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RESEARCH ARTICLE

AN ANALYTICAL STUDY ON AGRICULTURAL PRODUCTION AND PRODUCTIVITY TREND IN INDIA SINCE LIBERALISATION

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ABSTRACT

The present study discussed an agricultural production and productivity trend in India during the liberalization period from 1990-91 to 2014-15. Data on important variables like, Agricultural production, area under cultivation, yield and agricultural exports were compiled from the period 1990-91 to 2014-15. For analysis of this study were used the statistical tools like Simple Linear Regression Model, Semi- log model and annual growth rates. The major objectives of the study were to evaluate the performance of agricultural production in India, to analyse the trend of agricultural production and productivity in area under cultivation of food grains and major commercial crops in India from 1990-91 to 2014-15 and to compute the compound growth rate of agricultural production, area under cultivation and yield of food grains in India. The major findings were derived from the study on an average the production of food grains had been increased to 2.62 million per year during the liberalization period from 1990-91 to 2014-15. In 1990-91 to 2014-15, the average production of rice and wheat has been increased to 1.162 million and 1.38 million tonnesper year. Yield per hectare of food grain production was a declining trend during1990-91 to 2014-15. The share of agriculture and allied sector in the gross domestic product has registered a steady declined from 36.4 percent in 1982-83 to 14.1 percent in 2011-12. Not-withstanding, the declining trend in agriculture share in the GDP in India since liberalisation. So the Government of India has to give more importance to the agricultural sector to promote the economic growth.

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INTRODUCTION

Agriculture plays an important role in economic development, such as provision of food to the nation, enlarging exports, transfer of manpower to non-agricultural sectors, contribution to capital formation, and securing markets for industrialization. After the institution of planning 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. The share of agriculture and allied activities in GDP at factor cost was 14.6 percent in 2009-10. 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. Agriculture provides raw materials to various industries of national importance. In India, for a number of years there are three agricultural commoditieslike cotton textile, jute and tea accounted for more than 50 percent of export earnings of the country. The share of agriculture in total exports rose to around 70 percent to 75 percent. With economic progress and consequent diversification of production base, the share of agricultural goods in total exports has consistently fallen. For instance, the share of agricultural exports in total exports was 44.2 percent in 1960-61. This fell consistently to 30.7 percent in 1980-81 and 9.9 percent in 2009-10.

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Objectives

The main objectives of the study are,

1. To analyse the trend of area under cultivation, production and productivity of food grains and major commercial crops in India from 1990-91 to 2014-15.
2. Toanalyse the compound growth rate of production, area under cultivation and yield of food grains in India from 1990-91 to 2014-15.

MATERIALS AND METHODS

The data has been collected from secondary sources comprising of Handbook of Statistics on Indian Economy, Ministry of Agriculture in India from the period 1990-91 to 2014-15. 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,……,n) and

$\beta = \frac{\Sigma xiyi}{\Sigma xi}$.

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 R^2 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 {(anti log of β) - 1} x 100.

Agricultural Production and Productivity trendin India

Optimum food grain production is the most important need of people in each nation. It is essential part of food security policy of the country. Recently government has providing facilities to the food grain growers in India. Because of government support food grain production in India is increasing gradually. As far as food grains output in concerned, the total production increased from 50.8 million tonnes in 1950-51 to 187.0 million tonnes in the Eighth Plan and further to 202.9 million tonnes in the Ninth Plan. The total food grains output in the Tenth Plan was 202.2 million tonnes even less than the annual average recorded in the Ninth Plan. However, according to the Third Advance Estimates for the year 2010-11 released on April, 2011, the food grains production rose to the record production of 235.9 million tonnes in this year. The share of agriculture and allied sector in the gross domestic product has registered a steady decline from 36.4 percent in 1982-83 to 14.1 percent in 2011-12, the declining trend in agricultural share in the GDP in India. So the Government of India has to give more importance to the agricultural sector to promote the economic growth. The slope coefficient was statistically significant at 5 percent level at 23 degrees of freedom. The value of the slope coefficient was 3.50. This had disclosed that on an average of total food grain production had increased to3.50 million tonnes a year over the twenty five years of study period after implementation of new economic policy had been adopted. The value of R^2 was found to be 0.82, which had shown that 82 percent of the total variations had been explained by the dependent variable (total food grain production).In 1990-91, the total food grain production was 176.36 million tonnes and it was increased to 203.61 million tonnes in 1998-99. It rose further to 208.59 million tonnes in 2005-06 and 2014-15 it was 252.68 million tonnes.

Estimated trend equation of total food grainsproduction in India during 1990-91 to 2014-15 has been

	Coefficient	Standard Error	t Statistics
Intercept	165.20	5.33	32.99
Total food grains production	3.50	0.33	10.40

RSquare= 0.82. The table value of $t_{0.025}$ at 23 degrees of freedom= 2.07

Table 1. The result of regression value of total food grains production in India from1990-91 to 2014-15

Major Crops	Variables	Values	Standard Error	t value	R^2
Rice	Constant	72.78	2.32	31.35	0.72
	T	1.32*	0.18	6.55	
Wheat	Constant	54.79	1.97	27.79	0.87
	T	1.80*	0.15	9.21	
Coarse	Constant	28.13	1.62	17.36	0.43
Cereals	T	0.48*	0.12	3.91	
Total	Constant	155.69	4.86	33.03	0.77
Cereals	T	3.02*	0.37	8.17	
Pulses	Constant	12.33	0.64	19.40	0.28
	T	0.14	0.05	2.80	

Source: values computed from hand book of statistics on Indian Economy 2014-15.
*indicates that 5 per cent level of significance.

The above most of the estimated slope coefficients were statistically significant at 5 percent level and the one variable like pulses was statistically insignificant. The value of the slope coefficient was 1.32. This had disclosed that on an average production of Rice had been increased to1.32 million a year over the twenty five years of study period. R^2 value of Rice and Wheat was 0.72 and 0.87, this shows that 72 per cent and 87 per cent of the variation in the dependent variable that can be explained by the independent variable. Wheat is the second important food crop after the important food crop of Rice in India, an on average of 1.80 million tonnes increased per year. The slope coefficient of total cereals was 3.02, among the major cropstotal cereals were produced more in India during the post liberalisation period, but the production of pulses were increased a small amount compare to the cereals. In 1990-91, the production of rice, wheat and pulses were 74.29, 55.14 and 14.26 million tonnes respectively. It was rose from 88.53 million tonnes in 2003-04 to 105.30 million tonnes in 2014-15. The production of wheat increased from 55.14 million tonnes in 1999-2000. However, it fell thereafter and stood at 65.76 million tonnes in 2000-01. After 2004-05, wheat production was continuously increasing, in the year 2014-15 it rose to 94.88 million tonnes.The explanatory variable time(x) could explain more than 75 percentage of the variation in the dependent variables.

The most of the slope coefficients were found to be statistically significant at 5 per cent level and the other variables like Rapeseed and Mustard and Tobacco were statistically insignificant. Tea, Coffee and Sugarcane are the major exported commodities in India, the average rate of increase in the production of sugarcane, tea and coffee was 4.18 million, 5.72 million and 6.13 million tonnes per year respectively. The average increase of oilseeds and cotton was 0.48 million tonnes and 0.98 million tonnes during the post reform periods. The production of groundnut and tobacco was declined to 0.05 million tonnes and 0.004 million tonnes per year. R^2 value of Tea and Sugarcane was 0.98 and 0.48, which shows that 98 per

cent and 48 percentage of the variation in the dependent variable that can be explained by the independent variables during the post reform period in India.

Table 2. Regression results of major commercial crops in India from 1990-91 to 2014-15

Major Crops	Variables	Values	Standard Error	t value	R^2
Groundnut	Constant	7.79	0.59	13.18	0.05
	t	-0.05	0.04	-1.06	
Rapeseed	Constant	4.87	0.44	10.91	0.31
and Mustard	t	0.10	0.03	2.99	
Soya bean	Constant	2.07	0.50	4.15	0.86
	t	0.42*	0.04	11.07	
Total	Constant	17.86	1.37	12.99	0.51
Oilseeds	t	0.48*	0.10	4.57	
Coffee	Constant	181.33	11.52	15.74	0.71
	t	6.13*	0.86	6.98	
Cotton (lint)	Constant	4.92	2.02	2.43	0.67
	t	0.98*	0.15	6.34	
Raw Jute	Constant	9.18	0.33	27.66	0.48
and Mesta	t	0.12*	0.03	4.31	
Sugarcane	Constant	242.60	13.17	18.04	0.48
	t	4.18*	1.00	4.12	
Tea	Constant	658.60	12.52	54.76	0.98
	t	5.72*	0.95	16.33	
Tobacco	Constant	0.62	0.07	8.68	0.03
	t	-0.004	0.01	-0.85	

Source: values computed from hand book of statistics on Indian Economy 2014-15.
*indicates that 5 per cent level of significance.

In the non food grains of jute and cotton show the slow and halting progress in the periods 1990-91 to 2014-15. However, the production of cotton rose from 9.84 million pales in 1990-91and it rose to record level of 35.20 million pales in 2011-12. In 2006-07, sugarcane production attained a record level of 355.5 million tonnes but declined in subsequent years. In 2010-11, it was only 342.38 million tonnes but rose to 361.04 million tonnes in 2014-15.

Estimated trend equation of area under cultivation of total food grain production in India during 1990-91 to 2011-12 has been

	Coefficients	Standard Error	t Stat
Intercept	107.59	7.61	14.14
Area under Cultivation	0.89	0.51	1.75

$R^2 = 0.12$, the table value of $t_{0.025}$ at 23 degrees of freedom= 2.07.

The slope coefficient was statistically insignificant at 5 percent level at 23 degrees of freedom. The value of the slope coefficient was 0.89. This had disclosed that on an average of area under cultivation of total food grain production was increased to0.89 milliontonnes a year over periodof study after implementation of new economic policy. The value of R^2 was found to be 0.12, which had shown that only 12 percent of the variations had been explained by the dependent variable (area under cultivation of total food grain production in India).

The Table 3 shows that the slope coefficient of wheat and coarse cereals were statistically significant at 5 per cent level and the rest of other variables like Rice, Total Cereals and Pulses were statistically insignificant. The rate of average increases of area under cultivation of rice, wheat and pulses were 0.06 million hectares, 0.29 million hectares and 0.09 million hectares per year. But area under cultivation of the total cereals an on average 0.09 million hectares declined per year during the post liberalisation period. The value of R square shows that, the percentage of changes in the dependent variables that can be explained by the independent variables.

Table 3. Regression results of area under cultivationof food grain production in India from 1990-91 to 2014-15

Major Crops	Variables	Values	Standard Error	t value	R^2
Rice	Constant	42.92	0.53	80.71	0.05
	T	0.06	0.04	0.91	
Wheat	Constant	23.97	0.37	64.41	0.79
	T	0.29*	0.03	7.82	
Coarse Cereals	Constant	34.21	0.50	68.75	0.81
	T	-0.53*	0.04	-9.33	
Total Cereals	Constant	101.04	0.85	118.58	0.09
	T	-0.09	0.06	-1.42	
Pulses	Constant	22.00	0.63	35.02	0.14
	T	0.09	0.05	1.59	

Source: values computed from hand book of statistics on Indian Economy 2014-15.
*indicates that 5 per cent level of significance.

Table 4. Regression results of area under cultivation of major commercial crops in India from 1990-91 to 2014-15

Major Crops	Variables	Values	Standard Error	t value	R^2
Groundnut	Constant	8.62	0.18	46.61	0.89
	t	-0.14*	0.01	-10.14	
Rapeseed and	Constant	6.29	0.34	17.91	0.0007
Mustard	t	-0.003	0.03	-0.11	
Soya bean	Constant	2.84	0.20	14.04	0.98
	t	0.33*	0.01	22.22	
Total Oilseeds	Constant	24.93	0.75	33.03	0.09
	t	0.07*	0.06	1.18	
Sugarcane	Constant	3.89	0.15	23.92	0.62
	t	0.06*	0.01	5.02	
Tea	Constant	0.43	0.01	56.61	0.98
	t	0.01*	0.00	18.63	
Coffee	Constant	0.25	0.005	36.47	0.98
	t	0.01*	0.004	25.21	
Cotton (lint)	Constant	7.96	0.36	19.93	0.57
	t	0.14*	0.03	5.08	
Raw Jute and	Constant	1.16	0.03	34.05	0.26
Mesta	t	-0.01	0.00	-2.42	
Tobacco	Constant	0.56	0.04	10.95	0.19
	t	-0.01	0.00	-2.08	

Source: values computed from hand book of statistics on Indian Economy 2014-15.
*indicates that 5 per cent level of significance.

The Table 4 shows the estimated trend value of major commercial crops in India during the post reform period from 1990-91 to 2014-15. Most of the slope coefficients were statistically significant at 5 per cent level at 23 degrees of freedom and the other variables like Rapeseed and mustard, raw jute and Mesta and tobacco were statistically insignificant. The rate of increase on area under cultivation of Tea and Coffee was increased to 0.01 million hectares per year and the cultivation of sugarcane was 0.06 million hectares during the same period. Area under cultivation of Raw jute and Mesta and Tobacco was declined to 0.01 million hectares per year during the post reform period. The value of R square shows that the percentage of changes in the dependent variables(y) that can be explained by the independent variables(x). Soya bean, coffee and tea were explained more than 95 percentage of the variation in the independent variables. The oil production increased from 24.93 million hectare in 1990-91 to 26.23 million hectare in 1998-99. However, it fell stood at 21.49 million tonnes in 2002-03, but rose subsequently. In the non food grains of jute and cotton show the slow and halting progress in the periods 1990-91 to 2014-15. However, the

production of cotton rose from 7.44 million pales in 1990-91and it rose to record level of 12.18 million pales in 2014-15.

Regression result of Yield per hectare of total food grain production in India during 1990-91 to 2011-12 has been

	Coefficients	Standard Error	t Stat
Intercept	1344.24	30.38	44.25
Yield Per hectare	28.42	2.04	13.91

$R^2 = 0.89$, the table value of $t_{0.025}$ at 23 degrees of freedom= 2.07

The slope coefficients are statistically significant at 5 percent level at 23 degrees of freedom. The value of slope coefficient was 28.42, this shows that, an on average rate of increase in yield per hectare was 28.42kgs per hectares per year during the post reform period. R^2 value was 0.89, which shows that 89 per cent of the variation in yield per hectare of total food grain production in India during the post reform period.

Table 5. Regression results of Yield per hectare of food grains production in India from 1990-91 to 2014-15

Major Crops	Variables	Values	Standard Error	t value	R^2
Rice	Constant	1699.87	37.36	45.50	0.79
	T	24.73*	2.84	8.69	
Wheat	Constant	2321.79	44.38	52.32	0.78
	T	28.32*	3.38	8.38	
Coarse	Constant	794.35	46.42	17.11	0.77
Cereals	T	28.93*	3.53	8.18	
Total	Constant	1542.26	34.76	44.37	0.86
Cereals	T	31.36*	2.65	11.85	
Pulses	Constant	580.38	39.20	14.80	0.002
	T	0.73	2.98	0.24	

Source: values computed from hand book of statistics on Indian Economy 2014-15.
*indicates that 5 per cent level of significance.

The above estimated trend equation shows the yield per hectare of food grains production in India during the post reform periods. The most of the variables are statistically significant and the variable pulses were statistically insignificant at 5 per cent level. The rate of increase an average of per year of wheat and rice was 24.73 kgs and 28.32 per kgsrespectively. The total cereals were increased to 31.36 kgs per year. In 1990-91, yield per hectare of all food grains has increased from 1,380 kgs per hectare to 2,125 kgs per hectare in 2014-15. Most significant increase has been recorded by wheat with it yield increasing from 2,281kgs per hectare in 1990-91 to 3,119 kgs per hectare in 2014-15. While productivity of jowar, bajra and maize has increased relatively slow. Moreover, there are wide yearly fluctuations. In fact, the productivity of pulses rose somewhat to 578 kgs per hectare in 1990-91 and it slightly higher in 786 kgs in 2014-15. R^2 value shows that the percentage of the total variation of the dependent variable (Yield per hectare of total food grain production) that can be explained by the independent variable (Year).

Table 6 shows that, the most of the slope coefficients are statistically significant at 5 per cent level. Yield per hectare of tea, coffee and tobacco were shows the declining trend in the post reform periods and other variables are increasing trend. The oil production increased from 771kgs per hectare in 1990-91 to 944 kgs per hectare in 1998-99. However, it fell stood at 691kgs per hectare in 2002-03, but rose subsequently. It raised 1159 kgs per hectare in 2010-11 and further decline 1135 kgs per hectare in 2011-12. In the non food grains of jute and cotton show the slow and halting progress in the periods 1990-91 to 2014-15. R^2 value shows that the percentage of the total variation of the dependent variable (Yield per hectare of major commercial crops in India) that can be explained by the independent variable.

Table 6. Regression results of yield per hectare of major commercial crops in India from 1990-91 to 2011-12

Major Crops	Variables	Values	Standard Error	t value	R^2
Groundnut	Constant	900.88	77.18	11.67	0.22
	t	13.89	5.88	2.36	
Rapeseed	Constant	794.62	40.50	19.70	0.58
and Mustard	t	16.16*	3.08	5.24	
Soya bean	Constant	899.10	57.26	15.70	0.25
	t	11.14	4.36	2.56	
Total	Constant	729.58	37.79	19.31	0.59
Oilseeds	t	15.50*	2.88	5.39	
Sugarcane	Constant	67170.52	1348.75	49.80	0.00
	t	6.05	102.69	0.09	
Tea	Constant	1767.92	32.52	54.37	0.047
	t	-2.47	2.48	-0.99	
Coffee	Constant	845.47	29.35	28.81	0.003
	t	-0.57	2.23	-0.26	
Cotton (lint)	Constant	154.44	28.72	5.38	0.63
	t	12.96*	2.19	5.80	
Raw Jute	Constant	1568.66	23.85	65.78	0.94
and Mesta	t	31.78*	1.82	17.17	
Tobacco	Constant	1489.74	144.75	10.29	0.033
	t	-9.12	11.02	-0.83	

Source: computed from hand book of statistics on Indian Economy 2014-15.
*indicates that 5 per cent level of significance.

Table 7. Compound Growth Rate of area, production and yield of principle crops in India during 1990-91 to 2014-15

Crop	1990-91 to 1999-2000			2000-01 to 2014-15		
	Area	Production	Yield	Area	Production	Yield
Cereals	0.04	-0.02	1.59	0.09	2.01	3.19
Pulses	-0.60	0.59	0.93	1.62	3.35	1.90
Total Food grains	-0.07	2.02	1.52	0.37	2.12	2.89
Oilseeds	-0.86	1.63	1.15	2.14	4.60	3.59
Non Food grains	1.18	2.69	1.09	2.16	3.67	2.49
All Principal Crops	0.27	2.29	1.33	0.91	2.50	3.25

Source: Values computed from statistical handbook of on Indian Economy 2014-15.

Table 8 shows that the compound growth rate of area, production and yield of principle crops in India during post reform period. In 1990-91 to 1999-2000 the area under cultivation of cereals crops was 0.04 percent but it rose to 0.09 percent in the year 2000-01 to 2010-11. At the same time production of cereals was negative growth but the growth rate yield of cereals was 1.59 percent and it rose to 3.19 percent in 2000-01 to 2010-11. The area under cultivation of total food grains was declined to 0.07 percent in 1990-91 to 1999-2000 but it rose to 0.37 percent in the year 2000-01 to2010-11. At the same time production of total food grains was negative growth but the growth rate yield of total food grains was 2.02 percent and it rose to 2.12 percent in 2000-01 to 2010-11. The area under cultivation of non-food grains was 1.18 percent in 1990-91 to 1999-2000 but it rose to 3.67 percent in the year 2000-01 to 2010-11. At the same time production of non-food grains was 2.69 but it rose to 3.67 percent in a 2000-01 to 2010-11. The growth rate yield of non-food grains was 1.09 percent and it rose to 2.49 percent in 2000-01 to 2010-11. The area under cultivation of all principle of crops was 0.27 percent

in 1990-91 to 1999-2000 but it rose to 0.91 x in the year 2000-01 to 2010-11. At the same time production of all principle crops was 2.29 percent but it rose to 2.50 percent in the year.2000-01 to 2010-11. The growth rate yield of principle crops was 1.33 percent and it rapidly increase to 3.25 percent in year 2000-01 to 2010-11.

Table 8. Estimated trend of Agricultural Exports and Imports in India

Variables	Variables	Values	Standard Error	t value	R^2
Exports	Constant	-10973.5	5802.91	-1.89	0.84
	t	4577.56*	462.14	9.91	
Imports	Constant	-8132.95	3144.20	-2.59	0.83
	t	2429.54*	250.40	9.70	

Source: computed from hand book of statistics on Indian Economy 2014-15.
*indicates that 5 per cent level of significance.

From the above table shows that estimated trend of agricultural exports and imports in India during the post reform period. The slope coefficients were statistically significant at 5 per cent level and the rate increase on theaverage of agricultural exports and imports was Rs. 4577.56 crores and Rs. 2429.54 crores per year during the periods 1990-91 to 2011-12. During 1990-91 agricultural export was Rs.6012.72 (18.49 percentage) crores and the export was increased to Rs.89522.59 (20.33 percentage) crores. The percentage of agricultural export to total national exports is continuously declining from 1999-2000 to 2004-15, ie from 15.91 percent to 10.59 percent respectively.

Conclusion

The growth of agriculture in the eleventh plan was 3.7 percent, which is higher than in the tenth plan growth rate. The twelfth plantarget growth rate for agriculture is 4 percent with foodgrains growth rate is about 2 percent andnon-foodgrains sector growing at about 5 to 6 percent. The production of food grains, oilseeds, pulses and other commercial crops is increasing continually in India. But capital formation level is decreasing in the agricultural sector due to the unfavorable policy of the government regarding investment promotion. Globalization is a necessary but not a sufficient condition for high growth production, India has undertaken economic reforms, both internal and external. Agricultural price policy has played animportant role in Indian agriculture but is facing some challenges. The slowdown in agriculture growth could be attributed to the supply side factors such as public investment, irrigation watermanagement, rural credit, technology, land management, agricultural research anddevelopment including extension services, rural infrastructure like roads, electricity, marketing,post-harvest management and so on. Reforms are needed to address these issues in order toachieve 4 to 4.5 percent growth in agriculture. All farmers, agricultural labourers, societies, Government and people's organizations should work collectively to revive agriculture.

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