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Growth of Some Major Crop Production in India: A Trend Analysis

Dr. Asit Pandit
Assistant Professor in Economics,
Sabang Sajanikanta Mahavidyalaya,
Lutunia (West Bengal, India)
E-mail: asiteco88@gmail.com

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ABSTRACT:

This study examines the growth performance of foodgrain production, cultivated area, and yield in India during the period 2009–10 to 2023–24. Using secondary data, the study analyzes trends in agricultural development through growth rate analysis and linear trend models. The findings reveal a significant increase in foodgrain production over the study period, indicating steady progress in the agricultural sector. The cultivated area under foodgrains also shows a positive trend, although the rate of increase is comparatively lower than that of production. Yield growth emerges as the major contributor to the rise in foodgrain output, reflecting improvements in agricultural technology, irrigation facilities, use of high-yielding varieties, and better farming practices. Trend equations and coefficients of determination (R^2) indicate a strong and statistically reliable upward movement in production, area, and yield. Among major foodgrains, rice and wheat exhibit substantial growth, with productivity improvements playing a crucial role in enhancing overall output. The study concludes that sustained increases in yield are essential for ensuring food security and agricultural sustainability, particularly in the context of limited scope for area expansion. Policy measures focusing on technological innovation, efficient resource utilization, climate-resilient agriculture, and farmer support systems are recommended to maintain and accelerate foodgrain growth in the future.

Keywords: *Foodgrain Production, Cultivated Area, Yield, Growth Rate, Trend Analysis, Agricultural Development.*

I. Introduction:

Agriculture remains one of the most important sectors of the Indian economy, contributing significantly to GDP, employment, food security, and industrial development. The study examined the growth performance of food grain production, area under cultivation, and yield in India from 2009-10 to 2023-24, with special emphasis on the impact of the New Agricultural Policy (NAP) introduced in 2000, subsequent initiatives such as the National Food Security Mission (NFSM), Pradhan Mantri Krishi Sinchayee Yojana (PMKSY), promotion of improved seeds, crop diversification, and digital agricultural technologies significantly contributed to the growth of food grain production. The

government purposefully and consciously created this policy to promote the growth and development of agricultural production and productivity, thereby increasing income, employment, and living standards. This policy aimed to promote the agriculture sector's overall development. The goal of the policy was to promote the agriculture sector to attain more than in 4% each year. The findings reveal that total food grain production increased from 218.1 million tonnes in 2009-10 to 328.85 million tonnes in 2023-24, representing a growth of about 50.78 percent. Among major food grains, rice and wheat remained the dominant crops, accounting for the largest share of total production. Rice production increased from about 89.09 million tonnes in 2009-10 to 136.70 million tonnes in 2023–24, while wheat production rose from 80.08 million tonnes to 112.93 million tonnes during the same period. Pulses and coarse cereals also registered notable growth, particularly due to technological interventions and government programmes aimed at improving productivity. During the same period, yield increased substantially from 1798 kg/ha to 2,525 kg/ha, while the area under food grain cultivation remained almost stagnant. This indicates that growth in food grain production was driven primarily by improvements in productivity rather than expansion of cultivated area. Among major food grains, wheat recorded the highest growth in production, followed by rice and pulses. Coarse cereals experienced a decline in cultivated area but registered significant yield improvements. After the introduction of the New Agricultural Policy in 2000, food grain production, yield, and productivity improved considerably, supported by technological advancements, irrigation development, improved seed varieties, mechanization, government support programmes, and favorable pricing policies. The study concludes that the New Agricultural Policy contributed positively to agricultural growth, although productivity gains rather than area expansion remained the main source of increased food grain output. Structural stability analysis further indicated that India's food grain production system remained relatively stable over the study period.

Review of Literature:

Schultz (1964) and Hayami and Ruttan (1985) observed the role of human capital, technological innovation and institutional changes in enhancing agricultural productivity. Their studies highlighted that continuous growth in agricultural output depends largely on developments in technology rather than the expansion of cultivated land.

Mellor (1976) analysed that agricultural growth plays an important role in economic progress by creating employment, increasing rural incomes as well as ensuring food security. According to him, productivity improvement through technological development and irrigation progress is essential for realizing long-term agricultural growth.

Dantwala (1986) argued that Indian agriculture experienced significant structural conversion after the Green Revolution due to the implementation of high-yielding varieties, expansion of irrigation conveniences, and increased use of modern inputs. However, regional disparities in agricultural

progress remained a major concern.

Bhalla and Singh (2010) analysed agricultural growth in India and found that productivity growth was the principal source of increased food grain production, whereas the contribution of area expansion had declined considerably. Their study concluded that technological progress and public investment in agriculture were crucial determinants of production growth.

Chand (2012) examined the performance of Indian agriculture during the post-reform period and reported that the sector experienced moderate growth despite increasing pressure on land resources.

Birthal, Joshi and Gulati (2015) found that government interventions, including input subsidies, MSP (minimum support prices) and investment in agricultural research, significantly contributed to the growth of agricultural production and food security in India.

The National Food Security Mission (NFSM), launched in 2007, has been extensively studied by several researchers. Government reports and empirical studies indicate that the programme played an important role in increasing the production and productivity of rice, wheat, and pulses through the dissemination of improved seed varieties, balanced fertiliser use, and better crop management practices.

Studies on the Pradhan Mantri Krishi Sinchayee Yojana (PMKSY) suggest that improved irrigation facilities have contributed positively to agricultural productivity by reducing dependence on monsoon rainfall and promoting efficient water management practices.

Gulati, Roy and Hussain (2017) determined that technological interventions, mechanisation, and enhanced access to agricultural inputs significantly improved crop productivity in India. Their findings revealed that increases in food grain output were driven mainly by productivity improvements rather than by expansion of cultivated area.

Kumar and Sharma (2018) analysed the trends in food grain production and concluded that wheat and rice remained the major contributors to total food grain production, while pulses and coarse cereals showed substantial improvements in productivity due to targeted government programmes and technological advancements.

Several studies conducted after the introduction of the New Agricultural Policy (NAP), 2000, have conveyed positive outcomes in terms of production growth, diversification, and increased investment in agriculture. The policy expected at achieving agricultural growth exceeding four per cent per annum through technological advancement, efficient resource use, and strengthening of agricultural infrastructure.

Gap of existing review of literature:

The review of literature recommends that the growth of food grain production in India has been driven predominantly by improvements in productivity rather than expansion of cultivated area.

Existing studies generally agree that government policies, technological progress, irrigation development, and institutional support have contributed substantially to agricultural growth. However, relatively few studies have comprehensively examined the growth performance of food grain production, area, and yield in India during the post-New Agricultural Policy period up to 2023-24. Therefore, the present study attempts to fill this gap by analysing the trends and growth of food grain production and assessing the structural stability of India's food grain production system during the period 2009-10 to 2023-24.

Objectives of the Study:

In this brief background the present paper sets threefold objectives for itself:

1. To analyse the trend of growth of major crop production in India.
2. To examine the trend analysis of major crop production in India during 2009-10 to 2023-24.

Sources of data and methodology:

This study base on the Agricultural production, the data on the area under cultivation (in lakh hectares), production of crops (in lakh tonnes) and yield per hectares of food grains (Kg/hectare) has been collected secondary sources from (RBI, 2023-24) Ministry of Agriculture & Farmers Welfare, Government of India. We have been used to carry out the objectives of production, area under cultivation and the yield per hectares of food grains in India. We have also used average, compound annual growth rate (CAGR) analyses and also trend analysis of some major crop production in India during period 2009-10 to 2023-24

Plan of the Study:

The rest of the paper is divided into four sections. Section II determine the trend of growth of major crop production in India during 2009-10 to 2023-24. Section III to explore the trend analysis of agricultural production, Cultivated Area and Yield in India during 2009-10 to 2023-24. Section IV to analyses the major food grain production using by multiple regression model in India. Section V makes the concluding observations.

II. Trends of Growth Rate of Crop Production:

Table 1 Growth Rate of Agricultural Production (Lakh Tonnes), Cultivation Area (Lakh hectares) and Yield (Kg / hectare) during 2009-10 to 2023-24

Year	Production	Growth Rate of Production of Foodgrain	Area	Growth Rate of Cultivation area	Yield	Growth Rate of Yield
2009-10	2181.0		1213		1798	
2010-11	2445.0	12.10	1267	4.45	1930	7.34
2011-12	2593.0	6.05	1248	-1.50	2078	7.67

2012-13	2571.0	-0.85	1207	-3.29	2129	2.45
2013-14	2650.0	3.07	1260	4.39	2101	-1.32
2014-15	2520.0	-4.91	1220	-3.17	2070	-1.48
2015-16	2515.0	-0.20	1232	0.98	2056	-0.68
2016-17	2751.0	9.38	1292	4.87	2129	3.55
2017-18	2850.0	3.60	1275	-1.32	2235	4.98
2018-19	2852.0	0.07	1248	-2.12	2286	2.28
2019-20	2975.0	4.31	1270	1.76	2343	2.49
2020-21	3107.0	4.44	1298	2.20	2394	2.18
2021-22	3156.2	1.58	1302	0.31	2425	1.29
2022-23	3296.9	4.46	1322	1.54	2494	2.85
2023-24	3288.5	-0.25	1302	-1.51	2525	1.24

Source: Ministry of Agriculture & Farmers Welfare, Government of India, RBI

Agriculture is most important sector which play a vital role in promoting food security and economic development in India. An analysis of food grain production, cultivated area, and yield during the period 2009–10 to 2023–24 reveals significant progress in agricultural performance (In Table 1). The data reveal that total food grain production in India increased from 218.1 million tonnes in 2009–10 to 328.9 million tonnes in 2023–24, registering an overall increase of 50.78 percent during the study period. Production growth exhibited considerable fluctuations across years. The highest annual growth rate of 12.10 percent was recorded in 2010–11, followed by 9.38 percent in 2016–17. Negative growth was observed in 2012–13 (-0.85%), 2014–15 (-4.91%), 2015–16 (-0.20%), and 2023–24 (-0.25%), mainly due to adverse climatic conditions, droughts, and irregular rainfall patterns. Despite short-term fluctuations, the long-term trend indicates a steady increase in food grain production. The area under food grain cultivation increased marginally from 1,213 lakh hectares in 2009–10 to 1,302 lakh hectares in 2023–24, representing an increase of only 7.34 percent. The annual growth rate of cultivated area remained highly unstable, varying between 4.87 percent in 2016–17 and –3.29 percent in 2012–13. The limited growth in cultivated area suggests that land expansion has not been a major contributor to increased food grain production in India. Constraints such as urbanization, industrialization, and competing land uses have restricted the expansion of agricultural land. Food grain yield increased

significantly from 1,798 kg per hectare in 2009–10 to 2,525 kg per hectare in 2023–24, recording an overall increase of 40.43 percent. The highest annual growth rate in yield was observed in 2010–11 (7.34 percent), followed by 2011–12 (7.67 percent). Yield growth remained positive in most years, except during 2013–14, 2014–15, and 2015–16 when adverse weather conditions affected agricultural productivity. The continuous improvement in yield indicates the positive impact of improved seeds, irrigation facilities, mechanization, fertilizers, and government support programmes.

Table 2 Growth Rate of Agricultural Production (in Million Tonnes) during 2009-10 to 2023-24

	Production (Lakh Tonnes)		Cultivation Area (Lakh hectares)		Yield (Kg / hectare)	
	CAGR	Average	CAGR	Average	CAGR	Average
Rice	2.9	1131	0.85	444	2.0	2539
Wheat	2.3	988	0.61	304	1.6	3256
Coarse Cereals	3.3	453	-0.84	248	4.2	1837
Total Cereals	2.7	2572	0.34	996	2.4	2581
Pulses	3.5	212	0.99	268	2.5	785
Total Foodgrains	2.8	2783	0.47	1264	2.3	2200

Source: Ministry of Agriculture & Farmers Welfare, Government of India, RBI

The Compound Annual Growth Rate (CAGR) analysis of major foodgrain crops during 2009–10 to 2023–24 reveals a positive trend in agricultural production in India (In Table 2). Among the cereals, coarse cereals recorded the highest production growth rate at 3.3% per annum, followed by rice at 2.9 per annum and wheat at 2.3 per annum. The overall production of total cereals increased at an annual rate of 2.7 percent, while pulses registered the highest growth among all foodgrain groups at 3.5 percent. Consequently, total foodgrain production grew by 2.8 percent annually during the study period.

The analysis of cultivation area indicates relatively slower growth compared to production. The cultivated area under rice and wheat increased marginally at 0.85 percent and 0.61 percent per annum, respectively. The area under coarse cereals declined at an annual rate of 0.84 percent, suggesting a shift of land towards other crops or non-agricultural uses. The area under pulses expanded by 0.99 percent annually, while the overall foodgrain area grew modestly at 0.47 percent per year.

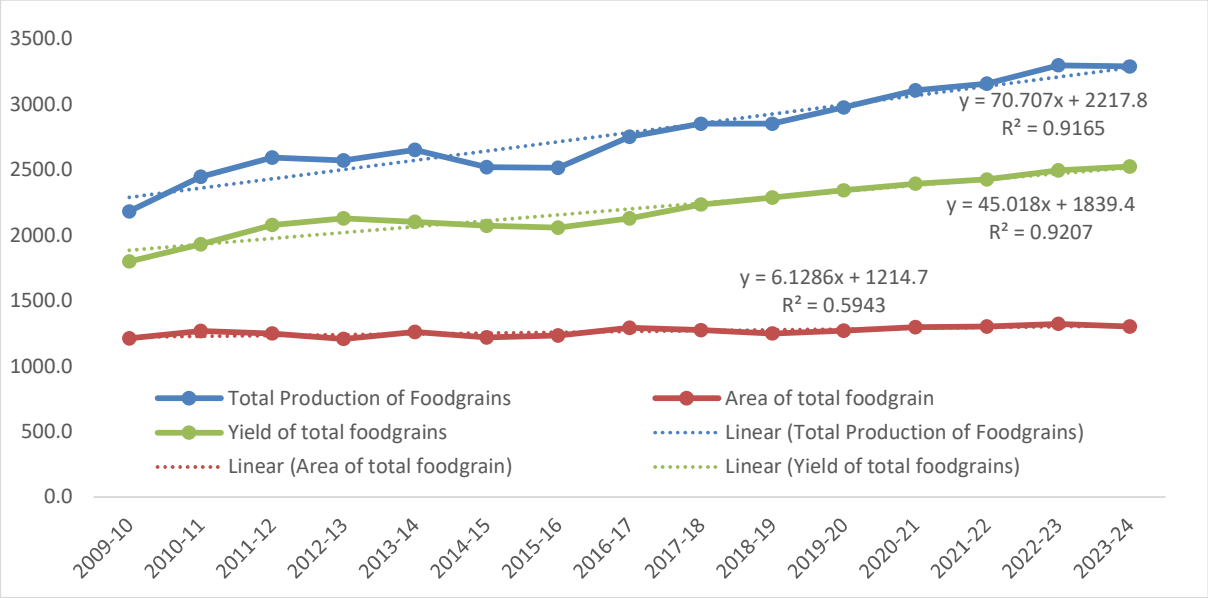
Yield growth played a crucial role in enhancing agricultural output. Coarse cereals achieved the highest yield growth rate (4.2%), followed by pulses (2.5%), total cereals (2.4%), and total foodgrains (2.3%). Rice and wheat yields increased by 2.0 percent and 1.6 percent per annum, respectively. The higher growth in yield compared to area expansion indicates that technological advancements, improved seed varieties, better irrigation facilities, and adoption of modern farming

practices were the primary drivers of increased agricultural production during the period.

The average production figures show that rice remained the dominant foodgrain crop with an average annual production of 1,131 million tonnes, followed by wheat (988 million tonnes). The average yield was highest for wheat (3,256 kg per hectare), reflecting its relatively superior productivity, whereas pulses recorded the lowest average yield (785 kg per hectare), highlighting the need for further technological interventions in pulse cultivation.

III. Trend of Production, Cultivated Area and Yield:

Figure 1 Trend of the Total Production, Area and Yield of food grains



Source: Ministry of Agriculture & Farmers Welfare, Government of India, RBI

The linear trend equations and coefficients of determination (R^2) provide insights into the long-term growth pattern of total production of foodgrain, area of total foodgrain, and yield of total foodgrain during 2009–10 to 2023–24 (In Figure 1). Total production of foodgrains explained a significantly positive trend in foodgrain production, with the trend equation $y = 70.707x + 2217.8$ and a high R^2 value of 0.9165explaine by 91.65 percent of the variation in total foodgrain production during this time. The cultivated area under also increased steadily ($y = 45.018x + 1839.4$; $R^2 = 0.9207$). Yield exposed a significant rising trend ($y = 6.1286x + 1214.7$; $R^2 = 0.5943$), suggesting that productivity enhancement was a major contributor to rising foodgrain production.

Table 3 Trend of the Total Production, Area and Yield of food grains

	Production	Area	Yield
Rice	y = 29.869x + 891.89 R^2 = 0.9289	y = 3.3143x + 417.62 R^2 = 0.7528	y = 48.018x + 2155.1 R^2 = 0.9357
Wheat	y = 20.477x + 823.77 R^2 = 0.8686	y = 1.3071x + 293.21 R^2 = 0.4091	y = 52.846x + 2833 R^2 = 0.0.8017

Coarse Cereals	y = 12.306x + 354.68 R^2 = 0.7633	y = -2.8214x + 270.7 R^2 = 0.5817	y = 69.311x + 1282.8 R^2 = 0.9162
Total Cereal	y = 20.477x + 823.77 R^2 = 0.8686	y = 1.3071x + 293.21 R^2 = 0.4091	y = 52.846x + 2833 R^2 = 0.8017
Pulses	y = 8.0557x + 147.57 R^2 = 0.7697	y = 4.2643x + 234.22 R^2 = 0.5281	y = 17.621x + 643.96 R^2 = 0.7556

Source: Ministry of Agriculture & Farmers Welfare, Government of India, RBI

The linear trend equations and coefficients of determination (R^2) provide insights into the long-term growth pattern of agricultural production, cultivated area, and yield of major foodgrain crops during 2009–10 to 2023–24 (In Table 3). Rice exhibited a strong positive trend in production, with the trend equation $y = 29.869x + 891.89$ and a high R^2 value of 0.9289, indicating that about 92.89 percent of the variation in rice production is explained by time. The cultivated area under rice also increased steadily ($y = 3.3143x + 417.62$; R^2 = 0.7528). Yield showed a significant upward trend ($y = 48.018x + 2155.1$; R^2 = 0.9357), suggesting that productivity enhancement was a major contributor to rising rice production. Wheat production followed a positive growth path, increasing by approximately 20.48 units annually ($y = 20.477x + 823.77$), with a high explanatory power (R^2 = 0.8686). However, the area under wheat expanded at a slower rate ($y = 1.3071x + 293.21$; R^2 = 0.4091), indicating relatively weak area growth. Yield increased substantially ($y = 52.846x + 2833$; R^2 = 0.8017), highlighting that technological progress and improved farming practices were key drivers of wheat production growth. Coarse cereals demonstrated a contrasting pattern. Production increased significantly ($y = 12.306x + 354.68$; R^2 = 0.7633), while cultivated area declined over time ($y = –2.8214x + 270.7$; R^2 = 0.5817). Despite shrinking acreage, yield recorded a strong positive trend ($y = 69.311x + 1282.8$; R^2 = 0.9162). This indicates that productivity gains more than compensated for the reduction in cultivated area. For pulses, production increased steadily with an annual increment of about 8.06 units ($y = 8.0557x + 147.57$), and the model explained nearly 77 percent of the variation in production (R^2 = 0.7697). The cultivated area under pulses also expanded ($y = 4.2643x + 234.22$; R^2 = 0.5281), while yield showed a positive upward trend ($y = 17.621x + 643.96$; R^2 = 0.7556), indicating improvements in both acreage and productivity. Overall, the trend analysis reveals that the growth of foodgrain production during the study period was driven predominantly by yield enhancement rather than area expansion. The high R^2 values for most yield equations indicate a strong and consistent increase in productivity over time. The case of coarse cereals is particularly noteworthy, where declining cultivated area was offset by substantial yield improvements. These findings emphasize the importance of technological advancement, improved seed varieties, irrigation facilities, and modern agricultural practices in sustaining agricultural growth and ensuring food security.

IV. Analyses Multiple Regression Model of Major Crop Production:

The results of the Multiple Regression Analysis provide important insights into the determinants of Agricultural production in India. The estimated regression model explains the relationship between Crop Production and selected explanatory variables such as Cultivation area and Yield. The estimated model is presented below:

$$\text{Production}_{it} = \alpha_0 + \alpha_1 \text{Area}_{it} + \alpha_2 \text{Yield}_{it} + U_{it} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{Eq}(1)$$

Where, α's is the coefficient of the independent variables and U is the error term. 'i' is used to denote the production unit and 't' for time and i = 1,2,3, ...,

The coefficient of determination ($R^2 = 0.999$) indicates that approximately 99 percent of the variation in profitability is explained by the explanatory variables included in the model (in Table 11). The Adjusted R^2value of 0.999 further confirms the strong explanatory power of the model after adjusting for degrees of freedom. The F-statistic value of 9867.00 with probability value 0.000 suggests that the overall regression model is highly significant and suitable for explaining the crop production.

Table 11 Multiple Regression Analysis of Crop Production

Variables	Coefficient	Std. Error	t-value	p-value	R^2= 0.999 Adjusted R^2 = 0.999
Constant	-2840.295	102.090	-27.821	0.0000	F-statistic =9867.00 Prob (F-statistic) = 0.000
Area	2.246	0.101	22.272	0.0000	
Yield	1.267	0.017	74140	0.000	Durbin-Watson = 1.134

The coefficient of Cultivation Area (2.246) is positive and statistically significant at the 1 percent level. This indicating that an expansion in the area under cultivation contributes positively to foodgrain output. Yield a Positive coefficient 1.267) and is highly significant at the 1 percent level. This indicates that improvements in agricultural productivity substantially increase foodgrain production. The findings suggest that both expansion of cultivated area and improvements in productivity have been the principal drivers of foodgrain production growth in India during the study period.

V. Conclusion:

Agriculture continues to play a important role in the Indian economy by contributing to food security, employment generation, and overall economic development. The present study examined the growth performance of food grain production, area under cultivation, and yield in India during the period 2009-10 to 2023-24 in the context of the New Agricultural Policy and subsequent government initiatives. The findings reveal a significant increase in total food grain production, which rose from 218.10 million tonnes in 2009-10 to 328.85 million tonnes in 2023-24, registering an overall growth

of about 50.78 per cent. Rice and wheat remained the dominant food grain crops and contributed the largest share of total production. Pulses and coarse cereals also recorded considerable improvements, particularly due to technological interventions and targeted government programmes. The analysis further indicates that the area under food grain cultivation remained almost stagnant during the study period, whereas yield increased substantially from 1,798 kg per hectare to 2,525 kg per hectare. This clearly suggests that the growth in food grain production was driven primarily by improvements in productivity rather than by the expansion of cultivated area. Technological progress, improved seed varieties, expansion of irrigation facilities, mechanisation, balanced use of fertilisers, and digital agricultural technologies played a significant role in enhancing agricultural productivity.

Government initiatives such as the National Food Security Mission (NFSM), Pradhan Mantri Krishi Sinchayee Yojana (PMKSY), increased public investment in agriculture, and favourable pricing and procurement policies contributed positively to agricultural growth and food security. Productivity enhancement has been the principal driver of food grain production growth in India during the post-New Agricultural Policy period.

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