INDIAN INSTITUTE OF MANAGEMENT
AHMEDABAD • INDIA

India's Agricultural Development under the New Economic Regime: Policy Perspective and Strategy for the 12th Five Year Plan

Vijay Paul Sharma

W.P. No. 2011-11-01
November 2011

INDIAN INSTITUTE OF MANAGEMENT
AHMEDABAD-380 015
INDIA

India's Agricultural Development under the New Economic Regime: Policy Perspective and Strategy for the 12th Five Year Plan[1]

Vijay Paul Sharma[2]

Abstract

During the last two decades Indian agriculture has been facing major challenges like deceleration in growth rate, inter-sectoral and inter-regional equity, declining input efficiency, degradation of natural resources, etc. with consequent adverse effects on food and nutritional security, food inflation and poverty reduction. However, the 11th Plan had some success in reversing the deceleration of agricultural growth witnessed during the 9th and 10th Plan but food inflation still remains a major concern. The growth in agriculture in the 11th Plan is likely to be around 3.2 percent per year, which is higher than 10th Plan growth rate but lower than the target (4.0%) for 11th Plan. The 12th Plan growth target for agriculture sector has been set at 4 percent with foodgrains growth at about 2 percent and non-foodgrains sector (horticulture, livestock and fisheries) growing at about 5-6 percent. However, looking at the growth in agriculture sector in general and high-value agriculture, particularly, horticulture, fisheries, dairy and meat sector during the 11th Plan, there is a need to put additional efforts to achieve 4 percent growth in agriculture.

The failure to achieve targeted growth in agriculture has resulted from the inadequacies of the provision of the critical public goods such as research and development, extension services, surface irrigation, rural infrastructure, etc. on which agricultural growth thrives as well as inappropriate policies. In order to achieve the targeted growth in 12th Plan, we need to address some of these inadequacies. The sector would require substantial increase in investment both by public and private sector in agriculture research and development including extension, rural infrastructure, post-harvest and market infrastructure including storage and processing, reforms in laws related to land markets and marketing of agricultural products, and appropriate price policy. The pricing of agricultural inputs such as irrigation, electricity for pumping water, fertilizer, etc. needs rationalization. The distributional aspects of agricultural credit including inter-regional and inter-class inequalities in access to credit, decline in rural branches, declining share of direct credit, etc. must be addressed. People's participation, which will help in promoting the bottom up approach of planning process and also help in faster diffusion of the technologies and best practices among farmers, community based actions and participation of disadvantaged sections of the society in developmental process, needs to be strengthened.

---

[1] *This paper was delivered as an invited keynote address at the 71st Annual Conference of the Indian Society of Agricultural Economics held at University of Agricultural Sciences, Dharwad 580 005 (Karnataka) during November 3-5, 2011*

[2] *Professor, Centre for Management in Agriculture, Indian Institute of Management, Ahmedabad 380 015, Email: vijays@iimahd.ernet.in*

India's Agricultural Development under the New Economic Regime: Policy Perspective and Strategy for the 12th Five Year Plan

Agriculture sector is the mainstay of the Indian economy, contributing about 15 per cent of national Gross Domestic Product (GDP) and more importantly, about half of India's population is wholly or significantly dependent on agriculture and allied activities for their livelihood (GOI, 2011). The contribution of agricultural sector to GDP has continued to decline over the years, while that of other sectors, particularly services, has increased. In 1970-71 agriculture contributed about 44 percent of GDP, which declined to 31.4 percent and 14.6 percent in 1990-91 and 2009-10 (at 2004-05 prices), respectively (CSO, 2011). Nevertheless, agriculture remains a major source of employment, absorbing about 52 percent of the total national work-force in 2004-05, down from about 70 percent in 1971. The share of agricultural exports in total export value declined from about 18.5 percent in 1990-91 to about 10.6 percent in 2009-10, while share of agricultural imports to total national imports increased from 2.8 percent in 1990-91 and reached a high of 8.2 percent in 1998-99 and declined to about 4.4 percent in 2009-10 (GoI, 2011a). Importance of agriculture in a country like India is not likely to decline due to concerns for food security, employment, rural poverty and availability of wage goods (Vyas, 2003).

Successive Five Year Plans have stressed on self-sufficiency and self-reliance in foodgrains production and concerted efforts in this direction have resulted in substantial increase in agricultural production and productivity. This is clear from the fact that from a level of about 52 million tonnes in 1951-52, foodgrains production rose to above 241.5 million tonnes (4th advance estimates) in 2010-11 (GoI, 2011b). However, since the early 1990s, liberalization and globalization have become core elements of development strategy of the government, which had indirect policy implications and impact on Indian agriculture. As a part of economic reforms agricultural markets were freed, external trade in agricultural commodities was liberalized and industry was de-protected to create more competition thereby reducing input prices and making terms of trade favourable to agriculture. "These measures would create a potentially

more profitable agriculture, which would be able to bear the economic costs of technological modernization and expansion" (Singh, 1995). The reforms have improved terms of trade in favour of agriculture but growth in agricultural sector has fallen short of targets and has been well below that of non-agricultural sectors and the gap between rural and urban incomes has been widening. Productivity gains from the Green Revolution technology have reached a platue in many regions, causing per capita foodgrains production to decline, which has serious implications for food and nutritional security, poverty alleviation, rural development, farm incomes and rural-urban equity. One of the important strategy challenges for faster, sustainable and more inclusive growth (9.0-9.5% growth rate) in the 12th Five Year Plan under structural changes and unfavorable global economic environment requires a significant acceleration in growth (4.0 to 4.5% growth rate) in agriculture. Agricultural growth has always been an important component for inclusiveness, and recent experience suggests that high GDP growth without high agricultural growth is likely to lead to acceleration in inflation in the country, which would adversely affect the larger growth process (GOI, 2011). The Eleventh Plan, which had attempted to reverse deceleration of agricultural growth during the Ninth and Tenth Plan, had some success in as foodgrains production has touched a new peak of 241.56 million tonnes in 2010-11 and growth in agriculture in the Eleventh Plan is likely to be about 3.3 percent per year. However, to achieve between 4 and 4.5 percent average growth in agricultural sector in the Twelfth Plan period adequate efforts on the part of the government are required. In view of importance of these issues, critical examination of recent trends in agriculture and the factors underlying the slow growth in agriculture is important to reorient programmes and policies in the 12th Plan. This paper is an attempt to address some of these issues. Section 2 provides a descriptive account of recent trends in Indian agriculture and identifies some key economic, institutional and technological policy issues that need to be addressed to accelerate growth in agriculture sector in the next plan. Concluding observations are presented in Section 3.

Section 2: Review of Performance and Major Concerns in Agricultural Sector

The primary purpose of this section is to study recent trends in agricultural sector. This is examined to highlight the differences rather than to search for their explanation. The section also identifies some key technological, institutional and economic policy challenges that need to be addressed in the 12th Plan.

2.1 Deceleration and/or Lower Productivity-led Agricultural Growth

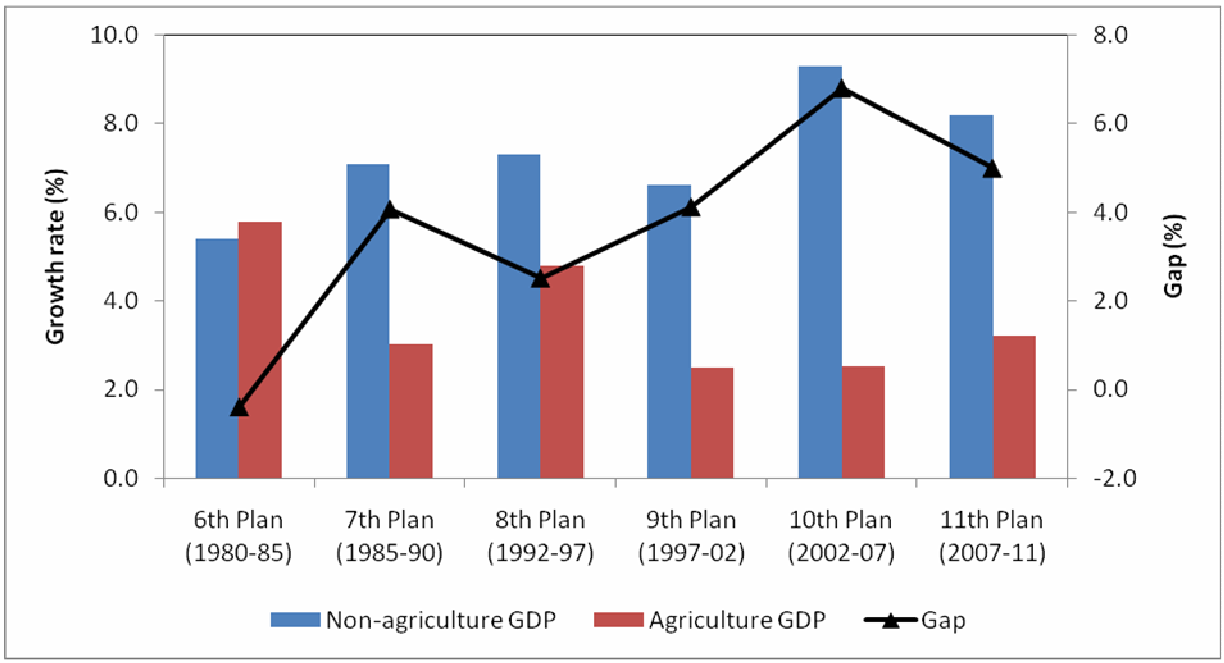
Four main criteria considered for studying this are: (i) growth rate of real agriculture and non-agriculture GDP, (ii) trends in area and production of major crops/crop groups, (iii) growth rate and level of physical productivity of agriculture, and (iv) high-value agriculture growth patterns in the pre- and post-reforms period.

Figure 1 presents the average growth rate of agriculture and non-agriculture GDP during the last three decades. The results clearly show that in post-reforms era growth rate of real agricultural GDP decelerated (5.8% in 8th Five Year Plan to about 2.5% in Tenth Plan) while that of non-agriculture GDP increased significantly from 5.4 percent to 9.3 percent during the same period. However, the gap between agriculture and non-agriculture GDP increased significantly in the post-reforms period. The ratio of growth rate of real agricultural GDP to that of total real non-agriculture GDP was lowest (0.27) in 10th Five Year Plan period compared to that in 8th Five Year Plan period (1.07), indicating deceleration in agricultural growth compared with non-agriculture GDP. However, there is definite growth recovery in agricultural sector during 11th Plan. The year-on-year annual growth rate during first four years of 11th Five Year Plan (2007-08 to 2010-11) averaged about 3.2 percent. The new programmes launched during the 11th Plan such as National Food Security Mission and Rashtriya Krishi Vikas Yojna have made significant impact on foodgrains production in the country.

Changing Shares of Acreage and Production of Major Crops/Crop Groups

During the last three decades net area sown declined from 142 million hectares in Triennium Ending (TE) 1983-84 to 140.8 million hectares in TE 2008-09, whereas total cropped area increased from 176.4 million hectares to 194 million hectares during the same period (Table 1). The area under foodgrains declined by about 6 million hectares between TE 1983-84 and TE 2008-09 and this decline in area under foodgrains reduced the share of foodgrains in total cropped area from about 73 percent in TE 1983-84 to about 63.8 percent in TE 2007-08 (Table 2). The area under pulses has remained almost stagnant at about 23 million hectares, while area under wheat has increased by 4.6 million hectares, and rice by 3.7 million hectares. The biggest loser has been coarse cereals where the area under cultivation has declined from 41.5 million hectares in TE 1983-84 to 33.6 million hectares in TE 1993-94 and 27.9 million hectares in TE 2008-09. The share of coarse cereals in total cropped area fell from 23.7 percent in early-1980s to 14.8 percent in TE 2007-08.

Figure 1. Growth rate (%/year) in GDP agriculture and non-agriculture sector in different plan periods (1999-00 prices for 8th to 10th Plan and 2004-05 prices for 11th Plan)



Source: CSO (2011)

During the last two decades, foodgrains production increased from 177.4 million tonnes in TE 1993-94 to 227.8 million tonnes in TE 2009-10, or by over 28 percent (Table 1). However, the highest increased was observed in case of cotton (>200% increase), followed by fruits and vegetables (97%), condiments and spices (66%) and wheat (39%). Pulses recorded the lowest increase in production, from 12.7 million tonnes in TE 1993-94 to 14.6 million tonnes in TE 2009-10. However, India is likely to have record pulses production estimated at about 18 million tonnes in 2010-11.

Table 1. Trends in area and production of major crops/crop groups: TE 1983-84 to TE 2008-09

	Area (million ha)			Production (million tonnes)		
Crops	TE 1983-84	TE 1993-94	TE 2008-09	TE 1983-84	TE 1993-94	TE 2009-10
Rice	40.1	42.3	43.8	53.5	75.9	95.0
Wheat	23.5	24.3	28.1	41.9	57.6	80.0
Coarse cereals	41.5	33.6	27.9	30.9	31.1	38.2
Pulses	23.4	22.4	23.0	12.1	12.7	14.6
Foodgrains	128.5	122.6	122.8	138.4	177.4	227.8
Oilseeds	18.5	26.0	26.8	11.6	20.1	27.5
Sugarcane	3.2	3.6	4.6	183.3	237.2	303.7
Fruits & vegetables	5.1	8.3	13.6	-	95.6	188.7
Condiments & spices	2.2	2.3	2.6	-	2.5	4.15
Cotton[3]	7.9	7.5	9.7	7.3	10.6	24.1
Net area sown	142.0	142.2	140.8	-	-	-
Total cropped area	176.4	184.8	194.0	-	-	-

Source: GoI (2010a)

[3] *Cotton production is in million bales of 170 kg each*

The decline in area under foodgrains resulted in increase in area under other crops. The largest beneficiary of this decline were oilseeds during the decade of 1980s, when area under oilseeds increased from 18.5 million hectares in TE 1983-84 to 26 million hectares in TE 1993-94 but area under oilseeds remained stable between TE 1993-94 and TE 2008-09. The share of oilseeds in total cropped area increased significantly from less than 10 percent in early-eighties to 14.8 percent in early nineties, which marginally declined to about 14.3 percent in TE 2007-08. The area under cotton, which declined by about half a million hectares between TE 1983-84 and TE 1993-94, increased by more than 2 million hectares between TE 1993-94 and TE 2008-09. Another beneficiary of decline in area under foodgrains was high-value crops mainly fruits and vegetables. The area under fruits and vegetables increased by about 8.5 million hectares between TE 1983-84 and TE 2008-09. The share of area under fruits and vegetables in total cropped area, which was less than 3 percent in TE 1983-84 increased to over 5 percent in TE 2007-08. The above results clearly show that crop pattern shifted towards oilseeds, sugarcane and fruits and vegetables during the 1980s, whereas in the 1990s and 2000s, the shift was more towards fruits and vegetables, cotton and sugarcane and other non-food crops.

The compound annual growth rates of area under major crops presented in Table 2 reveal that fruits and vegetables witnessed the highest growth rate (3.4%), followed by oilseeds (3.02%) and sugarcane (1.35%) during the 1980s. The main reason for significant growth in area under oilseeds during the 1980s was Technology Mission on Oilseeds and complete protection to domestic industry from imports. During the 1990s, area under fruits and vegetables again witnessed the highest growth rate (2.5%), followed by cotton (2.18%) and sugarcane (1.91%). Area under fruits and vegetables grew at an annual compound growth rate of 5.28 percent during the 2000s, followed by cotton (3.12%), oilseeds (2.57%) and wheat and sugarcane (about 1.3%). The main factors responsible for significant growth in area under fruits and vegetables include higher return relative to other crop groups, higher demand for fruits and vegetables, big push from the government through National Horticulture Mission and Horticulture Mission for North-East and Himalayan States (Sharma and Jain, 2011). In case of cotton, the increase in

area, production and productivity was mainly technology-driven (introduction of B_t cotton in 2002-03) as well as higher profitability compared with other competing crops.

Performance of Indian agriculture decelerated significantly during the 1990s (Table 2). The compound annual growth rates of all crops were significantly lower in 1990s compared with 1980s. Rice production which recorded a growth rate of 4.2 percent in 1980s declined to 1.87 percent in 1990s. Oilseeds sector was the most hit as the growth rate declined from 5.8 percent in 1980s to less than one percent in the nineties. There has been some revival in the first decade of the 2000s. Total foodgrains production increased at an annual growth rate of 2.24 percent compared with 1.9 percent during the 1990s. The highest increase in growth rate was witnessed in case of cotton (14.28%), followed by fruits and vegetables (6.76%), oilseeds (5.12%), pulses (3.04%) and coarse cereals (2.94%). The increase in production of fruits and vegetables was primarily driven by area expansion rather than productivity enhancement. Acceleration in growth rate of pulses and oilseeds is an encouraging trend as India is one of the largest importer of edible oils and pulses. Efforts are needed to accelerate the growth rates further to achieve 4-4.5 percent growth in agriculture sector during the 12^{th} Plan.

The trends in yield and annual compound growth rate of physical productivity of major crops are presented in Table 3. It is evident from the table that the average productivity of all crops improved between 1980s and 2000s but the increase was the highest in case of cotton (89.9%), followed by coarse cereals (59.1%) and oilseeds (41.6%). However, growth rate of productivity of all crops decelerated during the 1990s compared with 1980s. The growth rates accelerated for cotton, rice, coarse cereals, pulses, and oilseeds during the 2000s.

Table 2. Dynamics of Indian Agriculture: All India Share and Growth Rates of Major Crops/Crop Groups

Crops	Share in total cropped area (%)			CAGR (%) in area			CAGR (%) in production		
	TE 1983-84	TE 1993-94	TE 2007-08	1980s	1990s	2000s	1980s	1990s	2000s
Rice	22.81	22.94	22.62	0.6	0.78	-0.70	4.20	1.87	1.67
Wheat	13.24	13.20	14.24	0.36	1.40	1.30	3.39	3.11	2.45
Coarse cereals	23.68	18.48	14.84	-1.49	-1.61	-2.14	0.72	0.36	2.94
Total cereals	59.72	54.62	51.69	-0.29	-0.02	0.21	3.12	2.03	2.18
Pulses	13.36	12.56	12.08	0.09	-0.64	0.83	1.50	0.04	3.04
Foodgrains	73.09	67.18	63.78	-0.19	0.03	0.37	2.99	1.90	2.24
Oilseeds	9.77	14.80	14.34	3.02	-0.87	2.57	5.80	0.57	5.12
Sugarcane	1.97	2.12	2.48	1.35	1.91	1.29	2.97	2.74	2.26
Fruits & vegetables	2.91	3.82	5.10	3.40	2.50	5.28	na	4.96	6.76
Cotton	4.39	4.13	4.68	-0.97	2.18	3.12	3.32	0.24	14.28
Others	7.87	7.95	9.63	na	na	na	na	na	na

Source: GoI (2010a)

Table 3. Annual Compound Growth Rates of Physical Productivity of Major Crops in India

	Annual Compound Growth Rate (%)			***Yield (Kg/ha)***		
Crop	1980s	1990s	2000s	1980s	1990s	2000s
Rice	3.57	1.08	1.45	1508	1868	2080
Wheat	3.02	1.69	0.88	1983	2538	2728
Coarse cereals	2.24	2.00	2.93	772	984	1228
Pulses	1.41	0.68	1.21	537	588	602
Foodgrains	3.18	1.87	1.70	1191	1550	1735
Oilseeds	2.70	1.45	2.42	671	836	950
Sugarcane	1.61	0.82	0.51	60079	68442	65748
Potato	2.25	1.95	-0.78	14810	16890	17757
Fruits	-	1.22	0.63	-	11413	10850
Vegetables	-	3.04	2.09	-	13510	15298
Cotton	4.31	-1.90	11.21	188	233	357

Source: GoI (2010a)

The average productivity of all crops increased during the last three decades but the levels of physical productivity of major crops in India are lower than the world average and the best

found in major developed countries (Table 4). The average productivity of rice (3370 kg/ha) in India is significantly lower than world average (4309 kg/ha) and about half of that in China (6556 kg/ha) and Japan (6488 kg/ha). Similarly, maize productivity is less than half of world average and about 25 percent of that in USA. Milk productivity is also substantially lower than world average. The slow down in growth rate and plateauing of the productivity in major crops is a matter of concern and efforts are needed to step up crop productivity as there is no scope for area expansion. Ahluwalia (2011) observed that productivity can be increased by 80% to 100% for many crops in large areas by using modern agronomic practices based on available technologies but require state government actions.

Table 4. Average Physical Productivity (kg/ha) of Rice, Wheat, Maize and Milk in India, World and the Best in Developed Countries - 2008

Crop	*India*	*World*	*Best*
Rice (kg/ha)	3370	4309	Egypt (9731); China (6556); Japan (6488)
Wheat (kg/ha)	2802	3086	3108 (USA)
Maize (kg/ha)	2324	5109	9658 (USA)
Milk (kg/animal/year)	1145	2309	7342 (Netherlands)

Source: FAOSTAT production data, www.faostat.org (accessed on October 6, 2011)

High-Value Agriculture Growth Patterns: Some Concerns

The relative importance of foodgrains has declined during the past three decades. At the all-India level, the share of foodgrains in total value of output from agriculture and allied sectors (excluding forestry and logging) has fallen from 31.3 per cent (at 1999-00 prices) in TE 1983-84 to 26 percent in TE 2003-04 and reached a level of 24.7 percent in TE 2007-08 (Table 5). The decline in share was more pronounced in case of cereals, where it declined from 26.6 percent in TE 1993-94 to 21.7 percent in TE 2007-08, whereas share of pulses declined from 4 percent to 3 percent during the same period.

Due to shift in demand pattern towards high value crops, the farmers are also responding to market signals and gradually shifting production-mix to meet the growing demand for high-value commodities (Sharma and Jain, 2011). This is reflected in the changing share of high value crops in total value of output from agriculture. There is a clear shift from foodgrains towards fruits and vegetables, livestock products and fisheries. The share of high-value commodities/products (fruits and vegetables, livestock products, fisheries) increased from 37.3 percent in TE 1983-84 to 41.3 percent in TE 1993.94 and reached a level of 47.4 percent in TE 2007-08.

At the all-India level, the importance of livestock products has increased. The share of livestock in total value of agricultural output has increased from 20.6 per cent in TE 1983-84 to 23.9 percent in TE 1993-94 and 26.1 percent in TE 2007-08. Among livestock products, contribution of milk has increased at a faster rate, from 12.7 percent in TE 1983-84 to 17.4 percent in TE 2007-08 compared with meat (from 3.4% to 4.5%). The share of fisheries has also increased from 2.7 percent in TE 1983-84 to 4.6 percent in TE 2003-04 but marginally declined to 4.4 percent in TE 2007-08.

India is one of the major producers of fruits and vegetables with an estimated production of 188.7 million tonnes (64.3 million tonnes of fruits and 124.2 million tonnes of vegetables) in TE 2008-09. The share of fruits and vegetables in the total value of agricultural output increased from 14.1 per cent in TE 1983-84 to 15.4 per cent TE 1993-94 and 16.9 percent in TE 2007-08. This has happened largely due to increase in area and marginal improvements in productivity of fruits and vegetables. The increase in share of high value crops in total value of output from agriculture was slow between TE 1983-84 and 1993-94 and accelerated in post reforms period.

Trends in growth rates of value of output from agriculture and allied sectors given in Table 5 provide interesting insights. During the eighties, fisheries witnessed the highest growth (6%) followed by oilseeds (5.6%), condiments and spices (4.7%) and livestock (4.6%). The crop sector grew at a lower rate of 2.5 percent, cereals recorded 3.2 percent growth, and pulses grew at 1.7 percent, lowest among all crops/sub-sectors. However, during the nineties almost all crops

groups/sub-sectors except fruits and vegetables and condiments and spices, experienced deceleration in growth rates. Output of fruits and vegetables increased at much faster rate (6.3%) during the nineties compared to growth rate (2.2%) in the 1980s as well as other crop groups/sub-sectors. During the 1990s, condiments and spices also witnessed acceleration in rate of growth in output. The livestock sector grew at an annual compound growth rate of 3.7 percent (milk 4.3% and meat 2.6%) compared with 4.6 percent in the eighties. However, during the 2000s performance of crop sector improved and growth rate increased from 1.8 percent in 1990s to 2.4 percent in 2000s. Growth rate in fibres was the highest (17.2%), mainly because of B_t cotton effect, followed by oilseeds (6.4%). Foodgrains output increased by about 2.4 percent while rate of growth in livestock sector was almost same (3.8%) as during the 1990s. There was slow-down in growth of fisheries (2.9% in 2000s compared with 4.7% in 1990s), milk output (3.6%) and condiments and spices (3.5%). Growth rate of fruits and vegetables was also lower (3.5%) in the 2000s compared to growth rate (6.3%) in the 1990s. It is evident form the above analysis that high growth of high-value agriculture achieved during the 1990s could not be maintained in the 2000s mainly because of slow down in growth of fruits and vegetables and fisheries sector. However, the crop sector grew at about 3.5 percent during the 2000s because of better performance of fibres, cereals, pulses and oilseeds in the recent years.

Table 5. Dynamics of Indian Agriculture: Changing Shares of Major Crop Groups

	Share in value of output from agriculture (%)				Compound Annual Growth Rate (%)		
	TE1983-84	TE1993-94	TE2003-04	TE2007-08	1980s	1990s	2000s
Foodgrains	31.3	30.6	26.0	24.7	3.0	1.8	2.4
Cereals	26.3	26.6	22.7	21.7	3.2	2.0	2.5
Pulses	5.0	4.0	3.3	3.0	1.7	0.5	2.2
Oilseeds	5.3	6.7	5.2	5.8	5.6	0.4	6.4
Fruits & Vegetables	14.1	13.6	16.7	16.9	2.2	6.3	3.5
Livestock	20.6	23.9	25.9	26.1	4.6	3.7	3.8
Milk	12.7	15.4	17.4	17.4	5.2	4.3	3.6

Meat	3.4	4.4	4.5	4.5	5.2	2.6	3.9
Fisheries	2.7	3.9	4.6	4.4	6.0	4.7	2.9
Fibres	3.0	2.9	2.2	3.6	2.6	0.4	17.2
Condiments & spices	2.3	2.6	3.2	3.1	4.7	5.0	3.5
Crop Sector	76.7	72.3	69.5	69.5	2.5	3.0	3.5
High-value agriculture	37.3	41.3	47.2	47.4	3.9	4.6	3.6
Agri. & allied sectors	100.0	100.0	100.0	100.0	3.0	3.2	3.5

Source: CSO (2010)

However, as per Draft Approach Paper for the Twelfth Five Year Plan annual output growth rate of about 1.8 to 2 percent is envisaged for cereals with rice output likely to grow around 2 percent, pulses output has to be stepped up to achieve about 2 percent growth rate in foodgrains output (Govt. of India 2011). However, high-value agriculture segment, horticulture and animal husbandry are targeted to grow at 4.5 to 6 percent. Oilseeds sector should grow at over 3 percent. Overall, it would give an output growth of between 4 and 4.5 percent in agriculture sector. In order to meet these targets, efforts are required to increase productivity of all crops in general but pulses, fruits and vegetables, livestock particularly dairy sector and fisheries sector in particular, which have witnessed deceleration in output growth during the last decade.

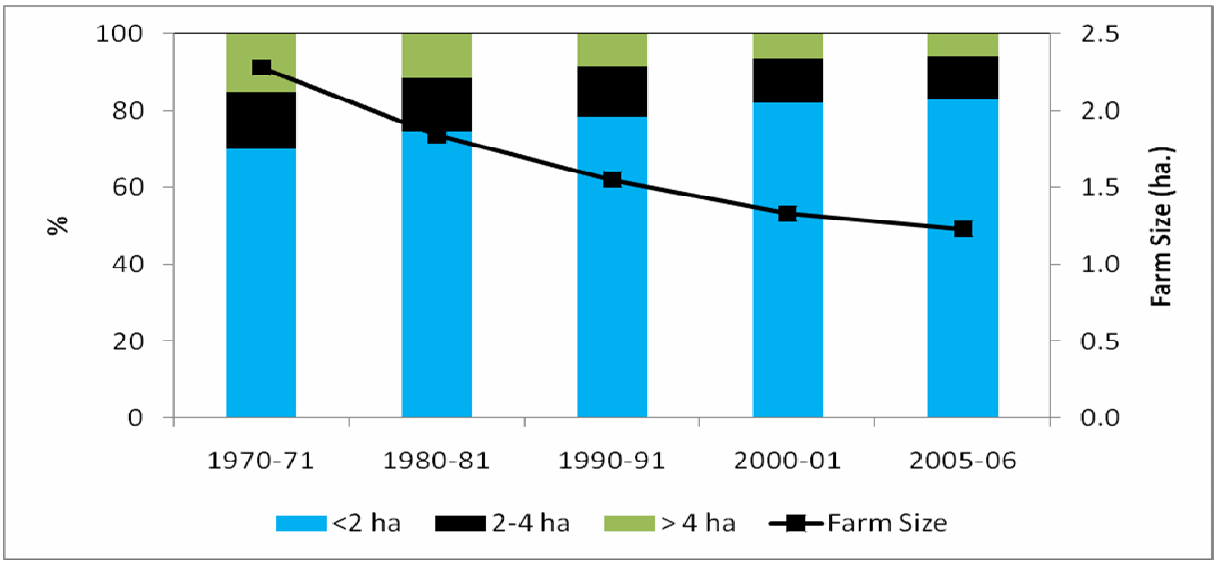
2.2 Rising Number of Small and Marginal Farmers and Fragmenting Farms

Indian agriculture is characterized by small and fragmented land holding. There are about 129 million operational holdings possessing about 158 million ha land with average farm size of only 1.23 hectares (Figure 2). Around 83 percent of farmers have land holdings less than 2 ha and they cultivate nearly 41 percent of the arable land. On the other hand, less than 1 percent of the farmers have operational land holding above 10 ha and account for 11.8 percent of the total cultivated land. The share of small and marginal farmers has increased from 69.7 percent

in 1970-71 to about 83 percent in 2005-06 while their share in total operational area has increased from 20.9 percent to over 41 percent during the same period. The average farm size in the country has declined from 2.3 ha in 1970-71 to 1.23 ha in 2005-06. This reduction in farm size has been higher in case of medium and large farmers compared with small and marginal farmers.

Inverse relationship between farm size and crop productivity has been well established (Sen, 1962, 1964; Mazumdar, 1965; Hanumantha Rao, 1966; Saini, 1971; Bardhan, 1973; Berry, 1972; Chand, et. al., 2011) but participation of smallholder producers in markets remains low due to a range of constraints such as low volumes, high transaction costs, lack of markets and information access. Improved market access can have large impact on smallholder incomes but it requires both policy and institutional reforms. Chand, et. al. (2011) observed that small farm in India is superior in terms of production performance but is weak in terms of generating adequate income and sustaining livelihoods. The study shows that small holdings below 0.8 hectare do not generate enough income to keep farm family out of poverty despite high productivity. Therefore, another area for policy intervention is land market reforms. As holdings are becoming small, fragmented and uneconomical, marginal farmers may be better off by leasing out the land to other farmers and seek gainful employment outside the sector. However, leasing is not legal in some states, which prohibits land markets to operate. Therefore, there is a need to have more flexible laws related to leasing of land but with sufficient safeguards to protect interest of small and marginal farmers leasing out land.

Figure 2. Changes in Composition of Different Categories of Farmers and Average Farm Size in India: 1970-71 to 2005-06



Source: GOI (2010)

2.3 Degradation of Natural Resources

Land and water are two most important resources for sustainable growth of agriculture. It is well established that health and strength of these scarce resources is degrading at an accelerated pace and productive resources are being diverted from agricultural to other sectors. In this section we discuss problems associated with groundwater over-exploitation and land degradation.

Over-exploitation of Groundwater Resources

With nearly 59 percent of irrigated agriculture and 85 percent of drinking water supplies dependent on it, groundwater is a vital resource for rural areas in India. Through the construction of millions of private tubewells and wells, there has been a phenomenal growth in the exploitation of groundwater in the last five decades. The groundwater irrigation was a prime driver of green revolution technology in mid-1960s and increasing cropping intensity in the country. However, this era of seemingly endless reliance on groundwater for both irrigation

and drinking water purposes is now approaching its limit as an increasing number of wells reach unsustainable levels of exploitation.

The over-exploitation of groundwater is emerging as an increasingly serious problem in certain agriculturally important districts of the country. The problem is more pronounced in rice-wheat based cropping systems in the Indo-Gangetic plains, and some sugarcane growing regions in the western and southern parts of the country. According to the 2004 nationwide assessment, 29 percent of the groundwater blocks are in the semi-critical, critical, or overexploited categories. For five states, Gujarat, Haryana, Punjab, Rajasthan, and Tamil Nadu taken together, about two-third of the groundwater blocks fall in these categories. A crisis situation now exists in a number of states. In Punjab, groundwater in 75 percent of blocks is over-exploited; in Rajasthan the corresponding figure is 59 percent; and for Karnataka and Tamil Nadu the figure is around 37 percent (Table 6). The situation is deteriorating at a rapid pace. Between 1995 and 2004, the proportion of unsafe districts (semi-critical, critical and overexploited) grew from 9 percent to 31 percent, the proportion of area affected increased from 5 percent to 33 percent and the population affected from 7 percent to 35 percent (GoI, 2011c)

A number of policy and institutional factors have been responsible for over-exploitation of groundwater in India. Easy availability of credit from financial institutions for installing tube wells and provision of highly subsidized or free electricity for pumping in many states has encouraged increased extraction. The potential socio-economic consequences of depletion of groundwater resources as well as overuse of surface irrigation water are serious.

Attempts to regulate groundwater extraction by imposing credit restrictions have not been successful because well-off farmers have accessed private resources. More fundamentally, a well defined system of property rights to water that limits individual and collective withdrawals has been absent. The electricity for agricultural sector is highly subsidized in many states and free of cost in some states but low predictability of power supply. Therefore, there is a need for linking electricity tariffs with the actual consumption of power, but its implementation is more

problematic in view of farmers' resistance to pay more for inputs in general and electricity in particular.

Depletion and Degradation of Land Resources

Shifts in resource availability and resulting land use changes are adversely affecting growth of agricultural sector and national food security. A high degree of degradation of existing land resources has aggravated the problem. The per capita availability of cultivable land has declined from 0.27 ha. in 1982 to 0.18 ha. in 2003. This, in turn, is adversely affecting the livelihoods of the farming community in general and small and marginal farmers in particular.

Table 6. Classification of Blocks/Mandals/Talukas in terms of Groundwater Exploitation

States	Total number of assessed units	Semi-critical		Critical		Over-exploited	
		Number	%	Number	%	Number	%
Andhra Pradesh	1231	175	14	77	6	219	18
Gujarat	223	69	31	12	5	31	14
Haryana	113	5	4	11	10	55	49
Karnataka	175	14	8	3	2	65	37
Kerala	151	30	20	15	10	5	3
Madhya Pradesh	312	19	6	5	2	24	8
Maharashtra	318	23	7	1	0	7	2
Punjab	137	4	3	5	4	103	75
Rajasthan	237	14	6	50	21	140	59
Tamil Nadu	385	57	15	33	9	142	37
Uttar Pradesh	803	88	11	13	2	37	5
West Bengal	269	37	14	1	0	0	0
India	5723	550	10	226	4	839	15

Source: GOI (2010b)

The trends in agricultural land use in India during the last three decades are given in Table 7. Land not available for cultivation has witnessed a continuous increase over time while land available for cultivation has declined. For example, net area sown has declined from about 142 million hectares in Triennium Ending (TE) 1983-84 to 140.76 million hectares in TE 2008-09, a reduction of about 1.3 million hectares. Land not available for cultivation has increased from about 40 million hectares in TE 1983-84 to 43.16 million hectares in TE 2008-09. Similarly, area under fallow land has increased from 23.26 million hectares to 25.3 million hectares during the same period. In view of declining availability of land for agriculture, increasing cropping intensity is the only answer to the problem of land constraint. As is evident from Table 7, cropping intensity has increased from 124.17 percent in TE 1983-84 to 138 percent in TE 2008-09. The increase in cropping intensity has been primarily driven by improved irrigation facilities. Given a high population pressure on land to meet food and developmental needs, more effective and efficient ways of using land resources must be adopted.

Table 7. Some indicators of land use and waste lands in India

(million ha)

Year	Gross Cropped Area	Net Sown Area	Not available for cultivation	Culturable wastelands	Cropping Intensity	Fallow land
TE1983-84	176.35	142.05 (46.7)	40.09 (13.2)	16.11 (5.3)	124.17	23.26 (7.6)
TE1993-94	184.82	142.23 (46.7)	40.84 (13.4)	14.66 (4.8)	129.93	24.22 (7.9)
TE2003-04	184.65	137.98 (45.2)	41.95 (13.7)	13.45 (4.4)	133.77	27.53 (9.0)
TE2008-09	194.25	140.76 (46.0)	43.16 (14.1)	13.03 (4.3)	138.00	25.30 (8.3)

Source: GOI (2010c)

Note: figures in parentheses are percentages to the total reported area

Land degradation due to desertification, soil erosion, excessive and unscientific use of agricultural inputs such as irrigation water, fertilizers, agrochemicals, etc. and deforestation is accelerating at an unprecedented rate. Land degradation will remain an important issue because of its adverse impact on crop productivity, the environment, and its effect on food security. The data on the extent of soil degradation in the country has been assessed by various agencies and these estimates vary widely from 63.9 million hectare to 187 million hectare, due to different approaches in defining degraded soils and adopting various criteria for delineation. The National Bureau of Soil Survey and Land Use Planning, Nagpur has estimated that 146.82 million hectare area is affected from various types of land degradation, which includes water erosion 93.68 million hectares, wind erosion 9.48 million hectares, water logging/flooding 14.30 million hectares, etc.

The expansion of cultivable land and intensification of production achieved through the use of irrigation have contributed to substantial production increases world-wide. For developing countries, its contribution to the attainment of development objectives of food security, poverty alleviation, and improvement of quality of life of the rural population has been significant. The sustainability of irrigated agriculture, however, now faces a growing risk. The expanded dependence on irrigation has not been without cost. Salinity and waterlogging, soil erosion and water pollution are a few of the serious problems that have gone hand-in-hand with irrigation. Irrigation induced salinity is without question an issue which had merited limited attention in the past. Amidst increasing demands for agricultural production to meet the growing demand of increasing population, the potential reduction in agricultural productivity due to salinity cannot be left unresolved. Although firm statistics on land areas affected by salinity and water logging are lacking but according to the CSSRI report (2011), nearly 6.73 million hectares of agricultural land is affected by varying degrees of salt problems and represent a serious threat to food production to meet the needs of the country. The estimates indicate that by 2030 the country may have about 15.5 million hectares area under salt affected soils.

2.4 Public Expenditure in Agriculture

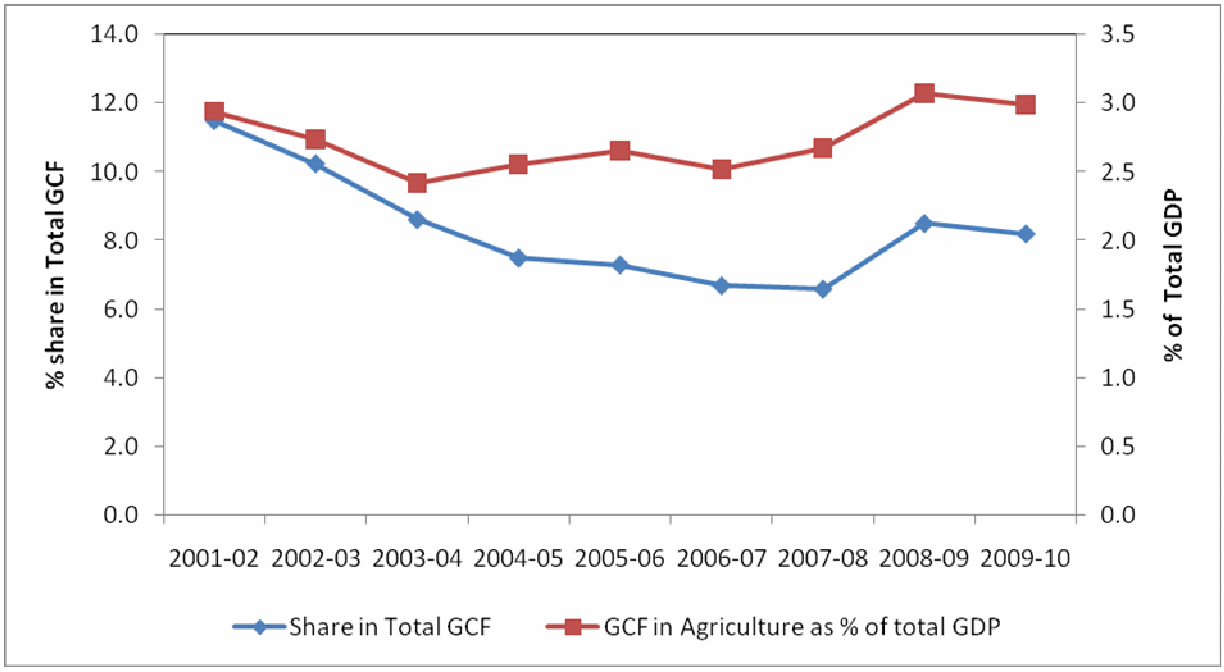
A 'big push' for public expenditure in agriculture is required to bring about technical change in agriculture, and higher agricultural growth. It is evident that there has been a significant decline in the allocation of public outlay on agriculture as a percent of total public outlay during the post-reforms period compared to what it was in pre-reforms period (Desai and Namboodiri 1997). The share of gross capital formation in agriculture and allied sector in total gross capital formation (at current prices) has declined from about 11.7 percent in 2001-02 to 6.89 percent in 2006-07 and further to 6.6 percent in 2007-08 (Figure 3). However, there has been a marked improvement in its share during the last couple of years and reached a level of 8.5 percent in 2008-09 and marginally declined to 8.2 percent in 2009-10. The GCF in agriculture and allied sectors as proportion to the GDP in agriculture which stagnated around 14 percent during the first half of last decade, increased to over 20 percent in 2009-10. However, the GCF in agriculture and allied sectors as percentage to total GDP has remained stagnant at around 2.5 to 3.0 percent. In order to achieve over 4-4.5 percent growth in agriculture sector, there is a need to step up investment in agriculture.

We have also analyzed the trends in public sector expenditure under (i) agriculture and allied sectors, (ii) irrigation, and flood control and (iii) rural development during the last three decades. We have also examined share of expenditure on agriculture research and education in total expenditure and trends in food and fertilizer subsidies. Table 8 presents the results for the pre-reforms (VI & VII FYPs) and post-reforms period (VIII to XI FYPs).

The data presented in table shows that share of public expenditure on agriculture and allied sectors declined from about 6 percent in 6th Plan to about 4.5 percent in Tenth plan. During 11th Plan a higher allocation (124%) of public sector resources was projected for agriculture and allied activities, from Tenth Plan realization level of Rs.60,702 crore, to Rs. 1,36,381 crore (at 2006-07 prices) by the Centre, States and UTs with share of Centre being 50,924 crore (GOI, 2011). Rashtriya Krishi Vikas Yojana, in the form of 100% grant-in-aid, was launched in the 11th

Five-Year Plan with a projected allocation of Rs. 25,000 crore over and above the other on-going programmes to incentivize the States to make higher investment in agriculture. The RKVY, which provides sufficient flexibility to the States to take into account local needs, has helped in increasing allocation to agricultural sector. Since public participation is highly essential for successful implementation of agricultural development programmes, people's involvement in the development endeavors will help in promoting the bottom up approach of planning process and also help in faster diffusion of the technologies and best practices among farmers, community based actions and participation of disadvantaged sections of the society in developmental process.

Figure 3. Trends in GCF in Agriculture and Allied Activities in India: 2001-02 to 2009-10



Source: CSO (2010)

Irrigation, which is a leading input for agricultural growth, expenditure also witnessed a declining trend (10% in Sixth plan to about 8% in Tenth plan). However, the share of public sector expenditure under rural development in total expenditure increased from 6.4 percent in

the Sixth plan to 9.2 percent in the Tenth plan. The expenditure on food and fertilizer subsidies has also increased significantly from 6.7 percent in Seventh plan to about 16 percent in Eleventh plan. Two main reasons for reduced share of public sector expenditure under agriculture and allied activities are: one, increased and larger public expenditure on rural development schemes like the Mahatma Gandhi National Rural Employment Guarantee Act. (MNREGA), other rural development and poverty alleviation programmes, and two, increased and larger spending on food and fertilizer subsidy. It is interesting to note that public expenditure on agriculture research and education as proportion of total expenditure on agriculture and allied sectors, which declined during 7th and 8th plans, increased significantly during the subsequent plan periods. However, public spending on agriculture research, education, and extension is about 0.6-0.7 percent of agricultural GDP (Chand, et. al. 2011), which is much lower than the international norm of 2 percent.

Table 8. Profile of Public Expenditure (% to Total Public Expenditure) on Agriculture, Irrigation and Flood Control and Rural Development since Sixth Five Year Plan

	6th Plan	7th Plan	8th Plan	9th Plan	10th Plan	11th Plan
Agriculture & allied sector	6.1	5.8	5.1	4.5	4.5	4.4
Rural development	6.4	7.0	8.3	6.9	9.2	9.0
Irrigation & flood control	10.0	7.6	6.5	7.7	8.1	7.2
Agriculture, irrigation & flood control and rural development	23.9	22.0	20.9	19.9	23.0	21.8
Agriculture research & education (% of total agri. & allied sector)	9.6	6.7	5.2	10.4	12.0	15.9
Food & fertilizer subsidy (% of total expenditure)	7.7	11.0	10.5	11.8	16.3	17.1

Source: GoI (2008), GoI (2010a), and GoI (2011a)

The rationale for higher public spending on agriculture research, education, and extension lies in that fact that (i) public spending for this purpose has high value of marginal product based

internal rate of return ranging from about 21 percent to 46 percent (Desai and Namboodiri 1997 and Chand, et. al. 2011), (ii) the sector has budget constraints for increasing number of extension workers, and (iii) it is further needed to undertake development and transfer of location specific new technologies by re-orienting ICAR's research and SAUs' higher education (Pal and Singh, 1997, Challa, et. al. 2011). These would require a big jump in allocation of budget for the agriculture and allied sectors both at the central and State government levels in total public spending. The public expenditure for technology-led agricultural growth must be prioritized in favour of agricultural research and education including extension; irrigation and flood control; soil and water conservation; rural infrastructure, rural financial institutions, and rural development and poverty alleviation programmes for creating community assets that directly contribute to agricultural growth.

2.4 Declining Input Use Efficiency

Modern inputs such as improved seeds (HYVs), irrigation, chemical fertilizers, etc. have played an important role in agricultural development in the country. However, there is widespread belief that declining efficiency of agricultural inputs is one of the major reasons for decelerating growth in Indian agriculture and improvement in input use efficiency is essential for accelerating agricultural growth.

Irrigation water Management

Net irrigated area has increased from around 21 million hectares (17.6% of total net sown area) in 1951-52 to over 63 million hectares by 2008-09 (about 45 percent of NSA). Gross irrigated area has increased at faster rate from about 23 million hectares to 88.4 million hectares due to increased intensity of cropping on irrigated lands. Over 85 percent of addition to irrigated area in the last three decades has come from groundwater (mostly from tubewell) and the balance from surface irrigation (almost entirely from large public sector canal system).

The data presented in Table 9 indicates major shifts in the sources of irrigation: Surface irrigation (canals+tanks) which accounted for about 58 percent of NIA in the TE 1953-54 is now

estimated to contribute less than 30 percent. The share of tanks has declined very significantly from 16.5 percent to 3.2 percent during the same period. The development of tube-well irrigation, supported by investment in electrification and credit provision, has been the main driving force behind irrigation expansion in the country, particularly in the northwest. As a result of this, the share of tubewells in net irrigated area has increased from less than 3 percent in early 1960s to 41.8 percent in TE 2008-09. The area irrigated by government canal system has more than doubled in absolute terms (from 7.5 million hectares in TE 1953-54 to 16.5 million hectares in TE2008-09) but their share in total irrigated area has shrunk from 35.2 percent to 26.2 percent. The area irrigated by canals has declined even in absolute terms since 1999-2000 but started picking up since 2005-06 due to efforts of the government. The trends in irrigation potential created during different plan periods are presented in Figure 4. The average rate of growth in irrigation potential created during First Plan to Tenth Plan is about 1.47 million hectares per year. Average irrigation potential created witnessed an increasing trend since Second Plan and reached a level of 11.3 million hectares during Seventh Plan and thereafter it started declining but increased marginally during Tenth Plan.

Table 9. Net Area Irrigated by different Sources in India

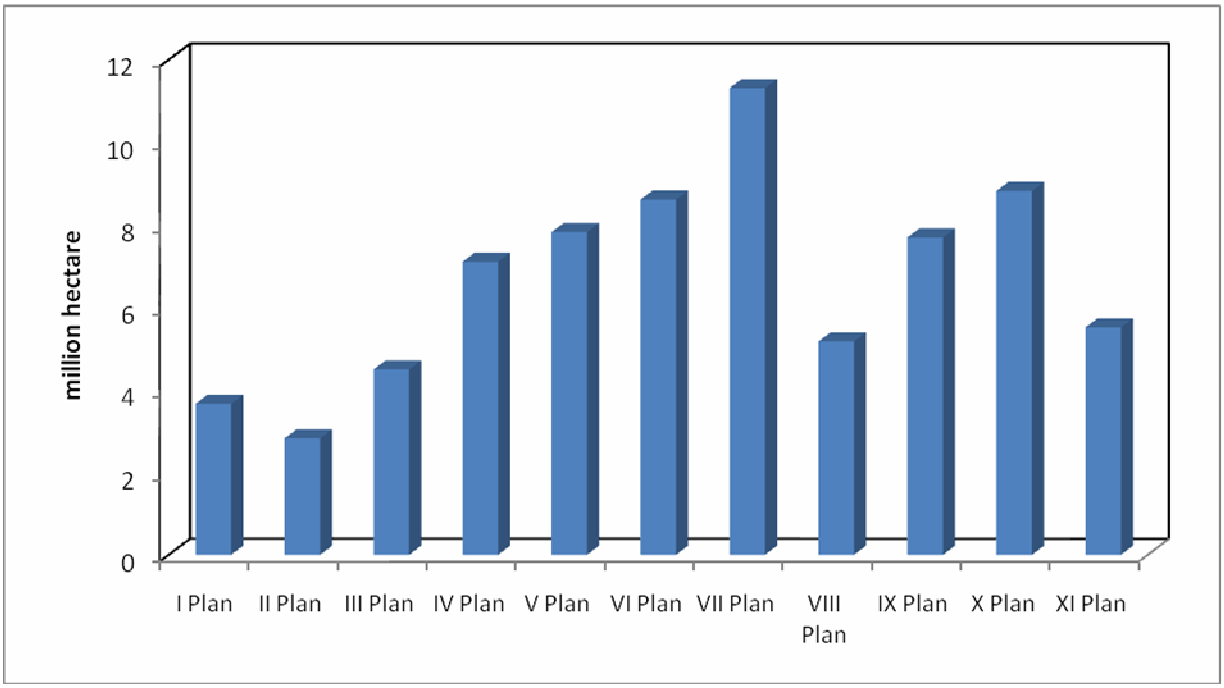
(million hectare)

Years	Govt. canals	Private canals	Tanks	Tubewells	Other wells	Other Sources	Total
TE1953-54	7.39 (35.2)	1.23 (5.8)	3.47 (16.5)	0.0 0.0	6.34 (30.2)	2.59 (12.3)	21.01
TE1963-64	9.63 (37.8)	1.16 (4.5)	4.66 (18.3)	0.73 (2.9)	6.87 (26.9)	2.43 (9.6)	25.48
TE1973-74	12.12 (38.5)	0.87 (2.7)	3.82 (12.1)	4.87 (15.5)	7.51 (23.8)	2.31 (7.3)	31.49
TE1983-84	15.82 (38.5)	0.48 (1.2)	3.28 (8.0)	10.68 (26.0)	8.48 (20.7)	2.31 (5.6)	41.05
TE1993-94	16.83 (33.3)	0.48 (0.9)	3.11 (6.2)	15.79 (31.3)	11.06 (21.9)	3.23 (6.4)	50.50
TE2003-04	14.85 (26.9)	0.21 (0.4)	2.15 (3.9)	23.10 (41.8)	11.37 (20.6)	3.63 (6.6)	55.31
TE2008-09	16.53 (26.2)	0.21 (0.3)	2.01 (3.2)	25.70 (40.8)	12.50 (19.8)	6.04 (9.6)	63.00

Source: Computed from GOI (2010c)
Figures in parentheses are percentages to net irrigated area

In spite of large investments and increase in area under irrigation, the performance of many irrigation systems is significantly below potential due to inadequate design, use of inappropriate technology, inappropriate government policies, and poor management practices. The water use efficiency in India is estimated to be about 38-40 percent for canal irrigation and about 60 percent for ground water irrigation. Agriculture, being the major water user, its share in the total demand is bound to decrease due to competing demands from other sectors. Therefore, improving water use efficiency is of great significance. It is estimated that with 10 percent increase in the present level of water use efficiency in irrigation projects, an additional 14 million hectares area can be brought under irrigation from the existing irrigation capacities which would involve a very moderate investment as compared to the investment that would be required for creating equivalent potential through new schemes (GOI, 2006). It is, therefore, important to ensure active participation of farmers in irrigation management and that would improve the performance and sustainability of irrigation systems.

Figure 4. Trends in Irrigation Potential Created (million hectares) during First Plan to XIth Plan



Another problem associated with irrigation is uneven distribution of irrigated areas among different states. The extent of irrigation (both in absolute terms and relative to cultivated area) has increased in all states. The percentage share of net irrigated area to net sown area varied from 18.2 percent in Maharashtra to 97.8 percent in Punjab. Between TE 1973-74 and TE 2008-09, the increase in NIA as percentage of NSA varied from 6.7 percentage points in Bihar to 35.6 percentage points in Haryana, compared to 21.9 percent in the national average. Out of 13 major states, seven states witnessed higher increase in overall irrigation ratio than national average; it is lower than national average in states like, Bihar, Maharashtra, Tamil Nadu, Andhra Pradesh, Karnataka and Uttar Pradesh.

Table 10. Changes in Percentage of Net (NIA) and Gross Irrigated Area (GIA) to Net Sown (NSA) and Gross Cropped Area (GCA) and Cropping Intensity in Major States

	% NIA to NSA		% GIA to GCA		CI (%)
State	TE1973-74	TE2008-09	TE1973-74	TE2008-09	TE2008-09
Andhra Pradesh	27.2	43.8	30.1	47.5	126.6
Bihar	28.3	35.0	26.0	35.9	123.3
Gujarat	14.2	43.2	14.9	45.3	120.7
Haryana	47.3	82.9	42.6	85.6	180.3
Karnataka	12.3	30.4	13.5	30.1	122.8
Madhya Pradesh	9.0	35.7	8.3	29.4	129.6
Maharashtra	8.0	18.2	8.9	19.2	128.6
Orissa	15.2	37.9	17.2	35.8	160.2
Punjab	70.2	97.8	53.3	97.6	188.6
Rajasthan	14.8	37.3	15.3	36.0	129.4
Tamil Nadu	44.2	57.0	47.3	56.9	114.8
Uttar Pradesh	41.6	62.5	36.4	61.3	156.0
West Bengal	27.3	59.2	21.2	56.5	183.7
All India	22.9	44.8	23.7	45.2	138.0

Source: GOI (2010c)

Irrigation plays an important role in increasing cropping intensity, changes in cropping patterns and enhancing crop yield due to its complemetarity with improved varieties and fertilizer use. It is quite evident that the scope for expansion of net sown area is more or less exhausted, availability of irrigation is fast approaching the physical, ecological and economic limit, and depletion of groundwater resources due to over-exploitation is serious. Therefore, it is important to focus on rainfed areas, where there is considerable scope for increasing productivity through soil and water conservation measures. It would also address the issue of growing disparities between irrigated and rainfed areas. Hence, importance of integrated watershed management and convergence of various programmes related to soil and water conservation including the MNRGEA. Improvement in water use efficiency in irrigated areas through technological (micro-irrigation), institutional (water user associations, convergence of agencies involved in watershed management and rainfed agriculture) and economic (irrigation water and electricity pricing) factors is very critical and must get priority in the 12th Five Year Plan.

Integrated Nutrient Management

Chemical fertilizers are key element of modern technology and have played an important role in agricultural productivity growth in India. India is the second largest consumer of fertilizers in the world after China, consuming about 26.5 million tonnes. However, average intensity of fertilizer use in India remains much lower than most countries in the world but there are many disparities in consumption patterns both between and within regions of India. Table 11 presents classification of districts according to range of fertilizer consumption per hectare of cropped area between TE 1986-87 and TE 2009-10. The data shows that during the TE 1986-87, only three districts were using more than 200 kg per hectare of fertilizer and another 12 districts were consuming between 100 to 150 kg/ha of fertilizer. In contrast about 60 per cent of the districts were using less than 50 kg fertilizer (N+P+K) per hectare. However, the number of districts in high-fertilizer use category (>200kg/ha) has increased significantly during the second-half of nineties and 2000s. In the TE 2002-03, out of 483 districts, 36 districts (7.5%)

were using more than 200 kg per hectare, while over one-third of the districts were consuming less than 50 kg. Between the TE 2002-03 and TE 2009-10, number of districts consuming more than 200 kg/ha more than tripled from 36 in to 112. In the TE 2009-10, 188 out of 538 districts (about 35%) consumed more than 150 kg per hectare, 105 districts between 100-150 kg and 127 districts between 50-100 kg/ha. About 22 percent of the districts had less than 50 kg/ha fertilizer use, much lower than recommended levels. Further less than 20 per cent of the districts accounted for about half of total fertilizer consumption in the country, indicating a high degree of concentration of fertilizer use (FAI, 2010). So, there are two extremes, (i) districts/areas having consistently high levels of fertilizer use and (ii) areas using less than recommended levels of fertilizers. The low level of fertilizer use is because of lack of awareness, non-availability of credit for buying fertilizers, timely and easy availability of fertilizers and other complementary inputs like irrigation, better seed, etc.

Table 11: Classification of Districts according to Ranges of Fertilizer Consumption (N+P+K)

Consumption (kg/ha)	TE 1986-87	TE 1996-97	TE 2002-03	TE 2009-10
Above 200	3 (0.9)	13 (3.1)	36 (7.5)	112 (20.77)
150-200	12 (3.4)	36 (8.6)	47 (9.7)	76 (14.20)
100-150	32 (9.2)	60 (14.4)	92 (19.0)	105 (19.47)
75-100	34(9.7)	59(14.1)	61 (12.6)	64 (11.84)
50-75	55 (15.8)	73 (17.5)	79 (16.4)	63 (11.72)
25-50	92 (26.4)	93 (22.2)	97 (20.1)	66 (12.28)
<25	121 (34.7)	84 (20.1)	71 (14.7)	52 (9.73)
Total	349 (100.0)	418 (100.0)	483 (100.0)	538 (100.0)

Figures in parentheses show per cent to total number of districts.

Source: FAI (2010)

One of the major constraints to fertilizer use efficiency in India is imbalance of applied nutrients. Nitrogen (N) applications tend to be too high in relation to the amount of potassium

(K) and phosphate (P) used. This is partly the result of a difference in price of different nutrients, and partly due to the lack of knowledge among farmers about the need for balanced fertilizer applications. The NPK ratio shows wide inter-regional and inter-state disparity. While existing variation from the ideal ratio (4:2:1) was nominal in the South (2.6:1.3:1.0) and the Eastern region (3.0:1.3:1.0), it was very wide (16.9:15.4:1.0) in the North in 2008-09 (Sharma and Thaker, 2010). State-wise consumption ratio of N and P in relation to K shows that greatest degree of N:P:K imbalance is in case of Haryana (44.4:14.1:1.0) followed by Punjab (39.7:12.9:1.0) and Rajasthan (35.9:11.8:1.0) in 2008-09. However the ratio has improved over time, e.g. in 1993-94 (after decontrol of P and K fertilizers in 1992), the ratio was 70.4:15.7:1.0 in northern region and 11.4:4.1:1.0 in western region which improved to 21.3:7.0:1.0 in north and 6.5:2.7:1.0 in the western region in 2007-08

Inefficient management of nutrients has led to multi-nutrient deficiency in Indian soils. In addition to macro-nutrient deficiency, there is growing deficiency of micro and secondary nutrients in soils. As per the Report on Optimization of Fertilizer Usage, the nutrient deficiency at all-India level is of the order to 89, 80, 50, 41, 49, 33, 13, 12, 5 and 3 percent for Nitrogen, Phosphorus, Potassium, Sulphur, Zinc, Bororn, Molybdenum, Iron, Manganese and Copper, respectively (GOI, 2010c). Use of organic matter including organic fertilizers is an important instrument for improving crop productivity but there is anecdotal evidence which suggests that use of organic manures is declining in the country. As per Agricultural Input Survey 2001-02 average use of FYM varied from about 0.7 tonnes per hectare in case of large farms to 1.9 tonnes per ha on marginal farms, which is much lower than required dose.

With the limited arable land resources, and burden of increasing population, development of new technologies and efficient use of available technologies and inputs such as chemical fertilizers will continue to play an important role in sustaining food security in India. However, there is a need to optimize the use and efficiency of fertilizer use through appropriate interventions. In some areas excessive use of fertilizers is a cause of concern as it might lead to environmental degradation particularly land and water resources while in other areas, still

about one-fourth of the districts use less than 50 kg/ha of fertilizers. Therefore, there is a need have two pronged strategy, (i) to monitor districts with high intensity of consumption and take corrective actions to reduce environmental degradation and (ii) to promote fertilizer consumption in low-use districts to improve crop productivity. An appropriate policy that encourages balanced use of fertilizers (organic and inorganic) including micro- and secondary nutrients is must. The recent policy change in subsidy regime to nutrient-based-subsidy (NBS) is an important step in this direction. However, partial deregulation of retail prices of P and K fertilizers (urea under control) would lead to imbalanced use of fertilizer nutrients. Deregulation of farmgate prices of fertilizers might help in cutting the subsidy burden of the government but the resulting increase in fertilizer prices would hurt the farming community in general and small and marginal farmers in particular. As per the recent report, the maximum retail price of DAP has increased to Rs. 18,180 per tone in October 2011 compared with Rs. 9,720 per tone in the same period last year (The Times of India, October 15, 2011). There has been a considerable discussion on the role of fertilizer prices vis-à-vis output prices in fertilizer consumption and the evidence clearly indicates dominance of non-price factors such as irrigation and high-yielding varieties over price factors (Kumar and Desai, 1995, Namboodiri and Desai, 1995, Nagaraj, 1983; and Sharma and Thaker, 2011). Of the two price policy instruments, affordable fertilizer prices and higher agricultural commodity prices, the former is more powerful in influencing fertilizer consumption (Sharma and Thaker, 2011). The high product price support policy benefits the large farmers who have net marketed surplus while low input prices benefit all categories of farmers. It should also be recognized that fertilizer subsidy ultimately benefits consumers of farm products and not only farmers. Therefore, in order to ensure self-sufficiency in foodgrains production in the country, availability of fertilizers at affordable prices to the producers is of utmost importance. The government should give due importance to non-price factors like better seeds, irrigation, credit, etc. to increase fertilizer use in the country. For this, more investment in irrigation, agricultural research and development, extension services and infrastructure are indispensable in the context of a country like India.

2.4 Rising Agricultural Subsidies

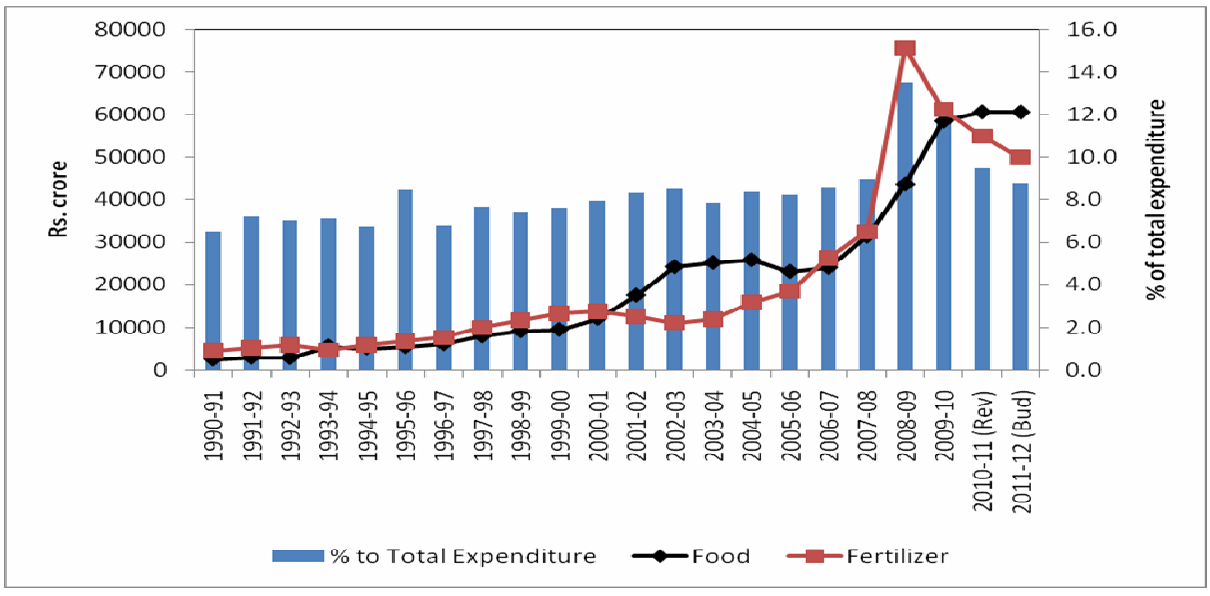
Agricultural subsidies have become one of the most contentious issues of the economic policy. While the original goals of subsidizing agriculture were to support small-scale producers for adopting modern technologies and inputs, facilitate the economic viability of farming, employment creation and to ensure national food security, the current rising outlays for agricultural inputs and food subsidies are of growing concern for policymakers. The Central and state governments subsidize major agricultural inputs such as canal irrigation water, fertilizers, power for groundwater pumping, credit, seeds, etc. This section provides a brief account of food and fertilizer subsidies.

The Indian fertilizer industry, given its strategic importance in achieving self-sufficiency of foodgrains production in the country, has for decades, been under government control. With the objective of providing fertilizers to farmers at an affordable price and ensuring adequate returns on investments to entrepreneurs, a fertilizer policy was envisaged of providing fertilizers to farmers at subsidized prices to induce farmers to use fertilizer. In order to achieve this objective, government introduced the Retention Price cum Subsidy scheme (RPS), a cost-plus approach, for nitrogenous fertilizers in 1977 and extended to complex fertilizers in 1979.

However, the mounting burden of subsidies compelled the policy planners to make a serious attempt to reform fertilizer price policy to rationalize the fertilizer subsidy. As part of economic reforms initiated in early-90s, the government decontrolled the import of complex fertilizers such as di-ammonium phosphate (DAP) and muriate of potash (MOP) in 1992, and extended a flat-rate concession on these fertilizers. But, urea imports continued to be restricted and canalized. Subsequently, several important committees including High Powered Fertilizer Pricing Policy Review Committee (HPC), Expenditure Reforms Commission (ERC), a New Pricing Scheme (NPS), Expert Group on P and K fertilizers, etc. were constituted to reform Indian fertilizer sector and contain and target fertilizer subsidies.

The estimates of fertilizer subsidy as per Central government budgets over the years in the post-reforms era show that fertilizer subsidy has increased significantly. Figure 5 presents the estimates of major subsidies including the food and fertilizer subsidies in the post-reforms period (1991-92 to 2010-11). It is evident from the figure that total subsidies have increased from Rs. 12,158 crore in 1990-91 to Rs. 1641533 crore in 2010-11 (Rev. est.), an increase by 13.5 times. The fertilizer subsidy has increased from Rs. 4389 crore in 1990-91 to Rs. 75,849 crore in 2008-09 representing an increase of over 17 times and then declined during 2009-10 (Rs. 61624.29 crore) and 2010-11 (Rs. 54876.68 crore). As a percentage of GDP from agriculture and allied sectors, this represents an increase from 4.5 percent in 1990-91 to 12.9 percent in 2008-09 and then marginal decline to 11 percent in 2009-10 and 8.3 percent in 2010-11 (Figure 5). The fertilizer subsidy in India as percentage of the GDP from agriculture varied from 2 percent in 1993-94 to 8.2 percent in 2008-09. The total food subsidy has jumped to about Rs. 60600 crore in 2008-09 from 2450 crores in 1990-91, about 24.7 fold increase in less than two decades in absolute terms. But if one looks at the percentage of GDP, then the burden of food subsidies in India is much less than that of many other developing countries. The food subsidy in India as percentage of the GDP has varied from 1.6 percent in 1990-91 to 5.4 in 2009-10, and on an average remained at about 3 percent over the last 19 years.

Figure 5. Trends in Food and Fertilizer Subsidies in India in Post-reforms Period



Source: GOI (2011d)

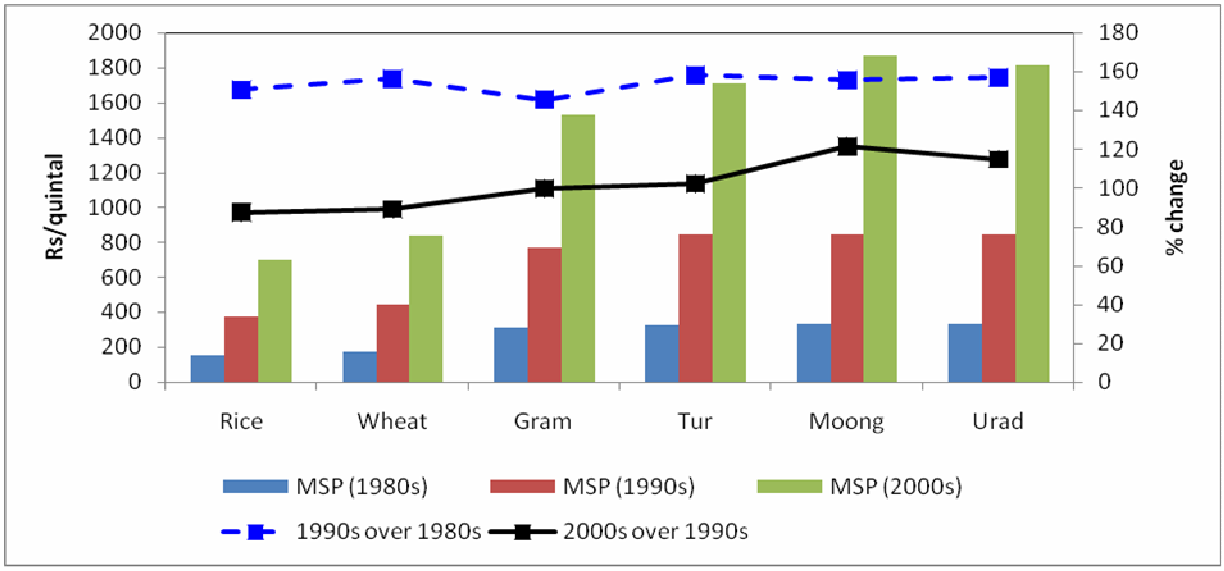
The above analysis shows that the volume of subsidies increased substantially during the post-reforms period. The rate of increase, however, was higher for food subsidy (compound annual growth rate of 17.1% per year) than for fertilizer (13.8%). The rate of change in the amount of subsidies was uneven over time. Total subsidies and fertilizer subsidy increased at a much faster rate during the 2000s while growth rate in food subsidies was higher (16.6%) during the 1990s compared with 2000s (13.4%). During the 2000s, fertilizer subsidy growth has increased significantly (25.2%) as against 13.6 percent during the 1990s, because international prices of fertilizers and raw materials, feedstocks and intermediates increased substantially and yet fertilizer farm gate prices remained constant in the country between 1991 and 2001 and 2002 and 2009. The main reasons for ever increasing food subsidies are (i) significant increase in procurement prices of foodgrains, (ii) increased government procurement and storage costs, and (iii) no increase in issue price of foodgrains provided through public distribution system during the last decade. Therefore, in order to contain rising input subsidies, moderate and gradual increase in prices of inputs is necessary to reduce the burden on fiscal and more importantly, for inducing farmers to use these inputs more efficiently. Full decontrol of fertilizer prices may lead to very high increase in prices and adversely affect farm incomes and agricultural production. Sharma and Thaker (2010) have reported that fertilizer subsidy is more equitably distributed among farm sizes and small and marginal farmers have a larger share in fertilizer subsidy in comparison to their share in cultivated area. The benefits of fertilizer subsidy have spread to unirrigated areas as the share of area treated with fertilizers has increased and the share of unirrigated areas in total fertilizer use has also increased. A reduction in fertilizer subsidy is, therefore, likely to have adverse impact on farm production and income of small and marginal farmers and unirrigated areas as they do not benefit from higher output prices but do benefit from lower input prices. Therefore, there is a need to contain fertilizer subsidies but it should not affect production and productivity of small and marginal farmers, who might cut down use of fertilizers if prices increase significantly.

2.5 Instrument of Price Support for Agriculture

Agricultural price policy, which is considered integral to the strategy for agricultural development, played an important role in achieving self-sufficiency in food grains, consumer welfare, improvement in the economic access to food and, through affecting the domestic terms of trade, important influence on growth, employment and income distribution in the economy. However, the role of food prices and intersectoral terms of trade in stimulating agricultural growth and effecting changes in income has also been the subject of considerable controversy. The section provides an overview of trends in minimum support price (MSP)/Procurement Price (PP) and recent policy changes in price policy.

The trends in MSP/PP show that increase in rice and wheat prices were higher during the decade of 1990s as compared to the 2000s (Figure 6). The paddy (common) prices increased from Rs. 149 per quintal in the 1980s (1981-82 to 1990-91) to Rs. 375 in 1990s (1991-92 to 2000-01) and Rs. 702 in 2000s (2001-02 to 2010-11) while prices of wheat increased from Rs. 173 in eighties to Rs. 443 in the 1990s and Rs. 831 in the 2000s. In the 1990s, rate of increase in MSP/PP of wheat was higher (156.4%) than that of paddy (150.7%). The year to year changes show that the MSP/PP of wheat and rice increased significantly in the first half of 1990s and second half of 2000s. Between 2005-06 and 2010-11, rice and wheat prices increased by about 72 and 60 percent, respectively. In case of pulses, the rate of increase in MSP/PP was higher during the 2000s compared with 1990s. The rate of increase was the highest in case of moong and lowest in gram. The prices of tur, moong and urad have more than doubled between 1990s and 2000s. The average increase (year-on-year basis) was the highest (10.7%) in case of moong, followed by tur (10.1%), urad (9.9%) and lowest in gram (6.9%). The inter-crop price parity between rice and wheat varied from 1.06 in 1994-95 and 1995-96 to 1.37 in 2006-07 because of sharp increase in price of wheat from Rs. 700 in 2005-06 to Rs. 850 in 2007-08.

Figure 6. Trends in Average Minimum Support/Procurement Prices of Major Foodgrains in India: 1980s to 2000s



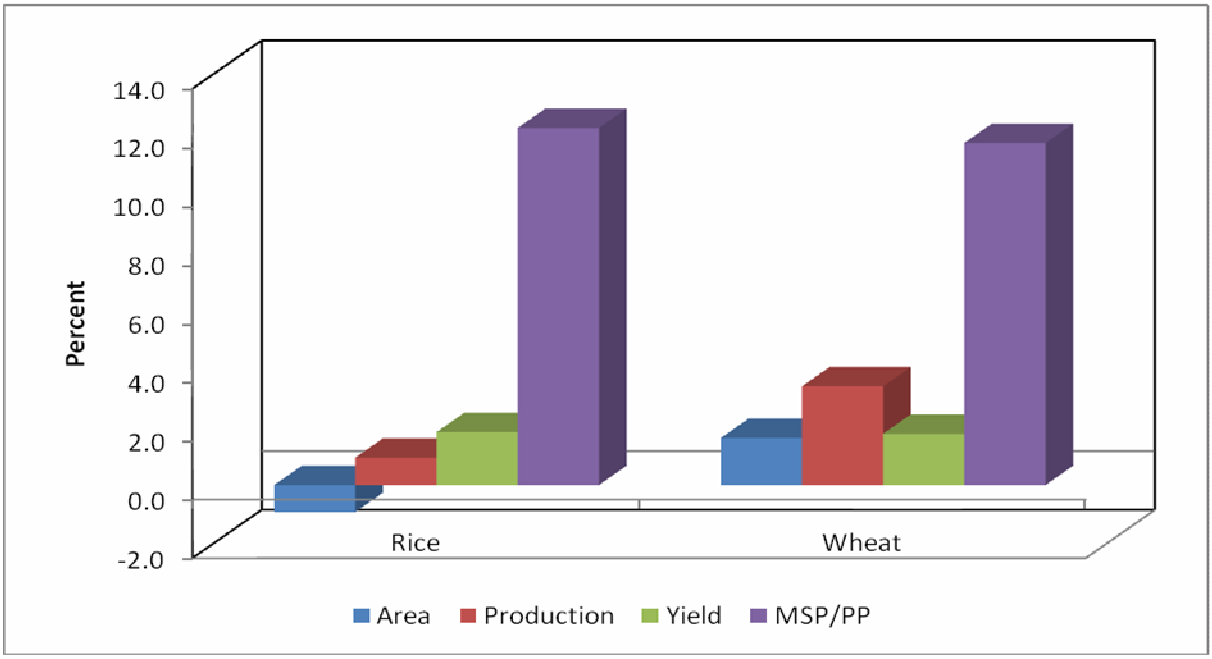
Source: http://fciweb.nic.in/

Dev and Rao (2010) reported that actual price realized by farmers was higher than MSP/PP during the last three decades. It was also observed that price realization was much lower in states like Orissa, Bihar, Assam, West Bengal and Uttar Pradesh compared to Punjab, Haryana, and Madhya Pradesh. The price policy has a limited role in increasing agricultural production as it mainly influences acreage allocation but not crop productivity. It is evident from Figure 7 that between 2005-06 and 2010-11 MSP/PP of wheat and rice increased (average of y-o-y growth rate) by 12.2 and 11.7 percent, respectively, while increase in wheat production (3.4%) came from area expansion as well as small improvement in crop yield and in case of rice, yield improvement contributed to increased production (0.9%). It is important to note that non-price factors such as technology, public investment agricultural research and development, extension services, irrigation, rural infrastructure, etc. play more important role in influencing productivity and production than pricing policy. Therefore, more emphasis on non-price interventions needs to be given to accelerate growth in agricultural sector.

The decentralized procurement policy (DCP) under which foodgrains are procured and distributed by the State Governments was introduced in 1997. The main objective of decentralized system of procurement was to increase coverage of more farmers and crops under MSP operations, improve efficiency of the PDS, providing more variety of foodgrains suited to local tastes and preferences and reduce transportation costs. The data presented in Figure 8 shows that in the case of rice, States under DCP operations have witnessed a significant increase in their share in procurement. For example, the share of Orissa has increased from 4.5 percent in 1997-98 to 7.9 percent in TE 2009-10 while in case of West Bengal the share has increased from 1.3 percent to 4.8 percent during the same period. The share of traditional states like Punjab and Haryana has declined significantly in post-DCP period. During 2009-10, rice procurement in DCP States was about 11.9 million tonnes. However, in the case of wheat, procurement in DCP States has not increased except for Madhya Pradesh where it has increased from 3.8 percent in 1999 to 11.2 percent in TE 2010-11 (Figure 9).

Under the decentralized system of procurement, the procurement of wheat has increased from less than 2 million tonnes in early 2000s to about 6.1 million tonnes in 2009-10. In 2010-11, the wheat procurement in DCP states has gone down primarily due to Uttar Pradesh withdrawing from the DCP scheme. Trends in procurement of rice and wheat in DCP states presented in Figure 10 show that there has been an increase in procurement by DCP states except in 2006-07 and 2007-08 for wheat mainly due to aggressive purchases by private companies on expectation of higher market prices and proximity to consumption markets. Therefore, there is a need to increase the scope and scale of DCP in high potential areas like Bihar, Orissa, Chhattisgarh, Assam, West Bengal, Madhya Pradesh, Rajasthan, eastern Uttar Pradesh, Gujarat, etc. However, most of these states have poor market infrastructure as well as less developed private sector trade. Efforts are required to create marketing infrastructure in these regions and also to expand scope of coverage of crops like coarse cereals.

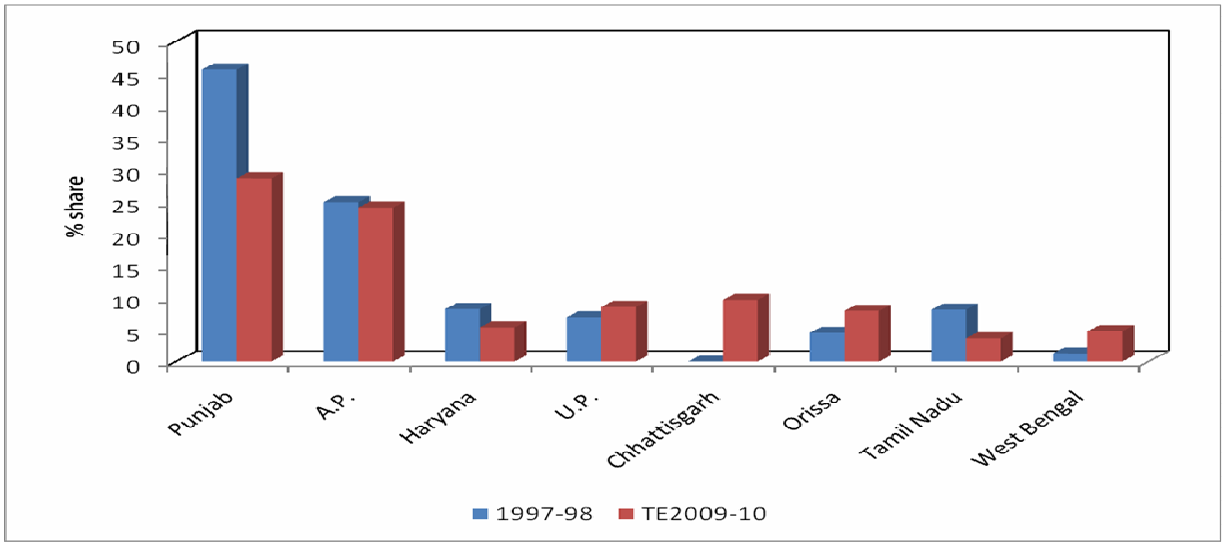
Figure 7. Growth Rates in Area, Production, Yield and MSP/PP of Rice and Wheat during 2005-06 to 2010-11



Source: http://fciweb.nic.in/ and GOI (2010)

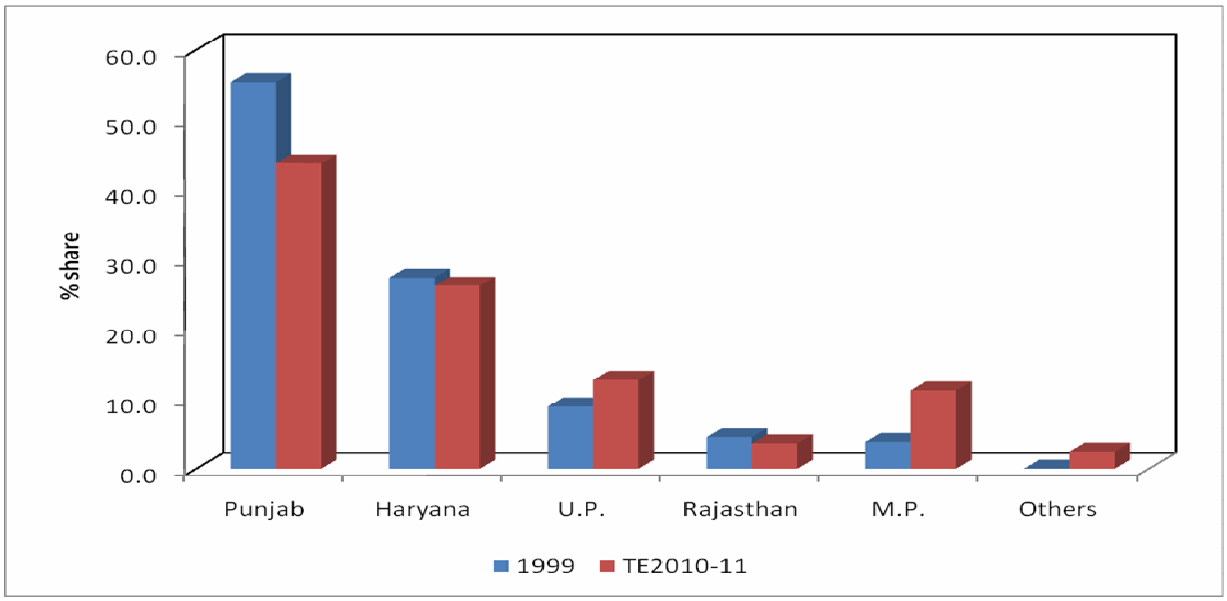
Another problem with agricultural price policy is mixing up the concepts of minimum support price (MSP) and procurement price (PP) but these policy instruments were introduced to serve different purposes. At present first one is not used though it was considered by the official policy during mid-1960s to mid-1970s. The purpose of MSP was to protect farmers against falling prices below a floor price and was determined based on the variable cost of production. The system of MSP must be restored as it is required to ensure farmers remain in business as long as their variable costs are covered. It will also incentivize farmers to adopt technical change. The government should announce MSP before the sowing season as it would help in area allocation decisions. The procurement price (PP) which is determined based on both the variable cost and the fixed cost of production, should be used to procure foodgrains needed for public distribution system (PDS), welfare schemes and buffer stocks required for food security purpose.

Figure 8. Changing Shares of States in Rice Procurement in India: Pre- and Post-Decentralized Procurement Periods



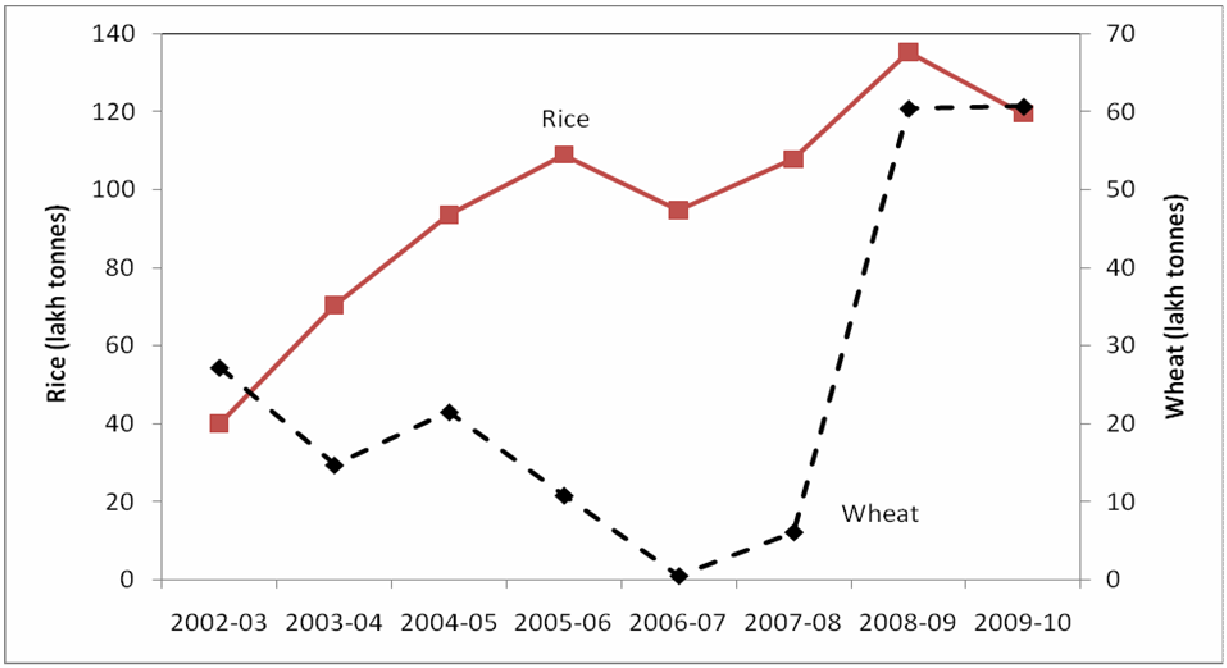
Source: GOI (2010a)

Figure 8. Changing Shares of States in Wheat Procurement in India: Pre- and Post-Decentralized Procurement Policy Periods



Source: GOI (2010a)

Figure 10. Trends in Procurement of Wheat and Rice in Decentralised Procurement States: 2002-03 to 2009-10



Source: GOI (2010a)

2.6 Agricultural Credit Issues

Agricultural credit has played a pivotal role in increasing agricultural production in India. The Green Revolution characterised by a higher use of modern inputs like fertilizers, high yielding variety seeds, irrigation and other inputs, increased credit requirements which were provided by the agricultural financial institutions.

The flow of credit to agriculture has increased significantly in the recent period as the total institutional credit to agriculture increased from Rs. 86,981 crore in 2003-04 to Rs. 446779 crore in 2010-11, at an annual compound growth rate of about 25 percent. The actual achievement in flow of credit has exceeded the targets during the period (Figure 11). In terms of total agency wise share, the commercial banks recorded a considerable growth (from around 36 per cent in TE 1993-94 to about 75 percent in TE 2010-11), while cooperative banks despite their wide network lost their dominant position and their share declined from 58.3 percent in

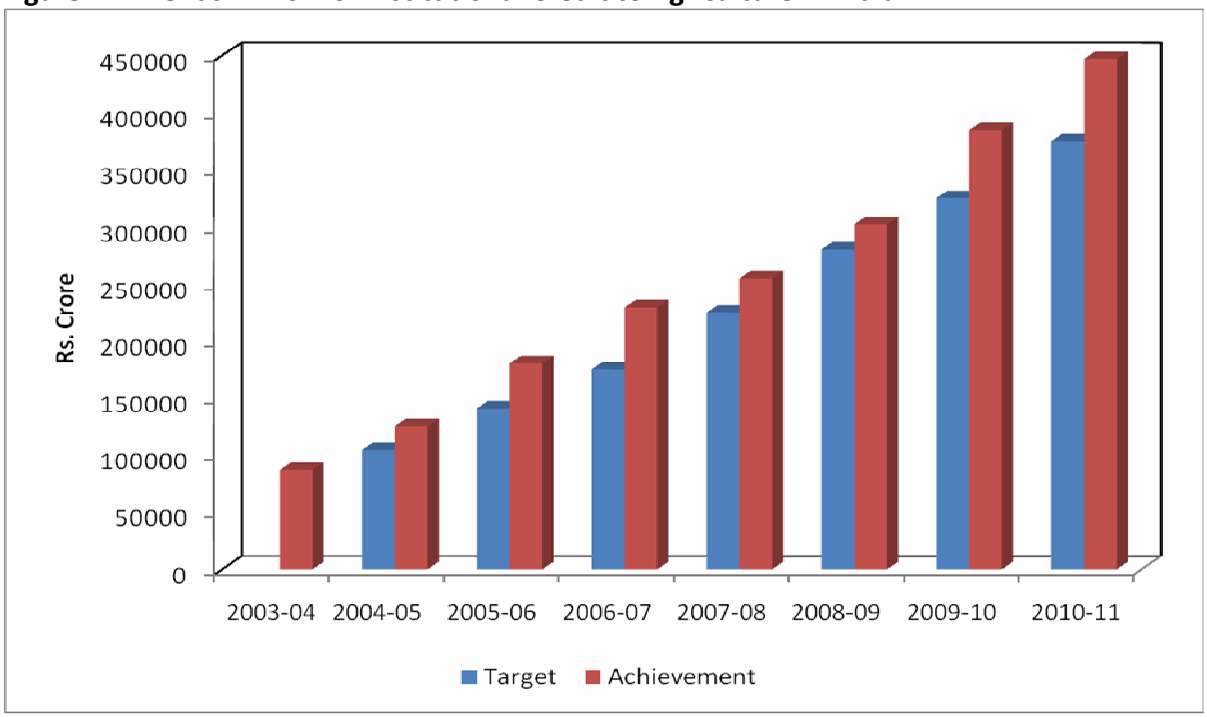
TE 1993-94 to 15.8 percent in TE 2010-11. The share of Regional Rural banks (RRBs) has increased from about 5 percent to 9.4 percent during the above period (Figure 12). Since cooperatives have strong presence in rural areas, the co-operative credit institutions need revamping to improve the efficiency of the credit delivery system in rural areas.

Though the amount of agricultural credit has increased during the last few years, several weaknesses have crept in which have affected small and marginal farmers' access to formal sources of credit. The Task Force on Credit Related Issues of Farmers observed that small and marginal farmers especially tenant farmers, oral lessees, share-coppers, who constitute the bulk of farming community, do not have adequate access to formal sources of credit (GoI, 2010c). Between TE 1993-94 and TE 2008-09, the share of small and marginal farmers in total operational holdings increased but their share in number of credit accounts decreased from 75.3 percent to 69.2 percent and in amount of credit disbursed decreased from 53.6 percent to 48.6 percent (RBI, 2011). On the other hand, for medium and large farmers the share of credit increased from 46.4 percent in TE 1993-94 to 51.4 percent in TE 2008-09 and number of accounts increased from 24.7 percent to 30.8 percent during the period. Similarly, per account credit disbursed across farm sizes had increasing skewed and the gap has widened between small and marginal and large farmers. There are wide variations in the availability of institutional credit per hectare of gross cropped area in different States.

The region-wise per account credit disbursed by commercial banks for different size-class farmers shows that amounts are relatively higher in northern and western region while in north-east and eastern regions credit disbursal is poor, which is a matter of concern. Another issue is decline in rural branches of commercial banks in the post-reforms period. Total number of commercial bank offices has increased significantly since nationalization of banks in 1969, the number of rural branches, which reached its peak in early 1990s (pre-reforms era), has declined significantly in the post-reforms period (Figure 13). In contrast metropolitan, urban and semi-urban branches have increased during this period. Furthermore, share of indirect credit in total credit has increased significantly from less than 20 percent in early-1990s to

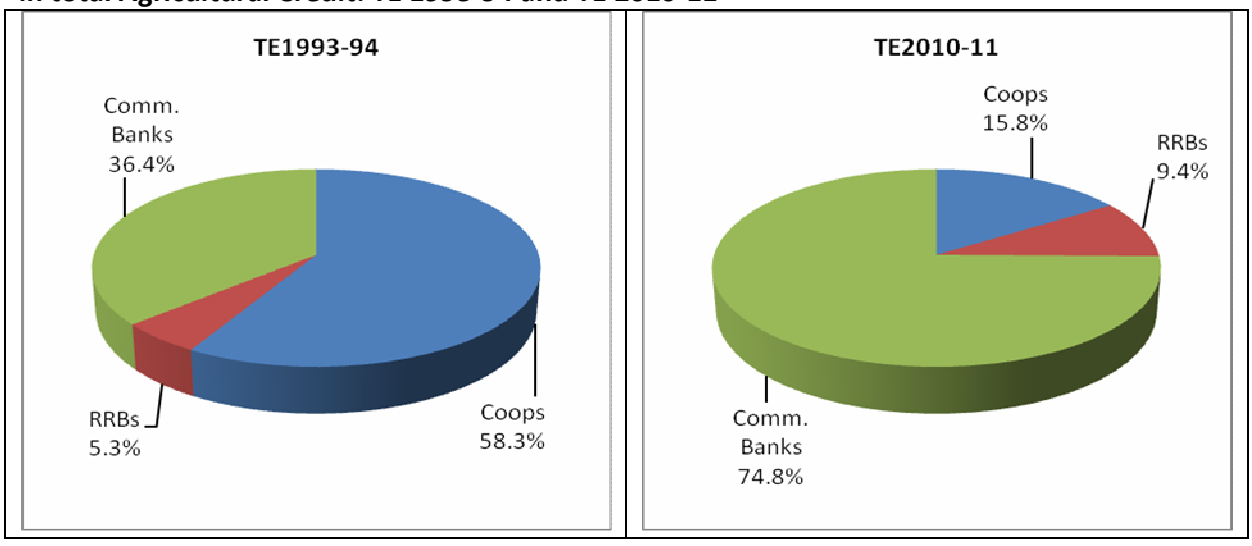
about 67 percent in early-2000s and then marginally declined to about 50 percent in 2008-09 (RBI, 2011).

Figure 11. Trends in Flow of Institutional Credit to Agriculture in India



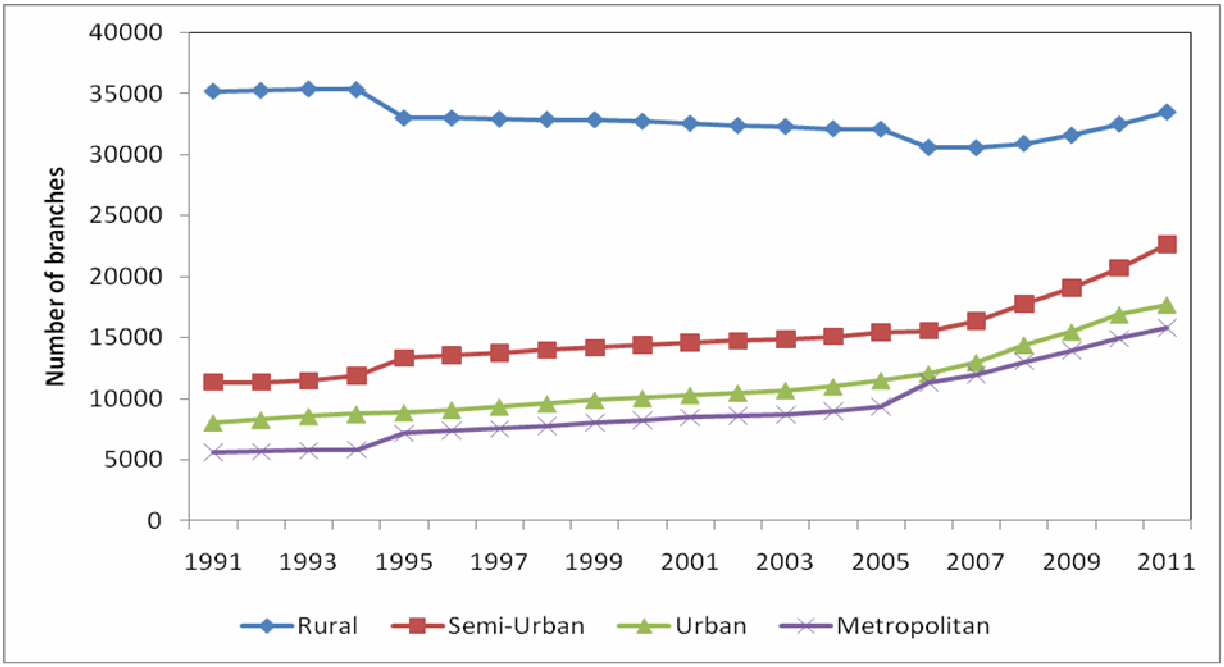
Source: RBI (2011)

Figure 12. Relative Share of Cooperatives, Regional Rural banks (RRBs) and Commercial Banks in total Agricultural Credit: TE 1993-94 and TE 2010-11



Source: Source: RBI (2011) and Golait (2007)

Figure 13. Trends in Rural, Semi-urban, Urban and Metropolitan Branches of Commercial Banks in India during Post-Reforms Period



Source: Source: RBI (2011)

It is a matter of great satisfaction that there has been significant improvement in flow of agricultural credit in recent years but there is a need to address distributional aspects of agricultural credit including not much improvement in the share of small and marginal farmers, decline in rural branches, increase in the share of indirect credit in total agricultural credit and significant regional and inter-class inequalities in credit.

Section 3: Concluding Observations

Since more than half of workforce is still engaged in agriculture for their livelihoods and employment, agriculture continues to be a predominant sector of Indian economy, even though its share in national Gross Domestic Product has declined in recent years. Rapid growth of the non-agriculture sectors, particularly services, in post-reforms period has failed to accelerate agricultural growth or poverty reduction. During the last two decades Indian agriculture has

been facing major challenges like deceleration in growth rate, degradation of natural resources, inter-sectoral, inter-regional equity, declining input efficiency, etc. However, the 11th Plan had some success in reversing the deceleration of agricultural growth witnessed during the 9th and 10th Plan. The growth in agriculture in the 11th Plan is likely to be around 3.2 percent per year, which is higher than 10th Plan growth rate but lower than the target for 11th Plan. The 12th Plan target growth rate for agriculture is 4 percent with foodgrains growth at about 2 percent and non-foodgrains sector (horticulture, livestock and fisheries) growing at about 5-6 percent. However, looking at the growth in agricultural sector in general and high-value agriculture, particularly, horticulture, fisheries, dairy and meat sector during the 11th Plan, there is a need to put additional efforts to achieve between 4 and 4.5 percent growth in agriculture.

The failure to achieve targeted growth in agriculture sector has resulted from the inadequacies of the provision of the critical public goods on which agricultural growth thrives. There is a need to address some of these inadequacies which would also have large multiplier effect of the higher farm incomes on demand for other sectors of the economy. The slowdown in agriculture growth could be attributed to the supply side factors such as public investment, irrigation water management, rural credit, technology, land management, agricultural research and development including extension services, rural infrastructure like roads, electricity, marketing, post-harvest management and so on. Reforms are needed to address these issues in order to achieve 4 - 4.5 percent growth in agriculture, equity in terms of higher growth in disadvantageous regions like rainfed and tribal areas, small and marginal farmers and women and sustainability.

Realising potential of the sector would requires substantial increase in public expenditure on agriculture, rural infrastructure, post-harvest and market infrastructure including storage and processing, reforms in laws related to land markets and marketing of agricultural products, promotion of farmers' organization/groups, Self Help Groups, etc. and appropriate agricultural price and food procurement and distribution policy.

The instrument of pricing of agricultural inputs such as irrigation, power for pumping water, and fertiliser needs rationalisation. The price of surface irrigation water should cover operations and maintenance costs of various projects. Pricing for electricity should be based on its volumetric consumption but with assured timely supply of power to farmers. The pricing of fertilizers needs rationalization so that it promotes balanced use of fertilizers including micro- and secondary nutrients and does not lead to exorbitant increase in prices which might hurt consumption mainly in case of small and marginal farmers. Farm and food subsidies should be rationalized and better targeted to benefit the poor. These subsidies are justified as they benefit not only producers but the society at large. Agricultural price policy has played an important role in Indian agriculture but is facing some challenges. The price support policy should follow the strategy of technological change which requires more emphasis on non-price factors. The practice of determining minimum support price based on variable costs should be restored and must be announced before sowing season while procurement price based on total costs should be used to procure foodgrains needed for public distribution system (PDS), welfare schemes and buffer stocks required for food security purpose. Although flow of agricultural credit in has increased significantly in recent years but we must address distributional aspects of agricultural credit including better access to small and marginal farmers, decline in rural branches, increase in the share of indirect credit and significant regional and inter-class inequalities in credit. There is a need to follow multi-dimensional model of organisation and management, which requires integration of agri-input, agri-production and agro-processing and marketing segments of value chain, restructuring of existing institutions to make them more responsive to the needs of users like farmers and industry, and demand driven, encourage involvement of private investment particularly in post harvest activities including storage, food processing and marketing.

References

Ahluwalia, Montek S (2011), "Prospects and Policy Challenges in the Twelfth Plan", *Economic and Political Weekly*, Vol. XLVI, No. 21, May 21, 2011, pp: 88-104.

Bardhan, P K (1973): "Size Productivity and Returns to Scale: An Analysis of Farm-level Data in Indian Agriculture", *Journal of Political Economy,* Vol 81(6): 1370-86.

Berry, R A (1972): "Farm Size Distribution, Income Distribution and the Efficiency of Agricultural Production: Colombia", *American Economic Review,* Vol 62(1): 403-08.

Challa, J., P. K. Joshi and Prabhakar Tamboli (2011), "Revitalizing Higher Agricultural Education in India: Issues and Challenges" *Economic and Political Weekly*, Vol. 46, Nos. 26 and 27, June 25, pp.

Chand, Ramesh, P A Lakshmi Prasanna and Aruna Singh (2011), "Farm Size and Productivity: Understanding the Strengths of Smallholders and Improving Their Livelihoods", *Economic and Political Weekly*, Vol. XLVI, No. 26 & 27, June 25, pp: 5-11.

Chand, Ramesh, Praduman Kumar and Sant Kumar (2011), "*Total Factor Productivity and Contribution of Research Investment to Agricultural Growth in India*", Policy Paper 25, National Centre for Agricultural Economics and Policy Research, New Delhi, xiii+74p.

CSO (2010), "*National Accounts Statistics, 2009-10 and earlier issues*", Central Statistics Office (CSO), Ministry of Statistics and Programme Implementation, Govt. of India, New Delhi.

CSO (2011), "*Revised Estimates of Annual National Income 2010-11 and Quarterly Estimates of Gross Domestic Product, 2010-11*", Central Statistics Office (CSO), Ministry of Statistics and Programme Implementation, Govt. of India, New Delhi.

CSSRI (2010), "*CSSRI Vision 2030*", Central Soil Salinity Research Institute, Indian Council of Agriculture Research, Karnal.

Desai, Bhupat M. and N. V. Namboodiri (1997), "Government Expenditure on Agriculture Under Planning Era", in Bhupat M. Desai (Ed.), Agricultural Paradigm for the Ninth Plan under New Economic Environment, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.

Dev S Mahendra (2009), "*Structural Reforms and Agriculture: Issues and Policies*" Keynote paper at the 92nd Annual Conference of the Indian Economic Association, 27th-29th December, Bhubaneswar, Orissa.

Dev S Mahendra and N Chandrasekhara Rao (2010), "Agricultural Price Policy, Farm Profitability and Food Security", *Economic and Political Weekly*, Vol. XLV, No. 26 & 27, June 26, pp. 174-82.

Fertilizer Association of India (2010), "*Fertiliser Statistics 2009-10*", The Fertilizer Association of India, New Delhi.

Food and Agricultural Organization, FAOSTAT database. Source: www.fao.org

Golait Ramesh (2007), "*Current Issues in Agriculture Credit in India: An Assessment*", Reserve Bank of India Occasional Papers Vol. 28, No. 1, Summer 2007, Reserve Bank of India, Mumbai.

Government of India (2006), "*Report of Sub-Committee on More Crop and Income per Drop of Water*", Ministry of Water Resources, Government of India, New Delhi.

Government of India (2008), "*Eleventh Five Year Plan 2007-2012*", Planning Commission, Government of India, Oxford University Press, New Delhi pp. 428.

Government of India (2010), "*National Accounts Statistics 2010 and Earlier Issues*", Central Statsitical Organisation, Ministry of Statistics and Programme Implementation, Govt. of India, New Delhi.

Government of India (2010a), "*Agricultural Statistics at a Glance 2010 and Earlier Issues*", Directorate of Economics & Statistics, Department of Agriculture & Cooperation, Ministry of Agriculture, Govt. of India, New Delhi.

Government of India (2010b), "Ground Water Scenario of India 2009-10", Central Ground Water Board, Ministry of Water Resources, Govt. of India, Fridabad.

Government of India (2010c), "*Land Use Statistics at a Glance: 1999-00 to 2008-09*", Directorate of Economics & Statistics, Department of Agriculture & Cooperation, Ministry of Agriculture, Govt. of India, New Delhi. Government of India, New Delhi.

Government of India (2010d), "*Report of the Task Force on Credit Related Issues of Farmers*", Ministry of Agriculture, Government of India, New Delhi.

Government of India (2011), "*Faster, Sustainable and More Inclusive Growth: An Approach to the 12th Five Year Plan (Draft)",* Planning Commission, Government of India, New Delhi.

Government of India (2011a), "*Economic Survey 2010-11 and Earlier Issues*", Economic Division, Department of Economic Affairs, Ministry of Finance, Govt. of India, Oxford University Press, New Delhi.

Government of India (2011b), "*First Advance Estimates of Production of Foodgrains for 2011-12 (as on 14-09-2011)*" Directorate of Economics & Statistics, Department of Agriculture & Cooperation, Ministry of Agriculture, Govt. of India, New Delhi.

Government of India (2011c), "*Mid-Term Appraisal Eleventh Five Year Plan 2007-2012*", Planning Commission, Government of India, Oxford University Press, New Delhi.

Government of India (2011d), "Union Budget 2011-12 and Earlier Issues", Economic Division, Department of Economic Affairs, Ministry of Finance, Govt. of India, Oxford University Press, New Delhi, pp. A82-85.

Hanumantha, Rao C H (1966): "Alternative Explanations of the Inverse Relationship between Farm Size and Output per Acre in India", *Indian Economic Review,* Vol. 1 (2).

Kumar, Praduman and Gunvant M Desai (1995), "*Fertiliser Use Patterns in India During the Mid-1980s*", in Gunvant M Desai and A Vaidyanathan (eds.), Strategic Issues in Future Growth of Fertiliser Use in India, Indian Council of Agricultural Research, New Delhi.

Mazumdar, Dipak (1965): "Size of Farm and Productivity: A Problem of Indian Peasant Agriculture", *Economica,* Vol 32, May, pp 161-73.

Nagaraj, R (1983), "Determinants of Fertiliser Use in Indian Agriculture" *Economic and Political Weekly*, Vol. 18, No. 13.

Namboodiri, N V and Gunvant M Desai (1995), "*Demand vs Supply Factors in Growth of Fertilizer Use: The Gujarat Experience*", in Gunvant M Desai and A Vaidyanathan (eds.), Strategic Issues in Future Growth of Fertiliser Use in India, Indian Council of Agricultural Research, New Delhi.

Pal, Suresh and Alka Singh (1997), "*Agricultural Research and Extension in India: Institutional Structure and Investment*", Policy Paper 7, National Centre for Agricultural Economics and Policy Research, New Delhi, xxx+63 p.

RBI (2011), "*Handbook Statistics on Indian Economy 2010-11*" Reserve Bank of India, Mumbai, pp. 122-24.

Saini, G R (1971): "Holding Size, Productivity and Some Related Aspects of Indian Agriculture", *Economic & Political Weekly, Review of Agriculture,* Vol VI, No. 26, pp: A79-85.

Sen, A K (1962): "An Aspect of Indian Agriculture', *The Economic Weekly,* Vol 14, No. 4-6, pp. 243-46.

Sen, A K (1964): "Size of Holdings and Productivity", *The Economic Weekly,* Vol 16, No. 5-7, pp. 323-26.

Sharma, Vijay Paul and Dinesh Jain (2011), "*High Value Agriculture in India: past Trends and Future Prospects*", W.P. No. 2011-07-02, Indian Institute of Management, Ahmedabad, July 2011.

Sharma, Vijay Paul and Hrima Thaker (2010), "*Economic Policy Reforms and Indian Fertilizer Industry*" Allied Publishers Pvt. Ltd. New Delhi.

Sharma, Vijay Paul and Hrima Thaker (2010), "Fertilizer Subsidy in India: Who are the Beneficiaries", *Economic and Political Weekly*, Vol. XLV, No. 12, March 20, pp. 68-76.

Sharma, Vijay Paul and Hrima Thaker (2011), "Demand for Fertiliser in India: Determinants and Outlook for 2020", W.P. No 2011-04-01, Indian Institute of Management, Ahmedabad, April 2011.

Singh, Manmohan (1995), "Inaugural Address" *Indian Journal of Agricultural Economics*, Vol. 50, No. 1, January-March, pp. 1-8.

Vaidyanathan, A. (2010), "*Agriculture Growth in India: Role of Technology, Incentives and Institutions*" Oxford University Press, New Delhi.

Vyas, V S (2003), "*India's Agrarian Structure, Economic Policies and Sustainable Development: Variations on a Theme*", Academic Foundation, New Delhi.