

Identifying Performance Indicators for the Agriculture Sector in Developing Countries Through the ARDL Model : Special Reference of India

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Abstract

Agriculture, the most prominent sector for a developing nation like India, is currently facing issues like low growth rate, inadequate finance, shifting of farmers from agriculture in the rural area to labor in the urban area, the lesser income of farmers, and lower contribution in GDP. The issues become more prominent when the agriculture sector accounts for more than half of the country's workforce in India. In this research paper, an attempt was made to identify the most prominent performance indicators of the agriculture sector. A total of 11 indicators were explored in the study by applying the ARDL model. After analysis, four out of 11 indicators were identified as the most prominent indicators.

Keywords : agriculture sector, performance indicators, agriculture finance, R&D in the agriculture sector, ARDL

JEL Classification Codes : C13, G2, M2, O4

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The agriculture sector is an important economic indicator relevant to all economies. It is considered that around half of the population of developing and underdeveloped countries are directly and indirectly dependent on the agriculture sector (Dumanski et al., 1998; Whitaker, 1991). The poverty of any nation is not confined to a lack of income or resources only. It is also the result of multidimensional factors, including malnutrition, hunger, discrimination, etc. The Indian government has identified a total of 19 indicators for the eradication of poverty (NITI Aayog, Government of India, 2021). One of the indicators is zero hunger. Under zero hunger, the government's goal is to increase agriculture productivity by two times (Ministry of Statistics and Programme Implementation, NSO, GOI, 2021). The involvement of technology in agriculture is essential for agriculture growth and poverty eradication, and research and development are vital components to achieve this (Pal, 2017).

The importance of the agriculture sector is manifold. It helps raise the living standard of a nation, eradicate poverty, provide food security, market generation for industry expansion, and contribute overall to economic

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growth (Jorgenson, 2017). Earlier in India, the focus was on increasing agriculture output and food security. With time, the focus has shifted to increasing productivity through technology, fertilizers, chemicals, and quality seeds. As a result, agriculture productivity has multiplied by 3.7 times over the years (Chand, 1970). Enhancing productivity and competitiveness in agriculture should be the most preferred objective of economic policymakers. Applying technology, building innovation capacities, educational level, skilled labor, health, and economic environment can raise productivity and competitiveness (Coronado et al., 2017). Agriculture is an inseparable sector of any developing economy. Agriculture produces for domestic consumption and generates foreign remittances (Reaz et al., 2020).

As a result of global initiatives, various countries have initiated policies to improve agriculture productivity. Such initiations are particularly significant in countries having agriculture as a primary and prominent economic sector (Food and Agriculture Organization of the United Nations, 2017). Jansson and Lagerqvist (2013) also suggested that the involvement of technology in agriculture should be followed by the availability of adequate credit to farm producers. They further commented that lack of business income, poor credit history, and the non-availability of collateral resulted in credit rejection for many farm producers.

The performance of the agriculture sector is a critical factor in the economic progress of developing and underdeveloped countries. The agriculture process involves multiple stages and depends on various factors for better performance. Identifying the most relevant and essential factors for the agriculture sector is critical. Various studies have examined the impact of factors like climate, availability of fertilizers, and electricity in isolation. This paper attempts to extend and incorporate other important performance indicators in its analysis.

Further, limited literature is available using the autoregressive distributed lag (ARDL) approach in the context of the Indian agriculture sector. This paper aims to identify significant performance indicators from the agriculture sector's viewpoint using the autoregressive distributed lag (ARDL) approach in an Indian setting. The study results are expected to enrich the knowledge of the agriculture sector's performance indicators. The study derives its importance and prominence as increasing farmers' income has been the agenda of every government across nations.

Review of Literature

The agriculture sector not only supplies food items and eradicates poverty but also plays its role in economic development. Sustainable growth of the agriculture sector is significant. Science and technology are playing a crucial role in the growth of the agriculture sector in recent times. Highlighting this, Ramasamy (2013) determined that agricultural sector growth also depends on technological innovation, which can be accomplished through research and development. In a study, Rodrigues (2022) suggested that technological change in agriculture is essential to reducing poverty, fostering development, and stimulating economic growth in many developing countries. The study further concluded that research & development in agriculture should not be the sole responsibility of public sector units only; private sector units should also play their role.

A study by Onoja et al. (2017) suggested that electricity supply was one of the essential infrastructure requirements for agricultural value expansion in the short and long run. The study highlighted implementing policies to ensure a reliable energy supply at a lower cost. A study also suggested commercialized farms had a more prominent role in agriculture (Wineman et al., 2020). Garzón Delvaux et al. (2020) indicated that larger farms were more efficient than small farms, although the rate of profitability of both small and large farms are the same. A study by Fuglie et al. (2016) suggested that agricultural productivity could ensure the welfare of any economy and food security. Economic policies, institutions, biological conditions, and socioeconomic factors influence agriculture productivity immensely.

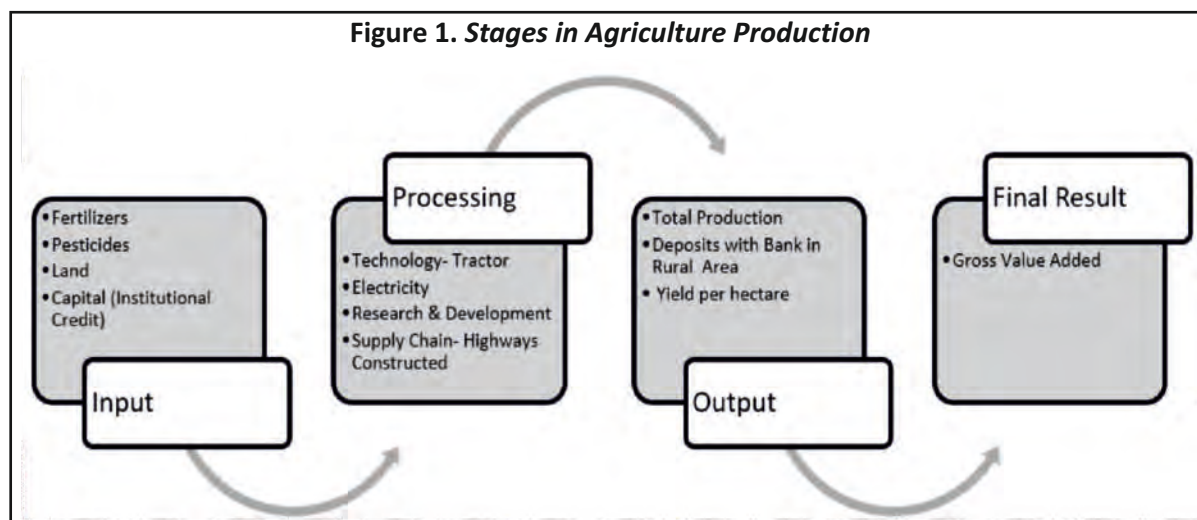
Sarkar (2013) tried to examine sales of tractors as an indicator of the sector's growth. The study concluded that tractor sales in India were influenced by two factors: first, the availability of credit for tractor purchases, and second, public investment in the agriculture sector. In their study, Raifu and Aminu (2020) suggested that a country's financial development is also linked to the development of the agriculture sector. An effective financial system will ensure the adequacy of the supply of credit to the agriculture sector. Further, it was also found that institutional credit, water, and area cultivated had a positive and significant impact on the agriculture sector in India (Singh et al., 2016; Singhal & Gupta, 2020). Macheek (2013) found that the agriculture sector's growth did not correspond to the economic growth of a nation; rather, it was found to be dependent on natural conditions. Singh and Tripathi (2017) suggested that entrepreneurial skills among farmers can also improve agriculture productivity.

Highlighting problems specific to India, Priscilla et al. (2017) found that India has surplus production of food grains and vegetables, even though most of the population strives for survival and fighting hunger. Educational level, inadequate finance, and marketing of agricultural produce were found to be significant reasons for the underperformance of the agriculture sector in India (Singla & Kaur, 2015). Logistics have also been a problem related to the Indian agriculture sector. Savadatti (2017) raised the alarm and suggested that there should be timely measures in the agriculture sector to improve the supply of food grains. Food security is also an important issue. Food insecurity makes poor people vulnerable and negatively affects their productivity and efficiency, resulting in a vicious cycle of poverty and malnutrition (Sahu, 2019).

Based on existing literature, the study identifies 11 indicators relevant to the agriculture sector of India that can impact its performance. Among these indicators, the most prominent performance indicators of the agriculture sector have been explored.

Conceptual Framework

The agricultural process is divided into four primary phases (Figure 1). This begins with the input phase and then progresses to input processing. The processed input is then converted into agricultural product output, and finally, the gross value is added by agricultural production. Each stage includes certain agricultural production factors, as shown in Figure 1.



In this study, the first stage – the input stage – comprises of four factors. These are fertilizers, pesticides, land, and capital as the primary and essential factors for agriculture production. After the availability of land and capital, the other two factors, fertilizers, and pesticides, can be procured. The processing stage has four factors, tractors for cultivating land, electricity for ensuring adequate water facilities, research and development for innovating new technology in agriculture processing, and supply chain for ensuring connectivity of rural agriculture areas with semi-urban and urban agriculture markets through well-connected highways. The output stage has three factors, total production of agricultural products, yield per hectare that indicates the efficiency of the processing stage, and the amount deposited in banks by individuals in a rural area. The quantum of the amount deposited with rural banks indicates income availability. The fourth and final result is gross value added by the agriculture sector through utilizing all the factors mentioned above.

Research Methodological Approach, Model Specification, and Data Source

Methodological Approach

Cobb–Douglas Production Function

This study employs the Cobb-Douglas production function. The function encompasses raw material, technology, research & development, supply chain, and yields as part of agriculture production apart from land and capital to identify the effect of various indicators on the agricultural sector's gross value. The Cobb-Douglas function is specified as follows (Equation 1):

$$Y=f(L,K) \text{ or } Y=AL^{\alpha}K^{\beta} \quad (1)$$

where, Y is the agricultural sector's gross value, A is the constant, L is land used in agriculture production, and K denotes capital employed in agriculture production. The α and β are land and capital-output elasticities, respectively. Agriculture production also employs various factors other than land and capital; in that case, the Cobb-Douglas production function is as follows (Equation 2) :

$$Y=f(L,K,F,P,T,E,R,S,O,D,Y) \quad (2)$$

where,

Y = gross value added by the agriculture sector,

L = land utilized for agriculture production,

K = capital employed,

F = quantity of fertilizers consumed in agriculture production,

P = quantity of pesticides consumed in agriculture production,

T = technology applied in agriculture production,

E = units of electricity supplied for agriculture production,

R = expenditure on research & development and education for the agriculture sector,

S = supply chain facility,

O = production of agriculture products,

D = deposits with the bank for an individual residing in the rural area, and

Y = yield per hectare of land cultivated.

In the linear form, the above-mentioned equation can be specified as follows (Equation 3):

$$\ln Y = \alpha_0 + \alpha_1 \ln \ddot{L} + \alpha_2 \ln K + \alpha_3 \ln F + \alpha_4 \ln pP + \alpha_5 \ln T + \alpha_6 \ln E + \alpha_7 \ln R + \alpha_8 \ln S + \alpha_9 \ln O + \alpha_{10} \ln D + \alpha_{11} \ln Y + \varepsilon_t \quad (3)$$

where,

ε_t denotes the error term, and factors/indicators are in the natural logarithm.

In this study, we proxy land utilized with area cultivated for the production of food grains, capital employed with institutional credit outstanding for the agriculture sector, technology with the sale of tractors utilized in agriculture production, and supply chain with national highways constructed.

Autoregressive Distributed Lag Method

A distributed-lag model is an essential model in which the effect of an independent variable on a dependent variable occurs over a period of time rather than all at once. In a time series analysis, the distributed lag method helps identify the independent variable's effect on the dependent variable. It also tries to answer the questions such as whether the effect is immediate, whether the effect emerges gradually, and whether there are any factors, the initial effect of which goes away with time.

Data Source

This study analyzes annual data for the period from 2001 – 2019. Data have been captured from - the *Handbook on Statistics of India* (Reserve Bank of India), economic surveys of India, the annual expenditure of the Government of India (Ministry of Finance of India), and statistical data published by the Ministry of Statistics and Programme Implementation of India. The dependent variable is the gross value added by the agriculture sector. Independent variables are area cultivated for the production of agriculture products, institutional credit outstanding, fertilizers consumed for the production of agriculture products, pesticides consumed for the production of agriculture products, sales of tractors used in agriculture, electricity supplied to the agriculture sector, expenditure on research & development for the agriculture sector, national highways constructed for improved supply chain facility, production of agriculture products, deposits with scheduled banks in the rural area, and yield per hectare of area cultivated. Table 1 presents the extended meanings of abbreviations used in this study.

Table 1. Meaning of the Abbreviations

Abbreviations	Extended Meaning
<i>acap</i>	Area cultivated for the production of agricultural products (food grains).
<i>ico</i>	Institutional credit outstanding for the agriculture sector.
<i>fcap</i>	Fertilizers consumed for the production of agricultural products.
<i>pcap</i>	Pesticides consumed for the production of agricultural products.
<i>esap</i>	Electricity supplied for agricultural production.
<i>tap</i>	Sale of tractors utilized in agriculture production.
<i>rdas</i>	Expenditure on research and development for the agriculture sector.
<i>nhc</i>	National highways constructed.
<i>pap</i>	Production of agricultural products.
<i>dbra</i>	The amount deposited with banks in the rural areas.
<i>yhac</i>	Yield per hectare of area cultivated.

<i>gva</i>	Gross value added by the agriculture sector.
Model-1	Model in which land cultivated for the production of food grains interacts with gross value added by the agriculture sector.
Model-2	Model in which capital interacts with gross value added by the agriculture sector.
Model-3	Model in which fertilizers consumed interact with gross value added by the agriculture sector.
Model-4	Model in which pesticides consumed interact with gross value added by the agriculture sector.
Model-5	Model in which electricity supplied interacts with gross value added by the agriculture sector.
Model-6	Model in the sale of tractors interacts with gross value added by the agriculture sector.
Model-7	Model in which expenditure on research and development in the agriculture sector by the government interacts with gross value added by the agriculture sector.
Model-8	Model in which highways constructed interact with gross value added by the agriculture sector.
Model-9	Model in which production of agriculture products interacts with gross value added by the agriculture sector.
Model-10	Model in which amount deposited with banks in rural areas interacts with gross value added by the agriculture sector.
Model-11	Model in which yield per hectare of land cultivated interacts with gross value added by the agriculture sector.

Analysis and Results

Correlation Matrix

Table 2 presents the results of the correlation matrix between independent and dependent variables. The outcome shows that all the variables have a positive and significant correlation. Area cultivated for agriculture production and national highways constructed has a positive correlation with gross value added by the agriculture sector at a significance level of 0.05. All other independent variables have a positive correlation at a significance level of 0.01.

Table 2. Correlation Matrix

	<i>acap</i>	<i>ico</i>	<i>fcap</i>	<i>pcap</i>	<i>nhc</i>	<i>esap</i>	<i>tap</i>	<i>rdas</i>	<i>pap</i>	<i>dbra</i>	<i>yhac</i>	<i>gva</i>
<i>acap</i>	1											
<i>ico</i>	0.548**	1										
<i>fcap</i>	0.591***	0.884***	1									
<i>pcap</i>	0.441*	0.742***	0.577***	1								
<i>nhc</i>	0.261	0.686***	0.498**	0.458**	1							
<i>esap</i>	0.561**	0.978***	0.814***	0.803***	0.655***	1						
<i>tap</i>	0.635***	0.956***	0.897***	0.780***	0.637***	0.941***	1					
<i>rdas</i>	0.615***	0.972***	0.925***	0.784***	0.642***	0.955***	0.970***	1				
<i>pap</i>	0.765***	0.916***	0.841***	0.743***	0.538**	0.917***	0.935***	0.928***	1			
<i>dbra</i>	0.566**	0.986***	0.861***	0.786***	0.642***	0.994***	0.945***	0.972***	0.922***	1		
<i>yhac</i>	0.661***	0.943***	0.845***	0.766***	0.567**	0.942***	0.945***	0.941***	0.989***	0.946***	1	
<i>gva</i>	0.469**	0.859***	0.834***	0.743***	0.475**	0.870***	0.870***	0.912***	0.800***	0.891***	0.826***	1

Note. *** (.01), ** (.05), * (.10).

Unit Root Test

The unit root test aims to assess the stationarity properties of the variables at the level or first difference. Unit root test is a pre-calculation requirement for applying the ARDL model. The ARDL model can be applied if variables are stationary at level or first difference. The Kwiatkowski–Phillips–Schmidt–Shin (KPSS) test has been performed in this study. The null hypothesis for the KPSS test is the assumption that the variables are stationary at level. The null hypothesis will be accepted if the test value is less than the critical value at the pre-determined significance level. In this study, test values for all the variables are less than the critical value at a .01 significance level, and the order of integration is at level, i.e., $I(0)$. Thus it can be concluded that the null hypothesis is accepted, and all the variables are stationary. Table 3 shows the results of the KPSS unit root test.

ARDL Bound Test

The ARDL bound test for co-integration is employed to examine the long-run relationship among variables. Pesaran et al. (2001) developed the ARDL bounds testing approach. This is a co-integration method to test the presence of the long-run relationship between the variables. The bound test can be applied to the time-series data

Table 3. KPSS Unit Root Test

Variable	Test Value	Critical Value (1% Significance Level)	Order of Integration
Land-Area Cultivated	0.0781	0.216	$I(0)$
Capital-Institutional Credit Outstanding	0.1964	0.216	$I(0)$
Fertilizers	0.154	0.216	$I(0)$
Pesticides	0.1352	0.216	$I(0)$
Supply Chain- Highway Constructed	0.1427	0.216	$I(0)$
Electricity	0.1918	0.216	$I(0)$
Tractor	0.1045	0.216	$I(0)$
Expenditure on Research & Development	0.0874	0.216	$I(0)$
Production of Agriculture Output	0.0688	0.216	$I(0)$
Deposits with Banks in Rural Areas	0.1879	0.216	$I(0)$
Yield per Hectare	0.0691	0.216	$I(0)$
Gross Value Added	0.1868	0.216	$I(0)$

Table 4. ARDL Bound Test Results

	Model-1	Model-2	Model-3	Model-4	Model-5	Model-6	Model-7	Model-8	Model-9	Model-10	Model-11
<i>F</i> - Test	10.966	8.364	11.427	5.982	100.3	7.884	4.795	2.382	5.558	12.33	4.31
<i>p</i> - value	0.05	0.05	0.05	0.10	0.05	0.05	0.10	0.05	0.10	0.05	0.10
Lower Bound	5.395	5.395	5.395	4.29	5.395	5.395	4.29	5.395	4.29	5.395	4.29
Upper Bound	6.35	6.35	6.35	5.08	6.35	6.35	5.08	6.35	5.08	6.35	5.08
Result	Cointegr- ated	Cointegr- ated	Cointegr- ated	Cointegr- ated	Cointegr- ated	Cointegr- ated	Inconcl- usive	Not Cointe- grated	Cointegr- ated	Cointegr- ated	Inconcl- usive

stationary at the level or first difference. The bound test can have either of the three results – co-integrated, inconclusive, or not co-integrated. F -statistics on variables are compared with the upper bound for establishing a relationship. If the value of F -statistics is greater than the upper bound, then the result is co-integrated. If the value of F -statistics is between the upper bound and lower bound, then the result is inconclusive, and if the value of F -statistics is less than the lower bound, then the result is not co-integrated. In this study, 11 models have been developed. Out of these 11 models, eight have bound test results culminating into co-integrated at a .05 significance level. Model 4 and Model 9 are co-integrated at a 0.1 significance level. The result of Model 8 is co-integrated, meaning the supply chain (highways constructed) and the gross value added by the agriculture sector have no long-run relationship. Model 7 and Model 11 results are inconclusive at a .1 significance level, meaning expenditure on research & development, yield per hectare, and gross value added by the agriculture sector have an inconclusive relationship. Table 4 presents the results of the ARDL Bound test.

ARDL Long–Run and Short–Run Analysis

The ARDL long-run analysis results for Model 1 show that the area cultivated for the production of food grains has a positive and insignificant impact on the agricultural sector's gross value with a coefficient of 1.072 ($p = 0.153$). In the case of Model 2 and Model 3, institutional credit outstanding by the agriculture sector and fertilizers consumed for the production of food grains have a positive and significant impact on gross value added with a coefficient of 0.232 ($p = 0.034$) and 0.633 ($p = 0.000$), respectively. On the other hand, Model 4 shows that pesticides consumed have a negative and significant impact on gross value added by the agriculture sector with a coefficient of -0.523 ($p = 0.037$). The results for Model 5 (-0.273 , $p = 0.630$) and Model 8 (-0.012 , $p = 0.557$) are negative and insignificant. This means that the electricity supply and national highways constructed do not impact the gross value added by the agriculture sector. Surprisingly, Model 6 (impact of the sale of tractors with coefficient 0.262, $p = 0.162$), Model 9 (production of agriculture products with coefficient 0.116, $p = 0.769$), and Model 11 (yield per hectare of area cultivated with coefficient 0.245, $p = 0.659$) results show positive and insignificant coefficients with gross value added by the agriculture sector. The coefficient for Model 7 and Model 10 is 0.282 ($p = 0.041$) and 0.618 ($p = 0.072$), respectively, denoting expenditure on research & development and deposits with banks in rural areas have a positive and significant impact on gross value added by the agriculture sector.

The overall significance of the model can also be verified by the R square and adjusted R square results. The results are significant for all models except for Model 5 and Model 6. The results for the ARDL short-run correspond with the long-run analysis except for Model 1 and Model 2. Surprisingly, short-run results for Model 1 and Model 2 are the reverse of long-run results. The area cultivated for agriculture production has a positive and significant impact on gross value added by the agriculture sector in the short-run with a coefficient of 1.32 ($p = 0.000$).

In comparison, industrial credit outstanding for the agriculture sector has a negative and insignificant impact on gross value added by the agriculture sector with a coefficient of -0.075 ($p = 0.431$). The impact of area cultivated and industrial credit on gross value added varies in the short and long run. The coefficients for Model 3, Model 6, Model 7, Model 9, Model 10, and Model 11 are 0.464 ($p = 0.002$), 0.202 ($p = 0.033$), 0.204 ($p = 0.0070$), 0.337 ($p = 0.008$), 1.031 ($p = 0.005$), and 0.358 ($p = 0.090$), respectively. The findings suggest that fertilizers consumed, sale of tractors, expenditure on research & development, production of agriculture products, deposits with banks in the rural area, and yield per hectare have a positive and significant impact on gross value added by the agriculture sector. On the other hand, Model 4 has a negative and insignificant coefficient of -0.092 ($p = 0.398$), which signifies the impact of pesticides consumed on the gross value added of the agricultural sector. Model 5 signifies that electricity supplied has a positive but insignificant impact on gross value added with a

coefficient of 0.309 ($p = 0.645$), and Model 8 signifies that national highways constructed have a negative and significant impact on gross value added by the agriculture sector with a coefficient of -0.025 ($p = 0.063$).

Table 5 shows the results of ARDL's long-run and short-run analysis output. From the table, it can be extracted that the most prominent factors that indicate the performance of the agriculture sector in terms of gross value added are institutional credit, fertilizers consumed, expenditure on research & development, and deposits with banks in a rural area.

Table 5. ARDL Long-Run and Short-Run Analysis Results

Variables	Model-1	Model-2	Model-3	Model-4	Model-5	Model-6	Model-7	Model-8	Model-9	Model-10	Model-11
Long Run Analysis											
$I(acap)$	1.072 (.153)										
$I(ico)$		.232 (.034)**									
$I(fcap)$			.633 (.000)***								
$I(pcap)$				-.523 (.037)**							
$I(esap)$					-.273 (.630)						
$I(tap)$						.262 (.162)					
$I(rdas)$							.282 (.041)**				
$I(nhc)$								-.012 (.557)			
$d(pap)$									.116 (.769)		
$I(dbra)$										.618 (.072)*	
$I(yhac)$											.245 (.659)
Short Run Analysis											
$d(acap)$	1.32 (.000)***										
$d(ico)$	–	–0.075 (0.431)									
$d(fcap)$			0.464 (.002)***								
$d(pcap)$				–0.092 (0.398)							

<i>d(esap)</i>					0.309						
					(0.645)						
<i>d(tap)</i>						0.202					
						(0.033)**					
<i>d(rdas)</i>							0.204				
							(0.007)***				
<i>d(nhc)</i>								-0.025			
								(.063)*			
<i>d(pap)</i>									0.337		
									(.008)***		
<i>d(dbra)</i>										1.031	
										(.005)***	
<i>d(yhac)</i>											0.358
											(.090)*
<i>R</i> ²	0.85	0.55	0.80	0.51	0.32	0.46	0.61	0.52	0.76	0.58	0.66
Adjusted <i>R</i> ²	0.80	0.40	0.74	0.34	0.09	0.28	0.48	0.36	0.68	0.44	0.51

Note. ***0.01, **0.05, *0.1.

Findings and Suggestions

In light of India's status as a developing and evolving economy, this study aims to define the performance indicators for the agriculture sector in India. Agriculture is the primary contributor to the country's gross domestic product. Based on the three stages of agriculture development, which include input, process, and output, 11 variables have been defined as performance indicators for study. This study creates 11 models for all performance indicators considered in this analysis, with each indicator interacting with the agriculture sector's gross value added. The agriculture sector's gross value added has been used as a metric for assessing the sector's efficiency.

Interestingly, out of 11 performance indicators, only four indicators have a positive and significant impact on gross value added by the agriculture sector. Two (fertilizers consumed in the production of food grains and institutional credit outstanding by the agriculture sector) of the four indicators belong to the input stage. The agriculture sector's expenditure on research and development is an indicator in the processing stage. The last indicator belongs to the output stage: deposits with banks in a rural area. In other words, the performance of the agriculture sector depends on the variables belonging to all three stages of agriculture production. However, the input stage leads the performance as it has two performance indicators. Out of these four indicators, fertilizers consumed is the most prominent performance indicator, followed by expenditure on research & development, deposits with banks in rural areas, and institutional credit outstanding. Deposits with banks in rural areas signify financial inclusion in rural areas. However, deposit with banks in a rural area has a positive coefficient at a .01 significance level, and the rest of the three indicators have a positive coefficient at a minimum of .05 significance level. There is a requirement for more penetrated financial inclusion policies in rural areas of India to ensure better performance of the agriculture sector. Institutional credit, considered one of the prominent performance indicators for the agriculture sector, has been ranked fourth in this study. This result should assist the government in framing policies for ensuring the adequacy of institutional credit to the agriculture sector.

Surprisingly, three indicators crucial for agriculture production and distribution have either negative or

positive but insignificant impacts. These indicators are the supply of electricity, the sale of tractors, and the construction of highways. The reason for these factors' underperformance is a low contribution to the agriculture sector's performance compared to other indicators. The government should design policies for an adequate supply of electricity for agriculture production, promotion of sale of tractors, and construct highways at a rapid speed.

Managerial and Theoretical Implications

The study reveals the importance of various performance indicators relevant to the agriculture sector that could increase the gross value added. The study puts forward both the theoretical implications and managerial implications. The ARDL approach in the agriculture sector has been explored scarcely in the Indian context. Thus, this research work tries to fill that gap. Eleven performance indicators have been explored in detail in this study. The policymakers and government can evaluate the significance of these performance indicators to take further courses of action to improve the overall performance of the agriculture sector.

Limitations of the Study and Scope for Further Research

The results of the study are dependent on the findings of the ARDL technique. The application of different techniques can result in different outputs and inferences. Only the Indian context has been studied in this research work. Other developing countries can also be explored for these indicators. The conceptual model used in the study can be tested and replicated in other contexts and duration. Future research can also examine the impact of other performance indicators.

Authors' Contribution

Rahul Singhal and Dr. Prateek Gupta envisaged the idea of this study. Rahul Singhal developed the conceptual framework and qualitative and quantitative design to undertake the study. Rahul Singhal implemented the statistical techniques to analyze the data using SPSS 23.0 and R Studio. Dr. Ajay Singh helped develop the conceptual background with literature reviews. Dr. Singh helped in the writing work with the support of the other authors.

Conflict of Interest

The authors certify that they have no affiliations with or involvement in any organization or entity with any financial interest, or non-financial interest in the subject matter, or materials discussed in this manuscript.

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