Challenges Ahead of Ailing Indian Agriculture

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I Introduction

Agriculture has been at the centre stage of rural life for centuries. The rural economy was almost exclusively determined by agricultural activities at the time of India's independence. As the country moved on an economic growth process in the post-independence era and the rural economy diversifies, the dominance of the agricultural sector in the overall economy has slowly declined over the years. Yet, a characteristic feature that still holds for the Indian economy is that a majority of its population is agriculture dependent for its livelihood. Also, agricultural dependent households form a major chunk of India's poor population. The growth and development of agriculture plays critical role in reducing rural poverty. The primary role of agriculture for livelihood of the rural population dependent on these activities as well as provision of food security to the nation as a whole will continue in future.

The world-wide development experience indicates that the structural changes of an economy in terms of income and employment moving away from agriculture to non-agriculture are inevitable in the economic growth process. Based on such historical experience, a long-run strategy for the developing world has been advocated in these lines of diversification of economy from agriculture to non-agriculture. This diversification strategy emphasises on the strong inter-sectoral linkages between agriculture and the rest of the economy. The performance of agriculture is crucial for the growth of non-agriculture sector especially rural non-farm sector. Agriculture supplies raw material to the agro-based industry and agricultural income is a source of demand for non-agricultural consumer goods. When the agriculture growth is on motion, incomes of farmers would be further increased by linkages of the farm sector with the rural non-farm sector. The growth of rural non-farm sector stimulates the agricultural growth by generating demand for agricultural products including food products and by supplying fertilisers, pesticides and implements etc., that help in raising agricultural productivity[1]. In view of these linkages a threshold level of growth in agriculture becomes an integral part of growth strategy of an economy.

Against the above backdrop, this paper takes stock of the state of agriculture in India, brings out with the stylised facts, issues and emerging challenges related to agriculture sector and then makes an attempt to formulate policy measures for further growth of the Indian agriculture.

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[1] See Mellor, 1976; Hazel and Haggablade, 1991; Lanjouw and Lanjouw, 2001 among others.

II Changing Structure

The striking feature of Indian economy is changing structure with respect to the value of production in the national income. While the share of agriculture sector in the gross domestic product (GDP) has shown a sharp decline from over 50% during the 1950s to about 15% in recent years, the share of non-agriculture sectors - especially that of the services sector - has been correspondingly rising over the years. As is typical in an economy growing from a low per capita income, the growth of agriculture GDP has been always lower than that of industry and services sectors on a medium term average basis. Admittedly, a non-agriculture income accruing to rural population is not insignificant; yet, it is not commensurate with its population share. This growth process has accentuated the rural-urban divide in terms of per capita income as measured by the net domestic product (NDP).

Across states, the structure of economy and the growth of agriculture have shown a considerable variation. A few states have made disproportionally higher contribution to the agricultural GDP at all India level when compared with their contribution to the country's population. Three Western states (Haryana, Punjab and Gujarat) and two Southern states (Andhra Pradesh and Karnataka) account for one-thirds of agriculture GDP of the whole country, though they have only one-fifth of the country's population.

The growth pattern of agriculture GSDP across states and that of India indicates that the sector frequently experiences negative growth. The occurrence of negative growth in agriculture and its frequency is not uniform across state. Although the negative growth in agriculture output at all India level is not as frequent phenomenon in recent decades, the aggregate hides the substantial variations across states as noted below.

The basic supply factors that determine the agricultural growth are land and water resources available for cultivation, technology that improves farming techniques/methods, the yield rate and thereby production, changes in cropping pattern or crop diversification towards high value crops and the growth of allied sectors. Besides, the factors that facilitate the growth are functioning of input, output and credit markets for agriculture, marketing of agricultural commodities and thereby remunerative prices, institutions ensuring better delivery system. The public investment plays critical role for the growth of agriculture in terms of developing land and water resources (improving soil quality, arresting degradation, and irrigation), in development of technology that improves the productivity of agriculture and a post harvest technology and infrastructure that reduces post harvest losses.

Ultimately, however, the rainfall and changing climate or weather conditions in terms of drought, floods and untimely heavy rains on harvestable crops which is a common phenomenon in the India context, do affect the growth of agriculture. The technological advancement and investments that India has made in this direction of forecasting, controlling or mitigating impact of these unfavourable conditions has not been focussed by the state.

Hence, the erratic weather conditions and the events of natural calamities, either floods or draught which are regular events in India, are one of the major factors behind the frequent experiences of negative growth of agriculture. Every year one or other states in India has been witnessing such situation. The number of states experiencing such a situation at time depends on the spread of such unfavourable weather conditions across states. Irrigation and dry land or rain-fed agriculture technology can cope up with the draught conditions but there is no such scope for flood conditions.

For instance, the year 2002-03 turned out to be unfavourable for agriculture in almost all major states in India; and as many as 10 to 12 states in the years 1997-98, 2000-01 and 1999-2000 found to be affected by unfavourable conditions for agriculture. But, all major states, except three, witnessed a favourable condition for agriculture in 2005-06. Tamil Nadu, Bihar, Gujarat and Assam experienced large number of years of negative agriculture growth between 1993-94 and 2009-10 and Bihar and Gujarat particularly experienced such occurrence for almost every alternative year. Despite the periodic unfavourable conditions, Gujarat is the only state in India that registered relatively better agriculture growth during the last decade. However it is uncommon to some states having favourable conditions continuously for 5 to 7 years. All these regional climatic dynamics affect the overall growth of agriculture at the all India level along with other supply side factors.

Employment Diversification

With respect to employment generation and source of livelihood, agriculture sector continues to be a source of livelihood for majority of the population in India. Although the percentage of workforce engaged in agricultural activities has been declining over time, still above 50% of the total workforce and more than two-thirds of rural workforce are engaged in agriculture on a usual status basis.

The slow pace of growth in agricultural income (GVA - gross value added) and rapid growth income of non-agriculture sector along with snail pace diversification of workforce from agriculture to non-agriculture resulted in widening gap in per capita value added per worker between agriculture and non-agriculture (Table 2.1 and Figure 2.1a&b). However, it is to be noted that increasing capital intensity over labour in non-agriculture and lack of it in the agriculture sector is one of the reasons for the widening gap in per capita value added per worker between agriculture and non-agriculture.

Table 2.1: Growth of GDP and Workforce in Agriculture and Non-Agriculture Sectors of India

Period	Growth of GDP			Growth of Employment		
	Overall	Agri	Non-Agri	Overall	Agri	Non-Agri
1972-73 to 1977-78	4.6	4.3	4.8	2.7	1.8	5.0
1977-78 to 1983	4.2	2.7	5.1	2.2	1.5	3.9
1983 to 1987-88	3.5	-0.03	5.3	1.5	0.4	3.9
1987-88 to 1993-94	5.6	4.7	6.0	2.4	2.2	2.8
1993-94 to 1999-00	6.7	3.3	7.9	1.1	0.1	2.7
1999-00 to 2004-05	5.8	1.6	6.9	2.8	1.4	4.8
2004-05 to 2009-10	8.7	3.2	9.8	0.22	-1.6	2.4

Note: Compound Annual Growth Rate (CAGR) presented in percent.

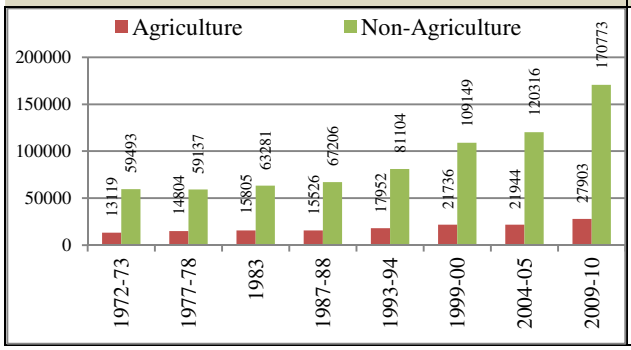
Source: Computed based on CSO for GDP and NSSO for Employment data.

There are substantial variations across states in terms of dependency on agriculture for employment and livelihood. For most of the states, the contribution of agriculture has declined to less than one-fourth of the respective state's GSDP. But more than half of their workforce is still engaged[2] in agricultural activities in many of these states. Moreover, for more than half of the rural population in a majority of the states, agriculture remained to be the major source of livelihood.

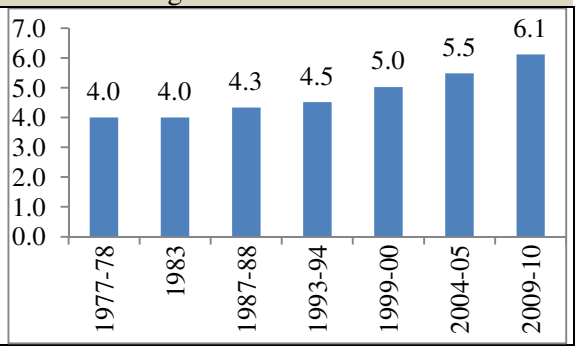
[2] Dependency on agriculture refers to when household's major source of livelihood is agriculture. The workforce engaged in agriculture is those who are employed in agriculture, irrespective of the major source of income.

Figure 2.1: Difference in GVA per Worker in Agriculture and Non-Agriculture

a) GVA per Workers in Agriculture and Non-Agriculture sectors



b) Ratio of Per Capita GDP per Worker engaged in Non-agriculture to that of Agriculture – All India



Note: 1. Percentage of workforce engaged in agricultural activities including crop sector, livestock, fishery, forestry and logging; 2. GVA – Gross Value Added.

Source: Using NSS Quinquennial Employment and Unemployment Survey.

Structural change in income is taking place very fast across the states compared the change in structure of employment giving rise to increasing ratio of the share of agriculture in the total workforce to that of income (GSDP). Bihar and Jharkhand are two interesting exceptions during the period 2004-05 to 2009-10. The recent trends in changing structure of state economies indicate that the laggard states like Bihar and Jharkhand in terms of structural change have registered relatively faster decline in the share of agriculture in both the GSDP and workforce.

Changes within Agriculture

There have been considerable changes within the agriculture itself. We discuss below the changing structure of agrarian economy.

Within agriculture sector and allied sectors together, while the share of forestry and logging is showing declining trend, the share of fisheries is increasing (Figure 2.2). Similarly, within the agriculture sector proper i.e. including crop sector and livestock, the share of livestock is increasing and correspondingly the share of crop sector is declining (Figure 2.3). The compositional change towards livestock and fishery is in response to stronger consumption demand by households towards protein producing sectors. Apart from supplementing income of rural households from crop production, expanding livestock production also plays a crucial role in helping to reduce year to year income fluctuations of farmers.

Secondly, Indian agriculture i.e. farm/crop sector, witnessed a transition from subsistence farming to commercial farming. The growing evidence of increasing the marketable surplus of food grains even from the small holdings is the testimony for the transition. For instance, with respect to paddy the most staple food crop, more than half of total production is available for sale – marketable surplus (Table 2.2). Even among the small farmers around 45% of the production is observed to be marketable surplus.

Thirdly, within the crop sector there is a changing cropping pattern towards commercial and high value added crops and horticulture. The area under food grains crops is declining and correspondingly the area under non-grain food crops is increasing (Figure 2.4).

Figure 2.2: Distribution of GVA of Agriculture and Allied by its sub-sectors, India

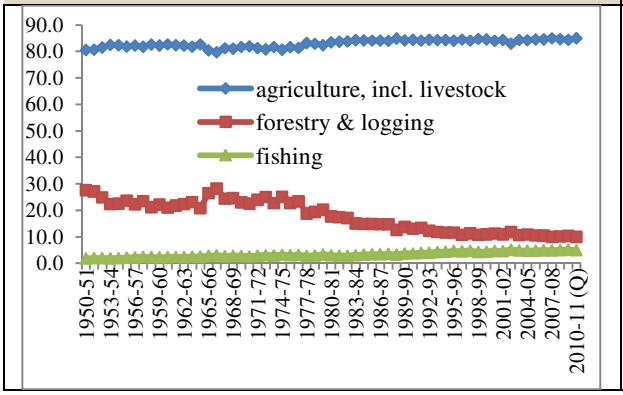
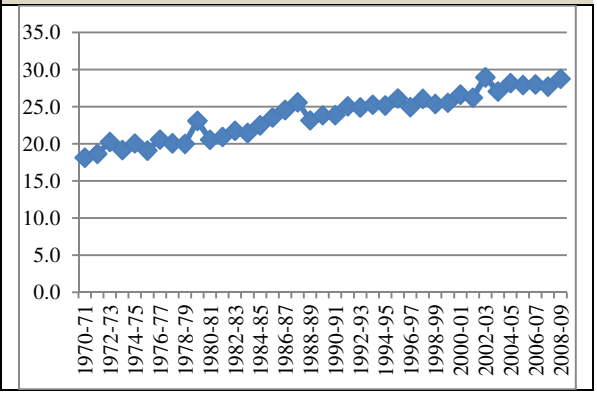


Figure 2.3: Share of Livestock Sector in the Total Value of Output in Agriculture, India



Note: Total Value of Output in Agriculture sector including crop and livestock sectors.

Source: NAS.

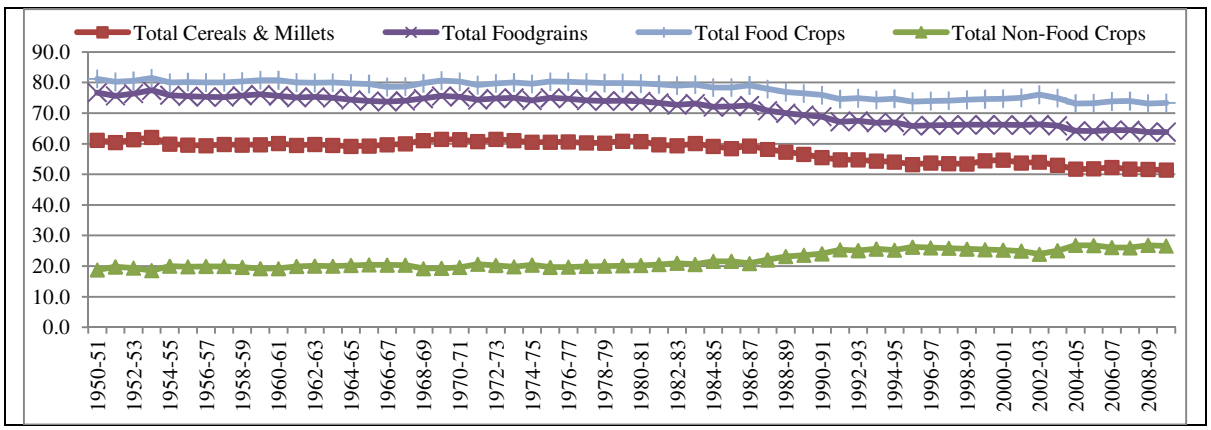
Table 2.2: Marketable/Marketed Surplus of Paddy out of Farm Production by Size Category of Farmers in India, Triennium ending 1998-99

Sno	Details	Quantity (in '000' tonnes)				Percentage			
		Small	Medium	Large	Total	Small	Medium	Large	Total
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
1	Total Production	52028.7	36672.4	33569.3	122270.3	100	100	100	100
2	Total farm family requirement including losses	28619.8	15268.7	10576.8	54465.3	55.0	41.6	31.5	44.5
3	Marketable Surplus	23408.9	21403.7	22992.4	67805.0	45.0	58.4	68.5	55.5
4	Quantity Sold – Marketed Surplus	22778.5	19619.1	21144.1	63541.7	43.8	53.5	63.0	52.0

Note: 1. Average of 1996-97, 1997-98 and 1998-99; 2. Size category of farmers based on the area under paddy cultivation. Difference bet marketable and marketed due to post harvest losses.

Source: GOI (2002).

Figure 2.4: Distribution of Cultivated Area under selected group of Crops, All India



Note: As percentage of total cropped (gross cropped) area.

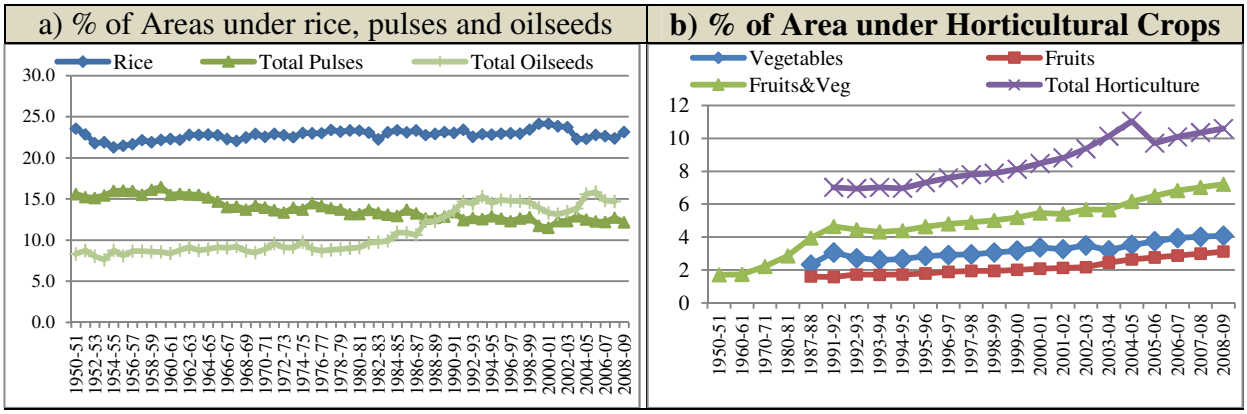
Source: Department of Agriculture.

Area under rice crop cultivation is almost constant over time, whereas the area under pulses has continuously been declining. But the area under oilseeds, and fruits and vegetables and other horticulture crops has been increasing (Figure 2.5). The area under horticulture crops increased to more than one-tenth of the total cropped area in the country. This reflects another

dimension of food basket diversification by consumers in addition to the changing preference towards protein noted earlier and elaborated later.

Within the crop sector, the share of cereals in total value of crop output increased till 1990s but declined thereafter during the decade of 2000s (Figure 2.6) whereas the share of pulses exhibited steep decline all through. Similarly share of kitchen garden, which was a small segment to begin with, is showing falling trend over the years. The crops which have shown an increase in the share are fruits and vegetables, and fibres. In case of oilseeds and fibres their shares remained same. The declining share of pulses has led to steep rise in its relative prices and needs urgent policy attention since Indian staple diet has traditionally been a mix of cereals and pulses.

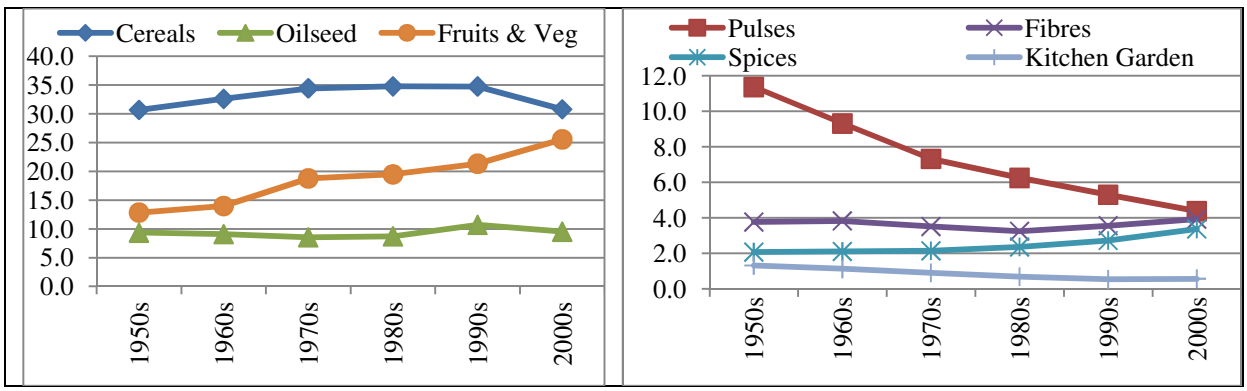
Figure 2.5: Percentage of Area Under cultivation of Rice, Pulses, Oilseeds and Horticulture Crops - All India



Note: As percentage of total cropped (gross cropped) area.

Source: 1. Department of Agriculture and Co-operation, Ministry of Agriculture, Government of India; 2. National Horticulture Board, India.

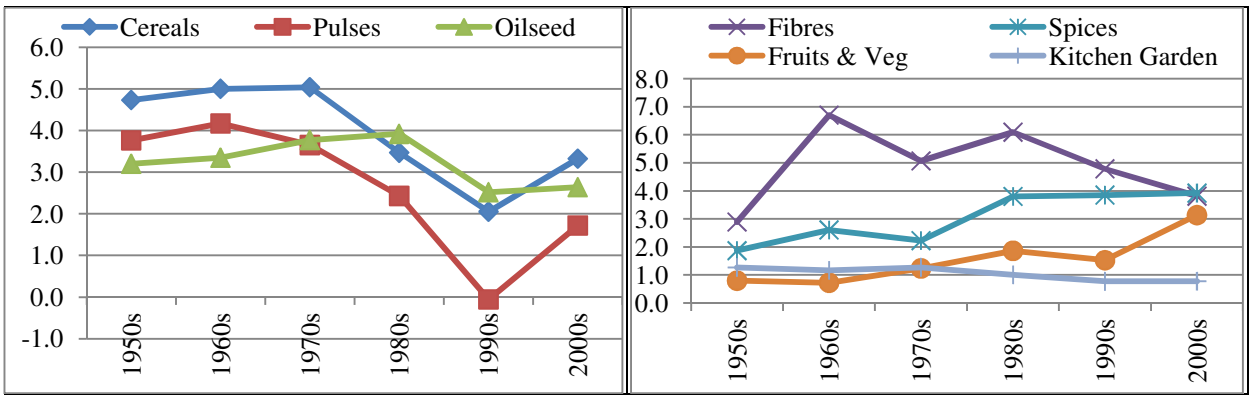
Figure 2.6: Percentage share of Selected Crops in Total Value of Agricultural (Crop Sector) Output, All India



Note: 1. Value of Agricultural Output excluding livestock sector; 2. The decadal averages.

Source: CSO.

Figure 2.7: Annual Average Growth (%) in Value of Output of Selected Crops, All India



Note: 1. Value of Agricultural Output excluding livestock sector; 2. The decadal averages.

Source: Computed using CSO data.

In terms of growth in value of output, there is steep decline from 1970s to 1990s in rate of growth in value of output for food grain crops such as cereals and pulses, and the oilseeds (Figure 2.7). The trend is showing considerable revival growth in value of output for these crops. Consistent acceleration in the growth of value of output is observed in cases of fruits and vegetables and spices. The deceleration in growth output value for fibres including cotton since 1990s is a cause of concern in the context of increasing area under Bt. Cotton.

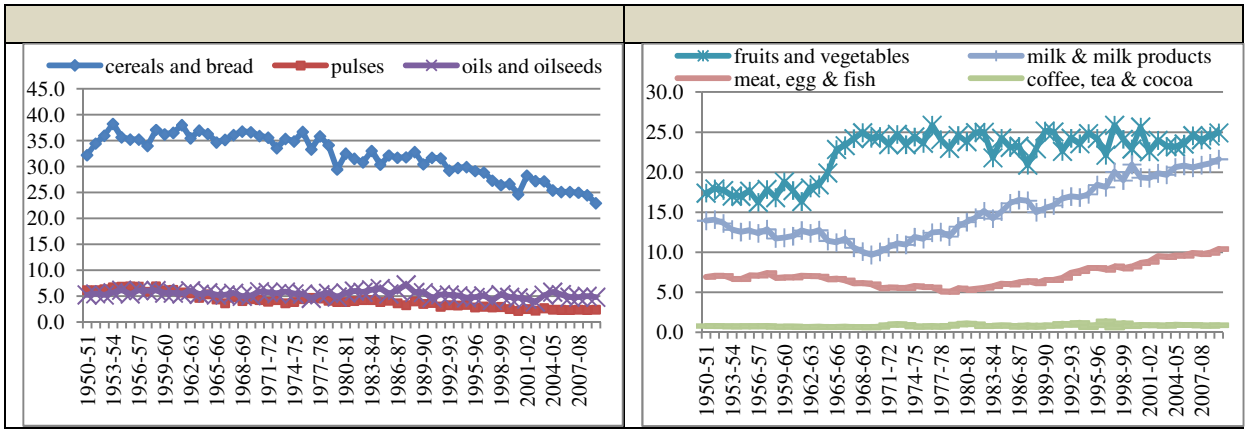
Changing Consumption pattern

The supply side changes observed above are reflected in the changing demand structure of food consumption in India. The share of food grains such as cereals and pulses in the total consumption expenditure, and the per capita quantity of these commodity consumed is declining over time (Figure 2.8 and Table 2.3). It shows that the changing cropping pattern is consistent with changing composition of food articles consumption basket. Herein one can say that the changing demand pattern has led to restructuring the agricultural production.

Human beings in general have a very wide range of foods to choose from and to decide their diet. The choice of food again depends on the satisfaction of hunger and palatability, and guided by cultural traditions. Moreover, human beings need a wide range of nutrients (including proteins, fat, carbohydrate, vitamins and minerals) present in the food, to perform various function of the body and to lead a healthy life. The minimum dietary requirement with certain nutrients for sustaining healthy and active life depends upon the climatic conditions and the amount of energy one needs to expend (intensive physical labour or sedentary). But the access to this wide variety of food articles depends on the climatic conditions and resources to produce and the purchasing power.

Moreover the demand for several food commodities is relatively inelastic in nature with respect to increasing purchasing power or income depending on the satisfaction of hunger and palatability of the consumer and energy needs and nutritional requirements. Once the quantity of food consumed meets these requirements the demand for food would turns out to be inelastic. In India still foodgrains are the major source of energy calorie and protein consumption. India is one of the few countries in the world in which for a majority of population, major source of energy calorie and protein consumption are foodgrains, unlike most of the other countries for which animal flesh is the major source of protein consumption.

Figure 2.8: Changing demand Food Products - % share of Selected Food Items in Total Private Final Consumption Expenditure on Food, All India



Note: line in graph shows the share in %.

Source: CSO.

Table 2.3: Per Capita (Kgs) Consumption of Food Commodities in India

	Rural				Urban			
Food Commodity	1993-94	1999-00	2004-05	2009-10	1993-94	1999-00	2004-05	2009-10
Cereals (Kgs.)	13.40	12.72	12.12	11.35	10.60	10.42	9.94	9.37
Pulses (Kgs.)	0.76	0.84	0.71	0.65	0.86	1.00	0.82	0.79
Vegetables (Kgs.)	2.71	3.30	2.92	4.04	2.91	3.49	3.17	4.12
Milk (liters)	3.94	3.79	3.87	4.12	4.89	5.10	5.11	5.36
Eggs (Nos)	0.64	1.09	1.01	1.73	1.48	2.06	1.72	2.67
Meat (Kgs.)	0.26	0.32	0.30	0.44	0.34	0.38	0.36	0.51

Note: 1. Quantity Consumption per capita per month; 2. Meat – all types of meat including Fish, Beef and Chicken.

Source: NSSO.

The decline in per capita quantity of food consumed at all India level has implications on the consumption of required nutrients particularly energy calories, protein and fats. One of the reasons for the declining per capita quantity of the cereals and the food grains could be due to the reduced energy requirement with reducing intensive physical labour and increased sedentary work.

The declining per capita quantity of foods consumed in India also resulted in decline in per capita quantity of proteins at the aggregate level. The protein consumption in India has declined from around 60 gms per person per day in 1993-94 to 55 gms in 2009-10 in rural areas and 57 gms to 53.5 gms in urban areas during the period. The composition of protein intake through different foods consumed is also changing wherein the major source of protein intake is cereal food whose share is declining, but it still contributes more than one-thirds of total protein intake. Pulses, milk and milk products which are relatively protein-rich when compared to cereals contribute less than 10% each of the total protein intake. Similarly, the most protein-rich foods such as meat including egg, fish and chicken is consumed less frequently in India given its culture and tradition of vegetarianism so that its contribution to the total protein intake is very marginal, though the per capita quantity of meat consumed is increasing over time.

If one contextualises the declining per capita quantity of food consumed and thereby the nutrient intake in India along with substantial level of malnutrition among the different population groups especially women and children in the country, it indicates that the actual consumption is still not meeting the dietary requirement and the required nutritional intake. Is it a supply side problem as the farmers while responding to the price signals of non-food crops and thereby diversifying their cropping pattern towards non-foodgrain crops, they are producing quantities of foodgrains lesser than those sufficient to meet dietary requirements and sufficient nutritional intake of all the population in India? Or it is demand side problem in terms of lack of purchasing power in the context of the increasing cost of cultivation and rising market prices of foods especially that of foodgrains. Or is it simply because of changing tastes and preferences irrespective of the nutritional requirements.

III Land Question

Changing Land Use pattern

Undoubtedly land is one of the critical supply factors determining the agricultural production and thereby its growth. The land use pattern in India is changing over time, though the percentage of new area sown (NAS) in the total geographical area remained almost stable around 46% since 1970s (Table 3.1). The expansion of cultivated area particularly the net area sown virtually has come to stop long back. Land available for cultivation is a net process. Virgin lands are opened up for farming and at the same time some exhausted/degraded lands are withdrawn from cultivation; sometimes the construction of infrastructure and non-agricultural use may take away the cultivated/cultivable land. In this process, since 1990s, there is virtually no net addition to the arable or cultivated or net sown area in India (Chadha, Sen and Sharma, 2004). For further expansion of area under crops the only possibility is through intensification of cultivation but it depends on favourable weather (rain fall) or irrigation. The crop intensity in India as a whole has been rising over time wherein a substantial part of it is associated with the expansion irrigation facility.

The share of permanent pasture and other grazing lands had increased till 1970s and thereafter it has shown a declining trend (Table 2.4). The area under current fallows land is also increasing. The increase in the current fallow land is very high when the situation was very much unfavourable for agriculture during the early 2000s particularly in 2002-03. A majority of the states in India had experienced such an unfavourable condition (either draught or floods) in this year so that the net area sown dipped to 3 percentage points from 46%.

More important is the increasing share of area under non-agricultural use. There is growing pressure on agricultural land for conversion to non-agricultural purposes. Increasing population and urbanisation meant the rise in the extent of land used for housing. Also the industrialisation process increased the demand for land for industrial use. Large scale allocation of farm lands to special economic zones (SEZs) and urban house builders has recently met with opposition from rural farming households giving rise to public debate[3]. As a result of increasing area under non-agricultural, the total agriculture land - including Land under Misc. Tree Crops & Groves, Cultural Waste Land, Total Fallow land and Net area sown – is declining (Table 3.1).

[3] For instance the cases of Singur in West Bengal, land acquisition related to a mining company, POSCO and Jindal, in Orissa and land deals related to steel company, Al Khima and Raheja, in Srikakulam and Vizianagaram districts of Andhra Pradesh raised severe protest against those attempts.

Table 3.1: Distribution (%) of Land by Use, All India

Land Use		Decadal Average						T E	
		1950s	1960s	1970s	1980s	1990s	2000s	2001-02	2009-10
Forests		17.2	20.0	21.7	22.0	22.5	22.9	22.8	22.9
Not Available for Cultivation	Area under Non-Agricultural Uses	4.6	5.0	5.9	6.7	7.4	8.2	7.8	8.5
	Barren and Un-Cultural Land	12.1	11.1	7.7	6.6	6.0	5.6	5.7	5.5
	Total	16.6	16.1	13.6	13.3	13.4	13.8	13.5	14.0
Other Uncultivated Land Excl. Fallow Land	Permnt Pastures&Grazing Lands	3.7	4.6	4.2	3.9	3.6	3.4	3.5	3.3
	Misc. Tree Crops & Groves	2.6	1.4	1.3	1.2	1.2	1.1	1.2	1.1
	Cultural Waste Land	7.5	5.7	5.7	5.2	4.7	4.3	4.5	4.2
	Total	13.9	11.7	11.1	10.2	9.5	8.9	9.1	8.7
Fallow Lands	Fallow other than Current Fallows	4.5	3.2	3.0	3.3	3.3	3.5	3.4	3.4
	Current Fallows	4.1	4.0	4.4	5.0	4.6	5.1	4.9	4.8
	Total	8.7	7.2	7.4	8.2	7.9	8.6	8.3	8.2
Net Area Sown (NAS)		43.6	45.0	46.1	46.2	46.7	45.8	46.2	46.2
Gross Sown Area		49.3	52.0	55.3	58.1	61.5	62.1	61.4	63.6
Area Sown more than once		5.7	6.9	9.2	11.9	14.8	16.3	15.2	17.4
Agriculture Land - Arable		62.4	59.3	60.5	60.8	60.5	59.9	60.2	59.7
Cultivated Land		47.7	49.0	50.5	51.2	51.3	50.9	51.2	51.0
Copping Intensity		113	115	120	126	132	135	133	138

Note: **1**. Percentage distribution by its use in the total land reported for the land use statistics, not geographical area; **2. T E** – Triennium Ending; **3**. ***Agriculture Land*** – including Land under Misc. Tree Crops & Groves, Cultural Waste Land, Total Fallow land and Net area sown; 4. ***Cultivable Land*** – including Current Fallow and Net Area Sown.

Source: Department of Agriculture and Co-operation, Ministry of Agriculture, Government of India.

Marginalisation of Farm Holdings

Although the total area under cultivation remained almost stable around 160 million hectares, the structure of landholding across different size classes of holdings has changed over time. Number of holdings in India has increased from 71 million in 1970-71 to nearly 137.8 million by 2010-11. As a result the average size of the land holding, which was low at 2.28 hectares in 1970-71, declined further to 1.16 hectares by 2010-11 (Table 3.2). Over time there is a increase in the area under small and marginal farmers with a corresponding decline in the area and number of holding under medium and large farmers. The share of marginal farmers with cultivated land below one acre (0.40 hectares) in total rural households with cultivated land is showing an increasing trend over time. Increasing population pressure and nuclear family systems accompanied by slow pace occupational diversification from agriculture to non-agriculture and thereby the fragmentation of landholding is one of the reasons for the increasing number of and share of marginal holdings in India.

Table 3.2: Changing Distribution of Land Holdings in India

Year	Total		Average Size	%Distribution of Holdings					% Distribution of Area				
	Holdings No (M)	Area (M) Hec		Marginal	Small	Semi-Medium	Medium	Large	Marginal	Small	Semi-Medium	Medium	Large
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*
1970-71	71.0	162.1	2.28	50.6	19.1	15.2	11.3	3.9	9.0	11.9	18.5	29.8	30.9
1980-81	88.9	163.8	1.84	56.4	18.1	14.0	9.1	2.4	12.0	14.1	21.2	29.6	23.0
1990-91	106.6	165.5	1.55	59.4	18.8	13.1	7.1	1.6	15.0	17.4	23.2	27.0	17.3
2000-01	120.8	159.9	1.33	63.1	18.9	11.6	5.7	1.0	18.8	20.2	24.0	23.8	13.2
2005-06	129.2	158.3	1.23	64.8	18.5	10.9	4.9	0.8	20.2	20.9	23.9	23.1	11.8
2010-11	137.8	159.2	1.16	67.08	17.93	10.05	4.25	0.73	22.25	22.07	23.59	21.18	10.92

Note: Marginal below one hectares, Small is between one and two hectares, Semi-medium is between two and four hectares, Medium is between four and ten hectares, Large is 10 and above hectares.

Source: All India Agricultural Census.

Impact of Land reforms

The ownership and tenure defines the access to and control over land resources. The Land Reforms programme in India soon after the independence was to remove anomalies and establish better land tenure systems which facilities the agricultural development in general and welfare of the farmers/cultivators in particular. There has been great debate over the implementation of land reforms and how far it is successful in realising its objectives. The implementation of land reforms since independence had, however, a considerable impact on the distribution of land holdings towards landless labour households. Though the distribution of total land to landless poor might not had a substantial impact on the increase the number of holdings in India, the indirect of impact of Land Ceiling Legislation on the land transfer is considerable. In this respect the impact of both the state policy and its legal mechanism (from the above) and the social movements (from the below) in those states wherever they are strong while implementing the land reforms in terms of distribution of concentrated land holdings to the landless poor households is considerable (Reddy, 2006).

Along with threat of social movements and policy measures, the structural changes in the economy with the economic growth also brought marketed driven distributional changes in the structure of land holdings in the rural agrarian economy of the country. The occupational shift from agriculture to non-agriculture especially rural land rich households, owing to growing non-agriculture sector along with educational development and thereby increasing employment opportunities in the non-agricultural sector, facilitated the transfer of land rights/ownership to landless or small and marginal farmers through the market mechanism. It also led to the fragmentation of single holding into more than one holding depending on the number of farmers sharing the total land sold (Babu, 2008). Very often it begins with the lease-in of the land and ends up with complete transfer of rights overtime, duration depends upon the capacity of the landless and small and marginal farmers to buy land.

However, the distribution of land to landless poor through land reforms without proper institutional arrangement for supporting their farming activity has, however, sometimes nullified the beneficial impact. Very often it was the case that when land distributed is uncultivated, the beneficiary has to make efforts to convert the land into cultivable one. While the beneficiary household may have sufficient own man power to convert the land to cultivable one but they may not have capital/investment required for the conversion of uncultivable land into cultivable and for the production. Many of them have to depend on the non-institutional credit market which is found to be risky.

The issues emerges herein is that increasing number and share of marginal farmers below one acre land is the cause of the concern. It is so because in the context of declining availability of family labour and increasing cost of cultivation, the viability of marginal holdings for commercial farming is at risk unless technological innovation comes to the rescue of these marginal farmers.

Changing Land Tenure System in India

The Tenancy Policy, as a part of Land Reforms programme Tenancy Reforms was launched to confirm the rights of occupancy by tenants, regulate rents on leased land and to secure their possession of tenanted land. The implementation and success of tenancy regulation especially the regulation of rents on leased-in land is also an issue of debate. Nevertheless, along with other aspects of land related issues tenancy continues to exist although the extent of tenancy seems to be declining (Table 3.3). Based on the NSS Land Holdings Survey, tenant holdings

as a percentage of total number operated holdings it reduced from 23.5% in 1960-61 to around 10% by 2002-03. Similarly, the area under tenancy as percentage of total operated had reduced from around 11% to 6.5% during the same period (Table 3.3).

Table 3.3: Trends in Extent of Tenancy in India by Size Class of Operated Holdings

Sno	Details	1960-61 (17th)	1970-71 (26th)	1981-82 (37th)	1991-92 (48th)	2002-03 (59th)
Percentage of Tenant Holdings in Total						
1	Marginal (<= 1 Hectare)	24.1	27.0	14.4	9.3	9.8
2	Small (1 to 2 Hec)	25.1	27.8	17.9	14.9	10.7
3	Semi-medium (2 to 4 Hec)	23.6	24.8	15.9	12.2	10.3
4	Medium (4 to 10 Hec)	20.5	20.0	14.5	13.1	7.8
5	Large (More than 10 Hec)	9.5	15.9	11.5	16.7	13.8
All		***23.5***	***25.7***	***15.2***	***11.0***	***9.9***
Percentage of Area under Tenant Holdings						
1	Marginal (<= 1 Hectare)	16.6	18.9	9.7	8.7	8.6
2	Small (1 to 2 Hec)	14.0	14.6	8.5	8.5	6.8
3	Semi-medium (2 to 4 Hec)	11.7	11.7	7.3	7.4	6.3
4	Medium (4 to 10 Hec)	9.6	8.7	6.6	6.9	4.2
5	Large (More than 10 Hec)	8.3	5.9	5.3	11.4	6.1
All		***10.7***	***10.6***	***7.2***	***8.3***	***6.5***

Source: NSSO Report – Some Aspects of Operational Land Holding in India.

It is interesting to note that the decline in extent of tenancy is observed across all the category of holdings, although the trend in the larger farm holding category is not showing any clear pattern. The trend shows that the extent of tenancy is higher among the large farmers than the lesser size category farmers (Table 3.3). It is, however, to be noted that some of the research scholars pinpoint at the underestimation of the extent tenancy by the information captured through NSSO's Land Holding Surveys while referring to individual researchers' village level studies (Rawal, 2011).

Table 3.4: Trends in Terms of Lease-in in India

Sno	Details	1960-61 (17th)	1970-71 (26th)	1981-82 (37th)	1991-92 (48th)	2002-03 (59th)
Percentage of Leased-in Holdings by Terms of lease-in						
1	Fixed Money	23.2	12.7	11.9	23.3	26.0
2	Fixed Produce	12.4	10.5	7.6	17.9	19.2
3	Share Cropping (produce)	42.0	50.7	38.7	42.1	43.3
4	Others	22.4	26.1	41.8	16.7	11.5
All		100	100	100	100	100
Percentage of Leased-in Area by Terms of lease-in						
1	Fixed Money	25.6	15.4	10.9	19	29.5
2	Fixed Produce	12.9	11.6	6.3	14.5	20.3
3	Share Cropping (produce)	38.2	47.9	41.9	34.4	40.3
4	Others	23.3	25.1	40.9	32.1	9.9
All		100	100	100	100	100

Source: NSSO Report – Some Aspects of Operational Land Holding in India.

The general concern with respect to the tenancy is the various forms of tenancy and insecurity and vulnerability of the tenant farmers. With respect to the forms of tenancy or terms of lease-in market how it operates, there are different forms of tenancy. The most prevalent forms of tenancy are fixed rent (cash or kind i.e. produce) and share cropping. Among these two, share cropping is the most prevalent form wherein more than two-fifths of the total holdings and area under tenancy are in this mode.

Although these forms of tenancy are not mutually exclusive in a particular area/region, in general, the fixed rents are common in irrigated areas and share cropping is predominant tenancy form in the dry land areas. Tenants under both the forms of tenancy are vulnerable to chances of crop failures in the events of drought or floods or due to pest attacks in the both the dry land and irrigated areas.

The issue is the problems of tenant farmers in terms insecurity, chances of crop failures, lack of crop insurance, lack of access to formal credit market and surplus extraction through different forms of exploitation by the land lords. Among the two forms of tenancy i.e. fixed rents and share cropping, the former is more risky than the latter in the event of crop failure – tenant has to pay the rent despite such an event unless the landlord is kind enough to relax. Share cropping is also seen as exploitation in terms surplus extraction through a credit system of land lord providing loans for production and consumption of the tenant at high rate in the absence of formal credit market and access to this institutional credit.

Given these vulnerabilities of tenant farmers time and again policy measures ensuring security for tenant farmers especially those small and marginal who are more vulnerable to risks of crop failures and input and output market price changes, are called for. The policy measure which ensures the occupancy right and secures the possession of tenant land may not have much leverage in the present context as it was the cases of Tenancy Reform. Rather it is the regulatory mechanism for fixing the rents and institutional support for tenant farms in terms of crop insurance in the events of crop failure, direct access to institutional credit and agricultural subsidies and schemes relevant to crop production.

An initiative considered to be successful in the country is the *Operation Barga* initiated by the West Bengal state government, as early as in late 1970s, in order to protect the rights of share cropping tenants, i.e. the Bargadars. It began with the registration of share cropping tenants and assuring them protection against eviction and ensuring them inheritable quasi property rights and guaranteed their due crop share. It also facilitated the conversion of tenants becoming land owners by giving them the priority right in cases of owner selling land. According to an estimate, around 1.5 million consists about 65% of the total tenants, are said to be registered under the Operation Barga. The initiative had changed the conditions of tenants, brought economic stability among farmers and contributed to the growth of agriculture in the state. Nevertheless as elsewhere in India, the supportive measures such as access to institutional credit for these resource poor tenant farmers, was not ensured.

Recently the Government of Andhra Pradesh is implementing a scheme of licensed tenant farmers. The identified tenant farmers are entitled to have access and avail benefit of the schemes related to farm production especially the agricultural subsidies directly circumventing their landlords4. Although it is an important and innovative initiative in Andhra Pradesh, the practical problems while implementing the policy in terms of identification of tenant farmers. Such a kind of policy measure with certain modification is worth emulating to the rest of the India. However, such a policy measure while distributing the benefits of any particular scheme meant for marginal and small tenant farmers must be cautious about the reverse tenancy taking place wherein the large farmers lease-in the marginal and small farmer's farm holdings.

[4] Prof. Jayati Ghosh Commission in the advent of agrarian distress witnessed in the state has recommended such a policy measure and finally it is implemented based on the recommendation of the Koneru Rangarao Committee.

Land Records

The more important issue related with land is the maintenance of land records. The advantages of a better land administration system are: guarantee of ownership / security of tenure, support for land property taxation, provision of security for credit, development and monitoring of land markets, protection of State lands, reduction of land disputes, facilitation of rural land reform and for imposition of land ceilings, support for environmental management and so on. On the whole it facilitates the better governance with respect to land and agricultural production.

Initial efforts of land survey and settlements began in the pre-British regimes. However, more methodical and scientific survey of lands and settlements of revenue lands and thereby maintenance of land records began during the British rule with the enactment of various Settlement Acts. The British system of land records was passed on to Independent India and it has been continuing till date. Although the cadastral maps5 were required to be updated every 30 years, most of the states have not carried out any survey and settlement operations since independence. These out dated land records may not reflect the ground realities with regard to ownership and possession. Also the accuracy of the original cadastral surveys, which were carried out based on the technology and accuracy standards relevant at that time, are wholly or partly inadequate now due to rapid fragmentation of land parcels coupled with the rising land prices.

Moreover, land records were not maintained in few regions of the British India and the states formed out of those regions in the post-independence period continued go without any form of land records; for instance, West Bengal and Bihar. Particularly in Zamindari areas of the British India had not maintained land records. In the non-land record state one cannot call out information on land utilisation and cropping pattern which are critical for development planning. There have been measures to maintain up-to-date informative land records across states even in those states which did not inherited the system of land records from the past.

Two centrally sponsored schemes introduced for the maintenance of up-to-date records of land and digitisation/computerisation of land record using information and communication technology (ICT). The scheme6 for Strengthening of Revenue Administration and Updating of Land Records (SRA & ULR) was started in 1987 with a view to assist States/UTs in the task of updating of land records. The other one Computerization of Land Records7 (CLR) commenced in 1988-89. Both the schemes were merged into a modified National Land Records Modernisation Programme (NLRMP) in 2008. These schemes have prompted the state governments to go for computerisation of land records.

Initially the CLR was launched on pilot basis in a few states and specific districts or tehsils. Later on the scheme of computerisation of land records (CLR) was extended to cover 4,423 talukas or tehsils (revenue circles) in 1021 sub-division in 582 districts of the country. Effort for computerization of land records was started in West Bengal from 1986-'87. The first version of the Land Records computerization software, named as "BHUMI" developed in

[5] Land surveys are two types: Topographical and Cadastral. The former in India is conducted by the Survey of India and the later is a Revenue Survey conducted by respective Revenue Departments. The Cadastral Survey determines the boundaries, area and ownership of each individual holding.

6 Under this Scheme, financial assistance is given for purchase of modern survey equipment like Global Positioning System (GPS) and others. It is based on 50:50 of centre and state funding.

7 The CLR scheme is based on 100% Central assistance pattern.

1989. Under CLR about 95% of the 367 lakhs records of rights (i.e., 349 lakhs) individual records have been computerized. The story of West Bengal is considered to be successful in this respect. Karnataka state government also made attempt. Under the Bhoomi E-Governance project all 20 million land records of 6.7 million land owners in 176 taluks of Karnataka have been computerised. Similarly states such as Andhra Pradesh, Punjab, Haryana and others have taken up the implementation of scheme.

The main objective of the scheme was to provide landowners with computerised copies of ownership, crop and tenancy and updated copies of records of rights (RoRs) on demand across states. But only 13 states out of 35 states and Union territories are in a position to provide RoRs on demand in 2008. These states are Andhra Pradesh, Chhattisgarh, Goa, Gujarat, Karnataka, Madhya Pradesh, Maharashtra, Rajasthan, Tamil Nadu, Sikkim, Uttar Pradesh, Uttarakhand and West Bengal8. The latest information (31/32011) shows that although 26 states including all the major states are said to have completed the computerisation of land records, only 16 states have placed the information on the website.

IV Technology and Growth of Agriculture

Since land available for cultivation is limited, improvement in productivity of land involving better farming systems and farming techniques, intensity of labour and capital, technology of seeds and other inputs, and infrastructure such as irrigation critical for increasing the agricultural production.

Concentrated effort in this direction in India began with the new strategy of agricultural development implemented during third and fourth five year plans and that in turn began with the implementation of the Intensive Agricultural District Programme (IADP) on a pilot basis in three districts in the beginning in 1960-61 and spread gradually to 13 more districts subsequently in those areas which were best endowed with food production. The encouraging results of the programme led to its expansion to several other parts of the country under the Intensive Agricultural Area Programme (IAAP). These were the pace setting demonstrational programmes and path finding experimental programmes that showed increase in yield rate thereby the production and they facilitated the development of new ideas, innovations and procedures for wider adoption of agricultural development. With a begging of the intensive cultivation under irrigated areas and increasing application of chemical fertiliser input, the new agricultural strategy realised the phenomenal increase in production of food grains and productivity of land through high yield varieties (HYV) of seeds.

Green Revolution Technology: HYV, Chemical Fertilisers and Mechanisation

Green Revolution Technology (GRT) is the first innovative technological application, in a large scale, made to Indian crop sector during mid-1960s and 1970s. The GRT has brought changes in farming techniques, high yield varieties (HYV) seed, application of chemical fertiliser and increased the intensity of labour and capital. But its application is limited to few crops (rice and wheat), states and irrigated areas. However, the externalities effect of the GRT in terms of inputs application is spread to remaining crops and states.

8 Financial Express (2/6/2008) "Rural India lags in land records computerisation", accessed through http://www.financialexpress.com/news/rural-india-lags-in-land-records-computerisation/317334/

The implementation of green revolution technology began with the use of high yield varieties (HYV) of seeds especially for paddy and wheat crops. Since its implementation of GRT, the area under HYV seeds increased tremendously, more than half of the gross sown area (GSA) in India is under HYV seeds of various crops. The HYV seeds have been developed scientifically with the help of genetic engineering over a period of time for most of the cereals and other crops. These seeds are known for higher resistance to pests, diseases and moisture stress. The cultivation of these seeds is usually associated with higher levels of inputs such as chemical fertilisers and pesticides.

Application of modern chemical fertilisers along with traditional manure or bio-fertiliser has also been an innovative practice with the implementation of green revolution technology. Since then there is tremendous increase in the chemical fertiliser application (Table 4.1). The intensity of application (kgs per hectare) increased eleven times higher in the recent past (2010-11) than that of the early part of the green revolution (i.e. 1970-71). A substantial part of the chemical fertilisers are imported from abroad especially most of the phosphorous fertilisers are imported from abroad.

The adverse impact of usage of chemical fertilisers particularly over and disproportionate ratios of chemicals especially nitrogen (out of three chemical Nitrogen, Phosphorus and Potassium – N P K) has reduced the soil fertility and thereby resulted in soil nutrient depletion. Nitrogen consists of more than two-thirds of the total chemical fertilisers consumed (Table 4.1). Indo-Gangetic Plains (IGP) are the most affected with and a witness for such a phenomenon. Heavy application of the chemical fertilisers especially the nitrogen had also been adversely affecting the water resources (both the surface and ground water) through water contamination.

Table 4.1: Chemical Fertilisers Consumption in India

Year	Total Consumed	GSA	Consumption per hectare	Consumption Composition (%)			% of Imports		
				N	P	K	N	P	K
1950-51	65.6	131.9	0.50	89.5	10.5	0.0	-	-	-
1960-61	292.1	152.8	1.91	71.9	18.2	9.9	-	-	-
1970-71	2177.0	165.8	13.13	68.3	21.2	10.5	-	-	-
1980-81	5515.6	172.6	31.95	66.7	22.0	11.3	25.9	25.9	95.7
1990-91	12546.2	185.7	67.55	63.7	25.7	10.6	5.2	31.5	100.0
2000-01	16702.3	185.3	90.12	65.4	25.2	9.4	20.3	22.3	113.8
2005-06	20340.3	193.3	105.22	62.6	25.6	11.9	1.4	9.4	98.3
2010-11	28122.21	193.3	145.47	58.9	28.6	12.5	10.9	21.5	113.8

Note: 1. Total Consumed – Total volume of chemical fertilisers consumed (in 000 tonnes); 2. GSA – Gross Sown Area (in million hectares); 3. Consumption is in kilograms per hectare; 4. % of Import – Imported fertilisers as a percentage of total chemical fertilisers consumed; 5. '-' Data not available.

Source: Department of Agriculture & Coopration, Ministry of Agriculture, Government of India.

The green revolution technology also brought the mechanisation of farming. With the application of the green revolution technology, and the timeliness in plantation / transplantation, application of different inputs, and harvesting, the work/labour intensity has increased in the crop sector. Mechanisation is seen in the form of diesel or electricity pump sets for ground water irrigation, ploughing and harvesting machinery etc.

The number of tractors and tillers for ploughing has increased tremendously. It is observed that more than three million tractors are in use in India for agriculture purposes – second largest in the world next to USA. Recent trend is a substantial increase in the number of

harvesters and threshers. Also there is phenomenal increase in the number of pump sets energised in India to lift the ground water for irrigation purposes. Moreover, around one-fourth of the electric power demand/consumption in India arises from the agriculture particularly for irrigation. In many parts of the country where electricity supply short fall of the demand particular for agriculture there the dependency is still on the diesel pump sets. The limiting factor in using ground water resource and thereby variation across states in this respect could be the availability of energy resources to lift the ground water.

Table 4.2: Growth in Sources of Mechanical Power used for Farming in India

Year	1951	1961	1971	1981	1991	2001	2006	2010
Tractor	0.008	0.031	0.148	0.52	1.32	2.6	-	-
Power Tiller	-	-	0.017	0.08	0.095	0.122	-	-
Electric pumps	0.02	0.10	1.6	4.3	8.9	9.5	-	-
Diesel pumps	0.08	0.23	1.5	3.1	4.7	6.5	-	-
Total pumps	0.11	0.39	3.2	6.7	14.4	-	-	-
Power sprayer/duster	-	-	0.045	0.124	0.2	-	-	-

Note: Figures in Millions.

Source: 1. Agricultural Research Data Book, 2001; 2. Ministry of Agriculture, Govt. of India.

A negative effect of mechanisation that was observed particularly in the Indian context during the period of green revolution technology implementation was the displacement of labour. Moreover, appropriateness of mechanisation to small and marginal holdings has also become a cause of concern.

Irrigation – Large Scale Irrigation to Micro/drip-irrigation Systems

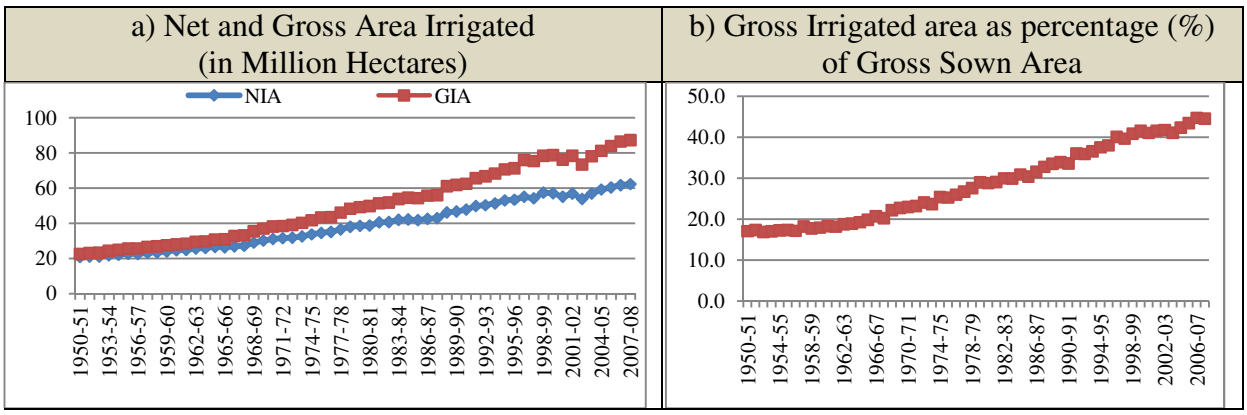
Irrigation infrastructure is the most important factor for the development of agriculture. First of all it stabilises the production in the crop sector and increases the crop intensity – area cultivated more than once in an agriculture year. The total irrigated area in India (Net/Gross) has shown remarkable improvement overtime (Figure 4.1a). The percentage of irrigated are to cropped area (GIA to GSA) has increased from 15% in 1950s to close to 50% in 2000s (Figure 4.1).

However, one concern in the context the surface irrigation system is that there is an increasing dependence on major irrigation systems and neglect of minor irrigation systems. Moreover between the surface and ground water resources, there is an increasing dependence on the groundwater resources for irrigation. The area irrigated under traditional tank based irrigation system has continuously been declining. With the emergence of large scale irrigation dams, actual area irrigated under canal irrigation system had increased till 1980s and thereafter the area under the ground water based irrigation system is increasing. In terms of the percentage of area irrigated under different irrigation systems to total net irrigated area, it has shown a declining trend for the Tanks, Canal, even under shallow type of well irrigation and all the other residual source of irrigation (Figure 4.2). The only source that has shown a steep rise in its contribution is tube well irrigation system and it is now contributing around 45% of the irrigated area in the country. If we combine both the tube well and other wells (shallow type) irrigation systems it would be 60% of the irrigated area.

The last decade witnessed a kind of stability or marginalising the pace of rapid decline in the contribution of all the sources of irrigation except the tube well source that experienced during the previous decades (Figure 2.10). The canal and other residual forms of irrigation systems have marginally improved their contributions since mid-2000s. It could be because of

Accelerated Irrigation Benefit Programme9 (AIBP) of Government of India helping state governments in completion of the on-going major irrigation dams and thereby enhancing canal irrigation system and check dams (residual sources of irrigation) under Watershed Development Programmes.

Figure 4.1: Growth in Irrigated Area, All India

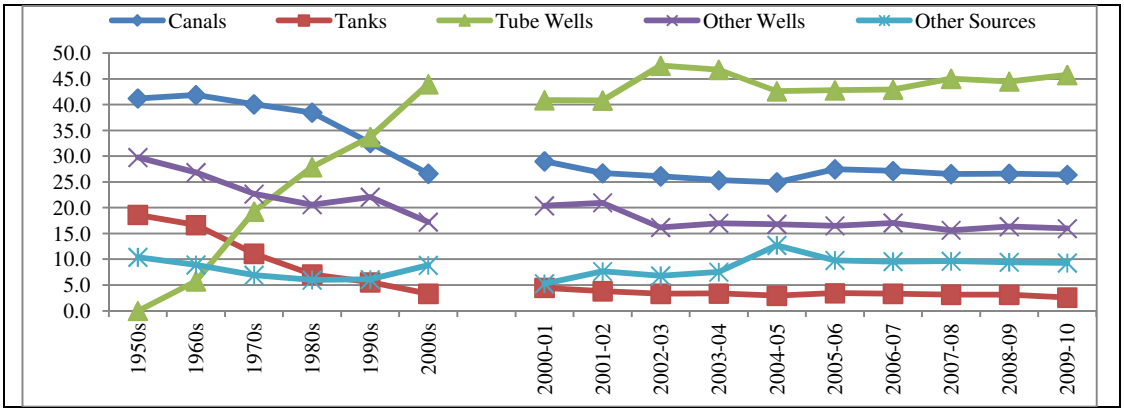


Note: NIA – Net Irrigated Areas; GIA – Gross Irrigated Area.

Source: 1. Reserve Bank of India; 2. Ministry of Agriculture, Government of India.

However, the growing demand for irrigation has its consequences. As the surface irrigation under tanks and through large scale to small scale minor irrigation is not meeting the increasing demand, ground water irrigation system (shallow wells and bore/tube wells) is growing inevitably. Negative consequences of growing dependence ground water irrigation system are: depletion of ground resources and thereby upcoming water crisis. Secondly, most of the ground water irrigation is based on the private investment. In the event of failure of bore/tube wells, farmers face wastage of scarce investment resources available to them. Large scale occurrence of such events contributed to agrarian crisis.

Figure 4.2: Percentage Distribution of Area Irrigated by Source – All India



Note: Distribution of Net Area Irrigated.

Source: Department of Agriculture and Co-operation, Ministry of Agriculture, Government of India.

[9] The AIBP was conceived in the year 1996 by the Government of India in order to provide financial assistance to States to complete various ongoing projects in the country so that envisaged irrigation potential of the project could be created and thereby extend irrigation to more areas (Ministry of Water Resources, Government of India).

Taking note of necessity irrigation and at the same time need for proper utilisation of scarce water resources, there are also efforts towards enhancing the micro irrigation technology (drip and sprinkle irrigation systems) particularly for dry land farming. This micro irrigation technology in fact helps in improving the water use efficiency. However, the micro irrigation system is yet to be widespread. Herein policy efforts needed to propagate the efficiency of micro irrigation systems.

Land Development Programmes

While recognising the importance of land development and irrigation need, Government of India as well as the respective state governments have initiated different land development programmes.

Land policy in India has undergone change in broadly four phases since independence. While land-reform legislation remained active, land policies in more recent decades have focused less on land reform and more on land development and administration. Land reforms were in the forefront in the first and longest phase (1950-72). During the second phase (1972-85) attention shifted to bringing uncultivated land under cultivation. In the third phase (1985-95) water and soil conservation was given more importance through Watershed Development, Drought-Prone Area Development (DPAP) and Desert-Area Development Programmes (DADP). A central government Wasteland Development Agency was established to focus on wasteland and degraded land. The fourth and current phase of policy (1995 onwards) centres on debates about the necessity to continue with land legislation and efforts to improve land revenue administration and, in particular, clarity in land records (Deshpande, 2003; Reddy, 2007). The implementation of watershed development programme through community mobilization and participation is said to be moderately successful in its endeavour. However, how far these land development programmes have improved the productivity of land and well-being of the rural agricultural dependent population is a matter of policy debate.

Productivity of Indian Agriculture

Another major concern is the productivity of the crop sector in India. Given the inelastic nature of the geographical area and thereby the area available for crop production, increasing the productivity of land and seed is the only way for the increase in the out turn of the crop sector. The green revolution technology and associated inputs along with irrigation infrastructure has witnessed remarkable improvement in the yield rates especially for the HYV crops such as rice and wheat.

The externality effect of green revolution technology especially in terms of irrigation and inputs like fertiliser and pesticide usage and the farming techniques applied to other crops also increased their yield rates. Most of the food and non-food crops have shown an increasing trend in their yield rates. As a result of the green revolution technology and its externality effects has increased the total food grains production and thereby facilitated the self-sufficiency in availability food grains for feeding the country's total population. However, the impact of green revolution technology is not ever lasting. In the post-green revolution period especially since 1990s, it said that there is a technological stalemate in the Indian agriculture sector. The country's Research and Development (R&D) has not seen any breakthrough in agriculture related research and technology.

There has been a policy concern for the dry land farming in the rain-fed backward regions of the country. More than half of the arable land in the country is rain-fed which depends on the

intensity and frequency of rainfall. Many of the crops grown in India - most of the pulses crops and oilseeds and some of the cereals particularly coarse cereals - are rain-fed crops. Dry land farming plays a dominant role in the production of food grains and others crops. The traditional farming in dry land area was more of a survival mechanism – subsistence in nature. Overtime with policy attention turned towards making the dry land farming a growth oriented activity.

The rate of growth in yield rates of the selected crops indicates that for most of the crops the rate of growth had decelerated during 1990s when compared to that of previous decade. For many of these crops which shown a deceleration in growth of yield rate during 1990s have improved during the last decade (2000s). Interestingly, however, the green revolutions' HYV crops such as rice and wheat have shown a deceleration in the rate growth in the yield rate since 1980s (Table 4.3). Among the cereals bajra and maize are the crops and the total of coarse cereals shown continuous increase over the last three decades in the rate of growth in their yield rate. Although most of these crops are intended to be grown under the dry land farming system, they are also increasingly grown in irrigated areas. Therefore, factor behind increase in yield rate in these crops traditional grown in dry land area is due to dry land farm technology or irrigated area is uncertain. Among the fibres, cotton has moved remarkably high rate of growth in its yield rate during the 2000s from almost a negative rate of growth in 1990s. It could be due to the Bt. variety of cotton grown in many parts of the country.

Table 4.3: Growth in Yield Rates of Principle Crops in India

Crops	1949-50 to 1968-69.	1980-81 to 1989-90	1990-91 to 1999-2000	2000-01 to 2010-11
All Principal Crops	1.53	2.6	1.3	3.3
Total Food grains	1.65	2.7	1.5	2.9
Non-Food grains	0.97	2.3	1.1	2.5
Total Cereals	1.82	2.9	1.6	3.2
Total Pulses	(-) 9.10	1.6	0.9	1.9
Total Oilseeds	0.53	2.4	1.2	3.6
Total Fibres	1.52	4.0	-0.3	9.6
Rice	1.78	3.2	1.3	1.6
Wheat	1.9	3.1	1.8	0.9
Jowar	1.42	1.3	0.5	2.8
Bajra	1.21	1.1	2.4	2.7
Maize	1.05	2.1	2.3	2.8
Ragi	1.51	1.1	2.1	1.9
Small Millets	-	1.1	-0.5	2.8
Coarse Cereals	-	1.6	1.8	4.2
Sugarcane	1.2	1.2	1.1	0.5
Groundnut	0.06	2.1	1.1	2.1
Nine Oilseeds	-	2.5	1.4	3.0
Cotton	1.98	4.1	-0.4	10.9
Jute	0.27	3.4	0.8	1.4

Note: 1. (-) indicates the negative growth; 2. '-' Not Available; 3. The figure for the period 1949-50 to 1968-69 are based on the Fourth Five Year Plan Document of Planning Commission, Government of India.

Source: 1. Planning Commission, Government of India; 2. Department Agriculture and Cooperation, Ministry of Agriculture, Government of India.

However, when compared to World average and the rest of the countries even in Asian region, the yield rates in India seem to be very low. For instance, for rice crop although India is the second largest in production, the yield rate of country is one of the lowest. The rice yield rate in India is around 3200 Kgs per hectares whereas the World average is around 4300

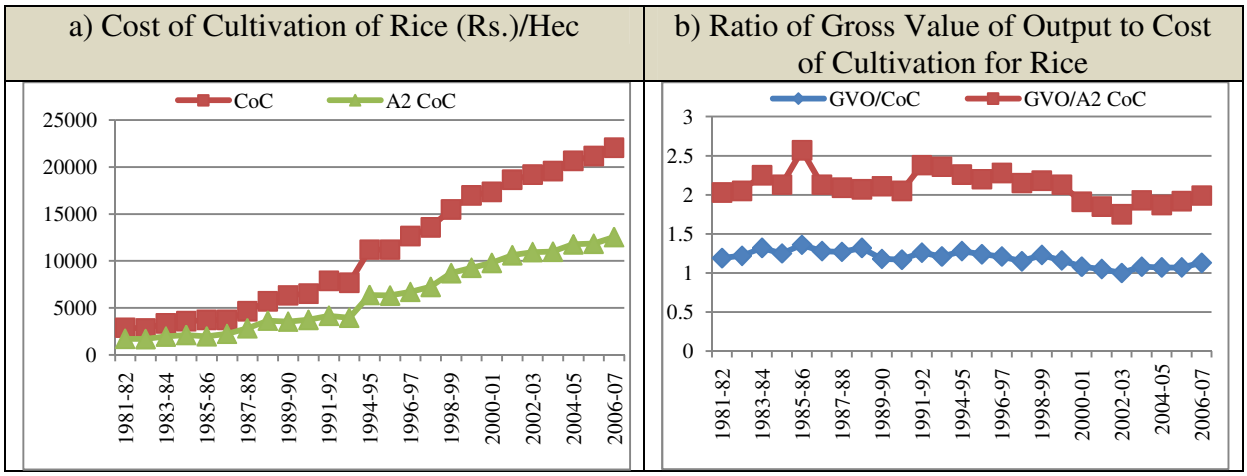
Kgs. Neighbouring countries such as China (6500 Kgs), Bangladesh (4200), Myanmar (4000) Sri Lanka (3700 kgs), and Pakistan (3500) are ahead of India. The highest yield rate in the world is 10000 Kgs in Egypt. It indicates the relatively poor performance of India.

V Increasing Cost of Agriculture

As mentioned above Indian agriculture has transformed from subsistence farming to commercial one. Subsequently the dependency input market is also increasing. As a result raising market prices for the necessary inputs required for the farming both the subsistence and commercial is adversely affecting the cost cultivation and income from the farming. Rising input costs owing to increasing costs of the labour as well as non-labour inputs, over time have increased the cost of cultivation/production in agriculture sector.

The Figure 5.1 below exhibits the increasing cost of cultivation especially since 1990s for rice. It also show that the declining the ratio of gross value of output of rice production to its cost of cultivation is declining. It indicates the profitability of the rice cultivation is declining over time. Similar pattern may be observed for the many of the other crops in India.

Figure 5.1: Cost of Cultivation in India for Rice



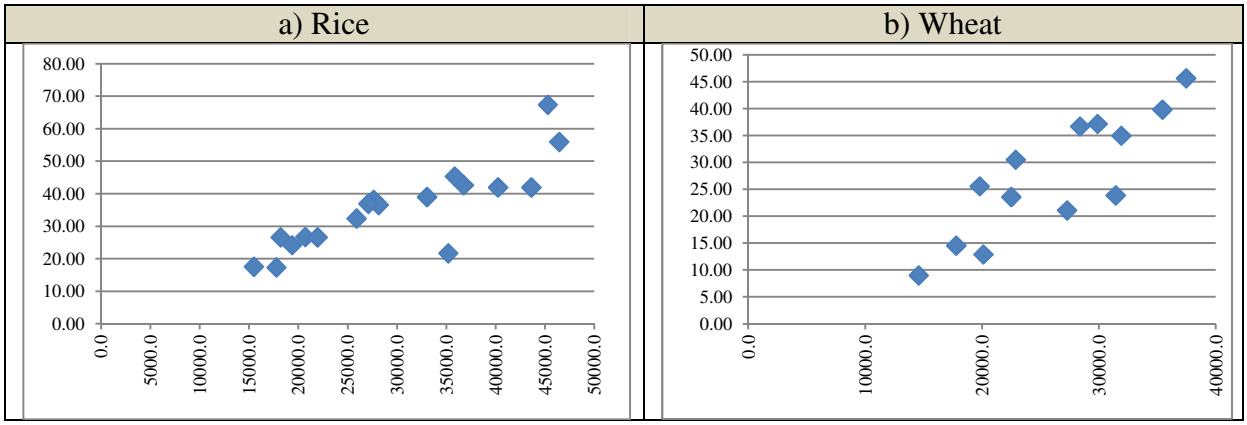
Note: CoC – Cost of Cultivation; GVO – Gross Value of Output

Source: Dev and Rao (2010).

It is also interesting to note that the yield rate is positively associated with the cost of cultivation (Figure 5.2a&b). In other words higher yield rates are observed in those states where the cost of cultivation is high. It indicates the investment requirements for the improvement in yield rates in agriculture.

However, unless the profit margin with respect to cost of cultivation and value of output increases with the increasing cost of cultivation and thereby yield rate, the incentive to investment especially that of the private investment of the farmers is null and void. In the commercialisation process of agriculture, for certain commercial crops given production and high value of crops the total value of output appears to be very high. But the experiences shows that there is marginal surplus out of the total value of the crop production after deducting the increasing high input costs and depreciation of fixed capital especially that of farm equipment and so on.

Figure 5.2: Scatter Plot Showing relationship between Cost of Cultivation (Rs.0.0 per hectare) and Yield Rate (Kgs per hectare) across States in India in India, 2008-09



Note: 1. Number of States considered for the analysis are major producing states 18 for Rice and 13 for Wheat; 2. Cost C2 includes all actual expenses in cash and kind incurred in production by owner, interest on value of owned fixed capital assets (including land), rental value of owned land (net of land revenue), rent paid for leased in land and imputed value of fixed capital assets.

Source: Directorate of Economics and Statistics, Department of Agriculture and Cooperation.

For the increase in cost of cultivation both the different types of external and domestic, input and output, markets are responsible. In a globalised world, integration of local economy with that of global economy, the local economy is vulnerable to the changes in the global economy. External shocks such as steep rise in oil prices affects the input cost of the agriculture such as fertilisers.

Box 5.1: Crop Holiday Declared by Farmers in Andhra Pradesh

The recent crop holiday declared by farmers in Andhra Pradesh is an unusual phenomenon in agrarian history and reflecting the symptom of larger crisis in agriculture. Crop Holiday declared by a section of the farmers of the Konaseema area of East Godavari district of Andhra Pradesh covering 85,050 acres was not cultivated by during the 2011 Kharif season. Spiraling effect of the declaration is that in many parts of the state and country a large tracts of land (around 3 lakh acres) remained uncultivated. In the wake of the declaration of a "Crop Holiday", the Government of Andhra Pradesh (GoAP) constituted a Committee chaired by Dr. Mohan Kanda. It is observed that increasing cost of cultivation is not being covered either by market price or by MSP. The Committee finds that an ineffictive procurement system, storage capacity, crop failures on account of frequent cyclones, improper maintenance of the drainage system, late release of canal waters, non-availability and high cost of labour and lack of suitable farm machinery are among the major reasons for declaring Crop Holiday.

Source: GoAP, 2011.

Traditional farming system using family labour and owned farming animals for ploughing is also losing its viability. Maintenance of farming animal involving fodder/feed cost owing to declining area under green pastures and common pool resources. The availability family labour is declining with declining family size. As Indian agriculture is no longer subsistence farming as it was three decade ago, commercial farming needs intensification of farm labour. Therefore, dependency on hired labour and mechanised cultivation is increasing and this phenomenon in turn increasing the cost of cultivation. Besides, the unregulated seed, fertilisers and other input markets leading to hoarding and black marketing are resulting in increasing cost of cultivation. Moreover the increasing private investment for ground water irrigation systems is also a matter of concern as it is increasing the cost of cultivation. It is

well documented that cost of irrigation in terms of fixed investment as well as operating costs is one of the factors contributed to the agrarian crisis resulted in the spate of farmers' suicides in different parts of India.

The minimum support prices (MSP) regime for agricultural commodities began during mid-1960s with the advent of green revolution technology and thereby increasing cost of cultivation, has been to ensure the price of the production at least meets the cost of production. It has been encouraging farmers continue the crop production. However, the recent trend has shown that there are instances that the MSP fixed by government of India is not able to cover the cost of cultivation particularly in case rice (see Dev and Rao, 2011). In the context of variation in cost of cultivation across states and region in India depending upon their labour and other input markets, the MSP fixed at all-India level may be beneficial to some states or regions but for other it may not cover the cost of production. The recent incidence of 'Crop Holiday' declared by rice producing farmer in Andhra Pradesh reflects the gap between cost of cultivation/production and the price they receive from the output market or the MSP wherein the price received is lower than the cost of production (Box 2.1; also see GoAP, 2011). Moreover the MSP based procurements are getting concentrated in particular states and region, not getting spread over to all the major producing states and regions.

Access to Credit – A constraint

The transition from traditional subsistence agriculture to modern and commercial agriculture in terms of both the input and output markets and concerns of the total factor productivity in agriculture had raised the necessity of financial investment requirement in the sector. But for the resource poor farmers mobilising resources for such a capital investment and operational costs to raise productivity their farm and crops they grown has been remained a limitation. Despite the policy efforts in terms of nationalisation of banks and agriculture as a priority sector lending in order to address such a limitation, access to institutional finance for agricultural activities is still inadequate in meeting the expanding credit demands from the farming entrepreneurs, particularly for small, marginal and tenant farmers it is out of their reach. The recent Expert Group on Agricultural Indebtedness has emphasized on the inadequacy of institutional credit while meeting increasing credit requirement in the increasingly modern and commercial nature of agriculture (GoI, 2007b).

Table 5.1: Institutional Credit to Agriculture

Year	Total Credit (Rs Crore)	Share in Total Credit Flown to Agriculture (%)			% of Short Term Credit
		Cooperatives	Commercial Banks	RRBs	
1970-71	744	100	-	-	-
1980-81	3,292	61.6	38.4	-	-
1900-91	9,830	49.0	47.6	3.4	
2000-01	52827	37.9	54.1	7.8	63.1
2001-02	62045	37.9	54.1	7.8	65.3
2002-03	69560	34.0	57.2	8.7	65.5
2003-04	86981	30.9	60.3	8.7	63.2
2004-05	125309	24.9	65.0	9.9	59.1
2005-06	180485	21.8	69.5	8.4	58.4
2006-07	229400	18.5	72.6	8.9	60.4
2007-08	254658	19.0	71.1	9.9	72.1
2008-09	301908	15.3	75.8	8.9	69.7
2009-10	384514	16.5	74.3	9.2	71.9

Note: RRBs – Regional Rural Banks.

Source: RBI.

Undoubtedly the institutional credit has been expanding since 1970s in the advent of nationalisation of banks (Table 5.1). However still about 40% farming households depending on the non-institutional source of credit (Table 5.2). Such a gap still exists despite the policy effort in expanding credit flow to agriculture sector through priority sector lending. The institutional credit flow, in absolute amounts, had increased more than 500 times from 1970-71 to 2009-10 (Table 5.1). Nevertheless, it is not keeping the pace of the increasing value of output and thereby investment requirement. It is a matter of concern that it is not able meet credit requirements both short-run and long-run, of the farmers. The gap in terms of substantial extent of dependency on non-institutional sources indicate inadequacy in access to institutional credit for agriculture especially the small and marginal farmers. Resorting non-institutional sources of credit is resulting in indebtedness. The NSS 59th round Survey on Indebtedness of Farmer Households conducted in 2003 has shown that 48.6% of farmer households were indebted; the incidence doubled that of the situation a decade ago (26% in 1991).The Expert Group on Agricultural Indebtedness has emphasized on the inadequacy of institutional credit leading to indebtedness associated with dependency on non-institutional source at high rate of interest (GoI, 2007a).

Table 5.2: Distribution (%) of Credit by Source: Farmer Households in India

Sources of Credit		1951	1961	1971	1981	1991	2002
A	Non-Institutional	92.7	81.3	68.3	36.8	30.6	38.9
a	Moneylenders	69.7	49.2	36.1	16.1	17.5	26.8
B	Institutional	7.3	18.7	31.7	63.2	66.3	61.1
a	Co-op Soc/Banks, etc	3.3	2.6	22.0	29.8	30.0	30.2
b	Commercial Banks	0.9	0.6	2.4	28.8	35.2	26.3
C	Unspecified	-	-	-	-	3.1	-
Total		**100**	**100**	**100**	**100**	**100**	**100**

Note: Based on All India Debt and Investment Survey (AIDIS) of NSSO.

Source: Mohan (2006).

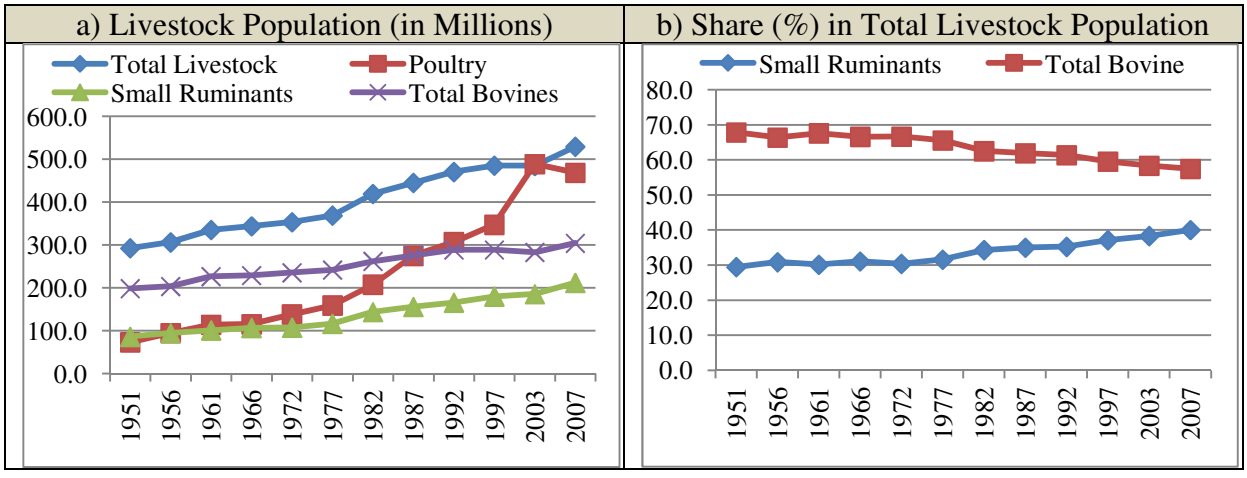
Moreover, the policy of priority sector lending is sometimes misinterpreted. It is a matter of concern that the absentee landlords still can make use of institutional agricultural credit for their non-agricultural activities but the tenant farmers who desperately needed the financial assistance do not have access to credit. In order to meet the target for the priority sector lending formal financial institutions especially the commercial banks, are overlooking the purpose of the borrowing once they ensure that loan disbursed is based on land ownership irrespective actually cultivating by the owner or the tenant. Moreover, as per the RBI norms in terms of those commercial banks which could not meet the priority sector lending target, they have to transfer the balance amount of the target to NABARD which is supposed to ensure the credit flow for the agriculture sector and for the rural development. Some of the commercial banks to avoid the risk of recovery in priority sector lending, are following safer route. The NABARD in turn is converting this amount to Rural Infrastructure Development Fund (RIDF) and disbursing this fund as a loan to the state governments. All this is used for rural infrastructure development purposes. By doing so, it is converting the short terms credit to the long term credit, and credit flow for agriculture proper (crop production and livestock) to the broader rural development. Moreover, for RIDF, NABARD is otherwise supposed mobilise funds from elsewhere, it is meeting the required funds from this fund made out of the unmet target of commercial banks in terms of priority sector lending.

VI Growth of Livestock Sector

Traditionally crop sector and livestock are complementary each other. The livestock, all the domesticated animals, is used for different purposes. The livestock supports the farming and supplements the farm income. As a draft animal and as a source of organic manure it supports the farming and supplements the farm income when they are raised for dairying and meat for market. The bovines especially the cattle are raised for meat, as dairy animals for milk and other dairy products, and as draft animals. The other products of the livestock include their hides for leather and dung for manure and fuel. Small ruminants such as goats and sheep are major source of meat in India. The other domesticated animals which have been used for transportation different regions depending on the topography are Horses and Ponies, Camels, Mules and Donkeys. Poultry has been an important source for eggs and meat. The diversification of farming households into raising livestock as a secondary occupation as an off-farm activity has been part of rural economy.

In terms of the size of live stock population, India is the largest country of bovine population with around 200 million cattle and 105 million buffalos. It contributes to around half of the bovine population in Asia and one-fifth that of the world. The size of the livestock population and poultry in India has continuously been increasing (Figure 6.1a). Within livestock, although both the bovine and small ruminants has shown increasing trend, the latter is faster. In terms of composition, the share of bovines in the total livestock population is declining and correspondingly the share of small ruminants (such as goat and sheep particularly) is increasing (Figure 6.1b). Also the size and share of domesticated animals used for the transportation has drastically reduced to negligible level in the total livestock population.

Figure 6.1: Trends in Size of the Livestock Population in India



Source: Department of Animal Husbandry, Dairying & Fisheries.

The rate of growth in livestock population has shown that during the 1990s it turned out to be negative for the bovines. The negative growth for the total bovines during 1990s was particularly associated with the decline in size of the cattle population particularly the male cattle which has been source of meat (i.e. beef) and they were used as draft animal in rural agriculture economy. The decline in land under green pastures or grazing land and thereby increasing cost of draft animals and their maintenance in terms of fodder and feed and the mechanisation of farming could be the factors behind the decline in the size of male cattle especially that of draft cattle. Moreover, the artificial insemination has reduced the need of the bulls for breeding purpose.

Table 6.1: Growth (%) of Livestock Population

Species	1951-61	1961-72	1972-82	1982-92	1992-03	2003-07
Total Livestock	***1.37***	***0.48***	***1.73***	***1.16***	***0.27***	***1.78***
Total Bovines	*1.33*	*0.35*	*1.08*	*0.97*	*-0.19*	*1.46*
Total Cattle	*1.24*	*0.14*	*0.77*	*0.61*	*-0.90*	*1.46*
Adult Female Cattle	-0.64	0.42	1.04	0.84	0.02	2.49
Total Buffalo	*1.67*	*1.04*	*1.97*	*1.90*	*1.38*	*1.47*
Adult Female Buffalo	1.47	1.49	1.29	3.03	1.39	1.34
Total Small Ruminants	*1.60*	*0.56*	*2.97*	*1.43*	*1.03*	*2.68*
Sheep	0.28	-0.05	2.00	0.41	1.75	3.09
Goats	2.58	0.94	3.50	1.93	0.69	2.48
Total Poultry	*4.51*	*1.77*	*4.14*	*3.99*	*4.32*	*-0.84*

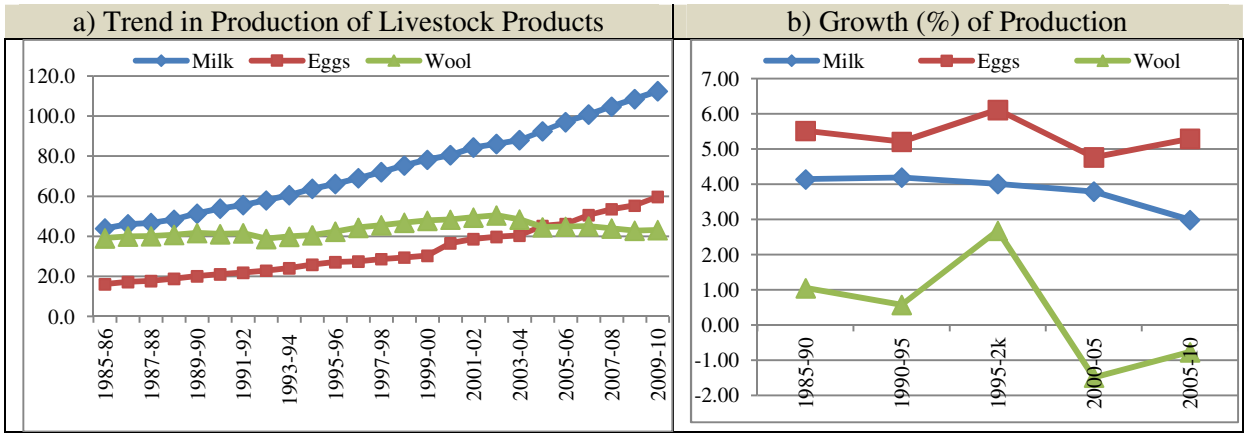
Note: Growth is Compound Annual Growth Rate (CAGR) in percent.

Source: Computed.

The high growth of the adult female buffalo during 1980s (i.e. between 1982 and 1992) could be due to the distribution of female buffalos for the below poverty line marginalised sections of population ST/SC under the Integrated Rural Development Programmes (IRDP). There is a possibility of inflating number by the concern Departments related the distribution of Buffalo in the scheme. Growing road infrastructure and transportation facilities has drastically reduced the dependence on animals used for transportation. With respect to the small ruminants' population, their rate of growth was highest ever during 1970s. With regard to poultry which is the basis for the egg production and also the meat (chicken), is showing very high growth for the last three decades of 20th century. But suddenly it has shown a negative growth during mid-2000s (i.e. between 2003 and 2007).

As regards the livestock products India is the largest producer of milk in the world with its milk production over 110 million tonnes. The trends in production of livestock products has shown that the production of milk and eggs are continuously been increasing whereas the wool production was increasing till the end of the last century and turned to showing a declining trend (Figure 6.2a). Interestingly, however, the rate of growth in milk production has continuously been declining especially since 1990s (Figure 6.2b).

Figure 6.2: Trend in Production of Livestock Products



Note: 1. Trend in Production is in terms of Milk in Million Tonnes; Eggs in Billons (in number of eggs); Wool in Million Kgs; 2. Growth is CAGR in percent.

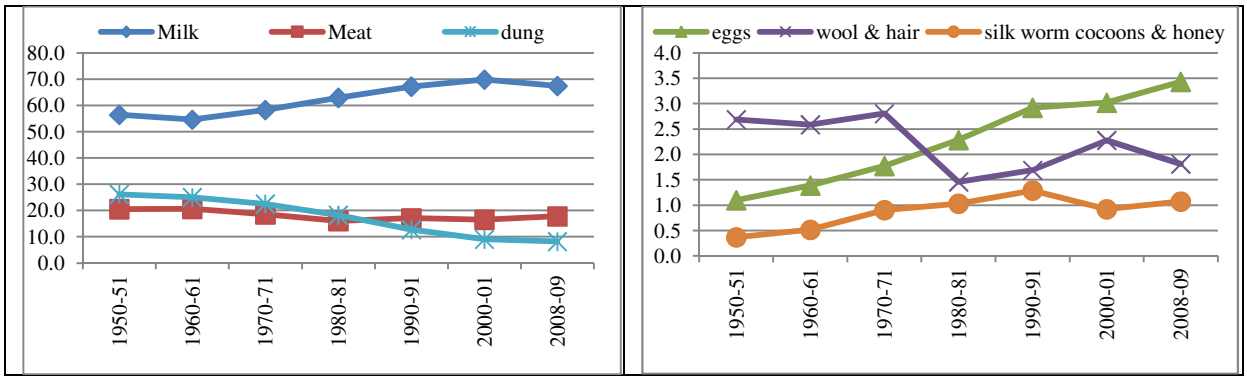
Source: Department of Animal Husbandry, Dairying & Fisheries, Government of India.

Although the milk production has increased more than four folds from a mere 17 million tonnes during 1950-51 to 112.5 million tonnes in 2009-10, the per capita availability of milk per day in the country is still lower than the world's daily average. Moreover, the decline in rate of growth in milk production is taking place despite the policy effort in this direction to improve the production. The consumption pattern of food products has also been showing an increasing demand for milk and its production. In this respect Government of India has initiated centrally sponsored scheme (CSS) of Milk Mission under National Dairy Plan (NDP) phase I. How far it will bring turn around in the milk production, one cannot predict at this moment.

In terms of contribution of different livestock products to the total value of output from the livestock indicates predominant contribution of milk and milk production in the total value followed by meat and dung wherein the latter's share has continuously been declining over time (Figure 6.3). Among those products which have been contributing marginally to the total value of livestock sectors, the share of value of eggs is increasing continuously but still remains below 5% of the total value of livestock sector. There is sudden drastic decline in the share of wool and its products during 1970s. The share of Silk Worm Cocoons and Honey is also showing a declining trend since 1990s.

The rate of growth in the total value of output from the Livestock sector was increasing till 1990s thereafter it is showing a declining trend. During 1980s, the value of output of most of the livestock products has grown at high rate. Among the livestock sector sub-groups, the value of output of eggs and silk worm, cocoons and honey have shown very high growth particularly during 1980s. In the recent past also theses two sub-groups value of output is growing faster than the other sub-groups. However, these two sub-sectors contribute less the 5% of the total value of output from livestock sector. The decelerating rate of growth for the value of output milk since 1990s is consistent with that of the milk production and thus it is cause of concern.

Figure 6.3: Share (%) of Selected of Livestock Products in the Total Value of Output from Livestock in India



Note: Constant Prices (2004-05)

Source: CSO.

Moreover, the livestock production in India is concentrated in few states only10. For instance, almost one-third of egg production arises from Andhra Pradesh only. Along with Tamil Nadu these two states produce more than half of the total egg production in India. With respect to

[10] Referring to year 2008-09 and based on state-wise production statistics of livestock sector.

meat production only four states – Andhra Pradesh, Maharashtra, Uttar Pradesh and Tamil Nadu – produce more than half of the total meat production in India. Similarly half of the total milk production in India is concentrated in five states – Uttar Pradesh, Andhra Pradesh, Rajasthan, Punjab and Gujarat. In some states such as Rajasthan, Bihar, Andhra Pradesh, Jharkand, Jammu and Kashmir, and Punjab, the livestock sector contributes around one-third or more of the total value of output from agriculture sector (including crop and livestock sector) of the respective states.

Table 6.4: Rate of Growth in the Value of Output of Livestock Products in India

Products	1951-61	1961-71	1971-81	1981-91	1991-2001	2001-09
Milk	1.2	1.4	4.5	5.5	4.2	2.7
Meat	1.6	-0.3	2.2	5.4	3.4	3.8
Eggs	3.9	3.2	6.3	7.4	4.1	4.4
Wool & hair	0.7	0.5	-4.9	2.6	3.3	-0.2
Dung	1.1	-0.3	1.5	1.1	0.2	2.1
Silk worm cocoons & honey	5.0	6.6	5.1	7.1	0.3	4.7
Total Value of Output	***1.5***	***0.7***	***3.7***	***4.8***	***3.8***	***3.1***

Note: Growth is CAGR in percent.

Source: Computed based on CSO data.

The livestock sector has high potentials for improving rural incomes and diversification of farm households. It is also helpful in mitigating the risks and vulnerability arises with unfavourable weather conditions for farm production thereby the farm income. However, the issues involved with the growth of livestock sector are poor yield rates, rising fodder and feed cost in the context of declining are under green pastures and grazing land, marketing of livestock products and access to processing technology and infrastructure.

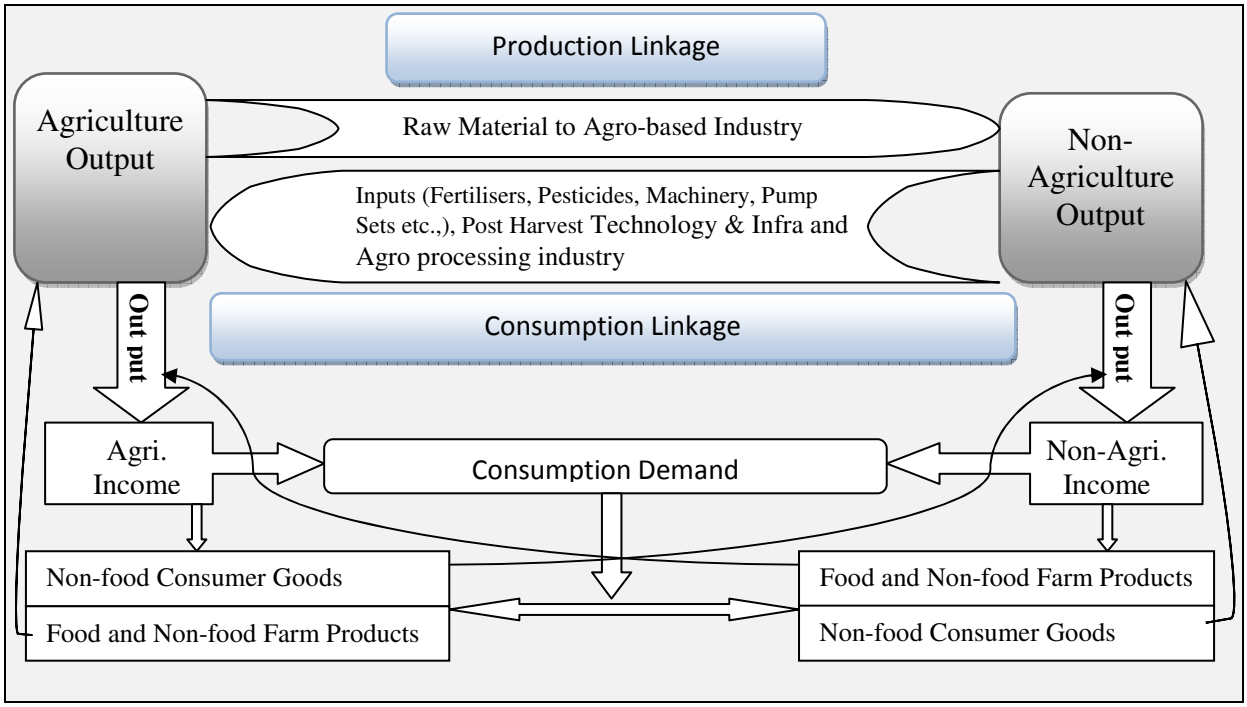
VII Agriculture and Non-Agriculture Linkages

The inter-sectoral, backward and forward, linkages between agriculture with non-agriculture are crucial for the agricultural development as well as for the rural development. Non-agriculture sector is the source of inputs for the agriculture and the source of demand for the agricultural commodities especially foods. Agriculture is a source of raw material for the agro-based industry and retail trading of agricultural commodities and manufactured products from agro-based industry. On the production front or intermediate goods demand front, agricultural sector has two types of inter-sectoral linkages with non-agriculture sector including industry and services. First, an increase in output of agriculture leads to an increase in demand for raw materials uses such as seeds, fertilisers, pesticides, and power. Second, an increase in output of agriculture would mean availability of additional amount of agricultural inputs such as oilseeds, sugarcane and cotton to respective agro-based manufacturing sectors which use agricultural raw materials. The first type of linkage is called backward linkage and the second type is called forward linkage of the agricultural sector. Both types of linkages reflect interdependence among various sectors of the economy through input use or supply. Growth of agriculture acts as a stimulus to other sectors in the economy either by requiring more inputs from other sectors or by providing more inputs to other sectors.

On the consumption front the growth of agriculture thereby increasing incomes do have a growing demand for non-agriculture commodities from agricultural households/population. Similarly growth of non-agriculture and thereby increasing non-agricultural source of income do rise the demand for food and non-food farm products. These consumption demand

linkages further stimulates the output growth of respective sectors. The following chart (Figure 7.1) can show the production and consumption linkages between agriculture and non-agriculture, both the forward and backward.

Figure 7.1: Flow Chart of Agriculture and Non-Agriculture Linkages



Note: lines indcates the linkages

Source: Author's.

Also, there is potentials investment linkage mostly forward – out flow of the agricultural surpluses non-agriculture sector. A backward linkage in this case is reverse flow of non-agricultural income as an investment in agriculture may not be much evident. Again the non-agriculture sector provides the post-harvest technology and infrastructure and then base for the agro-processing industry which will enhance the value addition for the agricultural commodities by improving their durability or shelf life without losing the quality of any agricultural commodity or nutritional content of food commodities.

An input-output table provides the database for estimating such linkage coefficients. The latest available input-output table for India relates to the year 2006-07. It shows that, for each rupee increase in value of its output, the agricultural sector as a whole spends about 16 paisa for raw materials supplied by agriculture itself, 6 paisa for raw materials supplied by industry, 4 paisa for commercial services, 2 paisa for petroleum products and another 3 paisa for services rendered by the transport sector. On the whole, a one rupee rise in output of agriculture results in input demand of 32 paisa for the economy. On the other hand, agriculture delivers 39 paisa of inputs per rupee of its total supply. A study by Pal (2010) has shown that a 1% rise in industrial consumption demand can induce agricultural output to rise by 0.13%.

Growth of Agro-based Industry and Post-harvest Technology and Infrastructure

The agro-based industry using the agricultural produce as a raw material, converts them into other usable manufactured goods. Initially agro-based industry used to be the predominant in the total manufacturing sector in India. Later on with the growth of chemical, metallic, electrical and electronics industries and the emerging pharmaceutical and bio-technology, non-agro-based industry began dominating the manufacturing sector. Most of the fast growing manufacturing industries capital intensive but agro-based industries are based on labour-intensive technology. Initially most of the agro-based industries even till 1980s, they are most primitive and based on energy of either animal or human power11. Later on they are mechanised using different systems of energy particularly electricity. Most of the agro-based manufacturing industries are tiny, small and medium scale ones. The so called large scale agro-based industries are jute, sugar, cotton ginning, spinning and textiles.

Table 7.1: Share and Growth of Agro-based Industry in India

Sno	Parameter	Value – Current Prices		Growth (%)	% Share in Total Manuf.	
		1999-2K	2009-10		1999-2K	2009-10
1	Factories (Nos)	55981	63654	1.3	42.6	40.1
2	Investment (lakhs)	15551266	42941436	10.7	27.4	22.2
3	Workers (Nos)	3225418	4117133	2.5	51.4	45.0
4	Total Persons (Nos)	3890467	4927301	2.4	47.6	41.8
5	Gross Value of Output (lakhs)	29045279	84323716	11.2	32.3	22.6
6	Net Value Added (lakhs)	3922004	10327686	10.2	25.3	17.4

Note: **1**. Agro-based Industry includes Crop & Animal Production, Hunting & Related Service Activities; Food Products; Beverages; Tobacco Products; Textiles; Wearing Apparel; Leather and Related Products; Wood and Products of Wood and Cork, except furniture; and Paper and Paper Products; **2**. Figures are in current prices; **3**. Data represents ASI Factory Sector only.

Source: ASI.

The agro-based industry still accounts around 40% of the total manufacturing units in India and it contributing to 45% of the total workforce engaged in manufacturing industry (Table 7.1). As it is less capital intensive, it contains only 22% of the total investment in the manufacturing sector and 17% of the total net value added originated from manufacturing. Another important farm-nonfarm linkage is in terms of post harvest technology and infrastructure which acts as a production and marketing linkage. The post harvest technology is to carry out scientific activities or simple methods for conserving and handling of agricultural produce and to make it usable as food, feed, fibre, fuel or industrial raw material. The post-harvest technology and associated infrastructure reduces the post harvest crop losses and the scientific storage infrastructure improves the durability and shelf life of the agricultural commodities. It improves the value addition to the agricultural produce. Such a technology and infrastructure arises in the non-agriculture sector.

In this respect the scope of the agro-processing industry encompasses all operations from the stage of harvest till the material reaches the end users in the desired form. Agro-processing industry involving grading, tinning or packing, conversion/translation of agricultural commodities into ready to eat (RTE) foods by cooking/baking or other processes, storage and transportation, is emerging in India. Agro-processing is regarded as the sunrise sector of the Indian economy given its large potential for growth and likely socio economic impact

[11] Common agro processing industries included hand pounding units for rice, water power driven flour mills, bullock driven oil ghanies, bullock operated sugarcane crushers, paper making units, spinning wheels and handloom units for weaving.

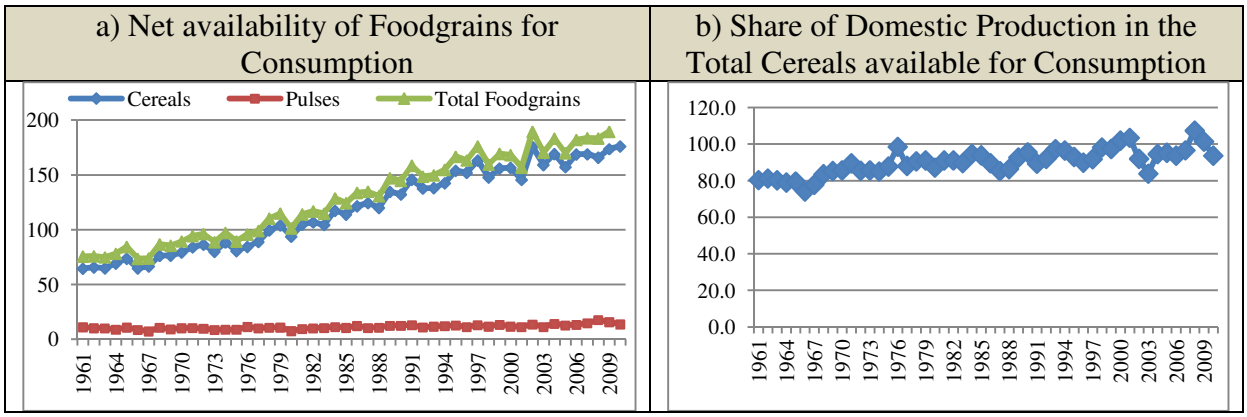
particularly on employment and income generation. Public investment in the agro-processing industry needs to be enhanced and private entrepreneurship needs to be promoted.

VIII Agriculture, Food Security and Rural Well-Being

The primacy of agriculture can be seen in two aspects: source of livelihood and source of food security. Agriculture is the main source of livelihoods for those dependent on it and the only source of food security of the country as a whole.

In terms of food security major achievement of the country is self sufficiency in food grains. The growth of Indian agriculture sector thanks to Green Revolution Technology, transformed from import dependent country for food grains during the first two decades after independence to the self sufficiently producing one thereafter. Most of the domestic consumption is met out of the domestic production (Figure 8.1b).

Figure 8.1: Net Availability of Foodgrains for Consumption in India



Note: The net availability of food grains is estimated to be gross production [-] seed, feed and wastage, [-] exports [+] imports, [+/-] change in stocks.

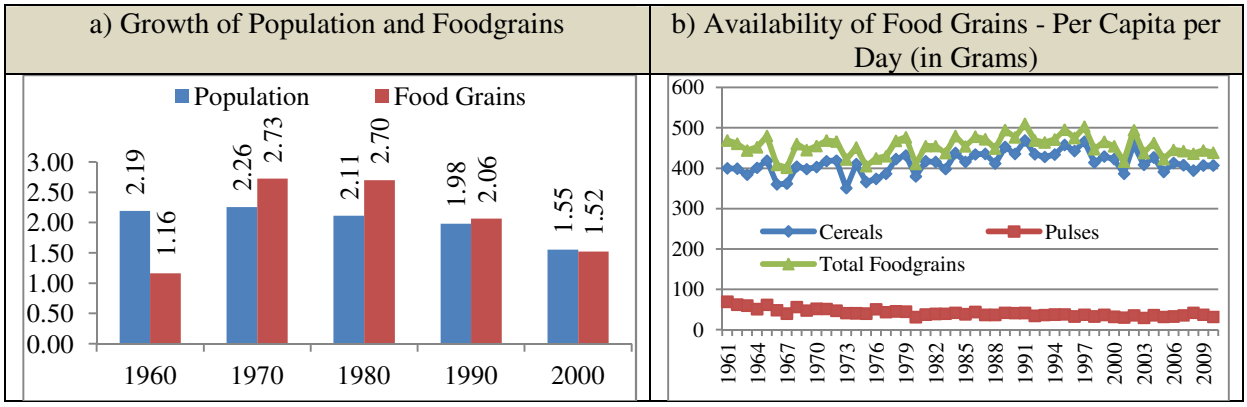
Source: Economic Survey 2012.

The growth of foodgrains production in the 1960s was very lower than that of the country's population. With the advent of green revolution technology in mid-1960s, the growth foodgrains increased substantially and higher than that of population during 1970's and 1980s (Figure 8.2). However, during the last two decades, the growth of foodgrain available for the domestic consumption in India is moving along with the growth of the population.

But the production of sufficient foodgrain with respect to the increasing population alone does not make sure the food security of the country. The purchasing power of the households, prices, supply and distribution of foodgrains across states given the fact that there is a considerable variation across regions and states in the production of foodgrains is also matter of concern.

Only two states – Punjab and Haryana with below 5% share in all-India population - contribute to about one-fifth of the total foodgrains production in the country (see Table 1). If one includes the Uttar Pradesh, Andhra Pradesh and West Bengal, these top five states, while accounting for around 35% of population and area under foodgrain crops in India, contribute more than half of the total foodgrains produced in the country.

Figure 8.2: Availability of Food grains for Consumption in India



Note: 1. Net availability of food grains; 2. Years represent decades.

Source: Economic Survey 2012.

Table 8.1: Top 8 States' Contribution to Total Food grain Production in India – Triennium Ending 2007-08

Sno	States	% in All India			Cumulative %		
		Pop	Area	Production	Pop	Area	Production
1	Uttar Pradesh	16.5	15.9	18.8	16.5	15.9	18.8
2	Punjab	2.3	5.1	11.8	18.8	21.0	30.6
3	Andhra Pradesh	7.0	5.9	8.0	25.8	26.9	38.6
4	West Bengal	7.5	5.2	7.3	33.3	32.1	45.9
5	Haryana	2.1	3.5	6.6	35.4	35.7	52.4
6	Rajasthan	5.7	10.5	6.4	41.1	46.2	58.8
7	Maharashtra	9.3	10.7	6.1	50.4	56.8	64.9
8	Madhya Pradesh	6.0	9.4	5.9	56.4	66.2	70.8
9	All Other States	43.6	33.8	29.2	100	100	100

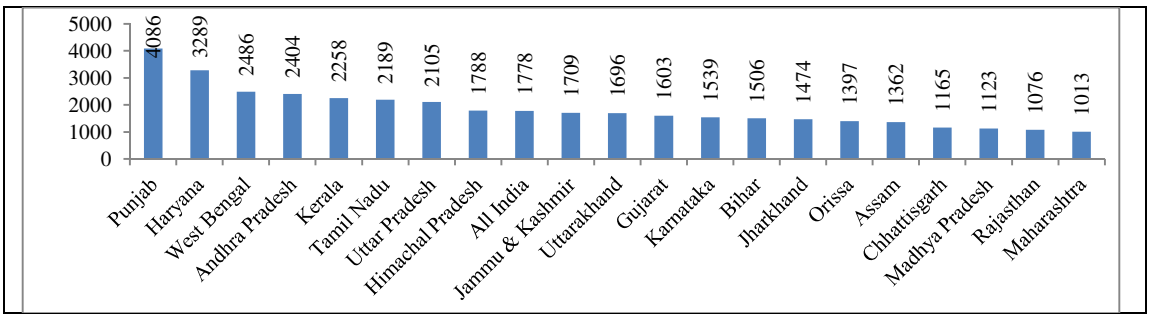
Note: ***1***. Order of the states based on the largest in the production of foodgrains to the least; ***2***. Pop – Population; Area – Area under foodgrain crops; Production – Production of Foodgrains.

Source: Department of Agriculture and Co-operation, Ministry of Agriculture, Government of India.

The state support in terms of Minimum Support Prices (MSP) is also a factor behind this phenomenon. If the farmers of some food grain surplus states change their cropping pattern towards non-food grains, it may threaten the food security of the country. In such an event, increasing yield rates in others states having potential comparative advantage would require a policy attention. There are huge variations across states in terms of current yield rates of food grain production (Figure 8.3). Some of the states have a yield rate that is one-third or one-fourth of the yield rate observed for the highest yield rate observed for Punjab.

Changing prices of the agricultural commodities especially food commodities affect the well-being of the poor in terms of hunger and malnutrition particularly in those households do not involve the food grains production in the food grain surplus as well as deficit states. The high food inflation noticed recently has become cause of the concern. Although supply of food grains through Public Distribution System (PDS) is a corrective measure to take care of shortage of food grains and price changes, the functioning of PDS itself is matter of concern in many states.

Figure 8.3: Yield Rate of Food grains across Major India States– TE 2007-08



Note: Triennium Ending 2007-08.

Source: Department of Agriculture and Co-operation, Ministry of Agriculture, Government of India.

With respect to agriculture as a source of livelihoods for those dependent on it, the growth of agriculture improves their well-being. In fact it was well observed that in the absence of welfare programmes till 1990s, the growth of agriculture was the main factor behind the reduction in poverty ratios in the countryside. Thereafter, although overall economic growth and safety net measures have also turned out to be significant factor for rural poverty reduction, the role of agriculture in determining well-being of the rural population cannot be undermined.

IX Sustaining the Viability of Indian Agriculture

The issues related to sustainability of agriculture and rural livelihoods from natural resources point of view are discussed in a subsequent chapter. Here the discussion would be on the economic viability of Indian agriculture in general and in the context of preponderance of small and marginal holdings in particular.

A notable aspect from the recent agrarian crisis is that agriculture has become unremunerative and is increasingly becoming unviable for a majority of the farmers (Pillai, 2007). A Situation Assessment Survey of Farmer Households conducted by NSSO in 2003 has shown that for most (96%) of the farmer households owning less than 4 hectares of land, their earning from all source are falling below their monthly consumption expenditure. Spiraling input prices and volatile prices in output market is responsible for the squeezing of their incomes. With the increasingly unviable nature of farming, farmers are finding it difficult to continue in agriculture. The 59th Round of the National Sample Survey revealed the fact that about 40% of the farmers reported to quit farming if given an option. Lack of alternative opportunities is compelling them to continue in the farming activity.

Public Investment, Institutions and Technology

Ever since the green revolution technology phase there has not been any breakthrough in the yield rates of both the cereal and non-cereal and non-food grain crops in India except cotton. It is said to be a technological stalemate in agricultural research and development thereafter. Retrogression of public sector in terms of investment, institutional support with respect to research and extension services in the agriculture sector is observed to be the major factor for such stagnation.

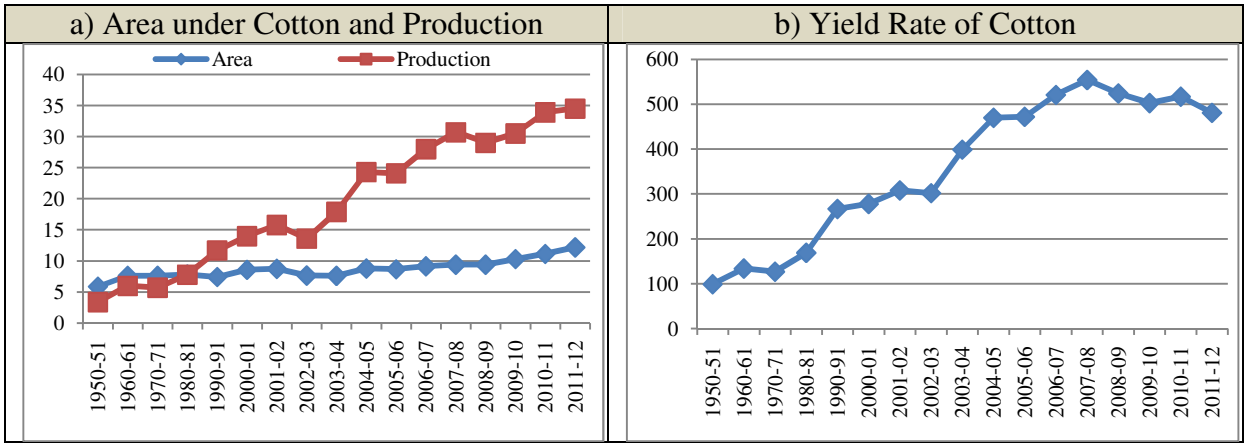
It is observed that although the amount invested in agriculture sector in general and agricultural research in particular over time in India, its share in the total investment, and its share in agricultural GDP has not shown any increase, if not a decline. While the developed countries spent an amount equal to more than 2% of their agricultural GDP in their agricultural research and developing countries spent between 0.5 to 1%, India is spending 0.5% or below to its agricultural GDP (Pal, 2009). Public investment in agriculture is critical factor: unlike industry which can mobilise investment from a large private entrepreneurship, the resource poor enterprenuring farmers cannot mobilise such investments. All that credit of developing technologies adopted under green revolution phase would definitely be associated with public sector efforts and endeavours. The current phase of developments is marked with public sectors' retrogression and advancement of private corporate sector's efforts, especially multinational corporations' (MNCs) ventures into the Indian farm sector. It is explicit in case of Bt. technology and contract farming, and seed market.

Is the Bt-Technology an Alternative?

The virtual stagnation in technological advancement in crop production especially with respect to breakthroughs in improvement in yield rates ever since green revolution technology phase is looking for alternatives. The emerging genetically modified variety (GMV) of seed technology in the form of Bt. Technology is considered to be a solution for the recent technological stalemate and as a technological advancement in the crop production. The Bt. variety of seeds market especially with respect to cotton and vegetables like Brinjal is flourishing in India. There have also been serious protests against the Bt. technology and seed varieties produced with such technology, by various civil society organisations including scientists. The protest is based on its long term consequences on bio-diversity and MNCs hold over the Indian seed market leading to monopolisation.

The better yield rate argument in favour of Bt. technology based seeds introduced in India for cotton production may have to be critically examined given recent experience of declining yield rates of cotton production in India (Figure 9.1b). It needs to be watched whether the initial high yield rate Bt. cotton are sustained in subsequent years.

Figure 9.1: Area under Cotton and its Production and Yield Rate in India



Note: 1. Area in million hectares and Production in million bales (Bale = 170 Kgs.); 2. Yield in Kgs per Hectare.

Source: Cotton Advisory Board.

The issues involved with Bt. variety of seeds are increasing cost of seed and uncertainty of seed market, monopoly versus competitiveness of private (MNCs) seed giants, diversity

versus mono variety for food grains and horticulture crops. Moreover, the recent thinking in the lines of post-modern agricultural technology emphasis on the need for innovations and technologies are beyond the modern green revolution technologies and the genetic engineering (Uphoff, 2010). For instance, innovation in terms of evolution of System of Rice Intensification (SRI) principles and practices in rice cultivation has demonstrated the higher yield rates and lower consumption of agricultural inputs such as chemical fertilisers and irrigation water.

Post Harvest Technology and Infrastructure and Agriculture Marketing

Post harvest technology and infrastructure (such as warehousing and cold storages) is found to be crucial for the agriculture sector development. It improves the durability and shelf life of agricultural commodities and it may also help in stabilising the otherwise volatile agricultural commodity prices. The glut in the market in the harvest season with over release of production by the producer to the market due to lack of storage facility, on their own, can be avoided. It can ensure the quantity and quality of the production. Public investment in developing post harvest technology and necessary infrastructure in rural areas is critical factor in this respect. Private entrepreneurship and investment can be facilitated in this domain.

Agricultural marketing is a larger issue of agriculture development. The difference in farm gate price or farm harvesting and the price paid by the final consumer needs the policy attention. The development of post harvest technology and required infrastructure may address part of the issue. Establishing supply chains and regulating those chains and monitoring them could help in solving another part of the problem.

Box 9.1: SHG Collectives in Marketing of Agricultural Produce

In Andhra Pradesh, under IKP (Indira Kranthi Patham), the women self-help groups (SHGs) began marketing the agricultural produce. It began with a small scale operation of 5 to 10 quintals of pulses, for a group to scaled up higher volume operations depending upon the groups' resources and its credit worthiness. The state's Society for Elimination of Rural Poverty (SERP) which is an implementing agency for IKP is planning for processing units to create a value addition for their procured produce.

Recently in a field visit to a village (*Chinnaramancherla*) in Warangal district of Andhra Pradesh, it is observed that the Village Samakhy (Village Organisation or VO) of SHGs in that village has purchased paddy produce of the last Rabi season from around 160 farmers. The total value of paddy purchased by VO of that village is Rs. 1.5 crores. The price paid per quintal of paddy is Rs. 1100/- which is 10% higher than what the individual buyers frequented to the village offered. The VO mobilised the money to be paid to the producer through banks which are willing to lend given the creditworthiness of SHGs in general. But due to lack of storage/warehousing facility to keep around 1360 tons of paddy, the VO succeeded to sell it off and hence making efforts while inviting rice millers and FCI for bidding.

In case of maize procurement in places where it is produced, SHGs have established direct marketing connections with Poultry Farms and Hatcharies which requires large volumes of maize floor for the feeding purpose. For theses Farms, direct linkages with those SHGs procured maize reduces their transaction costs.

Source: Author's.

Although the regulated markets were established to benefiting the producers in terms of better price, still the farmers are just receivers of the pricing decision made by the market committee. Moreover the transaction costs involved with these markets in terms of commission agents' commission and other market deductions along with transportation costs while bringing the produce to the market place, reduce their actual return on their produce.

There is need for innovative market strategies that benefit both the producer and the final consumer. For instance, marketing of agricultural produce adopted by women's self-help groups (SHGs) Andhra Pradesh is one such innovative marketing system (see Box 9.1). It can be scaled up and replicated but the problem is inadequate storage facilities accessible at the village or mandal/tehesil level. It has become a constraint in evolving such innovative strategies.

Viability of Marginal and Small Holdings

Increasing number of small and marginal holdings is raising the doubts on viability of farming in these holdings given changing scenarios of labour market and cost of cultivation. Although the size-productivity debate informed the family labour of the small and marginal farmer is more productive than larger farms, the demographic transition and declining family size indicates constraint of family labour. The technological advancements undertaken in India for the mechanization of agriculture are not much suitable for the small and marginal holdings. Moreover, draught animal based ploughing appears to be no longer viable because there is an increasing cost of draught animals and their maintenance cost, increasing cost of fodder, declining area under green pastures made available for farming animals. Mechanised farming may be an alternative, but the challenge is development of suitable technology for the mechanization marginal and small holdings. Given the experiences of some the countries in Asia, for instance Japan, and the rest of the world the technological innovation that facilitates the viability of the small holding is inevitable for India.

Moreover, the structuring and regulatory mechanism of the input and output markets of agriculture situates the viability of the small holdings. Here lies need for the policy intervention facilitating such technological innovations suitable to small and marginal holdings and access to credit market, extension services and other institutional arrangements with respect to input and output markets. Crop insurance would also help in sustaining the viability of marginal and small farm holdings.

Alternative Farming Systems

Further, alternative farming systems which enhances the viability of Indian agriculture in the contexts of increasing small and marginal holdings may be explored. The fragmentation of holdings, and marginal and small holdings are not able to derive benefits of scale effects. A phase of land reform policy attention turned towards the consolidation of holdings. But it could not succeed due to constraints related to differential prices and changing value of land by location, soil type and irrigation facility.

Co-operative/Collective Farming

In order to gain from the scale-effects of reasonably large holdings and mitigating risks and vulnerabilities of small and marginal holdings either collectivisation or the co-operative farming has been advocated. Such a co-operative farming system in India is well tested in parts of the country. The co-operative system developed in India is formed with democratic participation. Characteristic features of co-operative system are consensus, leadership, decision-making, distribution, sharing of risk and profit and group welfare. However the co-operative system could not succeed as evident from the rise and decline of Sugar Cane Co-operative farming in Maharashtra. One of major factor behind the dismantling of the sugar co-operatives in Maharastra is the political economy as the co-operatives become politically strong at base and leading to de-stabilisation of political hierarchy.

However, still there is scope for collectives and co-operatives in farming especially in the domain of marketing. These collectives can be in the form of farmers' associations or groups in accessing the institutional credit and they as a group can have better bargaining in input and output markets. The Expert Group on Agricultural Indebtedness emphasized on 'if farmers, especially small and marginal farmers, are organised through collectives like Self-Help Groups (SHGs) and cooperatives'. It is said that through these collectives besides innovative credit delivery, farmers can be helped in improving their farming practices through better accessing of appropriate technology, extension services, improved processing and marketing capabilities and risk management (GoI, 2007b).

Contract Farming

Contract farming in India is emerging as an important institutional arrangement in farm production. There are many corporate giants entering into the farming business. The Contract Farming in India has a long history back to Colonial period when commodities like Collin Indigo were produced by the Indian farmers for English factories. Again, in the recent past, it began with a multinational company (MNC), Pepsico, established its subsidiary, Pepsi Foods, in the early 1990s and set up a tomato processing unit in Punjab. Although Punjab is not a traditional tomato growing area the company could pursue local farmers and tied up with them to grow varieties of tomatoes that needed for making their product. Later on when Hindustan Lever, a subsidiary of a MNC (Unilever), taken over the Pepsico's tomato processing unit, the Pepsico stepped into processing of other agri-products. Pepsico, has been successfully emulating the model in foodgrains (Basmati rice), spices (chilies) and oilseeds (groundnut) and other vegetable crops like potato. There are national business firms along with few more multinational companies[12] which entered into the contract farming arrangements with farmers for different types of crops in several states in India.

Although there has not been any formal estimation of number of farmers under contract farming arrangement, the informal sources say that lakhs of marginal and small farmers in several parts of the country are in these arrangements with several national and multinational companies. Moreover, various government and semi-government agencies are involved with contract farming, and financial institutions and banks are also assisting contract farming. A changing dynamics of contract farming is the consortium approach (Singh, 2006).

The benefits of contract farming are the assured market and prices, and more importantly the access to support services. It is considered to be a corrective measure to market imperfection in the agricultural marketing. It facilitates both the backward and forward farm-firm production and market linkages.

In its National Agriculture Policy, the Government of India envisages that "Private sector participation will be promoted through contract farming and land leasing arrangements to allow accelerated technology transfer, capital inflow and assured market for crop production, especially of oilseeds, cotton and horticultural crops". Till 2003, the Agricultural Produce Marketing Act considered the transactions of selling and purchasing of agricultural

[12] MNCs like Cadbury in cocoa; PepsiCo in potato; chillies and groundnut; Unilever in tomato, chicory, tea and milk; ITC in tobacco, wood trees and oilseeds; and Cargill in seeds. Domestic Corporates are also in the field like Ballarpur Industries, JK Papers and Wimco in eucalyptus and poplar trees, Green Agro Pack, VST Natural Products, Global Green, Intergarden India, Kempscity Agro Exports and Sterling Agro in gherkins, United Breweries in barley, Nijjer Agro in tomato, Tarai Foods in vegetables, M Todd in mint, and Namdhari Seeds in seeds.

commodities in places other than in regulated markets as illegal. Thereafter, the modifications made for the act facilitates such transactions outside the regulated market places. Such a provision facilitated the contract farming which essentially makes transactions outside the regulated markets and arrangements made with farmers.

However, there are potential disadvantages and risks associated with contract farming. For instance, failing to obey the contract by both the farmers and the buyer is a risk. Secondly, agreed and assured price may not be the market price that is paid. Contract Farming is in fact an agreement between unequal parties, companies, Government bodies or individual entrepreneurs on the one hand and economically weaker farmers on the other. In this respect, contract farming arrangements are often criticized for being biased in favor of firms or large farmers, while exploiting the poor bargaining power of small farmers.

The state can play critical role in this respect of making the contract farming beneficial to both the farmers as well as the contracting firms. It can be done by enforcing all the contractual arrangement to be formal and giving them legal sanctity by making those contractual arrangements enforceable by law. It needs to provide safeguards for the farmers involved with such arrangements and against firms in cases of misconduct of contracts.

Climate change and Indian Agriculture

More importantly is the emerging issue of climate change and its impact on the agriculture. The Inter-Governmental Panel on Climate Change (IPCC) Assessment Reports and their Working groups have been indicating the damaging impact of climate change on agriculture. In any case agriculture is by nature vulnerable to changing weather conditions. The changing climatic intensifies the vulnerability of agriculture through increased droughts and floods which in turn are likely to increase production variability. It is observed that one degree increase in the temperature would result in a total failure or a substantial decline in productivity of many of the crops particularly grains such as rice, wheat etc. Moreover, the climate change not only reduces the yield but also increases the proliferation of weed and pests (IFPRI, 2007). In this respect the climate change while badly affecting the agricultural production, it is threatening the food security at the national and global level. Moreover, agriculture itself is the contributing domain of climate change. Agricultural activity is one of the anthropogenic sources of greenhouse gases such as carbon dioxide, methane and nitrous oxide.

In this context, what is needed is the development of methods and technologies for the agricultural production that reduces the green house gasses (GHGs) and those sustain in climate variability and changes in future. In this respect, one of emerging and adaptable method of rice cultivation, system of rice intensification (SRI) can be promoted because rice is the largest produced crop in India with a one-fifth area under its cultivation. Adapting SRI principles of practice can reduce the emission of GHGs by improving the water use efficiency particularly in semi-arid regions. It also improves the yield and reduces the cost of cultivation. Its advantages in the context of climate change are well documented (Uphoff 2007, V&A Programme 2009; Reddy and Venkatanarayana, 2013). In fact, National Food Security Mission (NFSM) if India has incorporated the promotion of SRI principles in rice cultivation in its programme, but its adoption rates very low due to inadequate dissemination mechanism.

X Concluding Remarks

Agriculture being the major source of livelihood for a majority of rural population, growth of agriculture is critical for the well-being of the dependent rural population and the source of food security for the nation as a whole. It is also source of growth for industry particularly that of agro-based one and retail trade of agricultural commodities.

India agriculture, has made great strides since independence, from chronic hunger and abject dependence on the import of foodgrains to not only self-sufficient in foodgrains production and become a net exporter of agricultural commodities including foodgrains. There have been significant structural changes within the agricultural sector itself in terms of several dimensions such as cropping pattern, adoption of production technology, irrigated area, land holdings and marketing. The government had played an active role in inducing some of these changes even as the farmers have responded to state initiatives as well as changes in market conditions and consumer demand preferences. A primarily subsistence agriculture has changed to commercial agriculture with a good proportion of the farmers looking beyond the local market to national and global markets for sale of their produce. Farming systems and techniques have improved over time and farmers have become more technology conscious.

The developments taking place in the agriculture sector also brought new types of problems and challenges that require better strategies and solutions. Over and disproportionate use of chemical fertilisers affected the soil fertility. Increasing necessity of irrigation led to private investment and harnessing of ground water resources especially semi-arid and rain-fed region has resulted in its own consequences. The changing cropping pattern, diversification from foodgrains to non-foodgrains and cash crops appears to be demand driven and based on price signal, the diversification process is keeping farmers under risk and making them vulnerable to instability in input and output markets thereby highly volatile price changes. It is because of the inadequate institutional arrangements supporting such a change. In the era of globalisation, Indian agriculture sector is more exposed to global market changes. Increasing subsidy costs affected the public investment in agriculture. The long term gains of investment are foregone for short gains of subsidies. In the wake of economic reforms, the retrogression of public sector in investment, institutional support in terms of credit, research and extension services had its adverse consequence on agriculture. Increasing private sector's active role in the development of bio-technology and genetic engineering that brought out Bt. seeds for cotton and other crops, provision of institutional support and services under contract farming in the recent past appears to be replacing the role played by the public sector during the green revolution period.

In the present context, agrarian distress resulted episodes of farmer's suicides in different parts of the country owing to increasing cost of cultivation calls for major policy initiatives and institutional arrangements. Further, sustainability of agriculture and sustaining the viability of agriculture a large part based on the marginal and small farm holding has also been a matter of policy concern in recent years. Moreover, despite the necessity of post harvest technology and infrastructure and marketing of agricultural produce is emphasised again and again, the policy measures and thereby the development of such technology and infrastructure is found to be inadequate. These are some of the issues that the chapter delves around.

But the concern is the producers are not able receive remunerative prices for their effort. Moreover, the diversification towards highly risky high value crops without proper

institutional arrangements including technical support, has led these enterprising farming in to problems. An emerging issue of concern is agrarian crisis led by increasing cost of cultivation. The increasing cost of cultivation is leaving farmers marginal farm incomes, sometimes losses not even covering the own investment and cost of their own labour. Given the inadequate access to institutional credit market, still the enterprising farmers have to depend on the non-institutional sources of credit.

With respect to the productivity of agriculture, the implementation of green revolution technology and its adoption of farmers, has brought in a remarkable increase in the productivity of Indian agriculture specially in foodgrains. But in the post-green revolution period there has been virtual stalemate agricultural technology. The efforts towards developing dry land farming technology especially in the post-green revolution period appear to be appropriate. Some of the crops grown in dry land farming have shown an increase in their yield rates.

As regards the land use, increasing area under non-agriculture use is a cause of concern particularly especially the farm land taken for Special Economic Zones (SEZs). Also the declining area under green pastures have implications on livestock sector and cost of cultivation through its impact on fodder cost while maintain the draught animals.

In this context of changing scenario of agriculture, the viability of increasing number of small and marginal holding is under the scrutiny. There are alternative systems of farming explored but every system has its own advantages and disadvantages. The technological innovations would definitely come to the rescue of these farmers as some of the developed countries such Japan has demonstrated given their topographical necessity. Therefore, the challenge ahead for the Indian context is the sustainability of agriculture with respect to the small and marginal farmers.

Moreover the impact of climate change on the agriculture is emerging challenge for the sector. Herein it needs a appropriate technology that overcomes the impact of climate change on the farm production especially the foodgrains in terms of food security perspective and also the technology that helps in reducing the production of green house gases through agricultural activities and production.

* * *

References

Babu, N S Dasari (2008) "Land, Caste and Economic Mobility: A Village in Delta Andhra", in G. Niranjan Rao and D. Narisimha Reddy (eds.) ***Rural Transformation: Perspectives from Village Studies in Andhra Pradesh***, *Studies in Local-Level Development*, Danish Books, Delhi.

Bhall, G S and Gurumail Singh (2010) **Report on Growth of Indian Agriculture: A District Level Study**, for Planning Commission, Government of India, prepared at Centre for the Study of Regional Developemnt, Jawaharlal Nehru University, New Delhi.

Binswanger-Mkhize, Hans P. and Kirit Parikh (2011) ***The Future of Indian Agriculture and Rural Poverty Reduction***, Centennial Group and Syngenta Foundation for Sustainable Agriculture, Washington DC, November.

Binswanger, Hans P; Kailash C. Pradhan; and Sudhir K. Singh (2011) "The Impact of Changing Prices and Rising Wages on Indian Agriculture: 1960-2007", Centennial Group and Syngenta Foundation for Sustainable Agriculture, Washington DC.

Binswanger-Mkhize, Hans P; Kailash C. Pradhan; Hari K. Nagarajan; Sudhir K. Singh; and J.P. Singh (2011) ***India 1997-2007: Structural Change at the Village and Household Level***, Centennial Group and Syngenta Foundation for Sustainable Agriculture, Washington DC.

Chadha, G K; Sucharita Sen and H R Sharma (2004) "Land Resources", in State of Indian Farmers, Volume 2, Academic Foundation, Delhi.

Chand, Ramesh (2009) "Capital Formation in Indian Agriculture: National and State Level Analysis", in D. Narasimha Reddy and Srijit Mishra (eds.) ***Agrarian Crisis in India***, O U P, New Delhi.

Deshpande, R S (2003) "Current Land Policy Issues in India", *Land Reform*, Special Edition, Vol. 3.

Dev, S. Mahendra (2008) **Inclusive Growth: Agriculture, Poverty and Human Development**, O U P, New Delhi.

Dev, S. Mahendra and N Chandrasekhar Rao (2010) "Agricultural Price Policy, Farm Profitability and Food Security:An Analysis of Rice and Wheat", Commission for Agricultural Costs and Prices, New Delhi.

GoAP (2011) ***Report of the State Level Committee To Study The Problems Of Farmers In Crop Holiday Affected Mandals Of East Godavari District of Andhra Pradesh*****,** Government of Andhra Pradesh, Hyderabad.

Government of India (2002) ***Marketable Surplus and Post Harvest Losses of Paddy in India 2002,*** Ministry of Agriculture (Department of Agriculture and Cooperation), Directorate Of Marketing & Inspection Branch Head Office, Nagpur.

GoI (2007) **National Policy for Farmers 2007**, Department of Agriculture and Cooperation, Ministry of Agriculture, Government of India, New Delhi.

GoI (2007b) ***Report of the Expert Group on Agricultural Indebtedness***, Ministry of Finance, Government of India, New Delhi.

Gulati, Ashok; P.K. Joshi and Maurice Landes (undated) "Contract Farming in India: An Introduction",

Hazell Peter B. R. and Haggablade Steven (1991) "Rural-Urban Growth Linkages in India", *Indian Journal of Agricultural Economics*, Vol. 46 (4), Oct-Dec.

IFPRI (2009) ***Climate Change: Impact on Agriculture and Costs of Adaptation***, International Food Policy Research Institute, Washington, D.C.

IPCC et al. (2007) ***Climate Change 2007: Impacts, Adaptation and Vulnerability***, Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge, UK: Cambridge University Press.

Jodha, N S (1986) "Research and Technology for Dry Land Farming in India: Some Issues For The Future Strategy", *Indian Journal of Agricultural Economics,* Vol. 41 (3), pp. 234-246.

Lanjouw, Jean O and Peter Lanjouw (2001) "The Rural Non-farm Sector: Issues and Evidence from Developing Countries", *Agricultural Economics*, Vol. 26.

Mellor, John W (1976) **The New Economics of Growth: A Strategy for India and the Developing World**, Cornell University Press, Ithaca.

Mishra, Srijit and D. Narsimha Reddy (2009) **Agrarian Crisis in India**, O U P, New Delhi.

Mishra, Srijit and D. Narsimha Reddy (2011) "Persistence of Crisis in Indian Agriculture: Need for Technological and Institutional Alternative", in D. M. Nachane (ed.) ***India Development Report 2011***, IGIDR, Mumbai and Oxford, New Delhi.

Mohan, Rakesh (2006) "Agriculture Credit in India: Status, Issues and Future Agenda", *Economic and Political Weekly*, March 18, 2006.

Pal, Swati (2010) ***Energy Use, Structural Change and Development: A Study in the Economies of India and Pakistan***, Unpublished Ph.D. Thesis submitted to Department of Economics, University of Kalyani, Kalyani.

Pal, Suresh (2009) "Managing Vulnerability of Indian Agriculture: Implications for Research and Development", in D. Narasimha Reddy and Srijit Mishra (eds.) ***Agrarian Crisis in India***, O U P, New Delhi.

Pillai, S. Ramachandran (2007) "Agrarian Crisis and the Way Out?", *The Marxist*, Vol. XXIII (3), July to September.

Rani, B. N. Shoja (undated) "Globalization and Contract Farming in India-Advantages and Problems", IIM Kozhikode.

Rao, V. M. (2009) "Farmers' Distress in a Modernising Agriculture – The Tragedy of the Upwardly Mobile: An Overview", in D. Narasimha Reddy and Srijit Mishra (eds.) ***Agrarian Crisis in India***, O U P, New Delhi.

Reddy, D. Narasimha (2006) "Economic Reforms, Agrarian Crisis and Rural Distress", ***Prof. B. Janaradhan Rao Memorial Lecture***, on 27th February, 2006, Department of Public Administration, and Human Resource Management, Kakatiya University, Warangal, Andhra Pradesh.

Reddy, D. Narasimha and Srijit Mishra (2009) "Agriculture in the Reforms Regime" in D. Narasimha Reddy and Srijit Mishra (eds.) ***Agrarian Crisis in India***, O U P, New Delhi.

Reddy, D. Narasimha and M. Venkatanarayana (2013) "SRI in Andhra Pradesh: Achievements, Problems and Implications for GHGs and Work", *RTGE Work-in-Progress Paper 13*: Project on 'Measuring Materiality in Informal Production-Distribution Systems', South Asia Studies, Oxford University.

Singh, Sukhpal (2006)

Uphoff, Norman (2007) "Envisioning 'Post-Modern Agriculture': A Thematic Research Paper", Cornell Univerisity, Ithacca: Accessed through WAASAN Website.

V & A Programme (2009) ***Vulnerability and Adaptation Experiences from Rajasthan and Andhra Pradesh: The System of Rice Intensification***, SDC V & A Programme, India.