

Analysis of Agricultural Growth in India Since the Green Revolution

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Abstract: *The present study discussed a growth of agricultural production and productivity trend in India since green revolution from 1966 - 67 to 2020 - 21. Data on important variables like, Agricultural production, area under cultivation, and yield per hectare in selected states like Andhra Pradesh, Bihar, Punjab, Rajasthan, Uttar Pradesh, TamilNadu and Madhya Pradesh and their major crops in India. For analysis of this study were used the statistical tools like Simple Linear Regression Model, and annual growth rates. The major objectives of the study were to analyse the trend and growth of production and productivity of major crops in selected states of India from 1966 - 67 to 2020 - 21. The study concluded that on an average of area production and yield per hectare of the major crops like Rice, Wheat, Maize, Jowar and Bajra were continuously increased after the green revolution by using of high yielding varieties of seeds over period.*

Keywords: Agricultural Production, Area under Cultivation, Yield Per Hectare, Rice, Wheat, Maize, Jowar, Bajra, Regression Equation, Annual Growth Rate

1. Introduction

Performance of Indian economy is dependent upon the growth of Agriculture sector. It contributes nearly 14 percentage of India's Gross Domestic Product (GDP) and 13 percentages of total exports. It provides employment to 52 percentage of the country's work force and livelihood security to more than 620 million people. Agriculture plays an important role for provision of food to the nation, enlarging exports, transfer of manpower to non - agricultural sectors, contribution to capital formation, and securing markets for industrialization. Under the new agricultural strategy emphasis has been on the development and widespread adoption of high - yielding varieties of seeds. Though the government had been paying attention to induce qualitative improvements in seeds ever since the initiation of planning process in the country, yet the real impetus to these efforts was given by the adoption of the new agricultural strategy in the kharif season of 1966. In 1966 - 67, area under high - yielding varieties of seeds was a meager 1.89 million hectares. This rose to 18.17 million hectares in 1971 - 72. The seventh plan kept a target of 70 million hectares for coverage in area under HYV. As against this, the actual area under HYV by the end of seventh plan was only 63.1 million hectares. In 1998 - 99, the coverage rose to 78.4 million hectares and it was further rose to 124.39 million hectares in 2021.

Green Revolution

In Mexico, Prof. Norman Borlaug and his associates developed new varieties of wheat which were early - maturing, highly productive and disease resistant during the mid 1960s and these varieties were imported and planted in selected region of India having adequate irrigation facility. Within a year of their introduction, it was conclusively demonstrated that the yields from the new varieties exceeded 25 to 100 per cent compared to the yields from traditional varieties.

The government of India introduced an intensive development programme in seven districts selected from seven states in 1960 and this programme was named Intensive Area Development Programme (IADP). A district selected under IADP was required to possess qualities such as assured water supply, minimum hazards (like floods, drainage problem, acute soil conservation problem, etc), well developed village institutions and maximum potentialities for increasing agricultural production within a short span of time. The seven districts selected were West Godavari in Andhra Pradesh, Shahabad in Bihar, Raipur in Madhya Pradesh, Thanjavur in TamilNadu, Ludhiana in Punjab, Aligarh in Uttar Pradesh and Pali in Rajasthan, the first four were selected for rice, the next two for wheat and the last one for millets. This programme was later extended to remaining state for intensive development.

Initially it was implemented in a total area of 1.89 million hectares. On the eve of the Fourth Plan, the coverage was estimated to be 9.2 million hectares. In 1998 - 99, total area under HYVP was 78.4 million hectares and it was 62.6 per cent of the total area under food grains. Introduction of such high - yielding varieties of wheat depends crucially on the availability of fertilizers, adequate water supply, pesticides and insecticides. Therefore they have to be launched in the form of 'package programme'. Unfortunately, the seeds revolution of 1960s and 1970s appears they have tapered off after encompassing only the cereal segment. Improved seeds technology continues to elude vital segments of the farm economy such as pulses, oilseeds, fruits and vegetables.

2. Review of Literature

Diptimayee Jena and Srijit Mishra (2022), in their study on "Growth and Decomposition of Nutri - cereals in India (1960 - 61 to 2019 - 20)", this study depicts that decline in production growth of nutri - cereals was observed in the year 1990s and also it was a declined trend in 1970s.

Urmi Pattanayak and Minati Mallick (2017), in their study on “Agricultural Production and Economic Growth in India: An Econometric Analysis”. This study reveals that 75 percent of the world’s poor in rural areas and most of them dependent on farming, agriculture must be part of world economic growth, poverty reduction and environmental sustainability.

Jothi Sivagnaanam K, and Murugan K (2020), Their study was “Impact of Hybrid Rice Cultivation on Framers Livelihood in Tamil Nadu”. This study explores those new verities of hybrid rice and its impact on overall production and productivity in Tamil Nadu. The study concluded that agriculture in general and successful adoption of the hybrid rice variety in particular is critically dependent on all full government support and required infrastructure creation, free seeds and know - how supply, price, support, proper monitoring by agricultural officials will promote increase both production and productivity in the state.

Dipak Bisai (2020), his study on “Trend analysis of production of yield of major crops over south Bengal, India during last six year”. His study reveals that the analysis of growth rate of production, yield and the area under cultivation of Aman, Boro, Ausand and Mustard in west Bengal. The initial production amount of Aman paddy exhibits 10256.384 in thousands tonnes in 2011 - 12, while in 2016 - 17 session, the production increase by 2108.175 in thousand tonnes and dry yield rate (kg/hect) also increase every year.

Halawar S. V (2019), in his study on “The Trend Analysis of Major Food Grains in India”. The present studies provide that estimates of future production of food grains like rice, wheat, coarse, sugarcane and pluses. The major findings of the study are the trend analysis of major food crops, sugarcane crops are a decreases year by year. There is significant difference between the food grains Karl person correlation is found to be positive, it indicates that the rice and wheat are production having same degree change in year wise production and they are varying in same direction.

3. Objectives of the study

The main objectives of the study are

- 1) To analyse the trend of agricultural production and productivity in major producing states (like Andhra Pradesh, Bihar, Madhya Pradesh, TamilNadu, Punjab, Rajasthan and Uttar Pradesh) in India from 1966 - 67 to 2020 - 21.
- 2) To study the growth of production and productivity of major food grains in selected states of India from 1966 - 67 to 2020 - 21.

Table 1: Estimated Regression Equation of Area, Production and Productivity of food grains in India under Irrigation from 1966 - 67to 2020 - 2021

Crops Irrigation	Intercept (α)	Slope (β)	t - statistics		P value	R ²	CGR
			Intercept (α)	Slope (β)			
Area	123.76	0.015	0.933	0.029	0.59	0.005	36.4
Production	75.01	3.75**	3.22	0.100	0.000	0.963	38.9
Yield	608.31	30.06**	20.34	0.63	0.000	0.97	37.2

Source: values computed from Agricultural statistics at a Glance 2021.

** indicates that statistically significant at 5 per cent level.

4. Methodology

The data has been collected from secondary sources comprising of Handbook of Statistics on Indian Economy, Ministry of Agriculture in India from the period 1966 - 67 to 2020 - 21. The collected data has been classified and analysed in a systematic manner. For analysis, statistical tools like Simple Linear Regression Model and Semi - log model have been used in this study.

The linear trend equation of the form, $Y_i = \alpha + \beta X_i$

Where, Y is the area under cultivation/ Production/ Productivity of food grains and Commercial crops in India.

X_i is the time periods (where $i = 1, 2, 3, \dots, n$) and $\beta = \frac{\sum x_i y_i}{\sum x_i}$.

If β is positive then y is increasing over time and if β is negative y is decreasing over time. If β has statistically significant at 5 per cent level and at $(n - 2)$ degrees of freedom and R² value is fairly high indicates that the change in y every year is a constant and is equal to β .

To estimate the compound growth rate using the semi - log functions of the form

$Y = \alpha \beta^t e^u$ have been estimated.

The compound growth rate is given by $\{ (\text{anti log of } \beta) - 1 \} \times 100$.

Growth of Agriculture in India

The share of agriculture has persistently declined on account of the development of the secondary and tertiary sectors of the economy. From 55.3 per cent in 1950 - 51, the share of Agriculture and allied activities in GDP at factor cost declined to 37.9 percent in 1980 - 81. In 1951, 69.5 percent of the working population was engaged in agriculture. This percentage fell to 66.9 percent in 1991 and to 56.7 percent in 2001. In 2004 - 05, agriculture provided employment to 52.1 percent of the work force. However, with rapid increase in population the absolute number of people engaged in agriculture has become exceedingly large. Domestic demand for food grains is expected to increase from 207 million in 2004 - 05 to 235.4 million by the end of the eleventh five year plan and further to 280.6 million by the end 2020 - 21. The share of agricultural exports in total exports was 44.2 per cent in 1960 - 61. This fell consistently to 30.7 per cent in 1980 - 81 and 9.9 per cent in 2020 - 2021. The agricultural production and productivity are the total production of food grains increased from 50.8 million in 1950 - 51 to 235.9 million tonnes in 2020 - 21.

The above table shows that the estimated trend equation of food grains in India since green revolution. The slope coefficients of production and productivity are statistically significant at 5 percent level ($p < 0.05$). The slope coefficient of production was indicating that, an on average rate was increases to 3.75 million tonnes per year. Productivity of food grains was also increases an on average rate was 30.06 kgs per hectare during the study period. R^2

value indicates that, more than 35 percent of the variation in the production, productivity and area under cultivation of food crops that can be explained by the after green revolution in India. The compound growth rate of area under production was 36.4 percent and the production was 38.9 percent during the post green revolution period from 1966 - 67 to 2020 - 21. The growth rate of yield per hectare was 37.2 percent in the study period.

Table 2: Estimated Regression Analysis of Area under cultivation, Production and Productivity of Major crops in India from 1966 - 67 to 2020 - 2021

Crops	Variables	Intercept (α)	Slope (β)	t - statistics		P value	R^2
				Intercept (α)	Slope (β)		
Rice	Area	37.56	0.14**	0.35	0.010	0.000	0.76
	Production	30.85	1.55**	1.34	0.041	0.000	0.96
	Yield	869.84	31.76**	25.61	0.795	0.000	0.96
Wheat	Area	17.09	0.268	0.34	0.010	7.14	0.920
	Production	12.26	1.66**	1.048	0.032	0.000	0.980
	Yield	1024	44.40**	37.37	1.161	0.000	0.96
Maize	Area	4.700	0.075	0.17	0.005	1.11	0.79
	Production	0.62	0.42**	0.85	0.026	0.000	0.82
	Yield	632.84	38.61**	59.009	1.833	0.000	0.89
Jowar	Area	19.77	- 0.27**	0.25	0.008	0.000	0.956
	Production	0.62	0.42**	0.85	0.026	0.000	0.82
	Yield	532.5	8.11**	24.99	0.776	0.000	0.67
Bajra	Area	12.76	- 0.09**	0.195	0.006	0.000	0.82
	Production	4.11	0.100**	0.404	0.012	0.000	0.54
	Yield	226.2	17.90**	38.601	1.199	0.000	0.80

Source: values computed from Agricultural statistics at a Glance 2021

** indicates that statistically significant at 5 per cent level.

Table 2 depicts that, most of the slope coefficients are statistically significant at 5 per cent level ($p < 0.05$). The above result indicates that, during the period of green revolution gave more importance to the five major food crops in India by using of High Yielding Varieties (HYV) of seeds to increase the production. Rice is the most important food grain crop in India. It was produced an on average of 1.55 million tonnes per year and the yield per hectare was 31.76 kgs during the study period. The second important food crop is Wheat, it was produced an on average rate was 1.66 million tonnes per year compared to more in rice. Productivity of wheat was 44.40 kgs per hectare. R^2 indicates that more than 90 percent of the variation in the food crops of Rice and Wheat that can be explained by the post green revolution period. The rest of the food crops like Maize, Jowar and Bajra are also a increasing trend in the production and productivity.

Table 3: Compound Growth rate of Area, Production and yield under cultivation of India from 1966 - 67 to 2020 - 2021

Major Crops	Area	Production	Yield
Rice	36.91	37.62	37.48
Wheat	37.21	38.02	37.58
Maize	37.17	38.01	37.62
Jowar	35.84	39.53	25.58
Bajra	36.42	37.33	37.70

Source: values computed from Agricultural statistics at a Glance 2021.

The above explained that the compound growth rate of major crops in India since green revolution. The growth rate was high in wheat compared to rice. Wheat was more exported than the rice. Area under cultivation, production and productivity was more 36 percent in rice and wheat was more than 37 per cent. Production and productivity of Jowar and Bajra was 39.53 per cent, 37.33 per cent, 25.58 per cent and 37.7 per cent from 1966 - 67 to 2020 - 21.

Table 4: Estimated Regression results of major crops in selected states of India from 1966 - 67 to 2020 - 2021

State	Crops	Intercept (α)	Slope (β)	t - statistics		P value	R^2
				Intercept (α)	Slope (β)		
Andhra Pradesh	Rice	8387.7	65.45	640.01	26.55	0.018	0.13
	Wheat	10.49	- 0.15**	1.13	0.047	0.002	0.21
	Total food Grains	10845	125.98**	911.37	37.81	0.001	0.22
Bihar	Rice	5044.8	30.71	430.42	17.85	0.093	0.07
	Wheat	2595.55	73.19**	176.3	7.31	0.000	0.71
	Total food Grains	9463	124.01**	614.80	25.50	0.000	0.37
Madhya Pradesh	Rice	4772	- 50.58	501.86	20.82	0.019	0.13
	Wheat	1255	332.2**	790.11	32.77	0.000	0.72

	Total food Grains	10511	381.62**	1608	66.72	0.000	0.45
TamilNadu	Rice	5423	18.07	417.4	17.31	0.302	0.02
	Wheat	0.29	- 0.009**	0.026	0.001	0.000	0.64
	Total food Grains	6321	68.81**	543.54	22.55	0.004	0.19
Punjab	Rice	3866	224.99**	169.90	7.04	0.000	0.96
	Wheat	9235	221.96**	278.00	11.53	0.000	0.90
	Total food Grains	13879	438.63**	363.49	15.08	0.000	0.95
Uttra Pradesh	Rice	6596	207.5**	392.31	16.27	0.000	0.80
	Wheat	13876	465.08**	555.80	23.05	0.000	0.91
	Total food Grains	26726	657.53**	1000	41.49	0.000	0.86
Rajasthan	Rice	55.76	7.98**	25.98	1.07	0.000	0.58
	Wheat	2151	193.72**	264.3	10.96	0.000	0.88
	Total food Grains	5112	383.33**	747.8	31.02	0.000	0.79

Source: values computed from Agricultural statistics at a Glance 2021

** indicates that statistically significant at 5 per cent level.

The above table explains that the estimated regression results of major states for producing major crop in India since green revolution. Most of the slope coefficients are statistically significant at 5 per cent level ($p < 0.05$). Andhra Pradesh, Bihar, Madhya Pradesh and TamilNadu were producing more in Rice. During the time of green revolution the above states were focused on rice. In Andhra Pradesh and Bihar, an on average rate of production of rice was 65.45 million tonnes and 30.17 million tonnes during the study period. Madhya Pradesh was in negative growth of rice and in more production of wheat compared to the other states like Andhra Pradesh and Punjab. Utter Pradesh an on average increase of wheat was 465.08 million tonnes per year. Punjab, the average rate of production of rice and wheat increases to 224.99 million tonnes and 221.96 million tonnes per year. R^2 indicates that there were percentage changes in the dependent variable that can be explained by the independent variable.

5. Conclusion

The study concluded that there was a positive growth in production and productivity of principle crops in India over period of study from 1996 - 67b to 2020 - 21. After the implementation of green revolution using of high yielding varieties of seeds of the important food crops like, rice, wheat, maize, Jowar and Bajra were produced more. Agriculture is the more important for Indians, it is highly imperative that crop production should increase and start to contributing significantly to the GDP of the country. Agricultural productivity will promote the industrial sector productivity and will enhance the employment opportunities in a country.

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