

WORKING PAPER ON AGRICULTURE SECTOR IN INDIA-POLICY REVIEW AND PERFORMANCE ANALYSIS

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Abstract : Agriculture plays a significance role in the process of economic development of less developed countries like India. Besides providing food to nation, agriculture releases labour, provides saving, contributes to market of industrial goods and earns foreign exchange. Agricultural development is an integral part of overall economic development. In India, agriculture was the main source of national income and occupation at the time of Independence. Agriculture and allied activities contributed around 50 percent to India's national income. The 72 percent (around) of total working population was engaged in agriculture. These confirm that Indian economy was a backward and agricultural based economy at the time of Independence. After 61 year of Independence, the share of agriculture in total national income declined from 50 percent in 1950 to 18 percent in 2007-08. But even today more than 60 percent of workforce is engaged in agriculture. In spite of this, it is also an important feature of agriculture that is to be noted that growth of other sectors and overall economy depends on the performance of agriculture to a considerable extent. Because of these reasons agriculture continues to be the dominant sector in Indian Economy. An attempt has been made to study the agriculture sector in India, to appraise Indian agricultural policy and to analyse the performance of Indian agricultural sector specially focused on agricultural inputs. For the present study secondary data has been utilized from published and unpublished sources like, thesis, reports, books, journals, newspapers, magazines, and various websites.

Key Words: *Agricultural Policy, Agricultural Inputs, Agriculture Sector Performance*

1. Introduction

Since independence India has made much progress in agriculture. Indian agriculture, which grew at the rate of about 1 percent per annum during the fifty years before Independence, has grown at the rate of about 2.6 percent per annum in the post-Independence era. Expansion of area was the main source of growth in the period of fifties and sixties after that the contribution of increased land area under agricultural production has declined overtime and increase in productivity became the main source of growth in agricultural production. Another important facet of progress in agriculture is its success in eradicating of its dependence on imported food grains. Indian agriculture has progressed not only in output and yield terms but the structural changes have also contributed. All these developments in Indian agriculture are contributed by a series of steps initiated by Indian Government. Land reforms, inauguration of Agricultural Price Commission with objective to ensure remunerative prices to producers, new agricultural strategy¹, investment in research and extension services, provision of credit facilities, and improving rural infrastructure are some of these steps.

Despite these progresses, the situation of agriculture turned adverse during post-WTO period and this covered all the sub sectors of agriculture. The growth rates in output of all crops decelerated from 2.93 percent to 1.57 percent. The livestock declined from 4.21 percent to 3.40 percent. The fisheries declined from 7.48 percent to 3.25 percent. Only, forestry witnessed a sharp increase from 0.09 percent to 1.82 percent.

The crop sector, which forms largest segment of agriculture, showed poorest growth during post-WTO period in comparison to all other periods. Further, within crop sector, all crops except sugar showed declining trend between initial years of reforms and post-WTO period. This deceleration is very high in Cereals, Coarse Cereals, Pulses, Oilseeds, and Drugs & Narcotics. The growth rate turned negative in the case of pulses. Both dominant nature of agriculture and decelerating growth trend in agriculture attracts attention of policymakers, researchers and economists. The main cause of failure of all development policy for agriculture is that there is no availability of any separate development strategy² for Indian agriculture.

2. Agriculture Policy: Review

In this section, we try to trace out the principle government policies for promoting agricultural development. For the overall development of Indian agriculture, many institutional and infrastructural changes have been introduced since Independence. Broadly, agricultural

¹ In order to achieve the goal of self sufficiency in agriculture, new agricultural strategy has been initiated in 1966-67. The fundamental of this strategy is the application of science and technology for increasing yield per hectare. This strategy, known as New Agricultural Strategy or Green Revolution, is based on the extension of high yielding varieties responsive to heavy doses of fertilizers and the package of improved practices in selected areas with assured rainfall or irrigation facilities. The programmes included under the new strategy are: (1) the high yielding varieties programme, (2) multiple cropping programme, (3) integrated development of dry areas, (4) plant protection measures, (5) increased use of fertilizers, and (6) new irrigation concept.

² Agriculture production is a biological process, agriculture is diminishing returns activity because land is ultimately a fixed factor of production and the demand for agricultural commodities is income inelastic. These characteristics make different to agriculture from other sector. Therefore, a separate policy for agricultural development is must.

policy followed during this period can be distinguished in four phases, these are: first phase considered from 1947 to mid-sixties, second phase considered period from mid-sixties to 1980, third phase included period from 1980 to 1991, and fourth phase includes period from 1991-92 onwards.

The first phase: of agricultural policy witnessed tremendous agrarian reforms, institutional changes, development of major irrigation project and strengthens of cooperative credit institution. The most important contribution of land reforms was abolition of intermediaries and giving land titles to the actual cultivators. This released productive forces and the owner cultivators put in their best to augment production on their holdings. Land reforms were important in increasing agricultural production during this phase. The Community Development Programme, decentralised planning and the Intensive Area Development Programmes were also initiated for regenerating Indian agriculture that had stagnated during the British period. In order to encourage the farmers to adopt better technology, incentive price policy was adopted in 1964 and the Agricultural Price Commission was setup to advise the Government on the fixation of support prices of agricultural crops. Notwithstanding the institutional changes and development programmes introduced by the Government during this phase, India remained dependent upon foreign countries for food to feed the rising population.

The second phase: in Indian agriculture started in mid 1960s with adoption of new agricultural strategy³. The new agricultural strategy relies on high-yielding varieties of crops, multiple cropping, the package approach, modern farm practices and spread of irrigation facilities. The biggest achievement of this strategy has been attainment of self sufficiency in food grains. Agrarian reforms during this period took back seat while research, extension, input supply, credit, marketing, price support and spread of technology were the prime concern of policy makers (Rao, 1996)⁴.

The third phase: in Indian agriculture began in early 1980s. This period started witnessing process of diversification which resulted into fast growth in non-food grains output like milk, fishery, poultry, vegetables, fruits etc., which accelerated growth in agricultural GDP during the 1980s (Chand, 2003)⁵. There has been a considerable increase in subsidies and support to agriculture sector during this period while public sector spending in agriculture for infrastructure development started showing decline in real term but investment by farmers kept on moving on a rising trend (Mishra and Chand, 1995⁶; Chand, 2001⁷).

The fourth phase: of agricultural policy started after initiation of economic reform process in 1991. Economic reforms process involved deregulation, reduced government participation in economic activities, and liberalization. Although there is no any direct reforms for agriculture but the sector was affected indirectly by devaluation of exchange rate, liberalization of external trade and disprotection to industry. During this period opening up of domestic market due to new international trade accord and WTO was another change that affected agriculture. This raised new challenges among policymakers. Because of this, a New Agricultural Policy was launched by Indian Government in July 2000. This aims to attain output growth rate of 4 percent per annum in agriculture sector based on efficient use of resources. It seeks to achieve this objective in a sustainable manner and with equity. This was first time when government released a national agriculture policy. The policy document discusses what ought to be done in agriculture but the subsequent step, how and when policy goals and objective would be achieved is not discussed (Chand, 2003)⁸. Therefore, it is highly desirable to prepare action plans at both centre and state level in quantity terms to implement the new policy agenda in a time bound framework.

3. Performance of Indian Agriculture

The Indian economy has undergone structural changes over time with the anticipated decline in the share of agriculture in the GDP. Despite a fall in its share from 55.1 per cent in 1950-51 to 17.0 percent in 2008-09, the importance of agriculture has not diminished for two major reasons. First, the country achieved self-sufficiency in food production at the macro level, but still is a food deficit country facing massive challenges of high prevalence of malnourished children and high incidence of rural poverty. The pressure on agriculture to produce more and raise farmers' income is high. Second, the dependence of the rural workforce on agriculture for employment has not declined in proportion to the sectoral contribution to GDP. This has resulted in widening the income disparity between the agricultural and non-agricultural sectors (Chand and Chauhan, 1999)⁹. The experiences of developed countries show that transfer of labour force from agriculture to non-agriculture, in particular the manufacturing sector took place. This had brought enhanced productivity growth in agriculture and hence higher income (Gollin et al., 2002)¹⁰. However, India's manufacturing sector witnessed volatile growth and its share in GDP has almost remained constant at 15 per cent for the last three decades. Further, given the fact that the current economic growth pattern is driven by the service sector, labour absorption outside agriculture will be slow until rural education improves dramatically in the near future. Under these circumstances, higher growth in agriculture assumes great importance and is a matter of concern for policy planners and research scholars in recent times (Chand et al., 2007; Balakrishnan et al., 2008; Bhalla and Singh, 2009; Reddy and Mishra, 2009; Vaidyanathan, 2010). Sustained agricultural growth, which is facilitated through constant policy and institutional support has the potential to augment growth in the rural economy and associated secondary activities like food

³ This is also known as Green Revolution strategy.

⁴ Rao, V. M. (1996), "Agricultural Development with a Human Face", *Economic and Political Weekly*, 31(26): A-52 - A-62.

⁵ Chand Ramesh (2003), "Government Intervention in Food grain Markets in the Changing Context", Policy Paper 19, National Centre for Agricultural Economics and Policy Research, New Delhi.

⁶ Mishra, S. N. and Ramesh Chand (1995), "Private and Public Capital Formation in Indian Agriculture: Comments on Complementarity Hypothesis and Others", *Economic and Political Weekly*, 30 (24): A-64 -A-79.

⁷ Chand Ramesh (2001), "Emerging Trends and Issues in Public and Private Investments in Indian Agriculture: a State wise Analysis", *Indian Journal of Agricultural Economics*, 56 (2), 161-184.

⁸ Chand Ramesh (2003), "Government Intervention in Food grain Markets in the Changing Context", Policy Paper 19, National Centre for Agricultural Economics and Policy Research, New Delhi.

⁹ Chand, Ramesh and Sonia Chauhan, (1999), *Are Disparities in Indian Agriculture Growing?*, Policy Brief No. 8. New Delhi: National Centre for Agricultural Economics and Policy Research.

¹⁰ Gollin, Douglas, Stephen Parente and Richard Rogerson, (2002), *Role of Agriculture in Development*, *The American Economic Review*, 92 (2): 160-64.

processing and retail trading. However, agriculture-led rural industrialisation has not received due attention from policy makers in the country notwithstanding the fact that maintaining the growth of agricultural per se was lost sight of during the 1990s (Sen, 1992; Bhalla and Singh, 2001; Rao, 2003; Bhalla and Singh, 2009). In fact, the growth performance of agriculture at the national level was splendid during the 1980s and its deceleration during the 1990s was attributed to the reduction in and/or stagnation of public expenditure on agricultural infrastructure, defunct extension services and biased economic reforms (Thamarajakshi, 1999; Balakrishnan, 2000; Hirashima, 2000; Mahendradev, 2000; Vyas, 2001; Rao, 2003).

Nevertheless, there has been a renewed policy thrust from the government since mid 2000s to revive agricultural growth through various development programmes such as interest subvention on crop loans, the National Food Security Mission, the National Agriculture Development Programme (Rashtriya Krishi Vikas Yojana) and the Pulses Development Programme. These programmes are likely to affect agricultural growth and farmers' income in the country by providing greater flexibility to the state governments to allocate resources to the priority areas of development. Aside, patterns and trends in India's agricultural growth is a well-researched subject. Systematic efforts were made to analyse growth in crop output and its elements through decomposition analysis (Minhas and Vaidyanathan, 1965; Sagar, 1977; Sagar, 1980; Sarma and Subrahmanyam, 1984; Majumdar and Basu, 2005, Joshi et al., 2006). Historical aspects of agricultural growth, disparity and impact on farmers' income and employment have been studied by several scholars. Some recent studies include those of Sawant and Achuthan (1995), Rao (1998), Bhalla and Singh (2001), Radhadrishna (2002), Bhalla and Singh (2009) and Vaidyanathan (2010). Some studies also looked at the effect of agricultural technology on growth of crop output and its instability (Cummings and Ray, 1969; Hazell, 1982; Ray, 1983; Mahendradev, 1987; Deshpande, 1988; Vaidyanathan, 1992; Chand and Raju, 2009). The present study contributes to the existing knowledge base on Indian agriculture in a way that it estimates the crop output growth model through econometric method. The study also discusses the trends and patterns in agricultural growth at the national and state levels.

Table 1: All India Crop-wise Yield

(Quintal/ hectare)

Crops	1950-51	1990-91	2000-01	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16
Rice	6.68	17.40	19.01	22.39	23.93	24.61	24.16	23.91	24.04
Jowar	3.53	8.14	7.64	9.49	9.57	8.50	9.57	8.85	7.81
Bajra	2.88	6.58	6.88	10.79	11.71	11.98	11.84	12.54	11.55
Maize	5.47	15.18	18.22	25.40	24.78	25.66	26.76	26.30	25.10
Wheat	6.63	22.81	27.08	29.88	31.77	31.17	31.45	27.50	30.93
Coarse Cereal	4.08	9.00	10.27	15.31	15.90	16.17	17.17	17.03	15.95
Gram	4.82	7.12	7.44	8.95	9.28	10.36	9.60	8.88	8.59
Tur or Arhar	7.88	6.73	6.18	6.55	6.62	7.76	8.13	7.30	6.56
Total Pulses	4.41	5.78	5.44	6.91	6.99	7.89	7.64	7.28	6.52
Total Foodgrains	5.22	13.80	16.26	19.30	20.78	21.29	21.20	20.28	20.56
Sugarcane	334.22	653.95	685.78	700.91	703.17	682.54	705.22	715.12	710.95
Groundnut	7.75	9.04	9.77	14.11	13.05	9.95	17.64	15.52	14.86
Rapeseed & Mustard	3.68	9.04	9.36	11.85	11.45	12.62	11.85	10.83	11.84
Soya bean	4.26	10.15	8.23	13.27	12.07	13.53	10.12	9.51	7.37
Sunflower	6.53	5.35	6.05	7.01	6.92	6.55	7.50	7.36	6.97
Total Oilseeds	4.81	7.71	8.10	11.93	11.35	11.68	11.68	10.75	9.68
Cotton	0.88	2.25	1.90	4.99	4.91	4.86	5.10	4.62	4.32
Tobacco	7.31	13.53	13.18	16.87	16.13	15.42	16.12	18.42	NA

Source: Directorate of Economics and Statistics, DAC&FW. NA : Not Available; * : 4th Advance Estimate.

However, it is interesting to witness a comparatively higher growth in the yield of all major crops during 1990s, i.e., the mature green revolution period. It indicates that crops other than rice and wheat shared the technological benefits. With decline in area, impressive growth in production of most crops was mainly contributed by growth in yield. Rice recorded yield growth rate of from 6.68 Q/H in 1950-51 to 24.04 Q/H. Wheat yield also showed impressive growth of 22.81 Q/H in 1990-91 to 30.93 Q/H in 2015-16. Growth in yield of Jowar and Bajra was appreciable, Jowar eyewitnesses yield growth from 3.53 Q/H in 1950-51 to 7.81 Q/H in 2015-16 and Bajra recorded growth in yield was 2.88 Q/H in 1950-51 to 11.55 in 2015-16. However, negative growth was reflected in the decline in area under food grains for Tur (Arhar) 7.88 Q/H in 1950 decreased to 6.56 Q/H in 2015-16. Despite this, total food-grains which was contributed by yield growth from 5.22 Q/H in 1950-51 to 20.56 Q/H in 2015-16. Sugarcane recorded yield growth 334.22 Q/H in 1950-51 to 710.95 in 2015-16. Oilseeds recorded a growth in yield 7.31 Q/H in 1950-51 to 18.42 Q/H in 2014-15. This could be attributed to technology mission on oilseeds launched in mid-1980s, which laid

emphasis on increasing productivity of oilseeds and bridging yield gaps between experimental stations and farmers' fields by adopting improved package of practices. Similarly, cotton showed high growth in yield by 0.88 Q/H in 1950-51 to 4.32 Q/H in 2015-16.

However, the growth in the yield of almost all crops declined during 1990-91 to 1999-00, i.e., the early economic reforms period. This was, in fact, a disturbing scenario, which resulted in low growth in crop output. However, there was increase in area for rice and wheat during this period. This occurred particularly in North West India where market incentives were in force in terms of price support, assured government procurement for wheat and rice and favourable policy environment for providing inputs to farmers at subsidised rates (Umali-Deininger et al., 2005)¹¹. In the case of pulses, the growth of yield was 4.41 in 1950-51 to 6.52 in 2015-16.

The Government of India has envisaged an annual growth rate of 4 per cent in agriculture and allied sectors since the 9th Five-Year Plan (1996-97 to 2001-02). As the crop sector constitutes over three-fourth of total output its growth performance assumes great importance in achieving this target. Further, crop productivity has to be improved through better soil and water management, profitable crop rotation, innovative marketing and investment in farm education and rural infrastructure. Among these factors, the former two are essential in ensuring sustainability of agricultural production through effective maintenance of soil fertility and controlling pests and diseases. The latter factors are important in making agriculture profitable through efficient marketing, access to and adoption of new technologies and providing incentives for making on-farm investment.

Table 2: Target and Achievement of Production of Major Crops

(Million Tonnes)

Crop	2013-14		2014-15		2015-16*	
	Target	Achievement	Target	Achievement	Target	Achievement
Rice	105.00	106.65	106.00	105.48	106.10	104.32
Wheat	92.50	95.85	94.00	86.53	94.75	93.50
Coarse Cereals	42.50	43.29	41.50	42.86	43.20	37.94
Pulses	19.00	19.25	19.50	17.15	20.05	16.47
Food-grains	259.00	265.04	261.00	252.02	264.10	252.22
Oilseeds	31.00	32.75	33.00	27.51	33.00	25.30
Sugarcane	340.00	352.14	345.00	362.33	355.00	352.16
Cotton#	35.00	35.90	35.00	34.80	35.15	30.14
Jute & Mesta@	12.00	11.69	11.20	11.13	11.70	10.46

Source: Directorate of Economics and Statistics, DAC&FW. * 4th Advance Estimates; @ : Million Bales of 180 kg each; # : Million Bales of 170 kg each.

The above Table enlightens the target and achievement of production of major crops in India. In 2013-14 target achieved in all major crops except Jute & Mesta, target was set 12.00 MT and achieved production was 11.69 MT. Target set for rice, wheat, coarse cereals, pulses, oilseeds, sugarcane and cotton was 105.00 MT, 92.50 MT, 42.50 MT, 19.00 MT, 31.00 MT, 340.00 MT, and 35.00 MT, respectively. Other hand in the same year production target achieved for rice, wheat, coarse cereals, pulses, oilseeds, sugarcane and cotton was 106.65 MT, 95.85 MT, 43.29 MT, 19.25 MT, 32.75 MT, 352.14 MT, and 35.90 MT respectively. In the year 2014-15 recorded marginally decrease in trends of actual production than the target ones except coarse cereals and sugarcane 43.20 MT and 362.33 MT with target set figures 41.50 MT and 345.00 MT respectively during 2014-15, other crops failed to achieved target figures. During 2015-16 estimated target figure and production achieved figures for major crops were also failed to reach target production (refer graph 1).

¹¹Umali-Deininger, Dina, Mona Sur, Klaus W Deininger, (2005), Food grains Subsidies in India: Are they Reaching the Poor?, American Agricultural Economics Association Annual Meeting, July 24-27, Rhode Island, <http://ageconsearch.umn.edu/bitstream/19486/1/sp05um01.pdf>.

Graph 1 : Target and Achievement of Production of Major Crops

(Million Tonnes)

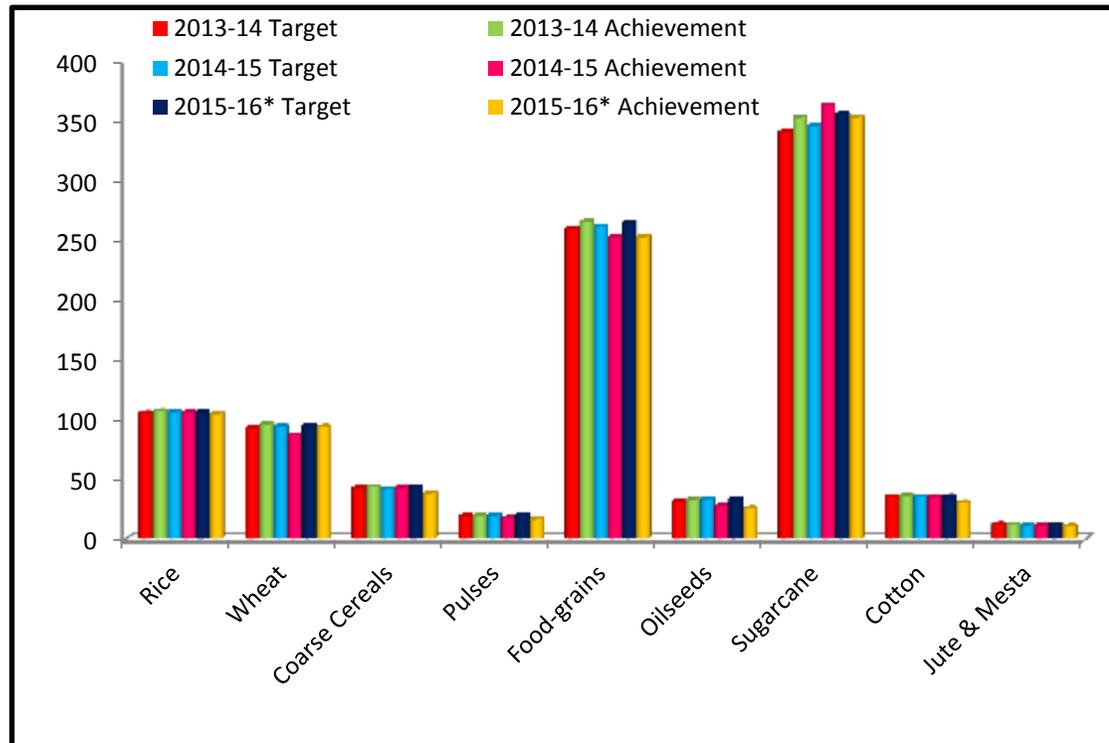


Table 3: Production and Use of Agricultural Inputs in India

Programme	Unit	2000-01	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16
1. Seeds								
(i) Production of Breeder Seeds	Thousand Qtls.	42.69	118.85	123.38	110.20	82.29	86.21	90.37
(ii) Production of Foundation Seeds	Lakh Qtls.	5.91	17.53	22.36	16.17	17.43	15.76	14.95
(iii) Distribution of Certified/Quality Seeds	Lakh Qtls.	86.27	277.34	294.85	313.44	301.39	303.12	304.04
2. Consumption of Chemical Fertilisers								
Nitrogenous (N)	Lakh Tonnes	109.20	165.58	173.00	168.21	167.50	169.46	173.72
Phosphatic (P)	Lakh Tonnes	42.15	80.50	79.14	66.53	56.33	60.98	69.79
Potassic (K)	Lakh Tonnes	15.67	35.14	25.76	20.62	20.99	25.32	24.02
Total (N+P+K)	Lakh Tonnes	167.02	281.22	277.90	255.36	244.82	255.76	267.53
Per Hectare **	kg	89.63	142.52	142.05	131.36	118.49	127.45	130.66
3. Consumption of Pesticides (Technical Grade Material)								
	Thousand Tonnes	43.58	55.54	52.98	45.62	60.28	56.12	50.41
4. Area Covered Under Soil Conservation (Cumulative)								
	Lakh Hectares	4.36	7.49	4.72	5.46	-	-	-

Source: Department of Agriculture, Cooperation & Farmers Welfare.

Agricultural production and efficiency largely depend upon the inputs applied and the methods adopted. In India, "while population grows, the land surface is fixed and of this only a certain proportion is available for cultivation" (Planning commission, 1961). Further scope for bringing extra land under the plough is limited. If more production is to be got out of this existing area, the problem has to be tackled on a wide front. This can be done by applying inputs in a more intensive way and by adopting modern methods of production through use of improved technology, besides making an adequate provision for institutional financing, better methods of marketing, etc.

Technical factors, i.e., technology have received increasing emphasis and the recent breakthrough in agriculture is the outcome of these factors. These technological factors comprise (i) irrigation; (ii) Consumption of fertilisers and manure; (iii) Improved seed, and (iv) agricultural implements.

Table 4 : Foodgrains: Area, Production and Yield during 2014-15 and 2015-16 in major Producing States Along with coverage under Irrigation
(Area - Million Hectares, Production - Million Tonnes, Yield - kg./Hectare)

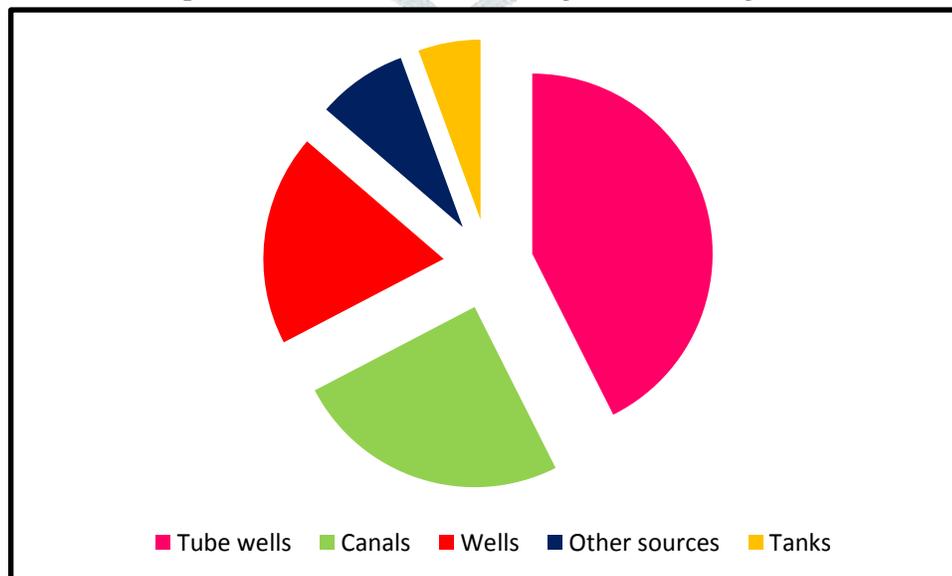
State	2015-16#					2014-15					Area Under Irrigation (%) 2013-14*
	Area	% to All India	Production	% to All India	Yield	Area	% to All India	Production	% to All India	Yield	
Uttar Pradesh	19.32	15.75	44.01	17.45	2278	20.08	16.15	39.59	15.71	1972	78.4
Madhya Pradesh	15.62	12.73	30.21	11.98	1935	15.46	12.44	28.69	11.38	1855	58.2
Punjab	6.65	5.42	28.41	11.26	4273	6.59	5.30	26.70	10.59	4054	98.8
Rajasthan	12.99	10.59	18.10	7.18	1393	12.83	10.33	19.62	7.79	1529	32.5
West Bengal	6.39	5.21	17.78	7.05	2783	6.13	4.93	16.53	6.56	2698	48.4
Haryana	4.47	3.64	16.38	6.50	3665	4.45	3.58	15.24	6.05	3427	92.0
Bihar	6.60	5.38	14.10	5.59	2135	6.73	5.41	13.21	5.24	1964	69.1
Tamil Nadu	3.86	3.15	11.94	4.73	3090	3.54	2.85	9.62	3.82	2720	56.4
Andhra Pradesh	4.14	3.37	10.57	4.19	2555	3.96	3.19	10.49	4.16	2650	66.6
Karnataka	7.16	5.84	9.97	3.95	1393	7.19	5.79	12.14	4.82	1687	26.9
Maharashtra	10.12	8.25	8.07	3.20	797	11.45	9.21	11.31	4.49	988	18.6
Chhattisgarh	4.99	4.07	6.96	2.76	1395	5.06	4.07	7.46	2.96	1475	31.3
Odisha	5.37	4.38	6.59	2.61	1226	5.17	4.16	8.98	3.56	1738	29.2
Gujarat	3.16	2.58	6.23	2.47	1973	3.53	2.84	7.11	2.82	2016	46.1
Assam	2.68	2.19	5.35	2.12	1995	2.70	2.17	5.46	2.17	2021	10.3
Telangana	2.19	1.78	5.03	1.99	2300	2.61	2.10	7.11	2.82	2723	65.4
Jharkhand	2.65	2.16	4.09	1.62	1544	2.55	2.05	4.78	1.90	1872	9.1
Uttarakhand	0.88	0.72	1.73	0.68	1967	0.90	0.72	1.63	0.65	1813	44.4
Others	3.42	2.79	6.71	2.66	@	3.39	6.36	6.36	2.52	@	-
All India	122.65	100.00	252.22	100.00	2056	124.30	96.52	252.02	100.00	2028	51.9

Source: Directorate of Economics & Statistics, DAC&FW.

Table 5 : The various Sources of Irrigation used in Agriculture.*

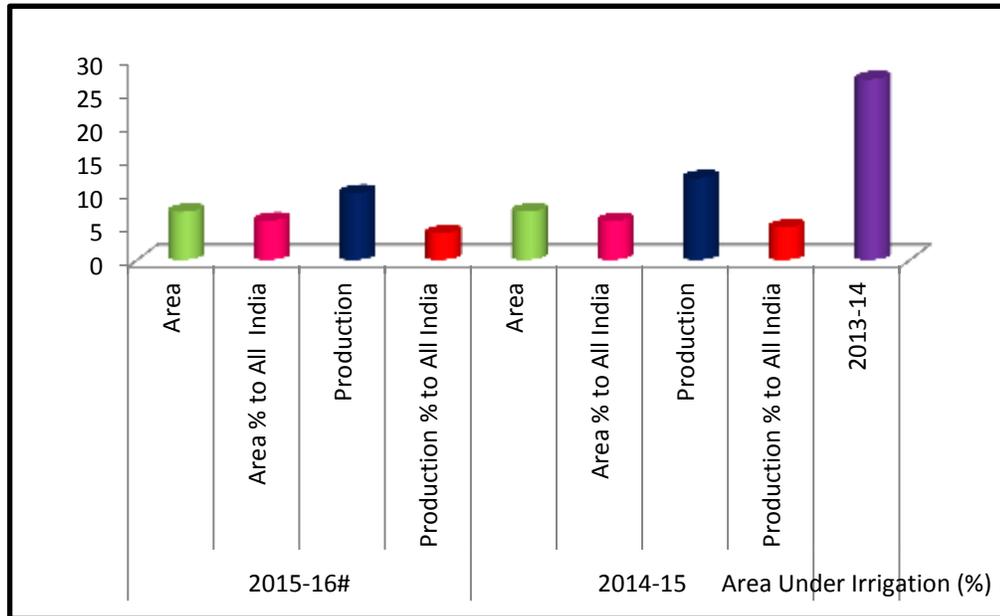
Source of Irrigation	% share of holdings	Number of holdings
Tube wells	44.2%	31,722
Canals	25.7%	18,414
Wells	19.7%	14,101
Other sources	8.4%	6,046
Tanks	5.8%	4,180

Sources: Agriculture Census 2011; PRS. (*as of 2010-11)

Graph 2 : The various Sources of Irrigation used in Agriculture

Water is another basic factor in agriculture next only to land. Only rainfall is the natural source of water in agriculture. But rainfall is the most unreliable and is marked by wide variations in different parts and also variation from year to year in its quantity, incidence, and duration. Therefore, only artificial supply of water through irrigation is the way to overcome the problem of deficiency of water. Irrigation water comes from two sources: surface water and ground water. Surface water is provided by the flowing water of rivers or the still water of tanks, ponds, lakes, and artificial reservoirs. The surface water is carried to the field by canals, distributaries, and channels. Ground water is tapped by sinking wells where drought animals, diesel or electric power is utilized to take out water. In India canals (25.7%), tanks (5.8%), wells (63.9%) including tube wells (44.2%) are the principal sources of irrigation. Around 51% of the agricultural area cultivating food-grains is covered by irrigation¹². The rest of the area is dependent on rainfall (rain-fed agriculture). Sources of irrigation include ground water (wells, tube-wells) and surface water (canals, tanks). Above Table depicts the various sources of irrigation in agriculture. There is a need to improve the efficiency of water use, especially in agriculture. Irrigation consumes about 84% of the total available water in the country. Approximately 65% of the irrigated land holdings use ground water sources such as tube wells and wells for irrigation. In Karnataka around 26.9% area under irrigation with a share percent to all India of 5.79 percent in 2014-15 and 5.84 percent estimated in 2015-16 with a yield of 1687 Kg/Hectare in 2014-15 (refer Graph 2).

Graph 3 : Foodgrains: Area, and Production during 2014-15 and 2015-16 in Karnataka Along with coverage under Irrigation



(Area - Million Hectares, Production - Million Tonnes)

The favourable agricultural policy environment presented to farmers which would be helpful to get agricultural inputs at subsidised rates.

The Department of Agriculture and Cooperation has been executed a central seed scheme called 'Development and Strengthening of Infrastructural Facilities for Production and Distribution of Quality Seeds' since from 2005-06 to ensure production and multiplication of high yielding certified/quality seeds of all crops in India. However, the public seed agencies in India invest very little on promotion and publicity (Morris et al., 1998;¹³ Kumar et al., 2012¹⁴), while the private seeds companies sell their seeds through different channels and use intensive marketing strategies¹⁵

However, the Quality seeds are one of the inputs necessary for agricultural productivity, and good quality seeds account for 20%-25% of increased crop productivity¹⁶. Seeds are regulated by the Seeds Act, 1966. The Act regulates the quality, production, and sale of seeds. The Seeds Control Order, 1983 regulates the licenses to sell, export and import seeds.

¹² Pocket Book of Agricultural Statistics, 2015, Ministry of Agriculture and Farmers Welfare, <http://eands.dacnet.nic.in/PDF/Pocket-Book2015.pdf>.

¹³ Morris, M.L., Singh, R.P. and Pal, S. 1998. India's maize seed industry in transition: Changing roles for the public and private sectors. Food Policy(1): 55-71.

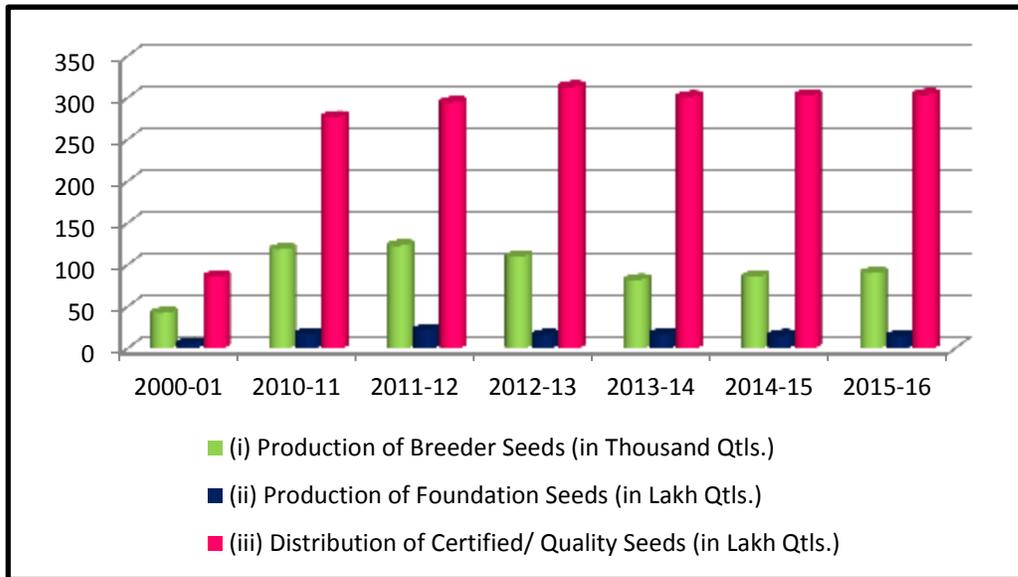
¹⁴ Kumar, R., Alam, K., Krishna, V.V. and Srinivas, K. 2012c. Value chain analysis of maize seed delivery system in public and private sectors in Bihar. Agricultural Economics Research Review 25: 387-398.

¹⁵ Kumar, R., K. Srinivas and N. Sivaramane (2013), Assessment of the maize situation, outlook and investment opportunities in India. Country Report – Regional Assessment Asia (MAIZE-CRP), National Academy of Agricultural Research Management, Hyderabad, India.

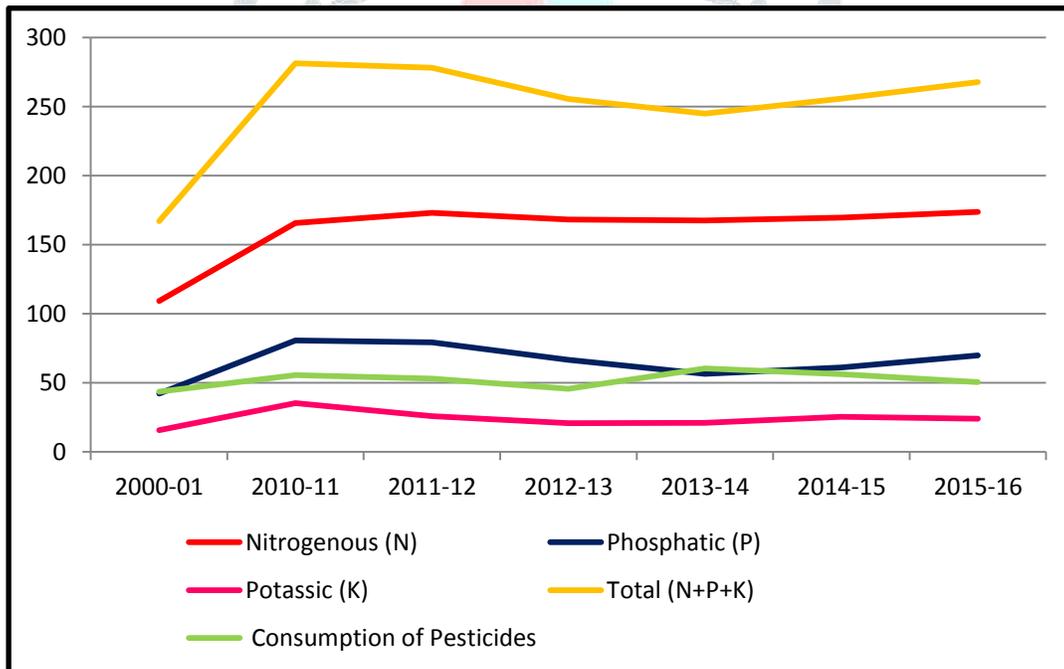
¹⁶ "Indian seed sector", Seednet India Portal, Ministry of Agriculture and Farmers Welfare, <http://seednet.gov.in/Material/IndianSeedSector.htm>.

From the above table it can be inferred that the production of breeder seed in 20,00-01 was 42.69 TQ, reached highest production of seeds 123.38 TQ in the year 2011-12 and decreased to 90.37 TQ in 2015-16 compared to 2011-12. The production of foundation seeds was 5.91 LQ in 2000-01 and reached its highest i.e. 22.36 LQ in 2011-12. From the year 2011-12 production of foundation seeds were recorded decreased trends 16.17 LQ, 17.43 LQ, 15.76 LQ and 14.95 LQ in 2012-13, 2013-14, 2014-15 and 2015-16 respectively. The distribution of certified/quality seeds was 86.27 LQ and increased to 277.34 LQ in 2000-01 and 2010-11 respectively. The estimated distribution of certified/quality seeds during 2015-16 was 304.04 LQ.

Graph 4 : The Production and Distribution of Agricultural Inputs (Seeds) in India



Graph 5 : Consumption of Chemical Fertilisers and Pesticides



NPK @ Lakh Tonnes and Pesticides @ Thousand Tonnes.

The various types of Fertilisers and pesticides were used to increase yield (various crops) and reduce the damage from insects and diseases. As farmers began to use chemical fertilisers and pesticides, these compounds gradually became an intrinsic part of agricultural practices¹⁷. In India the manufacture, sale, and distribution of fertilizers is regulated by the Ministry of Chemicals and Fertilizers, (The Essential Commodities Act, 1955). There are 3 major types of nutrients used as fertilizers i.e. (N+P+K) Nitrogenous (N), Phosphatic (P), and Potassic (K). Among these, the pricing of urea (containing N fertilizer) is controlled by the government, while P and K fertilizers were decontrolled in 1992, on the recommendation of a Joint Parliamentary Committee. However, the level of the fertilizer required for a crop depends upon the various

¹⁷ Environmental Management & Policy Research Institute (2012). State of Environment Report Karnataka 2011.

parameters, these are, soil type, level of yield, and water availability, in addition to the type of crop¹⁸. Certain crops such as rice, wheat, maize, cotton and sugarcane require larger quantities of nitrogen as compared to pulses, fruits and vegetables. Although, the ratio of N, P, and K fertilizer usage across crops has increased. It was observed that constantly the consumption of Nitrogenous (N) has increased; during 2000-01 consumed 109.20 Lakh Tonnes and 165.58 LT in 2010-11. In 2014-15 and 2015-16 it was 169.46 LT and 173.72 LT respectively. The Phosphatic (P) consumed during 2000-01 was 42.15 LT and increased in 2010-11 it was 80.50 LT, further decreased to 69.79 LT in 2015-16. The Potassic (K) consumption also varied, during 2000-01 it was 15.67 LT and increased in 2010-11 it was 35.14 LT, further decreased to 24.02 LT in 2015-16. However, the total consumption of N+P+K has increased since 2000-01 to 2015-16 i.e. from 167.02 LT to 267.53 LT.

The Farmers use chemical pesticides to control or eliminate insects and diseases that destroy crops and diminish food supply. These compounds work very well in killing insects that feed on the roots, leaves and stems of both food crops and garden flowers¹⁹. The consumption of chemical pesticides in the country has increased over the past years²⁰, from 43.58 TT in 2000-01 to 50.41 TT in 2015-16. However, it is pertinent note that the usage of more high yielding different variety of seeds, the appropriate consumption of fertilizers and pesticides has contributed to increase the agricultural production in India.

Agricultural Implements/Machinery

Mechanization/Implements are another aspect with a significant impact on Indian agricultural productivity. The use of agricultural implements in agriculture empowers agricultural labour to be used in other extended activities. It makes activities like tilling, spreading of seeds and fertilizers and harvesting more efficient and effective; hence, the cost of agriculture inputs is offset. Further, It makes the use of labour in agriculture more cost-effective. The mechanisation status in agriculture varies for different activities, while the overall level of mechanisation is still less than 50% compared to 90% mechanisation in developed countries. The highest level of mechanisation is observed in harvesting and threshing activities (around 60%-70%) and irrigation (around 37%). The lowest level of mechanisation is found in seeding and planting. To increase productivity, farm equipment which is durable, light-weight and low cost, and also specific to different crops and regions should be made available for small and marginal farmers²¹. Some challenges faced by farm mechanisation include different soil and climatic zones which require customised farm machinery, and small land holdings with lack of access to resources. Mechanisation should aim to increase agricultural efficiency by reducing the time and labour requirement, minimising wastage and reducing costs of labour²².

Conclusion:

The dominant nature of agriculture and decelerating growth trend in agriculture attracts attention of policymakers, researchers and economists. The main cause of failure of all development policy for agriculture is that there is no availability of any separate development strategy for Indian agriculture. However, Agricultural production and efficiency largely depend upon the inputs applied and the methods adopted. In India, “while population grows, the land surface is fixed and of this only a certain proportion is available for cultivation” (Planning commission, 1961). Further scope for bringing extra land under the plough is limited. If more production is to be got out of this existing area, the problem has to be tackled on a wide front. This can be done by applying inputs in a more intensive way and by adopting modern methods of production through use of improved technology, besides making an adequate provision for institutional financing, better methods of marketing, etc.

¹⁸ 29th Report: Impact of Chemical Fertilizers and Pesticides on Agriculture and allied sectors in the country, Standing Committee on Agriculture, August 11, 2016, http://164.100.47.134/lsscommittee/Agriculture/16_Agriculture_29.pdf.

¹⁹ Ibid Environmental Management & Policy Research Institute (2012). State of Environment Report Karnataka 2011.

²⁰ Farm Inputs and Management, State of Indian Agriculture 2015-16, Ministry of Agriculture and Farmers Welfare, May 2016, http://agricoop.nic.in/imagedefault/state_agri_1516.pdf.

²¹ Mechanization and Technology, Chapter 8, Agriculture and Food Management, Economic Survey 2013-14, <http://unionbudget.nic.in/budget2014-2015/es2013-14/echap-08.pdf>.

²² Ibid.,