% increase in the agricultural labor force, gross cropped area, and economic growth leads to a 0.47%, 0.53%, and 0.56% increase in agricultural productivity, respectively.

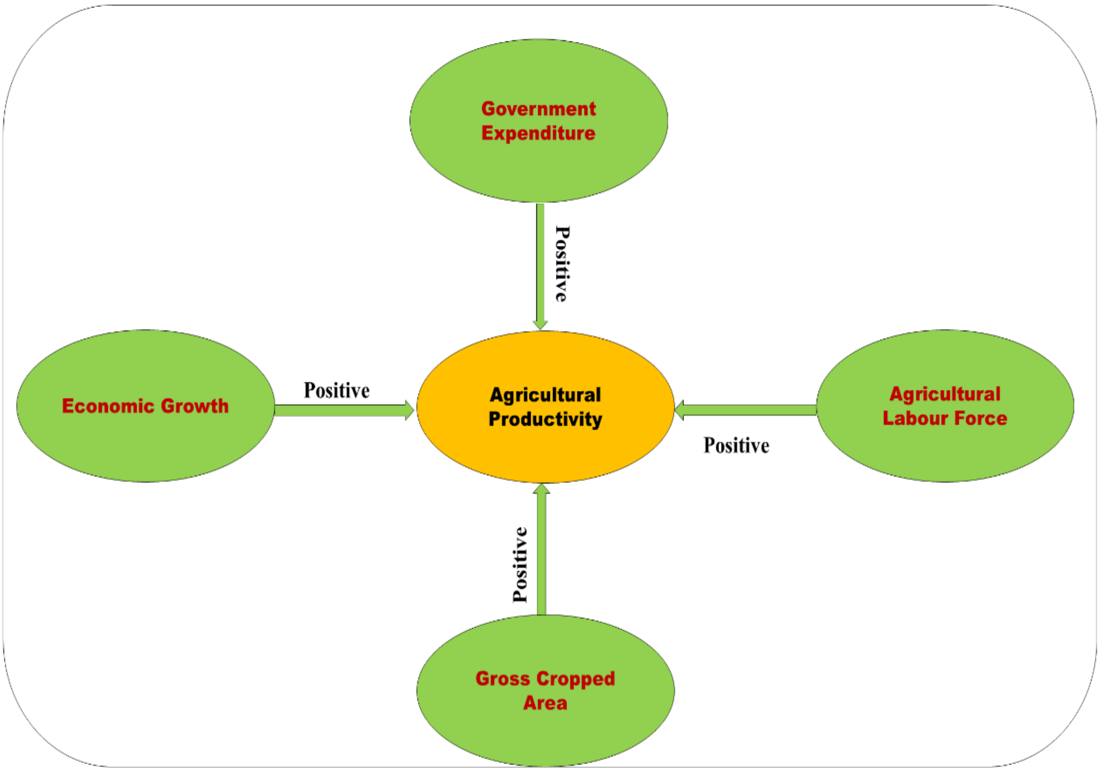

Figure 2. Graphical Findings of Long-Run Estimations

The short-run results are presented in Table 6 below.

Table 6: Results of ARDL (Short-Run)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(GAE)	0.0210	0.0552	0.3804	0.0003
D(ALF)	0.1021	0.2213	0.4613	0.5646
D(GCA)	0.0102	0.2446	0.0417	0.0021
D(EG)	0.0211	0.4442	0.0475	0.8564
Coefficient Equations (-1)*	-0.5578	0.2217	-2.5160	0.0001

Note: Compiled by Authors

Table 6 indicates that variables such as government expenditure on agriculture, the agricultural labor force, and gross cropped area contribute to stimulating agricultural productivity in India, even in the short term. While the coefficient for economic growth is positive, it is not statistically significant in the short run, as shown in Table 5.The error correction term (ECT) has a negative and significant value, with a coefficient of 0.55. This suggests that 55% of any deviation from the long-term equilibrium is corrected within one year.Additionally, diagnostic tests were performed to assess the stability of the model. The results of these tests are provided in Table 7 and Figure 3 below.

Table 7: Results of Diagnostic Tests

Tests	F-statistic	Prob.
Heteroscedasticity Test: Breusch-Pagan-Godfrey	0.5441	0.7597
Breusch-Godfrey Serial Correlation LM Test	0.4964	0.8563

Note: Calculated by Authors

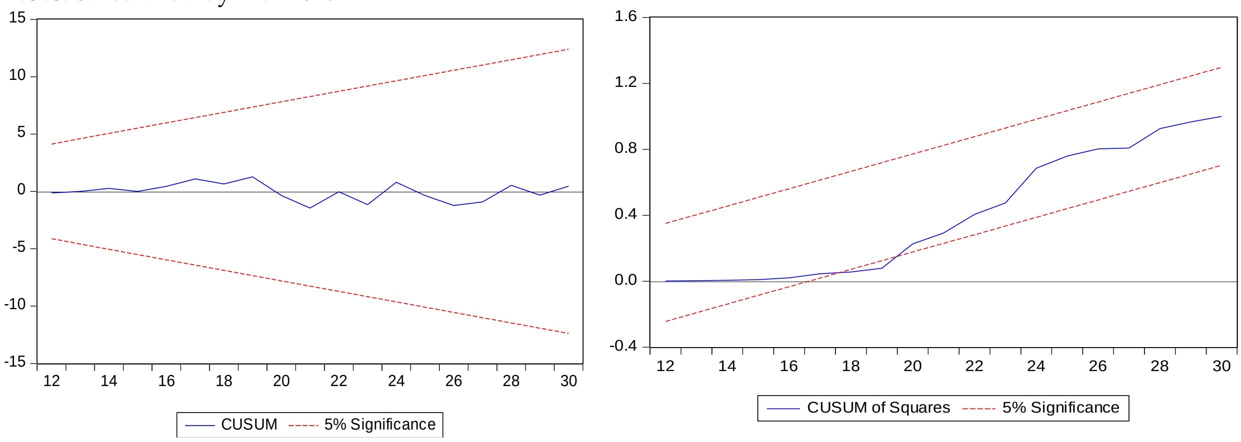

Figure 3.CUSUM and CUSUMSQ plots

Thus, the results of the heteroscedasticity tests, serial correlation tests, and CUSUM tests confirm that the model is stable and reliable. These findings indicate that the inferences drawn from the model can be confidently used for policy formulation, ensuring that the model provides valid and consistent insights for decision-making.**Robustness Checking**

The DOLS model was employed to test the robustness of the ARDL model. The results from the DOLS model indicate that all the variables exhibit a significant positive relationship with economic growth in India. This further strengthens the findings of the ARDL model and suggests that the relationships observed between government expenditure on agriculture, agricultural productivity, and economic growth are robust and consistent across different modeling approaches.

Table 8. DOLS Model (for Robustness Checking)

Variable	Coefficient	Std. Error	t-Statistic	P-value
GAE	0.2545	0.1655	0.8585	0.0000
ALF	0.3764	0.1216	0.9815	0.0003
GCA	0.3421	0.1875	0.9986	0.0002
EG	0.4684	0.1587	1.1847	0.0040
Constant	0.7454	0.2754	0.9731	0.0001

Note: Computed by Authors

Therefore, it is confirmed that the ARDL model used in this study is appropriate for explaining how government spending on agriculture stimulates agricultural productivity in India. The results indicate that government expenditure, the agricultural labor force, gross cropped area, and economic growth are all positively correlated with agricultural productivity in India. The statistical outcomes from the DOLS model further support that the ARDL model is correctly specified and that the estimated results are reliable.

5. Conclusion and Policy Implication

This research examines how government expenditure on agriculture impacts agricultural productivity in India during the post-reform era. To ensure robust findings, the study incorporates various control variables, including the agricultural workforce, total cultivated area, and economic expansion. Utilizing time series data from the Indian economy spanning 1990-1991 to 2020-2021, the researchers employed an advanced ARDL model. The ARDL-bound test confirmed the cointegration relationship among the variables of interest. The model's empirical results reveal a significant positive correlation between agricultural productivity and government spending on agriculture in both short and long-term scenarios. Other factors influencing agricultural productivity, such as the agricultural labor force, gross cropped area, and economic growth, show positive long-term effects on India's agricultural sector productivity. Based on these findings, the study offers several policy recommendations for the Indian government. Given that India's agricultural productivity is comparatively low relative to many developed and developing nations, there is a pressing need for increased public investment in the agricultural sector. Government support through infrastructure development, research and development initiatives, subsidies, credit facilities, and insurance programs can help farmers enhance their productivity, boost their income, and contribute to the nation's overall growth. In this context, India must prioritize strategies to boost agricultural productivity to address rising food demand, decrease reliance on imports, raise rural incomes, and generate employment opportunities in the agricultural sector.

References

1. Agbana, E. Z., & Lubo, E. (2022). Government Expenditure on Agriculture and Economic Growth in Nigeria. Journal of Good Governance and Sustainable Development in Africa. 7(2), 47–60.
2. Agboola, M. O., Bekun, F. V., Osundina, O. A., &Kirikkaleli, D. (2022). Revisiting the economic growth and agriculture nexus in Nigeria: evidence from asymmetric cointegration and frequency domain causality approaches. Journal of Public Affairs, 22(1), e2271. https://doi.org/10.1002/pa.2271
3. Aman, A., Itoo, H. H., Ali, N., Rasool, G. Khan, M.A. & Kamal, M. (2023). Exploring the relationship between agricultural productivity, economic growth, population growth, and environmental sustainability in India: Evidence from symmetric ARDL modeling. AMA, Agricultural Mechanization in Asia, Africa and Latin America, 54(2), 11811-11823.
4. Anwar, M. M., Farooqi, S., & Khan, G. Y. (2015). Agriculture sector performance: An analysis through the role of agriculture sector share in GDP. Journal of Agricultural Economics, Extension and Rural Development, 3(3), 270-275.
5. Atayi, A. V., Boniface J. V., Bobola, A. O. andOlorunrinu, A. S. (2020). The Effect of Government Expenditure on Agricultural Output in Nigeria, 1981-2018. International Journal of Applied Management Science, 3: 1-14.
6. Awokuse, T. O., & Xie, R. (2015). Does agriculture really matter for economic growth in developing countries? Canadian Journal of Agricultural Economics/Revue canadienne d'agroeconomie, 63(1), 77-99.
7. Awoyemi, B. O., Afolabi, B., & Akomolafe, K. J. (2017). Agricultural productivity and economic growth: impact analysis from Nigeria. Scientific Research Journal (SCIRJ), 5(10), 1-7.
8. Babatunde, S. A. (2018). Government spending on infrastructure and economic growth in Nigeria. Economic research-Ekonomskaistraživanja, 31(1), 997-1014.
9. Baig, I. A., Ali, M., Salam, A., & Khan, S. M. (2020). Agriculture, manufacturing and economic growth in India: a co-integration analysis. Journal of Economics and Business, 3(3).
10. Bansal, S., Kumar, P., Mohammad, S., Ali, N., & Ansari, M. A. (2021). Asymmetric effects of cereal crops on agricultural economic growth: a case study of India. SN Business & Economics, 1(12), 160.
11. Benin, S. (2011). Public expenditure on agriculture and its impact. Ghana's. Economic and Agricultural Transformation, 2013 (2014), 2015.
12. Cagliarini, A., & Rush, A. (2011). Economic development and agriculture in India. RBA Bulletin, June, 15-22.
13. Ceesay, E. K., Francis, P. C., Jawneh, S., Njie, M., Belford, C., &Fanneh, M. M. (2022). Climate Change, Growth in Agriculture Value Added, Food Availability and Economic Growth Nexus in the Gambia: A Granger Causality and ARDL Modeling Approach. In Food Security and Safety Volume 2: African Perspectives (pp. 435-468). Cham: Springer International Publishing. https://doi.org/10.1007/s43546-021-00100-6

14. Chandio, A. A., Jiang, Y., Rehman, A., Jingdong, L., & Dean, D. (2016). Impact of government expenditure on agricultural sector and economic growth in Pakistan. International Journal of Advanced Biotechnology and Research, 7(3), 1046-1053.
15. Dastagiri, M. B. (2010). The effect of government expenditure on promoting livestock GDP and reducing rural poverty in India. Outlook on AGRICULTURE, 39(2), 127-133.
16. De, U. K. (2018). Public expenditure on agriculture and economic growth: a case study of Meghalaya. Agricultural Economics Research Review, 31(2), 271-279.
17. Dynan, K., & Sheiner, L. (2018). GDP as a measure of economic well-being (Vol. 43, p. 53). Hutchins Center Working Paper.
18. Ernawati, E., Tajuddin, T., & Nur, S. (2021). Does government expenditure affect regional inclusive growth? An experience of implementing village fund policy in Indonesia. Economies, 9(4), 164.
19. Fan, S., Hazell, P., & Thorat, S. (2000). Government spending, growth and poverty in rural India. American journal of agricultural economics, 82(4), 1038-1051.
20. Fontan Sers, C., & Mughal, M. (2019). From Maputo to Malabo: public agricultural spending and food security in Africa. Applied economics, 51(46), 5045-5062.
21. Gokmenoglu, K. K., & Taspinar, N. (2018). Testing the agriculture-induced EKC hypothesis: the case of Pakistan. Environmental Science and Pollution Research, 25, 22829-22841.
22. Hongdou, L., Shiping, L., & Hao, L. (2018). Existing agricultural ecosystem in China leads to environmental pollution: an econometric approach. Environmental Science and Pollution Research, 25, 24488-24499.
23. Keynes, John M. (1936). The General Theory of Employment, Interest, and Money. London: Macmillan, pp. 1-190.
24. Lencucha, R., Pal, N. E., Appau, A., Thow, A. M., & Drope, J. (2020). Government policy and agricultural production: a scoping review to inform research and policy on healthy agricultural commodities. Globalization and health, 16, 1-15.
25. Liu, X., Zhang, S., & Bae, J. (2017). The nexus of renewable energy-agriculture-environment in BRICS. Applied energy, 204, 489-496.
26. Makin, A. J. (2015). Expansionary versus contractionary government spending. Contemporary Economic Policy,33(1), 56-65.
27. Megbowon, E. T., Mothae, L., & Relebohile, J. R. (2022). Effect of government agricultural expenditure on economic growth: Evidence from a developing country. Studia Universitatis Babes-Bolyai, 67(2), 1-20.
28. Mogues, T., & Anson, R. (2018). How comparable are cross-country data on agricultural public expenditures? Global food security, 16, 46-53.
29. Mohammed, T., Damba, T., &Amikuzuno, J. (2020). Agricultural output and economic growth nexus in Ghana. International Journal of Irrigation and Agricultural Development (IJIRAD), 4(1), 211-220.

30. Moreno-Dodson, B. (2008). Assessing the impact of public spending on growth-an empirical analysis for seven fast growing countries. World Bank Policy Research Working Paper, (4663). Available online: http://hdl.handle.net/10986/6850
31. Mulugeta Emeru, G. (2023). Effect of public expenditure on economic growth in the case of Ethiopia. The Scientific World Journal, 2023.
32. Ngobeni, E., &Muchopa, C. L. (2022). The Impact of Government Expenditure in Agriculture and Other Selected Variables on the Value of Agricultural Production in South Africa (1983–2019): Vector Autoregressive Approach. Economies, 10(9), 205.
33. Olumba, C. C., Onunka, C. N., & Ume, C. (2020). Government Expenditure on Agricultural Development and Economic Growth in Africa. Journal of Gender, Information and Development in Africa (jGIDA) 9(2), 48–58.
34. Onder, M, Ceyhan, E & Kahraman, A. (2011). Effects of agricultural practices on environment, International Conference on Biology, Environment and Chemistry, Singapore 2011, IPCBEE, 24.
35. Patra, N. K., & Babu, S. C. (2017). Mapping Indian agricultural emissions: lessons for food system transformation and policy support for climate-smart agriculture. IFPRI-Discussion Papers, (1660).
36. Poku, K., Opoku, E., &Agyeiwaa Ennin, P. (2022). The influence of government expenditure on economic growth in Ghana: An Ardl approach. Cogent Economics & Finance, 10(1), 2160036.
37. Rajesh, T., P. Shivaswamy, G., Anuja, A. R., Singh, K. N., Shekhawat, R. S., & HV, H. K. (2020). Public expenditure on agricultural inputs and farm support services in India–An Overview.
38. Ramakumar, R., Surya, A., & Das, R. (2022). Public spending on agriculture in India: 2010–11 to 2019–20: A project report (p. 66). Bengaluru: The Foundation for Agrarian Studies.
39. Selvanathan, E. A., Selvanathan, S., & Jayasinghe, M. S. (2021). Revisiting Wagner's and Keynesian's propositions and the relationship between sectoral government expenditure and economic growth. Economic Analysis and Policy, 71, 355-370.
40. Selvaraj, K. N. (1993). Impact of government expenditure on agriculture and performance of agricultural sector in India. Bangladesh Journal of Agricultural Economics, 16(2), 1-13.
41. Sertoglu, K., Ugural, S., &Bekun, F. V. (2017). The contribution of agricultural sector on economic growth of Nigeria. International Journal of Economics and Financial Issues, 7(1), 547-552.
42. Ullah, A., Khan, D., Khan, I., & Zheng, S. (2018). Does agricultural ecosystem cause environmental pollution in Pakistan? Promise and menace. Environmental Science and Pollution Research, 25, 13938-13955.
43. Wagner, A. (1883). Three Extracts on Public Finance. Classics in the Theory of Public Finance, edited by Richard. A. Musgrave and Alan T. Peacock, 1–15.

44. Zafar, S., & Tarique, M. (2023). Efficacy of public spending for agricultural development in India: a disaggregate analysis contextualizing subsidies vs investment debate. International Journal of Social Economics.

***