Growth and Productivity in Agricultural Sector

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***Abstract*: Agriculture continues to be the backbone of the Indian economy - this is hardly an extravagant statement. India is the world's second most populous country after China. India ranks as the world's second-biggest producer of wheat, rice, cotton, groundnuts, sugarcane, and horticultural crops. It is also the world's greatest producer of jute, pulses, and milk. The interrelationships between agricultural output and economic growth were examined in the current study while keeping in mind established policy directives for agricultural development in India. The Augmented Dickey– Fuller test (ADF) and regression analysis were used to evaluate the performance of the set model. The econometric model was developed using aggregate data available for the period of 2001–2021 (economic reforms to new India idea). This study looked at India's agricultural output and how it affects the country's economic development. According to the report, there would have been no a rise in agricultural production (explanatory factors), India's economy would not have grown as quickly.**

Keywords*: GDP, economic growth, regression model, agricultural production*

I INTRODUCTION

As the economic growth of this nation is heavily dependent on agricultural activities, agriculture is the foundation of the Indian economy. In addition to supplying the people of the country with food, agriculture offers prospects for employment, savings, contributing to the market for industrial goods, and earning foreign currency. Various actions involved in moving agricultural products from the site of production to the point of consumption are referred to as marketing of agricultural products. India's agricultural production system is distinguished by small-scale production, seasonality in supply and demand, and many other factors.

The agriculture sector received a specific emphasis to meet the food crisis during the first five-year plan (1951–1956). Since then, there has been a steady drop in the percentage of GDP that is derived from agriculture and related sectors. The 11th five-year plan (2007–2008–2011–2012) set an aim to stop the sluggish development and productivity of the agricultural sector in response to the agricultural crisis and decreased production. The fast and inclusive expansion of agriculture is the primary goal of the 12th five-year plan. Sluggish growth in all of India's sectors has been caused by the weak growth rate of the global economy from 2008–2009. Despite being lower than in other industrialised nations, farm production has increased as a result of some development efforts. The primary goal of

the 12th five-year plan is the rapid and inclusive expansion of agriculture. Since 2008–2009, the global economy has grown at a sluggish pace, which has led to weak development in all of India's industries. Despite being lower than in other industrialised nations, farm production has increased as a result of some development efforts. These include the use of enhanced fertilisers, insecticides, and pesticides, the adoption of (High Yielding Varieties) HYV seeds, new cropping patterns, new irrigation systems, farm research, and management techniques. Increase in the production of various agricultural products is not sufficient for the economic development process in this country. It also requires a systematic and scientific marketing system for the purpose of marketing agricultural products in domestic market as well as in international market.

II LITERATURE REVIEW

In this section, a comprehensive review of prior scholarly research is presented to facilitate a deeper understanding of the issues pertaining to the objectives of this study.

Kannan and Sundaram (2011) undertook a thorough examination of the national and state-level trends and patterns in India's agriculture sector growth. They also created a crop production growth model to analyse the factors influencing growth on a national level as part of their study. Their study revealed a significant transition in India's cropping pattern, with a significant shift from the cultivation of traditional food grains to the growing of commercial commodities.

Cao and Birchenall (2013) examined the crucial part that agricultural output played as a key factor in the post-reform economic development and sectoral reallocation of China. Their research suggested a link between economic growth and the reallocation of labour in China towards higher agricultural production.

Awan and Anum (2014) conducted a thorough investigation to look into the main forces driving the agriculture sector and the complex interactions between agricultural economic development and GDP growth. Their results highlighted a large and favourable relationship between agricultural expansion and total GDP growth, highlighting the critical function of agriculture in promoting the nation's economic development.

Oyakhilomen and Zibah (2014) claimed that in Nigeria, there was a favourable trend in the association between agricultural output and economic growth. Their study emphasised the persistent influence of agriculture on economic growth by establishing the relevance of this link throughout the short and long terms.
Awokuse and Xie (2015) embarked on a comprehensive exploration of the dynamic interplay between agriculture productivity and economic growth on a global scale. Their investigation encompassed an examination of the relationship between agricultural production and economic growth across 15 developing and transition economies spanning Latin America, Asia, and Africa. Their findings conclusively highlighted agriculture's paramount role as a catalyst for economic growth. Moreover, their study suggested that trade openness had a positive and favorable influence on GDP per capita.

In conclusion, this survey of the literature offers important new perspectives on the complex connections among agriculture, economic development, and sectoral reallocation in many national settings. These studies highlight the importance of agriculture as a force for economic growth and the demand for a complex knowledge of the mechanisms at work in this vital industry.

III OBJECTIVES

The main objectives of the study are:

1. To examine how agricultural production contributes to the economic growth in India (2001 - 2021).
2. To fit the linear regression growth model to find out the relationship between gross domestic product and the selected variables of agricultural production in India.
3. Identify the trends in the growth of agricultural production.

I. DATABASE AND METHODOLOGY:

The Handbook of Statistics for the years 2001 to 2021 is the source of the secondary data used in this study (Tables 17 and 18). The main crops and other variables that have an impact on the nation's economic growth are used as explanatory variables in the linear growth regression model, which uses GDP as a dependent variable. The STATA-16 data analysis programme is used.

1. Model Specification

A linear growth regression model was employed in this investigation. GDP is the dependent variable, while the independent variables in the model comprise eight important crops: cereals, pulses, oilseeds, coffee, sugarcane, cotton, tea, and tobacco. The following describes the linear regression model:

$GDP= \beta_0+ \beta_1 cereals+\beta_2 pulses+ \beta_3 oilseeds+ \beta_4 coffee + \beta_5 tea + \beta_6 sugarcane+ \beta_7 cotton+ \beta_8 tobacco + u_t$

Where, GDP= is the Gross domestic Product, β_0 = is a constant β_1, β_2, β_3, β_4, β_5, β_6, $\beta_7$and β_8 = are parameters to be estimated and u_t = error term in t period.

2. Variables Applied to the Model

(i) Dependent Variable:

Gross Domestic Product (GDP): The GDP at factor cost is used in the current study as a stand-in for economic growth, which gauges the entire production in a country. Data from the agricultural GDP is used here.

(ii) Independent Variables:

Cereals, Pulses, Coffee, Tea, Sugarcane, Cotton, and Tobacco are the independent variables.

Data and Method of Analysis

STATA software was used for the study's data analysis. Running regression models using GDP as the dependent variable and other agricultural elements (cereals, pulses, oilseeds, coffee, tea, sugarcane, cotton, and tobacco) as the independent variables required. This made it possible to investigate the relationship between alterations in key agricultural variables

and alterations in GDP across time. The programme utilised for these studies was STATA_16.

ANOVA Table

Source	SS	df	MS	Number of obs	=	20
				F(8, 11)	>	99999.00
Model	149050556	8	18631319.4	Prob > F	=	0.0000
Residual	3.01933298	11	.274484816	R-squared	=	1.0000
				Adj R-squared	=	1.0000
Total	149050559	19	7844766.24	Root MSE	=	.52391

Sources: Model, residual, and total are the types of variances in the outcome table. Total variances are the position into the variance which can be explained by the independent variable (model) and the variance which is not explained by the independent (residual).

SS: There are sum of square associated with the 3 sources of variance - residual model total.
MS: These are means square, sum of the square divided thereof.

df: In statistics, "degrees of freedom" (df) refers to the number of variables that can change in a statistic's final computation that is free to vary. The total variance has N-1 df i.e. 20 – 1 =19. the model df (no. of coefficient estimated – 1) = 9-1=8 . The residual df 11.

F(8,11): This is the F statistic which is the model mean square divided by residual mean square

Prob > F: Here Prob>F in the regression output is 0.0000 so we can say that the regression model is overall significant at 1% LOS .

R – Squared and Adj R – square: Here R – squared is 1.0000 so we can say that GDP is 100% explained by the independent variables because this GDP is only agricultural GDP. So these variables are very much good fit for this model.

Root MSE: The square root of the mean square residual and the error term's standard deviation.

Parameter Estimate

gdp	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
cereals	.9967735	.0018876	528.05	0.000	.9926188	1.000928
pulses	.9891923	.009569	103.37	0.000	.9681312	1.010254
oilseeds	1.015465	.0080847	125.60	0.000	.9976706	1.033259
coffee	1.000667	.0009072	1103.07	0.000	.99867	1.002663
tea	1.00055	.0002357	4244.79	0.000	1.000031	1.001069
sugarcane	1.000842	.0004506	2220.95	0.000	.9998506	1.001834
cotton	.9942378	.0043069	230.85	0.000	.9847584	1.003717
tobacco	.9391816	.0714791	13.14	0.000	.7818571	1.096506
_cons	-4.295495	3.171457	-1.35	0.203	-11.27583	2.684836

Here the regression equation

GDP= β_0 + β_1 cereals + β_2 pulses + β_3 oilseeds + β_4 coffee + β_5 tea + β_6 sugarcane+ β_7 cotton + β_8 tobacco + u_t

GDP= -4.295495 + .9967735 cereals + .9891923 pulses + 1.015465 oilseeds + 1.000667 coffee + 1.00055 tea+ 1.000842 sugarcane + .9942378 cotton + .9391816 tobacco + u_t

The provided regression results indicate the relationships between Gross Domestic Product (GDP) and various independent variables (Cereals, Pulses, Oilseeds, Coffee, Tea, Sugarcane, Cotton, Tobacco). Here's a summary of the findings:

Coefficient Values: The coefficient values associated with each independent variable indicate the strength and direction of their relationship with GDP. For instance, positive coefficients (greater than 1) suggest a positive impact on GDP, while negative coefficients (less than 1) imply a negative impact.

t-Statistic: The t-statistic is used to test whether a given coefficient is significantly different from zero. If the calculated t-value is greater than the critical t-value (tabulated t-value), it indicates that the null hypothesis (no relationship) can be rejected in favor of the alternative hypothesis, which suggests a meaningful relationship between the independent and dependent variables.

P-Value (P>|t|): The p-value is associated with the t-test and indicates the probability of obtaining the observed t-statistic by random chance alone. In most cases, a significance level (α) of 0.05 is used. If the p-value is less than 0.05, it implies that the coefficient of the variable is significantly different from zero, supporting the existence of a meaningful relationship.

In this case, the p-values for all independent variables (Cereals, Pulses, Oilseeds, Coffee, Tea, Sugarcane, Cotton, Tobacco) are reported as P = 0.000. This means that the p-values are less than 0.05 (the chosen significance level), indicating that all of these independent variables have a statistically significant impact on GDP. In other words, the null hypothesis of no relationship between these agricultural variables and GDP is rejected in favour of the alternative hypothesis, confirming that these variables do explain variations in GDP.

ADF Test:

Dickey-Fuller test for unit root **Number of obs = 19**

Interpolated Dickey-Fuller --------

Variables	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value	MacKinnon approximate p-value for Z(t)	Decision (at 99% confidence interval)

GDP	-0.208	-3.75	-3	-2.63	0.9375	Stationary
cereals	-0.478	-3.75	-3	-2.63	0.8963	Stationary
pulses	-0.64	-3.75	-3	-2.63	0.8616	Stationary
oilseeds	-2.274	-3.75	-3	-2.63	0.1804	Stationary
coffee	-1.283	-3.75	-3	-2.63	0.6367	Stationary
tea	-0.834	-3.75	-3	-2.63	0.809	Stationary
sugar cane	-1.545	-3.75	-3	-2.63	0.5111	Stationary
cotton	-1.662	-3.75	-3	-2.63	0.4509	Stationary
tobacco	-1.727	-3.75	-3	-2.63	0.4171	Stationary

Second the stationary of the data series is tested through the unit root method using Augmented Dickey - Fuller test (ADF). STATA16 software is used for the data analysis. On each of the study's variables, the ADF test is run. The following describes the unit root ADF test's null hypothesis:

Null Hypothesis: H_0: $\beta_0 = 0$ (i.e., there is a unit root or time series is non - stationary).

Alternative Hypothesis: H_1: $\beta_0 < 0$ (stationary).

If the calculated ADF test statistic is greater than critical t-values, then the null hypothesis will be rejected and the variables are stationary. This table examined that all the variables, including GDP, cereals, pulses, oilseeds, coffee, tea, sugarcane, cotton, and tobacco, have ADF test statistics more negative than the critical values at the 1% significance level. Additionally, their MacKinnon p-values are greater than 0.01. Therefore, based on the ADF test results at the 99% confidence interval, it can be concluded that all these variables are stationary, meaning they exhibit stable and predictable patterns over time.

Growth

Thirdly we see the growth rate of GDP and its main component. Growth table and graph shown below:

year	growth
2001-02	
2002-03	-0.05206
2003-04	0.017453
2004-05	0.014204
2005-06	0.058868
2006-07	0.066819
2007-08	0.001488
2008-09	-0.04283
2009-10	0.019584
2010-11	0.043166

2011-12	0.086426
2012-13	0.010397
2013-14	0.038223
2014-15	0.000817
2015-16	0.014565
2016-17	-0.01157
2017-18	0.071173
2018-19	0.020537
2019-20	-0.00976
2020-21	0.006902

The Gross Domestic Product (GDP) growth rates for India from 2001–2002 to 2020–21 are shown in the table. These growth rates reflect the GDP's percentage change from the prior year. A few noteworthy events include the GDP's tiny fall in 2002–2003, moderate but positive growth in the middle of the 2000s, a decline during the 2008–2009 global financial crisis, recovery, major growth spikes in 2011–12 and 2017–18, and more recent changes in 2019–20 and 2020–21. This information gives a succinct assessment of the yearly economic performance and trends during the preceding two decades.

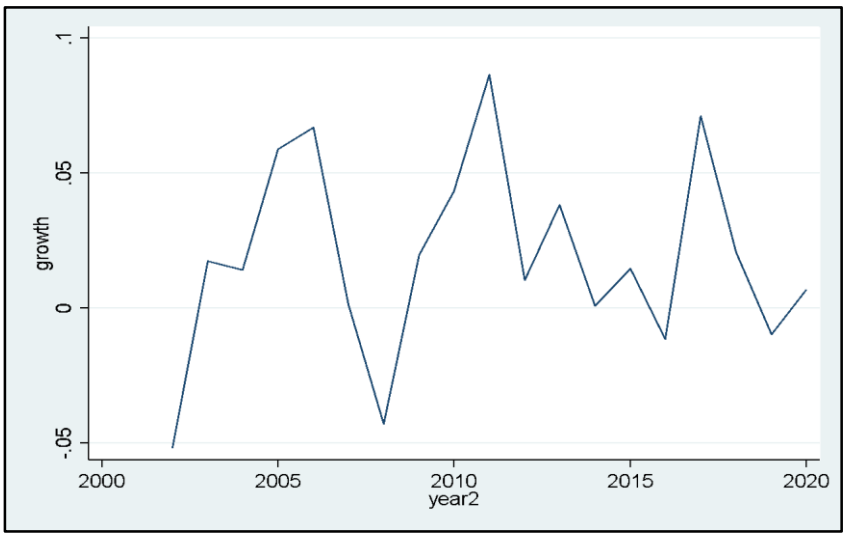


Fig.1 Agricultural Growth in India

PRODUCTIVITY

This table shows the percentage of cereals, pulses, oilseeds, tea, sugarcane, cotton, tobacco for GDP. . Here tea production is too high. Using EXCEL, we obtain this table..

Percentage distribution of different crops in agriculture

Cereals	11.25%
Pulses	0.87%
Oilseeds	1.39%
Coffee	14.90%
Tea	53.93%

Sugarcane	16.32%
Cotton	1.31%
Tobacco	0.03%

The table shows how the agriculture sector's various crops are distributed as a percentage of India's Gross Domestic Product (GDP). It is clear from this statistics that the economic contributions of various crops to the country range significantly from one another.

The production of tea stands out among the highlighted crops, significantly contributing 53.93% to GDP. The economic importance of the tea business within the agricultural sector is highlighted by this high percentage. The production of tobacco, on the other hand, has the least influence on the economy overall, contributing only 0.03% of GDP, underscoring its comparatively little significance. The diversity and relative importance of many crops in determining India's agricultural landscape—and, consequently, its economic composition—are illuminated by this distribution. In order to maintain a balanced and sustainable agricultural sector, it emphasises the economic importance of some products, such as sugarcane and tea, and the necessity of careful agricultural planning.

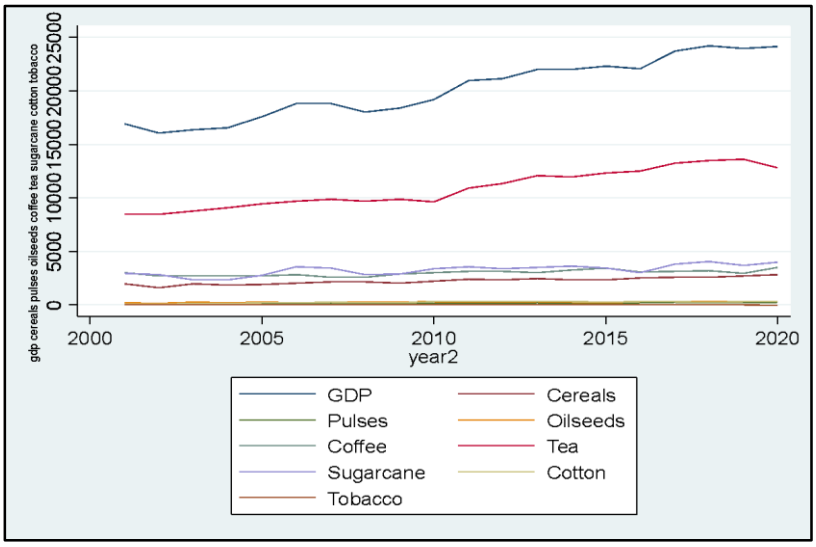
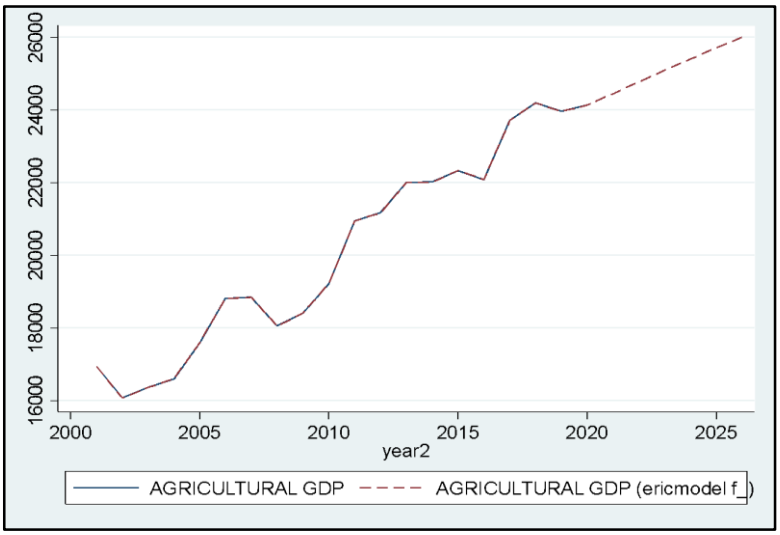


Fig.2 Agricultural Productivity in India

FORECAST after 5 years -------



Problem Areas In Agricultural Marketing

1.Small and scattered holding: Many farmers have sparsely populated areas of land, which raises production costs, complicates transportation, and lowers their ability to influence market prices.

2.Lack of Appropriate Storage Facilities: Farmers are forced to sell their goods fast and frequently for less money due to a lack of warehouse and storage choices. The quality and shelf life of agricultural products are sometimes impacted by the low quality of the current storage facilities. These difficulties underscore the necessity of infrastructure upgrading and funding for agriculture.

3.A lack of transport infrastructure, such as all-weather roads, vehicles suitable for transporting perishable commodities, and a lack of connection roads to mandis, has a major impact on the agricultural sector. As a result, the amount of money spent on transportation is increased.

4. Lack of Uniformity in Grading and Standardisation: Farmers' limited negotiating power and the selling of agricultural products at lower prices are caused by a lack of adequate grading facilities and standardised measures for categorising agricultural production.

5. Poor facilities for handling, packing, packaging, and processing: Lack of appropriate tools for handling and processing agricultural products, as well as a lack of scientific packing methods, cause significant waste and financial loss for farmers. The product is vulnerable to significant physical damage and quality degradation due to improper handling and packaging.

IV CONCLUSION AND POLICY PRESCRIPTION

This The study's empirical results show that agricultural productivity directly affects agricultural income and employment, and on the other side, they also demonstrate that, from an Indian viewpoint, economic expansion directly affects agricultural production. In the Indian economy, the study shows a positive correlation between the dependent variable, gross domestic product (GDP), and the chosen independent factors. The report emphasises that the Indian economy would expand more slowly if there is no improvement in agricultural productivity in India. Despite the several measures the government of India (GOI) took from 1961 to 2017 to increase agricultural production in India, the agricultural industry is still having significant issues. In order to completely remove the agricultural issues, the following can be considered in the policy making:

- ✓ Examining the obvious effects on crop selection, crop productivities, variety of yields, diversity of seeds, availability of HYV and GM seeds, e-NAM, and APMCs for the benefit of small and marginal farmers in particular for farm loans is vital.
- ✓ Making an efficient approach to inform farmers about farming education is urgently needed.

- ✓ For India's flood and drought problems as well as irrigation problems, it is necessary to establish effective strategies for joining the rivers. The research urges prompt implementation of the rivers' connectivity as soon as practicable.
- ✓ Unwavering attention to industries that produce goods for export, such as tea, spices, grains, mangoes, grapes, and floriculture.
- ✓ Every year, permit controlled exports of some excess goods; respect international contract conditions.
- ✓ A three-year ban on term loan and interest payback.

V REFERENCES:

1. Kannan, E., & Sundaram, S. (2011). *Analysis of trends in India's Agricultural Growth*. Bangalore, India.
2. Michell, Kular, I. K., & Brar, A. S. (2012). Transforming Indian agriculture through agripreneurs. *Indian Journal of Marketing*, *42*(3), 22-29.
3. Kulshrestha, D., & Agrawal, K. K. (2019). An econometric analysis of agricultural production and economic growth in India. *Indian Journal of Marketing*, *49*(11), 56-65.
4. Awan, A. G., & Anum, V. (2014). Impact of infrastructure development on economic growth: A case study of Pakistan. *International Journal of Economics and Sustainable Development*, *2*(5), 1-15.