

# TECHNOLOGICAL ADVANCEMENT AND AGRICULTURAL PRODUCTIVITY: A STUDY ON RESEARCH EXPENSES AND ACHIEVEMENTS UNDER FIVE YEAR PLANS

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## ABSTRACT

*The period of green revolution to the liberalization phase and most importantly – five year plans, be it under planning commission or NITI AAYOG, agriculture has always remained center of public measures like infrastructure creation, generation and dissemination of improved technology, spreading modern inputs and enhancing irrigation facilities. The eleventh five year focused upon 4 percent growth rate in agriculture, improving food and nutrient security inclusive growth. For addressing such issues, the expenditure on agricultural research and development and technological upgradation in working methods has been done in primary sector. The present paper examines the gross value added by agriculture and allied sectors in various decades, interstate comparisons on average annual growth rates a result of modern inputs and various technical policy measures of twelfth five year plan to achieve targeted performance.*

***Keywords: expenditure, five year plans, GDP, green revolution , research, technology,***

## LINTRODUCTION

Focusing on enhancing the productivity during the green revolution of 1967-68, less importance was given to proper management of inputs and therefore ecological impacts has resulted in environmental degradation. About 120 million hectares of land in the country suffers from one or the other form of degradation (Singh 2011).

Similarly since the past five decades, technological changes in agriculture and allied sectors along with the massive investment in irrigation, infrastructure and institutions have helped many food insecure developing countries, including India into food self sufficiency. The adoption of biochemical and mechanical technologies in India have led to near tremendous rise of food grains production and fourfold acceleration in production of fruits and vegetables during the period 1966-67 to 2011-12 (Birthal, 2013). But sooner, the past growth effects of technology, earlier regarded as the key drivers of agricultural growth have started diminishing of the growth in total factor productivity in yields of major food crops and livestock species have tend to decrease considerably in recent years (Chand et al., 2011). Discussing about the Ninth Five- Year Plan onwards scenario, but the actual growth rate has remained considerably lower than this target. Several studies have pointed out to

the deceleration in agricultural growth during 1990s continuing towards middle of first decade of the 21st century.

The only alternative to enhance productivity without adversely affecting environment, limited natural resources is by maximizing the resource input use efficiency using latest technologies. The technology that tends to match in-field variations in soil fertility and crop conditions as well as agricultural inputs like seed, fertilizer, irrigation, insecticide, pesticide, etc. to optimize the input or maximizing the crop yield. Benefits such as on-farm experimentation, risk reduction potential, resource use efficiency, reduction in cost of production, saving inputs, stress management, farm management and the environmental sustainability have been reported by several literature as reasons for using agriculture technologies (Snyder, 1996, Bongiovanni and LowenbergDeBoer, 1998, Patil, 2009 and Yu et al., 2000).

With the view to examine interstate disparities in average annual growth rates of GSDP from agriculture and allied sectors the paper tends to divide entire nation into 5 zones – central, east, west, south & north zone. In order to cover each zone states have been selected from each i.e. Punjab from North zone, Gujarat and Rajasthan from West zone, Kerala from Southern zone, West Bengal & Arunachal Pradesh from eastern zone and Madhya Pradesh from the central zone. Moreover, the data has been examined through its division into seven phases- pre green revolution, green revolution, post green revolution, early liberalization, ninth, tenth and eleventh five year plan.

## **II.OBJECTIVES**

The main objectives of the present study are

- To make interstate comparisons on average annual growth rate of agriculture and its allied sectors due to technological upgradation.
- To study to contribution of agriculture in GDP of nation in various decades.
- To examine planned and non-planned expenditure of centre and state for further agricultural research and development.
- To analyze the correlation between productivity and best irrigation facilities used on farms.
- To study the gross value added by agriculture and allied sectors during seven main phases.
- To discuss certain new policy measures under twelfth five year plan

## **III.RESEARCH METHODOLOGY & STATISTICAL TOOLS**

### **[I] Source**

In order to achieve stipulated objectives of the study the secondary data has been collected from various government publications- Statistical Abstract of India ; Central Statistical Office, New Delhi ; Central Statistical Office National Accounts Division ; Land use statistics, Ministry Of Agriculture and estimates by Twelfth Plan Working Group on Crop Husbandry, Demand and Supply Projections, Agricultural Inputs and Agricultural Statistics;

### **[II] Statistical Method**

The tabular and functional analytical procedures were used for analysis work. The statistical techniques such as averages, variances and the correlation coefficients have been found among various parameters and have been tested at 5 percent and 1 percent level of significance using below formula:

$$t = \frac{r\sqrt{n-2}}{\sqrt{1-r^2}}$$

Here it is based on (n-2) degrees of freedom. The hypothesis that the two variables are uncorrelated has been tested.

#### **IV.RESULT AND DISCUSSION**

##### **[I]GROWTH RATE OF AGRICULTURE AND ALLIED SECTORS IN ECONOMY**

The average growth of agriculture and allied sectors during 11<sup>th</sup> five year plan is short of its target of 4 percent but it seemed to be much greater than what existed in 10<sup>th</sup> five year plan that is 2.4 percent. But this increase was only found in initial year of eleventh plan. The reason for the failure is high inflation in prices of food and other primary commodities.

Table 1 clearly depicts that the annual growth rate again went to 7.9 percent i.e. highest among all years which later on again dropped to 3.6 percent in 2011-12. The reason could be the worst drought ever in last 5 decades made is go down and irrigation facilities failed to match upto required levels. The correlation coefficient among Growth rate of Agriculture and Allied Sectors and growth rate of total economy was found to be 0.554 indicating moderate correlation among the two.

**Table 1.average annualgrowth rate of agriculture and allied sectors in economy**

PLAN	Share of Agriculture in economy	Growth rate of Agriculture and Allied Sectors	Growth rate of Total Economy
Ninth Plan	23.4	2.5	5.7
Tenth Plan	19	2.4	7.6
Eleventh Plan			
2007-08	16.8	5.8	9.3
2008-09	15.8	0.1	6.7
2009-10	14.6	0.8	8.6
2010-11	14.5	7.9	9.3
2011-12	14.1	3.6	6.2
Average	15.2	3.7	8
R		0.554	

Source: Central Statistical Office, New Delhi Press, Release dated 7<sup>th</sup> Feb 2013

##### **[II] STATE WISE PERFORMANCE**

For the purpose of discussing state-wise growth rate of agricultural production in last few years the entire nation has been divided into 5 zones i.e. Punjab from North zone, Gujarat and Rajasthan from West zone, Kerala from

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Southern zone, West Bengal & Arunachal Pradesh from eastern zone and Madhya Pradesh from the central zone which are clearly depicted in table 2.

The appraisal of eleventh five year plan shows the positive trends in agriculture after 2004 due to renewed dynamism in the rain fed areas.

1. Few states particularly hill stations, have managed reduction in the growth variability during 200-12 as compared to previous decade.
2. The states Jharkhand, Manipur, Chhattisgarh, Rajasthan, Gujarat, Karnataka have shown the best performance of more than 5 percent growth rate.
3. The growth revival has been seen in both highly irrigated areas (Punjab, Haryana, UP) as well as low irrigated areas (Kerala, HP and Jammu & Kashmir) where cropping pattern includes more of horticulture crops.

**Table 2.state wise performancein last four decades**

Year	1981-82 to 1993-94	1994-95 to 1999-2000	2000-01 to 2004-05	2005-06 to 2011-12
<b>East</b>				
Arunachal Pradesh	9.3	-0.8	1.6	5
Assam	2.5	0.2	-0.1	4.1
Meghalaya	1.1	7.2	4.8	3.3
Sikkim	-	-1.2	6.5	3.4
West Bengal	5.3	4.1	2.4	2.6
Average	4.55	1.9	3.04	3.68
<b>West</b>				
Rajasthan	5.9	5.5	10.9	5.5
Maharashtra	5.7	3.1	1.6	5.3
Gujarat	8.8	5.2	9.1	5.5
Average	6.8	4.6	7.2	5.4
<b>North</b>				
Punjab	4.9	2.5	1.8	1.8
Haryana	4.5	2.1	2.7	4.2
Himachal Pradesh	2.8	0.3	8	1.5
Uttrakhand	2.8	2.4	3.3	2
Average	3.75	1.825	3.95	2.375
<b>South</b>				
Andhra Pradesh	3.9	2.8	4.7	5
Karnataka	4.5	4.1	-2.9	5.1
Kerala	3.2	1.9	1.7	-0.2

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Tamil Nadu	5.8	1.8	-0.5	4.6
Average	4.35	2.65	0.75	3.625
Middle				
Chhattisgarh	4.9	-2.1	4.6	7.3
Madhya Pradesh	4.9	1.6	2.2	4.4
Jharkhand	1.1	4.3	5	8
Bihar	1.1	3.1	7.4	3.3
Average	3	1.725	4.8	5.75

Source: Central Statistical Office, New Delhi Press

### III IRRIGATION AND PRODUCTIVITY

Table 3 shows the correlation between irrigation facilities and their productivity. The high irrigation areas refers to GSDP sum over Haryana, Punjab, UP and WB where ratio of net irrigated area and Arable land is greater than 55% in 2008-09. The low irrigation areas are those where ratio of net irrigated area and arable land is less than 30 percent like Assam, Chhattisgarh, Himachal Pradesh, Karnataka, Kerala, Maharashtra and Rajasthan. The medium irrigation states includes all the rest of the states which are not included in other two categories. The high productivity states are recorded as Haryana, Punjab, UP Tripura, West Bengal and Himachal Pradesh where ratio of GSDP and arable land is greater than Rs. 70,000 per hectare at 2004-05 prices. Where as low productivity states have same variable ratios by less than Rs. 35,000. It includes states of Rajasthan, Meghalaya, Madhya Pradesh, Karnataka, Odisha and Gujarat. The correlation coefficient details tells that there is high degree of correlation among irrigation levels and productivities and it has been proved at 5 percent and 1 percent level that there is significantly zero correlation between the high irrigation and high productivity as well as among medium irrigation and medium productivity. But for low irrigation and low productivity there has been some correlation among the two.

**Table 3: correlation between irrigation and productivity**

	High Irrigation States	High Productivity States	medium Irrigation States	medium Productivity States	Low Irrigation States	Low Productivity States
1981-82 to 1993-94	3.8	4.1	2.9	3	3.6	3.6
1994-95 to 1999-2000	3.2	2.9	1.8	2.4	2.8	2.6
2000-01 to 2004-05	1.7	2.5	3.1	2.1	1.5	2.5
2005-06 to	2.7	2.1	4.2	3.7	4.5	5.1

2011-12						
Mean	2.85		3		3.1	
Variance	0.79		0.96		1.62	
correlation	0.75		0.70		0.901	
t statistics	1.602		1.39		2.95	

Source: Central Statistical Office, New Delhi Press

**IV] GROSS VALUE ADDED BY AGRICULTURE AND ALLIED SECTORS**

Table 4 depicts the growth of output, inputs and the total value added by agricultural sector dividing the time into 7 major time spheres - Pre-green revolution, Green revolution, post green revolution, liberalization period, Ninth five year plan (1997-2002), Tenth five year plan (2002-07), Eleventh five year plant (2007-12). The analysis of the table concluded that

- The gross value added growth rate for 11<sup>th</sup> five year plan in cross and livestock was averaged at 3.8 percent per annum which was highest among seven inter-period comparisons on basis of averages.
- The total growth rate of non-horticulture crops was much faster than the target set for eleventh five year plan, for instance-actual growth for oilseeds was 4.5 percent against 4 percent and 3.1 percent against 2.3 for food grains.
- The growth rate of output was 3 percent for fishing for eleventh five year plan which fall short of target of 6 percent for that period.
- All the periods showed lower growth rate of use of modern inputs. The reduced fertilizers and fuel subsidies were found consistent with desired moderation.

**Table 4: Gross Value Added By Agriculture And Allied Sectors**

	Pre- green revolution 1951-52 to 1967-68	Green revolution 1968-69 to 1980-81	Post green revolution 1981-82 to 1990-91	Early liberalisation 1991-92 to 1996-97	Ninth Plan	Tenth Plan	Eleventh Plan
Value of Output (2004-05 prices)							
all crops	3	3	3	3.1	2.3	2.1	3.4
Livestock	1	3.3	4.8	4	3.6	3.6	4.8
crop & livestock	2.5	3	3.3	3.3	2.6	2.5	3.8
Fishing	4.7	3.1	5.7	7.1	2.7	3.3	3.6
Forestry	1.7	-0.2	0.3	0.3	2.7	1.3	2.3
Value of Intermediate Inputs (2004-05 prices)							
feed of livestock	1.9	4	0.1	0.9	3.9	0.7	3.3
organic manure	0	1.3	0.7	0.5	1.6	2.9	3.3
fertilizers & pesticides	18.2	9.3	8.7	2	3.9	4.8	6.7

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all input crops& livestock	2.4	4.5	2.2	1.9	3	2.5	4.4
inputs for fishing	4.6	3.3	5.4	6.5	2.7	1.5	3.5
inputs for forestry	1.7	-0.2	0.1	0.3	2.6	1.3	2.3
Gross Value Added (2004-05 prices)							
crop & livestock	2.7	2.7	3.7	3.7	2.5	2.5	3.5
Fishing	4.7	3	5.8	7.2	2.7	3.6	3.7
Forestry	1.7	-0.2	0.4	0.3	2.8	1.3	2.3

Source: Central Statistical Office (CSO): National Accounts (2004-05 prices)

### [V] EXPENDITURE ON RESEARCH AND EDUCATION

The research, innovations and technological upgradations synonymously used words, ultimately plays vital role in changing the outlook of any sector and developing the entire economy. The eleventh five year plan has witnessed need of increasing production potential by more intensive use of biochemical inputs, matter and most importantly on long term environment impact of inputs and natural resources used. Indian Council of Agricultural Research (ICAR) undertakes basic, strategic and definite responsibility of improving agriculture output and income. The table 5 depicts that the share of expenditure on research and education as percentage of GDP aggregate has been increasing drastically from 10<sup>th</sup> five year plan to 2010-11 but later it again came down to 0.70 percent in eleventh five year plan.

**Table 5: Expenditure On Research And Education**

**(Rscore at 2006-07 prices)**

	STATE			CENTRE			GDP Agri& Allied (2006-07 prices)	Research & Education as %GDP
	Plan	Non- Plan	Total	Plan	Non- Plan	Total		
Tenth Plan	4151	6477	10628	4977	4125	9102	3340648	0.59
2007-08	694	1464	2158	1210	852	2063	764890	0.55
2008-09	965	1315	2280	1418	1040	2458	765601	0.61
2009-10	1070	1497	2567	1402	1235	2636	773565	0.67
2010-11	1289	1755	3044	1909	2168	4077	827969	0.86
2011-12	1382	1599	2981	1998	1512	3510	850812	0.76
Eleventh Plan	5401	7629	13030	7938	6808	147	3982837	0.7

Source: Central Statistical Office (CSO): National Accounts

### [VI] CONTRIBUTION OF PUBLIC-SECTOR

A significant amount of contribution has been done by public sector to research and development there has been gradual improvements in basmati varieties, introduction of improved rust resistant wheat varieties including ug 99, improved varieties of soya bean, chickpea, single cross hybrid maize that led to growth in agricultural yield.

Although the Bt cotton hybrids are made available by private producers only. While concerning the natural resource management, public research claims major contribution in developing resource conservation technologies like micro irrigation, zero tillage, laser levelling, situ rain water harvesting.

Apart from this public sector contributes in fruits and vegetables too by making availability of better varieties and hybrid and disease management. In livestock and fisheries management, the disease management technologies including vaccination and diagnostics, improving reproductive health and feed and fodder management is done by public sector.

#### **[VII] RESEARCH AND DEVELOPMENT STRATEGIES FOR TWELFTH FIVE YEAR PLAN**

- A new collaborative research ‘National Initiative on Climate Resilient Agriculture (NICRA)’ has been launched by ICAR in February 2011 as a network project with several collaborating institutions in order to enhance climate vulnerability through strategic and technology demonstration on crops, livestock, fisheries and natural resource management. It plans to demonstrate site-specific technology packages on farmers’ fields for adapting to current climate risks which will be continued during the Twelfth Plan.
- Research platforms for focused, time bound multi-disciplinary research in areas of ‘Agro Biodiversity Management; Genomics; Seed; Hybrids; High Value Compounds/Phytochemicals; Nanotechnology; Diagnostics and Vaccines; Conservation Agriculture; Waste Management; Water Management; Farm Mechanisation and Energy; Secondary Agriculture and Agriincubators. This Inter-departmental platforms for research areas capacity building in basic sciences, remote sensing and medium range agri-advisory services will be fostered.
- A National Agricultural Education Project for Systemic Improvement in Higher Agricultural Education and Institution Development is proposed to be undertaken in State Agricultural Universities.
- To build an ecosystem for nurturing entrepreneurship development through translational research, management of technologies for commercialization, research for breakthrough technologies for accelerated growth and higher-economic impact.
- To move beyond production and productivity and to make technology delivery process more effective through the existing 630 Krishi Vigyan Kendras, a new initiative will enhance farmers–scientist contact through multi-stakeholders’ participation
- A one-year composite programme, the Rural Entrepreneurship and Awareness Development Yojana (READY) is proposed with the objective to develop professional skills for entrepreneurship, confidence through end to end approach in product development; and enterprise management capabilities including skills for project development and execution, accountancy and national/ international marketing.
- Development of Models and technology interventions regarding the rational use of inputs, major nutrients and irrigation water and farmer participatory mode in order to accelerate their use efficiency and farm profits.
- The priority is to enhance the yield potential of pulses, by examining the physiological and biochemical limitations of the existing crop and designing more efficient types which improves the nutritional quality of pulses and reduces various anti-nutritional factors.

- Main emphasis is to be given to post-harvest management, secondary agriculture and value addition, along with by-products and waste management. The agricultural technologies that have been developed and matured in the Eleventh Plan should be taken for commercialization in the Twelfth Plan.

## **V.CONCLUSION**

The paper summarizes that although technological advancements leads to rise in agricultural productivity but still the results lacked behind the targets. Therefore certain steps needs to be taken in further plans of the government to take advantage of the innovations in a better way.

- 1) Better funded research and emphasis to be laid on getting more from existing technology.
- 2) Decentralization of funds accurately to encourage initiations at both state and lower governments.
- 3) Instead of focusing upon farmers production, stress should be laid upon farm incomes, suggesting the encouragement of group activity with land and reforms.
- 4) To deliver faster growth, more inclusive and less concentrated spatially.
- 5) Increase public awareness and encourage adoption of the technology through mass media platforms.
- 6) Intensification of various agricultural extension services regarding the technology through farmer field schools, agricultural exhibitions and on actual demonstration plots.
- 7) To guarantee easy access to all rural institutional credit facilities to enable farmers invest efficiently in the technology since the initial capital investments are relatively high.
- 8) To facilitate the local market access of farming equipment at subsidized rates to enhance quick uptake by farmers and get its benefit.

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