Position Paper 5

Challenges of Food Security and its Management

2011

National Rainfed Area Authority
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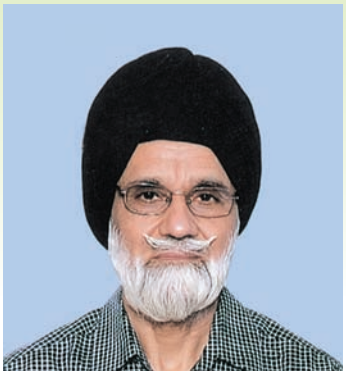
Foreword



Food and nutritional security to its population has been the prime concern of India's policies. With increase in population, income and urbanization, the demand for food grains has also increased and diversified. Although there has been more than four-fold increase in food grain production from 1950-51 (50.82 mt) to 2008-09 (233.88 mt) a large section of our population continues to suffer from malnutrition and inadequacy of food grains. Inflation in food prices during January, 2011 was mainly due to fresh food and negligible due to rice and wheat grains supplies. On the other hand degradation of land water and other natural resources have started impacting production through increased biotic and abiotic stresses.

As a result of green revolution the productivity of wheat and rice have increased many-fold in irrigated areas which is roughly 40% of total cultivated area of the country. The remaining 60% of cultivated area continues to be rainfed and poor in productivity. Of late, the rate of growth in productivity has shown declining trend in both irrigated and rainfed areas. Occasionally productivity and production of coarse cereals especially Bajra (*Pearl millet*) goes high in favourable rainfall years and market prices crash being undesirable for primary producers i.e. farmers. Under these circumstances, maintaining the pace of increase in overall food grain production to meet the demand of growing population requires continuous innovation and careful planning to harness the potential of available natural resources keeping in view the path of sustainable growth rate.

In the present Position Paper an attempt has been made by National Rainfed Area Authority to address the challenges of food security through analyses of the present trend of growth in production, procurement and safe storage of different food grain crops, their future potential and possible impact of diversification into non-PDS, fruits/vegetables and other commercial crops on national food security. This kind of analysis is likely to help planners and policy makers in choosing appropriate policy framework in evolving the strategies for enacting and operationalization of food security Act.

Dated: 1-05-2011
Place New Delhi

(J.S. SAMRA)
Chief Executive Officer

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Figure

1. Executive Summary

Experiences of food for work, public distribution system, mid-day meal to school children, women and child development scheme, *Antodya* etc. are being consolidated into an innovative comprehensive Food Security (Entitlement) Bill. According to various estimates and extent of coverage of families, the Government of India would require about 52-74 million tonnes of food and Rs.69,000 to 92,000 crores subsidy per annum for servicing the entitlement. Demand and supply issues have been examined in the light of productivity, production, pipeline technologies, marketed surplus, private trade, market arrivals, procurement, safe storage, movement and distribution logistics of food grains.

Food grain producing land acreage has fluctuated around an almost constant figure of 121 million ha during past 15 years and it may even go down due to other competitive demands of industrialization and urbanization. However, productivity trends are generally positive but declining and total production is volatile over the years due to weather erraticities. Peaked production of food grains of 234 million tonnes during 2008-09 almost matched the estimated requirement of direct and indirect consumption of 11th Plan and went down by 16 million tonnes to 218 million tonnes in the very next year due to rainfall inadequacies. Recent procurements, buffer stocks and PDS consisted of 55% rice, 45% wheat and occasionally 1% coarse cereals/millets. Domestic/global wheat production, its demand, prices and stocks have been quite volatile since 2006. There is hardly any international trade in ordinary rice since it is cultivated and consumed in highly populated Asia. There is insignificant international trade in fine *basmati* rice and it is not a part of PDS. Controlling repeated inflation bouts especially in fresh food prices is getting difficult and is raising food grain market sentiments also. Government procurement during past two years (2008-10) was about 56.5 million tonnes as compared to previous 5 years average (2003-08) of 39 million tonnes and overall supply scenario falls short of Food Security bill commitments.

Predominantly wheat eating states of Punjab and Haryana, both producing about 26 million tonnes of wheat are generating 75-80% of marketed surplus and only 70% of that is actually procured and rest is privately traded. Remaining of the non-wheat eating states, generating marketed surplus in the range of 50-67% are able to procure only 1-8% due to lack of infrastructure and financial arrangements. About 98% of rice produced in non-rice eating state of Punjab is marketed surplus, 85% of that is procured and remaining 15% is perhaps fine quality, premium priced *Basmati* rice, traded privately. About 96% of rice produced in Haryana is marketed surplus, 56% of mostly non-*Basmati* rice is procured and 40% privately traded premium priced *Basmati* rice is not preferable for subsidised PDS. Due to

unprecedented decline in water table, rice production in north-west India is not sustainable. Non-procurement of vast quantities of marketed rice in rice eating states especially of border States of West Bengal, Assam and UP is quite baffling.

A minimum 16 million tonnes would be required to buffer frequently occurring fluctuations in production due to increasing frequency and intensity of extreme weather/disastrous events of global warming. Rice and wheat have been major commodities of procurement and public distribution of food. Rice, wheat and other grains procurement capacities of States other than Punjab, Haryana, UP, Andhra Pradesh, etc. are grossly inadequate. Food Corporation of India is having 30.6 million tonnes of storage capacity consisting of 90% in godowns and 10% covered and plinth (CAP). About 51% of storage capacity is in public sector and 49% is rented from private sector. About 71-73% of the capacity has actually been utilized in the past. By all means the current safe storage capacity and its quality falls short of the food security requirements of 52 to 74 million tonnes. Lack of extended safe storage into modern silos with controlled conditions is a great infrastructural and managerial challenge.

Diversification into non-PDS, non-food and better commercial crops of fine and superfine *basmati* rice, premium quality and premium priced wheat in Malwa region of MP, sugarcane, soybean, Bt cotton; vegetables, fruits; leakages across the porous borders, hoarding etc. are important challenges of organising committed food stocks. There is very liitle international trade in the staple food of rice while high volatility in the international prices and trade barriers of wheat and other foods complicate imports for maintaining stocks.

Relatively high productivity potential of irrigated regions have been harnessed; there is a larger concern of sustaining ground water supplies and further productivity improvements will be high tech and input intensive. Presently, scope of improved technologies and realising relatively higher marginal response or returns to inputs is better in the rainfed region. An additional 10-11 million tonnes of food grains can be managed by ensuring rain water conservation and improved practices in about 20-27 million ha. However, coarse cereals are the major crops of rainfed area and consumers' preference for nutritious coarse cereals is declining. Rainfed regions are complex, diverse, risky and 13-15 times under invested compared to irrigated command development. Innovative safety nets against risks would be required to convince farmers for adopting improved rainfed technologies and intensive inputs.

Keeping in view the necessity of vast range of enabling policies, technologies, infrastructure, investment portfolio, governance, volatility in the domestic and international production, etc., matching of demand and supply of food entitlement bill is quite a challenging task. It would be preferable to implement in stages and expand according to developing or emerging production scenarios.

2. Introduction

Sustainable productivity, production, marketed surplus, market arrivals, procurement, milling of rice, extended safe storage of stocks, distribution logistics, physical availability, access/affordability and farm profitability provide security of food, social harmony and sovereignty. Traditionally, kings used to take up construction of castles and palaces to create work for food during droughts and other calamities. Non-monetary and non-inflationary food for work programme has generally been used to transfer food to poors, landless, assetless, children, women and disadvantaged households during calamities of droughts, untimely rains, floods and others till recently. An innovative, out-of-box, well structured, equitable, transparent and decentralised Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS) scheme since 2005 has supplemented income/wage earnings and food purchasing power. Accelerated overall growth in the economy has also made significant changes in the taste and preferences of food nature and quantum of the demands of several sections of the society. Supplies are getting constrained due to competitive demands of urbanisation, industrialization and demographic growth on natural resources for non-agricultural uses. Disaggregated analysis of the recent repeated bouts of inflation revealed maximum price rise of 18.32% ending December, 2010 in vegetables, fruits, meat, milk etc. Sales of relatively highly expensive imported fruits, locally unseasonal vegetables, fast foods etc. have penetrated beyond the metro cities indicating deep penetration of demands. About 25% rise in vegetable prices and 19% in eggs, meat and fish in December, 2010 over December, 2009 also confirms messing up of demands and supplies by the chain of intermediaries. Prices of main cereals like wheat and rice are relatively less volatile being non-perishable and well stocked grains. The policy of minimum support prices announced before sowing of the crops, procurement, prompt payment to farmers, safe storage, movement and public distribution logistics enabled the cereal deliveries especially to *Antodya* (poorest of poor) and BPL in the past. Mid day meals for school children is expected to ensure their nutrition, health and regular attendance in the schools. Women and child development schemes, *Antodya* and old age homes are some other important elements of food security system.

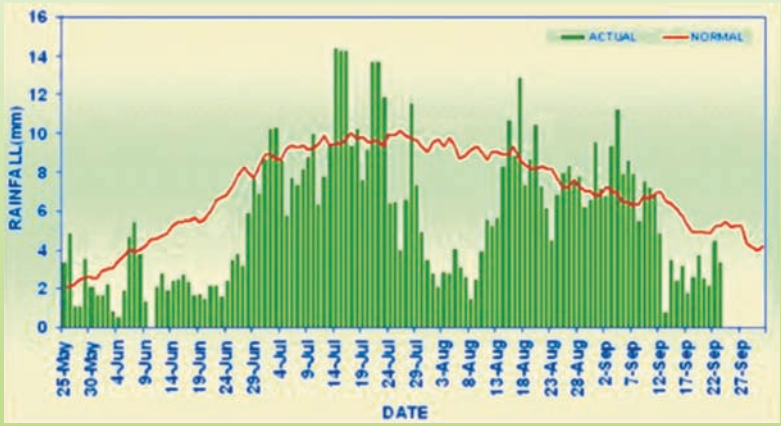
A more comprehensive Food Security (entitlement) Bill is being considered for parliamentary budget session of 2011 for providing definite quantity of food to a family at some fixed minimum affordable prices after detailed socio-economic analysis. Pricing of rice, wheat and millets at Rs.3 Rs.2 and Re.1 per kg., the annual estimated subsidy costs of different agencies are ranging from Rs.69,000 to 92,000 crores. Apart from financial resources, it envisages enabling commitments of assured productivity, production, marketable surplus, procurement, rice milling, adequate stocks, quality control, extended storage and leak proof distribution networks. The total food commitment under different coverage assumptions varies from 52 to

74 million tonnes per annum and exact figure will be known after finalizing the Act. However, production is uncertain due to declining per capita availability of land, water, biodiversity and other natural resources, escalating demand for non-agricultural land uses due to population growth, urbanization and additional food production is to be realised primarily by increasing productivity and efficiency.

Enhancing productivity of food grains during the first green revolution based on assured surface and ground water irrigation, energy inputs, deep alluvial soils, improved technologies, extension, mechanization, internalizing of social capital, rural infrastructure, marketing and credit has nearly reached its technological limits. It is rather getting afflicted by over-utilization of natural resources, excessive exploitation, degradation or fatigue of soil, climatic changes and marginal output to incremental inputs has drastically gone down. Cropping/farming systems are being diversified to conserve natural resources, enhance productivity, improving efficiency and farm income to meet aspirations of the farmers or primary producers and consumers. Genetically modified/engineered transgenic and other foods have tremendous potentials but their environmental, phyto- and bio-safety for human consumption and public acceptability is a major bottleneck of utilizing R&D products.

Rainfed agriculture being practised on 60% of cultivated land, supporting 40% of population, 60% of livestock and 40% of food is having significantly low productivity as compared to assured irrigated farming and has some unexploited potentials. However, it is complex, diverse, fragile, under invested, risky, distress prone with wider gaps among improved and demonstrated technological potentials and actual district/state level average productivity. Marginal returns or responses of investments into rainwater management, energy, fertilizers and other inputs is much higher in rainfed area as compared to irrigated well endowed regions. However, rainfall and its distribution is very erratic (Fig.1) and leads to significant year to year fluctuations in rainfed production, market volatilities and distress of primary producers and end-consumers. Climatic changes have lead to high frequency and

Figure 1: Daily mean rainfall (mm) over the country as a whole during 2009



occurrences of extreme weather events like droughts, floods, heat/cold waves etc. and increased distress of farmers and consumers. Safety nets and risk management is called upon as the most important driver of promoting latest technologies, investments and productivity.

3. Demand Supply Analysis

Requirement of cereals and pulses for household consumption and other uses at the end of 11th Plan (2011-12) and 2020-21 analysed by Chand (2007) is expected to be 235 and 280.6 million tonnes respectively (Table 1). The average triennium

Table 1: Annual demand for foodgrains as household food and other uses (in million tonnes)

Food Item/Type of Demand	Base Year 2004-05	By 2011-12	By 2020-21
Cereals (i) Direct demand as household food	151.7	159.1	166.6
(ii) Indirect food demand and other uses	41.1	59.8	94.9
Total Cereals demand	192.8	218.9	261.5
Pulses (i) Direct demand as household food	9.8	11.8	12.5
(ii) Indirect food demand and other uses	4.4	4.3	6.6
Total Pulses demand	14.2	16.1	19.1
Foodgrain (i) Direct demand as household food	161.5	172.5	187.4
(ii) Indirect food demand and other uses	45.5	64.1	101.5
Total Foodgrain demand	207.0 (200.3)#	235.0 (233.88)* (218.0)**	280.6

& Actual production recorded in 2008-09 and 2009-10 respectively.*
 # Triennium average production of 2004-05
Source: Ramesh Chand, Economic and Political Weekly, Dec., 2007

(2002-04) production of 200.27 m.t. was short of the corresponding estimated demand of 207 m.t. (2004) by about six million tonnes. The demand for vegetables, fruits, milk and meat will grow at a significantly higher rate as compared to cereals (Alagh 2011) and appropriate diversification is necessary. In the year of 2008-09 India could harvest 233.88 million tonnes of food grains very close to the demand

projection of 235 million tonnes by 2010-11 with ever highest procurement of 56 million tonnes of food grains. However, the very next year turned out to be risky, production dipped by 16 million tonnes and came down to 218 m.t. in 2009-10 due to drought in 2009. There are several similar instances of dips in the production of food grains (Fig. 2), rice (Fig. 3), wheat (Fig. 4), Pulses (Fig. 5) and coarse cereals (Fig. 6). Triennium average (2007-09) food production jumped over the previous similar average by 19.2 million tonnes, food prices still inflated and could not ensure sufficient food due to inefficient marketing, lack of extended safe storage and distributional deficiencies or inadequacies. Mopping up of sufficient stocks, scientific storage and transparent or leak proof distribution of 65-74 million tonnes for the proposed food security entitlement by public procurement will be a very challenging task due to several other limitations described later on.

Figure 2 : Foodgrains - Production and drought in different years

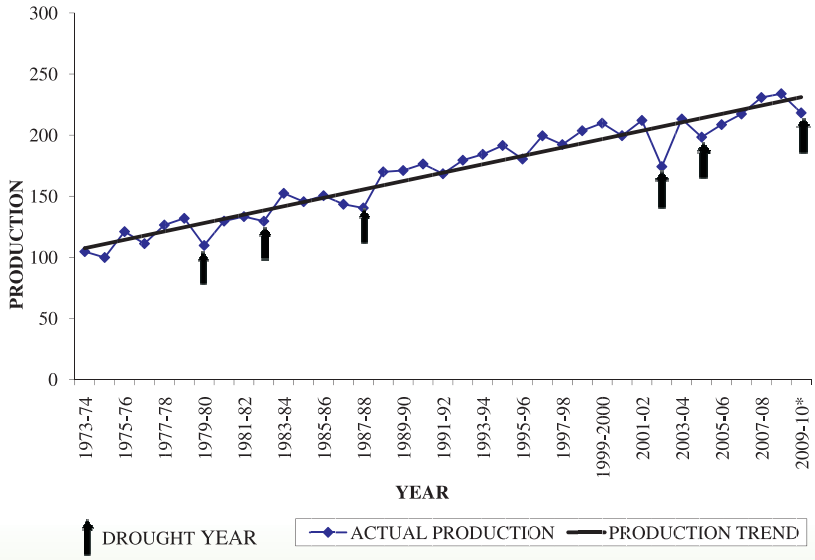
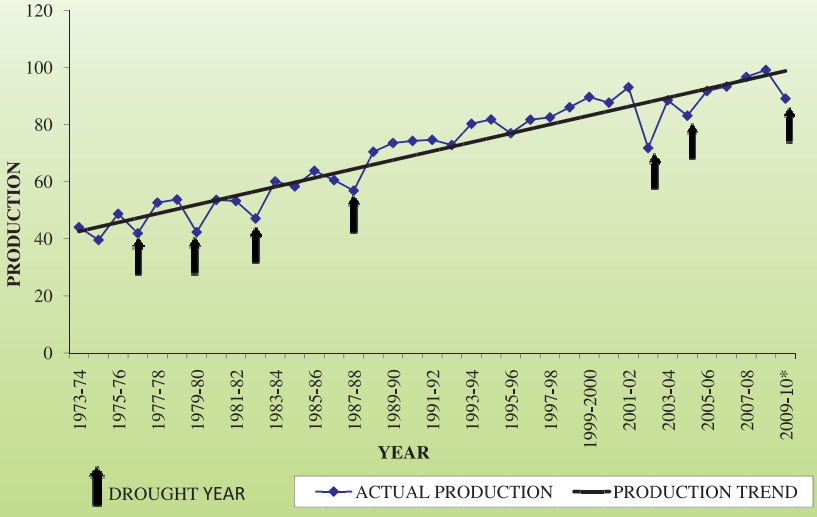


Figure 3: RICE - Production and drought in different years



** indicates estimate*

Figure 4: WHEAT - Production and drought in different years

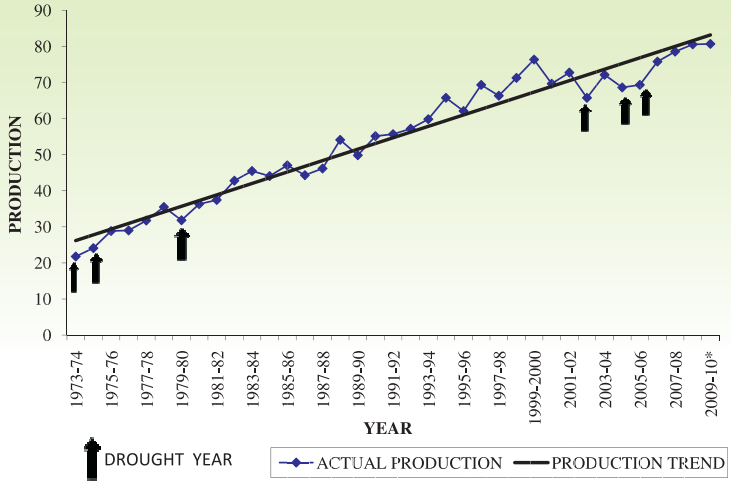


Figure 5: TOTAL PULSES - Production and drought in different years

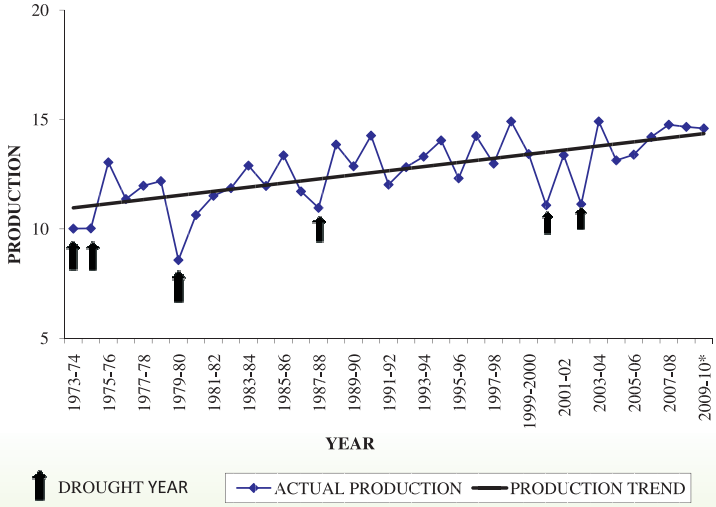
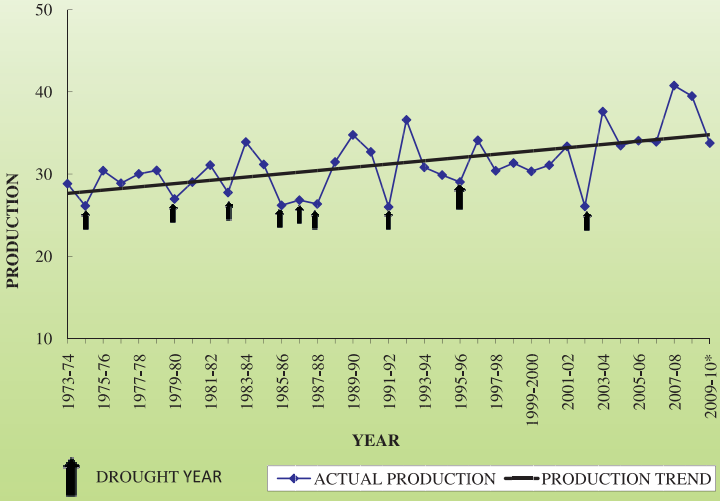


Figure 6: COARSE CEREALS - Production and drought in different years



** Indicates estimate*

Per capita consumption of total cereals especially coarse ones is going to decline by 2020-21 due to change in tastes, dietary habits, preferences, urbanization and standards of living (Table 2) and demand for fresh food consisting of vegetables, fruits, milk and animal products will step up. A significant reduction in the preference, consumption and demand of nutritious, minerals and fibre rich coarse cereals being consumed by specific sects in specific regions will also trigger their diversification in favour of fine cereals, vegetables, fruits, animal products and commercial crops. There are always some leakages to neighbouring countries, hoarding, clandestine trade, export of fine and superfine *basmati* rice, private trade in some premium priced commodities, unsafe storage and losses etc. The international food grain prices are also highly volatile, FAO price index of rice and wheat is escalating since 2006 and management of domestic inflation in food articles continues to be a tricky job. There are forcasts of higher food grain prices during the next decade. In fact the WFPRI (World Food Policy Research Institute) has not only cautioned about the higher food grain prices but also scarcity of food. There are unique manifestations of climate changes like drought in the initial rainy period of 2009 ending with floods in Bihar and Krishna Basin (Andhra Pradesh, Karnataka and Maharashtra) at the fag end confounded food production and farmers' distress (NRAA, 2009). Buffer stocks are being deployed to even out or level off year to year production variation, regionally erratic supplies and contain volatility of market prices.

Table 2: Trend in per capita direct consumption of cereals and pulses as food (kg/year)

Commodity	1973-74	1983-84	1993-94	2004-05	2011-12	2020-21
Rural + Urban						
Rice	79.98	76.87	79.92	73.77	70.53	66.83
Wheat	44.91	55.30	54.55	53.46	52.24	50.62
Coarse Cereals	48.86	37.76	19.77	12.62	9.80	7.57
Total Cereals	173.76	169.94	154.24	139.86	132.58	125.01
Pulses	-	-	9.56	8.99	9.01	9.37
Foodgrains	-	-	163.80	148.85	141.59	134.39

Source: Ramesh Chand, Economic and Political Weekly, Dec., 2007

The next year of 2010 received very high rainfall especially in north and south-west with 25 more rainy days. The standing rice crop in Andhra Pradesh, Tamil Nadu, Orissa etc. was damaged due to unseasonal or untimely rains and farmers are demanding compensation. At the same time eastern UP, Bihar and Jharkhand witnessed drought. Damage to onion crop due to untimely rains in 2006 (Samra et.al. 2006) and in January, 2011 sparked unexpected inflation in its prices, exports were banned, import duty cut to zero and monetary liquidity regulated. At the same time, eastern UP, Bihar, Jharkhand etc. received deficient rain and it is difficult

to manage drought in this part of the country. There was over-production of bajra (pearl millet) in Rajasthan but market prices crashed due to lack of procurement by the state. Such dicey events are quite common, going to multiply with global warming and versatile safety nets of food security, livelihood and farm income are called upon.

4. Availability, production, marketed surplus, market arrivals procurement and stocks

Per capita availability of food grains in India increased during 1951 to 1991 and declined post 1991 (Table 3). At the present demographic growth rate per capita availability of cereals may not remain comfortable especially of pulses and other cereals which has declined constantly after 1991. Triennium averages reveal that during past

Table 3: Trends in per capita availability of foodgrain in India (Decadal average)

(gms/person/day)

Year	Rice	Wheat	Other Cereals	Total Cereals	Pulses	Total foodgrains
1951	159	66	110	334	61	395
1961	201	79	120	400	69	469
1971	193	104	121	418	51	469
1981	198	130	90	417	38	455
1991	222	169	80	469	42	510
2001	191	136	56	386	30	416
2007	194	158	55	407	35	443
2008	175	145	54	395	42	436
2009	188	155	64	407	37	444

Source : Agricultural Statistics at a Glance. 2009, DAC, Min of Agriculture, GOI

16 years, area under food grain cultivation has fluctuated around a constant value of 121 million ha whereas total production has increased due to gradually improving productivity (Table 4). After 1996-97 additional production came mostly from three commodities of rice, wheat and maize only i.e. very narrow base. Growth rate in sown area and production is bumpy over the years with sufficient negative values. It is due to uncertainties in the behaviour of weather especially rainfall, its onset, long dry spells in between, withdrawal and distribution, floods, hot/cold waves, cyclones etc. Intensity and frequency of occurrences of extreme weather events or risks have gone high during the past 10-15 years as manifestations of global warming and climatic changes. It requires mitigation measures, innovative alternative land uses for reducing vulnerability and improvements in the safety nets especially in rainfed area to assure the farmers to go in for the input intensive modern technologies. Market interventions and infrastructural investments into silos to regulate volatility of prices, farmers/consumers distress, procurement, prompt payments, extended safe storages

Table 4: Three year averages of area, production, productivity and growth rate of food grain 1984-86 to 2009-10

Year	Area (mha)	Production (mt)	Productivity (t/ha)	Compound Growth Rate %		
				Area	Production	Productivity
1984-86	128.62	149.45	1.16	-1.20	-0.64	0.43
1987-89	124.85	151.23	1.21	0.18	8.85	8.97
1990-92	125.49	171.94	1.37	-1.95	-0.78	1.48
1993-95	123.25	185.08	1.50	0.29	3.29	3.06
1996-98	122.81	190.71	1.56	1.17	3.23	1.99
1999-01	123.11	203.41	1.65	-1.66	-1.68	0.00
2002-04	120.03	200.27	1.66	0.27	0.08	-0.29
2005-07	121.77	208.08	1.70	1.53	4.66	2.99
2007-09	123.67	227.31	1.83	-0.20	3.75	3.92
2009-10*	-	218.20	-	-	-	-

**Single year figures*
Source : Agricultural Statistics at a Glance. 2009, DAC, Min of Agriculture, GOI

and flawless distribution networks need very high priority.

Relative maximum contribution of 18.5% of coarse cereals to the total food production has declined slightly after 1990-91 (Table 5) and there is hardly any public procurement and distribution other than rice and wheat. Highest technological productivity improvement has been realized in coarse cereals and it is a paradoxical

Table 5: Contribution of coarse cereals in overall food production in recent years

	Total food production (mt)	Coarse Cereals (mt)	% of Coarse Cereals
1985-86	150.44	26.20	17.41
1990-91	176.39	32.70	18.53
1995-96	180.42	29.03	16.09
2000-01	196.81	33.38	16.96
2005-06	208.60	34.07	16.33
2008-09	233.88	39.48	16.88
2009-10	218.20	33.77	15.47

Source : Agricultural Statistics at a Glance. 2009, DAC, Min of Agriculture, GOI

situation that its demand is declining. Periodical over-production of coarse cereals during favourable rainfall year always led to crashing of market prices.

Although Minimum Support Price (MSP) for coarse cereals is announced by the Government of India but most of the producing states do not deploy any infrastructure and financial resources to procure, make prompt payments to the farmers, store and utilize the grains efficiently. Millets should be included in procurement, warehousing, PDS and food price subsidy. Pearl millet (bajra) is the dual purpose, drought tolerant main coarse cereal crop, most important fodder for animals, witnessed highest productivity growth among all cereals (Table 11) and its prices crashed during high rainfall years of 2003 and 2010 due to market failures. Almost similar is the fate of sorghum. The next highest production is in another coarse cereal hybrid maize and its marketing is also most inefficient without any public intervention to assure minimum returns. Till 2009-10, on an average rice

Table 6: Status of procurement of foodgrains

Year	Procurement			Percent procurement of Rice & wheat			
	Rice (mt)	Wheat (mt)	Rice+ Wheat (mt)	Total Food-grain	Total Cereals	Total Rice + Wheat	Marketed surplus (Rice+ Wheat)
1998-99	12.5	12.6	25.2	12.3	13.3	16.0	—
1999-2000	18.2	14.1	32.3	15.4	16.4	19.4	28.4
2000-01	21.2	16.3	37.6	19.1	20.2	24.3	29.3
2001-02	22.1	20.6	42.7	20.0	21.4	25.7	35.7
2002-03	16.4	19.0	35.4	20.2	21.6	25.7	—
2003-04	22.8	15.8	38.6	18.1	19.4	24.0	33.4
2004-05	24.6	16.7	41.4	20.8	22.3	27.3	33.5
2005-06	27.6	14.7	42.4	20.3	21.7	26.3	41.0
2006-07	25.1	9.2	34.3	15.7	16.8	20.2	27.6
2007-08	28.4	11.7	40.2	17.4	18.6	22.9	33.8
2008-09	33.7	22.6	56.3	24.1	25.6	30.0	—
2009-10	31.4	25.4	56.8	26.03	27.89	33.44	-
Average	23.7 (59%)#	16.5 (41%)#	40.2 (65-70)*	19.11	20.4	24.6	32.8

 # Percent of total food grain procurement

** Of the estimated requirement of food security draft act.*

and wheat constituted 59 and 41% of procurement for public distribution system of India (Table 6). Except two drought years of 2002-03 and 2006-07, procurement generally continued to increase upto 56 million tonnes each in the last two years (2008-10) as compared to previous five years (2003-08) average of 40 million tonnes constituting 19.1% of total food grain, 20.4% of total cereals, 24.6% of total rice plus wheat production and 32.8% of total marketed surplus of rice plus wheat. Procurement of 56 million tonnes of food grain in the drought year of 2009 was due to realizing higher productivity of rice under disease/pest free, abundant sunshine and assured irrigated conditions of North-West. There was also a special drive for procurement. Year and state-wise production, marketed surplus ratios, procurement and stocks during 2001-02 to 2009-10 of rice and wheat are given in Annexure 1 and 2 and summarized in Table 7 and 8.

Among cereals, rice with its maximum production has relatively better spread across regions, states and agro-ecologies as compared to wheat. Punjab, being non-rice eating state, on an average produced 9.94 million tonnes out of which about 98% was marketed surplus and about 85% was procured and rest was purchased by

Table: 7: Annual average* production, marketed surplus ratio, marketed surplus and procurement of rice from different states

State	Production (mt)	Marketed Surplus Ratio (%)	Marketed Surplus (mt)	Total Market Arrival (mt)	Procurement (mt)	Procurement as % of		
						Production	Marketed Surplus	Total Market Arrival
Punjab	9.94	97.8	9.72	8.90	8.37	83.3	85.1	94.0
Haryana	3.05	95.6	2.98	2.11	1.60	51.8	55.5	75.8
U. P	11.33	61.8	7.31	3.87	2.57	22.7	45.3	66.4
W.B	14.77	59.8	8.85	0.76	0.86	5.8	10.3	113.0
A.P	11.00	84.2	9.39	6.96	5.40	48.6	57.2	77.6
TN	5.32	78.1	4.12	1.08	0.76	13.7	18.1	70.3
Chtgarh	4.77	-	-	3.31	2.57	53.1	-	77.6
Orissa	6.48	63.6	4.44	2.04	1.77	27.0	38.6	86.8
Karnataka	3.52	86.0	3.23	-	-	-	-	-
M. P	1.43	66.5	1.00	0.133	0.13	9.5	11.5	98.0
Other States	1.82	-	-	-	1.82	-	-	-
Total	79.76	77.0	51.04	29.16	25.85	32.4	50.6	88.6

**(Average of nine years from 2001/02-2009/10)*

private traders mostly *Basmati*. About 94% of the rice actually arrived in the market was procured on behalf of FCI. Haryana produced about 96% marketed surplus and only 55% of it was actually procured and rest being fine or superfine rice (*Basmati*) was privately traded. About 75.8% paddy that actually arrived in market was procured by FCI. Andhra, being an important rice cultivating state, produced 84% marketed surplus and only 57% was procured by FCI and the rest was traded locally or by private brokers since it is a rice eating state. UP state produced 62% marketed surplus and only 45% was procured by government agencies. In Orissa only 38.6% of marketed surplus was procured by government agencies. In rest of the states, less than 16% of marketed surplus was actually procured by government. West Bengal being the highest rice producing state (average 14.8 million tonnes/ year) with about 60% marketed surplus procured only 10% of the stock. In West Bengal procurement exceeded the market arrival and this discrepancy indicates that rice mills must have purchased paddy directly without being reflected into market arrival whereas levy rice added to the procurement. In the ultimate analysis Punjab and Haryana, being non-rice eating states, are the only best bets of rice procurement for PDS. AP and Chhattisgarh are other two states where procurement is picking up. There is hardly any scope to improve percentage of procurement in other 25 states. Very little market arrival, very poor procurement and overshooting of arrivals in West Bengal is not understandable.

Haryana and Punjab produced 75-82% of marketed wheat surplus and about 50-60% of that was procured by the government (Table 8). About 98-100% of market

Table 8: Annual average* production, marketed surplus ratio, marketed surplus and procurement of wheat from different states

State	Production (mt)	Marketed Surplus Ratio (%)	Marketed Surplus (mt)	Total Market Arrival (mt)	Procurement (mt)	Procurement as % of		
						Production	Marketed Surplus	Total Market Arrival
Punjab	14.9	82.2	12.28	9.33	9.10	59.8	70.6	97.5
Haryana	9.6	75.1	7.11	4.97	4.97	49.8	68.5	100.0
U. P	25.0	49.8	12.32	1.99	1.73	5.8	8.5	86.9
RAJ.	6.2	56.6	3.60	0.74	0.44	5.4	8.9	59.4
M. P	6.4	65.6	4.35	1.27	0.76	9.6	7.0	59.8
Bihar	3.9	67.3	2.55	-	0.13	2.0	0.5	-
Other States	6.6	-	-	0.44	1.02	-	-	-
Total	72.6	66.1	42.2	18.74	18.15	25.0	60.3	96.8

**(Average of nine years from 2001/02-2009/10)*

arrival was procured. UP being highest wheat producing state (average 25 mt/year) generated about 50% (12.32 mt/year) marketed surplus and only 8.5% of that was procured by government agencies. Similar is the situation in Rajasthan. In MP only 7% of its marketed surplus of 4.35 mt/year was procured because its wheat quality is premium and is mostly traded privately with premium rates especially in metro cities. Private traders purchased about 40% of wheat that arrived in the markets of MP and Rajasthan. Bihar procured only 0.5% of its marketed surplus. Very poor procurement of sizeable marketed surplus of rice in the border state of West Bengal, UP, Assam and wheat in other border states of UP and premium quality wheat growing States of MP and Rajasthan may be due to illegal trade across the border.

The latest global situation of prices, production, utilization and stocks of wheat and rice is also uncomfortable (Table 9). India may not resort to imports or exports of rice and wheat as on today, but international market sentiments do influence domestic prices, private and illegal trading practices. There was depletion of global ending stocks of wheat during 2006-08 whereas rice stocks continued to be levied. As per an unconfirmed press report, global demand for wheat during 2010-11 has overshot supply by 20.3 million tonnes (-5.1%) and accordingly buffer stocks have got depleted. Rice stocks have improved by 5.6% and international trade from Asia

Table 9: World production, utilization and ending stocks of wheat and rice 2004-2009

Year	WHEAT			RICE*		
	Production (mt)	Utilization (mt)	Ending Stocks (mt)	Production (mt)	Utilization (mt)	Ending Stocks (mt)
2004-05	632.1	619.5	173.5	408.5	415.1	99.3
2005-06	624.4	625.3	170.4	421.3	418.5	102.3
2006-07	614.9	627.0	160.0	425.6	420.6	106.1
2007-08	610.9	617.6	151.8	441.0	437.9	109.2
2008-09	683.8	644.4	186.8	459.1	449.4	119.2
2009-10	655.2	649.4	191.9	460.2	455.3	123.3

**Rice (Milled basis) Source: FAOSTAT*

to outside is mainly in terms of fine and superfine rice which is not a component of subsidized food security of India.

Keeping in view year to year variation in the past, about 16 million tonnes of food grain has to be kept in buffer stock against frequent yearly fluctuations and at present it seems difficult to mop up envisaged food security requirement of 65-74 million tonnes. Inflation in domestic and international food prices is a

frequently recurring event and some deflationary stocks would be a good strategy. There is considerable domestic consumption by primary producers, local and higher level private trade. Rice constitutes about 59% of the procurement against 41% of wheat and most of the procurement is from UP, Haryana and Punjab. Of late limited quantity of rice is also procured in Andhra Pradesh and Chhattisgarh. Nine years average indicates that Punjab procured 85%, A.P. 57%, Haryana 56%, UP 45%, Orissa 39%, TN 18%, MP 12% and WB only 10% of marketed surplus and very small quantity from rest of the 20 states (Table 7). Wheat procurement of marketed surplus is normally being 71% in Punjab, 69% in Haryana, about 8% each in UP, Rajasthan, MP and only half percent in Bihar and negligible quantities in the remaining states. Well established infrastructure in Punjab and Haryana is moping up almost all of the market arrival and there is no scope of additional procurement unless productivity and production are stepped up. There is hardly any infrastructure or capacity to mop up most of the marketable rice and other food grains in most of the other states. Some of the rice seems to be traded clandestinely along the north and eastern border. Major procurement interventions in the self consumption and well entrenched private trade are also debatable.

Private investments into long, safe and efficient storage of procured grains under controlled environments of modern silos may not be attractive due to proposed food security, essential commodities and APMC acts. Such bottlenecks need to be resolved to ensure private participation for the full implementation of the proposed food security act. Assured long term (20-30 years) rental contracts could be attractive to the newly coming up infrastructure companies. Biometric (Adhar) system of servicing the targeted food insecure families transparently may be operationalized to prevent distributional leakages and malpractices because of highly subsidized rates. Clandestine exports and genuine international trade also need to be addressed.

5. Safe storage of grains, movement and distribution logistics

Warehousing capacity, quality of safe storage infrastructure, moisture content of procured grains, drying losses/ gains, breakage and recovery of rice during milling and shelf life of the grains are important

Staking of food grain in gunny bags.

considerations of efficient servicing of food security. Food Corporation of India (FCI) has about 30.6 million tonnes capacity consisting of 90% in godowns and 10% cover and plinth (CAP) storage (Table 10). About 51% of storage capacity was owned by the FCI and 49% was hired or rented from the private sector during 2010. The latest utilization figure ranges from 71 to 73%. Maintaining of buffer stocks of 16.2 million tonnes on 1st April, 26.9 million tonnes on 1st July, 16.2 million tonnes

Table 10: Storage capacity with Food Corporation of India (FCI) and its % age utilization as on 31.12.2009 and 31.12.2010 (million tonnes)

	Covered storage (Godowns)			Open storage Covered and plinth (CAP)			
	Owned	Hired	Total	Owned	Hired	Total	Grand Total
Position as on 31.12.2009							
Capacity (million tones)	12.9 (46%)	12.36 (44%)	25.33 (90%)	2.39 (9%)	0.37 (1%)	2.77 (10%)	28.1 (100%)
Utilization %	75	76	76	40	66	43	73
Position as on 31.12.2010							
Capacity (million tones)	12.99 (42%)	14.49 (48%)	27.48 (90%)	2.62 (9%)	0.50 (1%)	3.13 (10%)	30.61 (100%)
Utilization %	69	78	74	42	78	48	71

Source: Food Corporation of India, 2011

on 1st October and 20.0 million tonnes on 1st January of the year is necessary to take care of year to year variation due to droughts, floods, other extreme weather/ disastrous events, epidemics etc. (Samra and Singh, 2002; Samra et.al. 2003; Samra and Singh 2005; Samra 2006).

The most modern (automatically controlled conditions), scientific, safest and longest storage into silos is almost non–existent in India. Adani Group has demonstrated silos infrastructure of 0.2 million tonnes each at Kaithal (Haryana) and Moga (Punjab) for bulk handling and transporting of grains without gunny bags. LT Foods Ltd., Gurgaon is also

A view of Modern Silo for stage of food grains

constructing 5 silos each of 50,000 tonnes capacity at Amritsar (Punjab) for handling 200 trucks per day and 25 days filling period. This entire capacity has been hired by Punjab government for 30 year period and maintenance of the infrastructure, storage conditions and losses/damages within prescribed limit is responsibility of the infrastructure company. At present the silos construction material is imported but private manufacturers are ready to produce indigenously if there is sufficient demand. In that case cost will further come down. Moreover silos being vertical storage require only one third of the space as compared to traditional godowns. According to one estimate especially for premium cities or locations, conversion of old godowns into silos will spare or unlock about 60% of expensive land more than sufficient to meet the replacement cost with silos construction.

Both modern silos and traditional godowns have their own relative advantages and disadvantages and optimum mix has to be planned keeping in view the requirement under the proposed Food Security bill. The present capacity of 30.6 million tonnes and quality of warehousing in any case is insufficient and inadequate for the projected demand of 65-74 million tonnes under food security bill. While designing and locating safe storage, most efficient movement of grain has also to be networked. Since price differential between PDS and open market will be great, there are definite risks of targeting most deserving and genuine families, leakage, pilferages, misuse etc. Risks have recently been discovered in the adulteration of petrol/diesel with pilfered cheap kerosene in Maharashtra and burning of official around 26th January, 2011. Unique identification number, monitoring, social audit and other transparency measures should be the pillars of food security delivery services.

6. Productivity growth rate of food grain crops

It has been analysed earlier that growth in productivity is the main stake of consolidating food security and its crop wise disaggregated growth rate analysis is reported in Table 11. As per average of past 12 years, rice and wheat are the two major crops contributing 59 and 41% to the central pool of buffer stock and supporting public distribution system. Outside the North-West region, rice is a preferred or staple food especially in the poverty inflicted and food insecure states of Eastern region. Consumption of wheat is extending to Central, South and among coarse cereal consuming population elsewhere. Details of productivity growth in cereals, pulses and oil seeds are asymmetrical to their relative importance in food security as summarized below:

6.1 Cereals

In spite of relatively higher R&D priority investments, growth in productivity of the two major food securing crops of wheat and rice has declined over 1980-1990 decennial and out of the two there is relatively greater concern for irrigated wheat (Table 11). Rice and wheat contribute 59 and 41% to the total procurement and

subsequently PDS. The lowest current growth of 0.58% in wheat and 1.92% in rice as compared to 4.88% in coarse cereals is quite alarming. Consumers' preference and area under coarse cereals with highest growth rate is also declining and is another caution to augment food supplies in future. After 1996-97 wheat production over years was relatively more unstable than rice and maize due

A view of Harvesting of Wheat crop

Table 11: Decennial compound growth rate (%) of productivity of important foodgrain crops

	1980-1981 to 1989-1990	1991-1992 to 1999-2000	2001-2002 to 2008-2009
Rice	3.19	1.34	1.92
Wheat	3.10	1.83	0.58
Bajra	1.09	2.44	4.22
Jowar	1.29	0.48	3.66
Maize	2.09	2.32	2.87
Small millets	1.14	-0.51	2.63
Ragi	1.14	2.10	1.37
Coarse Cereals	1.62	1.82	4.88
Total Foodgrains	2.74	1.52	3.32

Source : Agricultural Statistics at a Glance. 2009, DAC, Min of Agriculture, GOI

to its global warming sensitivity. Most of the fine and superfine *Basmati* rice and premium quality wheat like *Sharbati* being cultivated in Malwa region of MP are being traded privately at premium rate especially in metro cities and for confectionary items. Such premium priced and premium quality commodities/stocks are privately traded by the cultivators to earn maximum income. Productivity in the green revolutionized regions, agro-ecologies and states is very high and massive injection of new technologies and investment is called upon to overcome stagnation or to reach next higher level.

6.2 Coarse cereals

About 87% of coarse cereals are un-irrigated and showed a better resilient growth rate of productivity and production (Annexure 5). Predominantly rainfed

coarse cereals of pearl millet (bajra), sorghum (jowar), small millets and maize have registered accelerated higher productivity growth due to improved hybrids and watershed management. In spite of being rainfed, decennial productivity of the group of coarse cereals of 4.88% is higher than the 3.31% of total food grains (Table 11). Among individual coarse cereals, highest productivity has been analysed in bajra (4.22%) followed by jowar (3.66%), maize (2.87%), small millets (2.63%) and Ragi (1.37%) as compared to declined growth in assured irrigated wheat (0.58%) and 1.92%, irrigated (50%) and rainfed (50%) rice. Winter maize in Eastern India has shown very high productivity, private industry will always be interested in its hybrid seeds business and inefficient marketing is not allowing realization of its full potentials. However, area and consumers' preference for coarse cereals has declined and is projected to go down in future also (Annexure 5). In spite of being nutritious, relative contribution of coarse cereals to the total food grain production declined slightly after 1990-91 and is almost constant after that (Table 5). High productivity and production of pearl millet (bajra) in good rainfall years of 2003 and 2010 led to crash in the market prices and farmers sold their produce 25-30% below the Minimum Support Price (MSP). Short shelf life of its oil rich flour and difficult or laborious cooking of coarse cereals has shrunk demand. These conflicts or contradictions in demand, supply, consumers' preference and marketing of coarse grains need their products diversification.

A field view of Hybrid Bajara.

Long term analysis based on three years (triennial) average of major crops of rice, wheat, and coarse cereals (Annexure 3 to 5) also reveals both positivities and occasional negativities in the growth rates especially of area and to a lesser extent of productivity and production. About 50% of rice is rainfed and rainfall is quite uncertain. Similarly 30% of wheat is also rain dependent and subject to distribution and amount of rainfall. There is a strong case of managing risks by unique policies, technologies, strategies, budgetary provisions, safety nets and buffer stocks to watch interests of both producers and consumers.

6.3 Pulses

About 87% of pulse production of India is rainfed or without irrigation. Water harvesting under watershed development programme generally leads to knocking out

Table 12: Three year average area, production, productivity and growth rate of total pulses 1984-86 to 2009-10

Year	Area (mha)	Production (mt)	Productivity (t/ha)	Compound Growth Rate %		
				Area	Production	Productivity
1984-86	23.57	12.74	0.54	1.85	1.81	-0.09
1987-89	22.53	12.17	0.54	-0.02	8.75	8.71
1990-92	23.54	13.05	0.55	-1.88	-3.32	-1.47
1993-95	22.55	13.39	0.59	1.49	4.65	3.18
1996-98	22.53	13.18	0.58	1.32	2.69	1.35
1999-01	21.66	13.14	0.60	-6.94	-13.80	-7.37
2002-04	21.99	13.14	0.60	3.24	5.60	2.28
2005-07	22.78	13.57	0.60	0.94	3.99	2.99
2007-09	23.06	14.54	0.63	-1.78	1.61	3.45
2009-10*	-	14.59	-	-	-	-

**Single year figures*
Source : Agricultural Statistics at a Glance. 2009, DAC, Min of Agriculture, GOI

of pulses by other crops due to their low productivity and profitability. There is hardly any significant change or growth in the area, production and productivity since 1984-86 (Table 12) whereas it is a major source of nutrition and protein a large section of vegetarian population of India. Chana or grams (chick peas) and summer moong have shown better performance in the recent years. There is very small growth in productivity due to genetic reasons, lack of investments and non-priority of research for enhancing pulses productivity and production. There is generally 3-4 million tonnes deficit in its supplies with high instability in the growth of area, productivity and production due to variability in rainfall, its onset, withdrawal and distribution. Gap in demand and supply is being met through imports.

A field view of Gram (Chickpeas) crop

About 10-11 million ha area remains fallow after rice harvesting in eastern and central India. Sowing of pulses especially lentil, chickpeas, sweet peas, non-toxic Lathyrus etc. can be internalized by in situ conservation of rainwater, run off harvesting into farm ponds, check dams, ground water recharging

and recovery through dug wells in hard rock area and tube wells elsewhere. Seed production of pulses is a low priority of the private sector because of restricted business and public sector is not geared up to enhance replacement of low yielding old varieties with high yielding new ones.

Since demand of coarse cereals is shrinking and their productivity is growing at a relatively higher rate, the saved area could be considered for kharif pulses like black gram, moong and others by producing seeds of improved varieties. An accelerated pulses production programme is in operation. Funds of Integrated Watershed Management Programme (IWMP), MGNREGA and special pulse production drive could be converged for creating critical mass of investments to promote productivity and production. Tata Chemicals is leveraging branded pulse production in North and Eastern India and Rallis India in South and Western India since 2010 like that of e-chaupal model of ITC for promoting soybean production. While creating opportunities of better extension of technologies and efficient brand marketing in PP mode, it may compete with the low priced non-labelled and non-branded requirements of the food security supplies. Overall production and availability of pulses is highly uncertain and imports will be unavoidable for the time being.

6.4 Oil Seeds

A view of Mustard crop in Flowering Stage

Vegetable oil is a major food cooking medium in India. Oil seeds are relatively drought tolerant and production is mainly under rainfed or limited irrigation conditions and there are significant year to year variations. Like pulses, growth in area, productivity and production is quite erratic to meet the demands sustainability (Table 13). The maximum growth in productivity has been realized in rapeseed and production of sunflower both due to area expansion and productivity enhancement. There is, of course, consistent improvement in the productivity and some negative growth rate due to extreme year to year variation and estimates are based on moving averages. However, there have been bumps of positive and negative growth rates in the area, productivity and production over the years due to variation in amount, distribution, onset, and withdrawal of rainfall with long dry spells in between. High gestation period of relatively more tolerant palm oil plantations and tree borne oil seeds will require more time to stabilize through diversification for robust production. Dumping of cheap oil into India through international trades does affect its domestic prices,

Table 13: Three year average area, production, productivity and growth rate of Oil Seeds 1984-86 to 2007-09

Year	Area (mha)	Production (mt)	Productivity (t/ha)	Compound Growth Rate %		
				Area	Production	Productivity
1984-86	18.88	12.16	0.64	0.88	-7.62	-8.38
1987-89	20.22	13.98	0.69	8.42	26.48	16.70
1990-92	24.28	18.04	0.74	6.56	4.85	-1.56
1993-95	25.81	20.98	0.81	0.12	3.01	2.85
1996-98	26.14	22.60	0.86	0.31	-1.80	-2.08
1999-01	24.43	21.30	0.87	-6.83	-13.68	-7.37
2002-04	22.60	20.23	0.89	2.23	10.42	7.95
2005-07	27.30	25.54	0.94	-1.85	-0.12	1.74
2007-09	26.89	27.40	1.02	1.78	7.67	5.83
2009-10*	-	24.93	-	-	-	-

**Single year figures*
Source : Agricultural Statistics at a Glance. 2009, DAC, Min of Agriculture, GOI

production and farmers' income. Protection to domestic production through tariff and non-tariff barriers is necessary.

7. Yield Gap Analysis

First green revolution happened due to realization of enhanced productivity by massive R&D investments in India as well as internationally in irrigated rice and wheat in collaboration with International Rice Research Institute Manila (Philippines) and CIMMYT (Mexico) in wheat. Less endowed and risky rainfed regions are also being targeted through domestic capacities and international collaboration to harness relatively less utilized potential. India should, however, invest immediately to realize demonstrated technological gaps through improved extension, supply of quality seeds, inputs and efficient marketing.

7.1 Wheat

Full benefits of improved technologies are not being enjoyed by the primary producers due to several bottlenecks (Table 14). The results of improved practices (I), frontline demonstrations on farmers field (F) show a considerable gap from the states' average productivity (A) across the crops indicating significant scope for increasing production. Similar conclusions could be drawn by analysing data at district levels also. Productivity of crops like wheat in irrigated areas of Punjab, Haryana and Rajasthan has already reached close to the existing technological or

Table 14: State-wise yield gap analysis of irrigated wheat (average of three years) Yield: t/ha (2002-03 to 2004-05)

State	Improved practice (I)	Farmers demons-trations (F)	State average 2003-04 (A)	Yield gap % between	
				I and F GAP-1	I and A GAP-2
Punjab	4.46	4.03	4.20	10.6	6.1
Haryana	4.75	4.52	3.96	5.1	19.8
Rajasthan	3.94	3.72	2.79	6.0	41.3
Uttar Pradesh	4.20	3.32	2.79	26.5	50.5
Gujarat	4.03	3.49	2.68	15.6	50.5
Madhya Pradesh	3.29	2.47	1.78	33.4	84.3
Bihar	3.65	2.90	1.78	25.7	104.8
Maharashtra	3.41	2.90	1.33	17.3	155.5
Average	3.96	3.41	2.66	21.71	32.82

Source: FLDAICRIP Wheat 2002-03 – 2004-05.

genetic potential and there is scope for enhancing productivity of 30% rainfed areas especially in M.P., Bihar and Maharashtra (Table 14). Unrealized technological gaps (GAP-1 and GAP-2) in wheat production in Punjab, Haryana and Rajasthan are very small. Growth in the wheat productivity has also highly decelerated. These are the three most important States contributing to PDS stock and provide very little scope for consolidating procurement and supplies and strategy has to be focussed elsewhere. The average productivity of wheat in the States of Punjab and Haryana is over 4.0 t/ha, whereas the productivity of Maharashtra, M.P. and Bihar is less than 2.0 t/ha against the estimated potentials of these States of 3.5 to 4.0 t/ha and the gap varies from 84 to 155% in MP, Bihar and Maharashtra. Climate regime of these states for existing genetic material is less favourable and heat tolerant varieties found in Sudan etc. need to be explored.

There is also a challenge to ward off adverse effect of rise in temperature on wheat yield after mid March in the Indo-Gangetic plains especially due to global warming. Early sowing of wheat to escape terminal heat is constrained due to two reasons (i) early transplantation of paddy has been banned in Punjab and Haryana to save ground water which excludes possibility of early seeding of the next wheat to avoid heat at maturity time and (ii) fine and superfine *Basmati* rice is giving highest economic return and is planted late so that it should mature during low temperature to develop maximum aroma. This also negates possibilities of early sowing of subsequent wheat to avoid terminal heat. After 1996-97, production of wheat over years was relatively less stable as compared to rice due to global warming. Over mining of

productivity and genetic potential in Punjab, Haryana, etc. with 70% procurement of marketed surplus is demanding very high tech management of multi nutrients and their ratios to sustain and improve the productivity. Marginal returns and efficiency of fertilizers, inputs, power etc. is very low in the wheat growing Indo-Gangetic plains, factor productivity is declining and further improvements in technologies are called upon.

Standing crop of Rice

7.2 Rice

The most important PDS rice is grown both under irrigated (50%) as well as rainfed (50%) conditions The productivity of upland rainfed rice is about 1.5 to 2.0 t/ha (Table 15). Gap between technologically improved level (I) of rainfed (upland) rice and demonstrated at Farmers' field (F) varies from 19.2% to 66.1% with a mean of 27.3%. The second gap between technologically improved (I) and state average productivity of very large areas (A) is still higher in the range of 35.2% to 157% with an average of 92.8%.

Table 15: State-wise yield gap analysis of rainfed rice Yield: t/ha (2003-04 to 2004-05)

State	Improved Practice (I)	Farmer Demons-trations (F)	State Average (A)	Yield Gap % between	
				GAP-1 I and F	GAP-2 I and A
Rainfed (upland) Rice (2003-04)					
Jharkhand	2.29	1.38	1.69	66.1	35.2
Uttar Pradesh	3.62	2.48	1.94	46.0	86.4
Chhattisgarh	3.74	3.13	1.45	19.2	157.0
Average	3.21	2.33	1.69	27.32	92.8
Rainfed (shallow lowland)/ Boro Rice ; 2003/04, 2004/05					
Uttar Pradesh	3.65	3.43	2.18	6.5	67.2
Jharkhand	3.48	2.30	1.69	51.3	105.3
Chhattisgarh	3.55	2.78	1.45	27.7	144.2
Assam	4.52	2.55	1.53	77.3	194.7
Average	3.80	2.76	1.71	27.36	55.0

Source: FLDAICRIP Rice 2003-04 – 2004-05

Both the gap-1 and gap-2 are significant for shallow, low land and Boro-rice. The frontline demonstrations conducted on farmers' field have indicated huge potential for increasing productivity of rainfed rice in the States of Chhattisgarh, Assam, Jharkhand and U.P. Hybrid varieties are giving relatively higher productivity of rainfed rice. The productivity in these States can be enhanced from 1.5 to 3.0 t/ha under rainfed conditions. Productivity in the irrigated pockets of these states can also be doubled by promoting improved practices of quality inputs for bridging the

Table 16: State-wise yield gap analysis of irrigated rice (2003-04 to 2004-05) Yield: t/ha

State	Improved practice (I)	Farmer Demons-trations (F)	State Average 2003-04 (A)	Yield Gap % between	
				GAP-1 I and F	GAP-2 I and A
Punjab	8.25	7.85	5.28	05.0	56.0
Haryana	7.11	6.78	4.82	15.0	47.0
Chhattisgarh	3.91	3.13	1.45	24.9	169.4
Bihar	4.88	4.15	1.51	17.6	223.1
Gujarat	5.58	4.89	1.89	14.2	195.3
U.P.	7.05	5.20	2.18	35.6	223.4
Uttaranchal	3.85	3.20	1.94	20.3	98.4
Average	5.80	5.02	2.72	18.94	144.65

Source: FLD AICRIP (Rice) 2003/04–2004/05

gaps (Table 16). The irrigated and major PDS rice contributing states of Punjab and Haryana had smallest difference in technological potential and actual productivity of the State. About 95-98% of their produce is marketed surplus and actually procured. These states provide very little scope of additionalities and other states have to be geared up. Lack of consolidation of fragmented land holdings, rural electrification, quality inputs and market infrastructure are the major handicaps especially in Bihar, Orissa, Jharkhand etc. There is hardly any mechanism of extension, supplying quality inputs, honouring minimum support price, procurement, prompt payments, safe storage and distribution networks. Marketing and procurement in these alternative states is inefficient and weak. Bihar state has abolished APMC Act and alternative marketing system has not been activated. There is unscrupulous trade and across border leakages due to non operation of marketing policies in parts of India.

Rice productivity under irrigated conditions of Haryana and Punjab is already in the range of 3.5 to 4.0 t/ha, market infrastructure, enforcement of MSP, 85% procurement of marketed surplus in Punjab and prompt payments are highly secured and sustaining high productivity is important. Present technologies of fine

and superfine rice for export give Rs.10,000 to 15,000 extra economic returns per ha in North-West India as compared to ordinary rice being targeted in PDS through MSP. It is another challenge of assuring ordinary rice under food security act.

Productivity, production, marketed surplus/arrival, procurement and milling of rice are already saturated in irrigated North West India. There are always complaints of grains movement logistics for evacuation of their godowns for accommodating next harvest. More safe and scientific storage infrastructures of silos should be the highest priority to address grievances of these states being bedrock of procurement for maintaining adequate stocks.

Standing crop of Sorghum (Jowar)

7.3 Sorghum

The productivity of Sorghum continues to be very low in major Sorghum producing States like Maharashtra, Karnataka, M.P., Rajasthan and Andhra Pradesh. The estimated kharif yield gap-1 in Sorghum in UP, MP and Rajasthan

Table 17: State-wise yield gap analysis of irrigated Sorghum Yield: t/ha (2002-03 to 2003-04)

State	Improved Practice (I)	Farmer Demons-trations (F)	State Average 2003-04 (A)	Yield Gap % between	
				GAP-1 I and F	GAP-2 I and A
Rainfed (Kharif) Madhya Pradesh*	1.51	0.98	1.33	53.5	13.3
Uttar Pradesh*	1.75	1.12	1.00	56.5	74.8
Rajasthan*	1.91	0.61	0.71	212.7	167.6
Average	1.72	0.90	1.01	91.1	70.3
Irrigated (Rabi) Andhra Pradesh	2.40	1.51	1.14	58.8	109.8
Gujarat	2.13	1.41	1.00	50.9	112.1
Maharashtra	1.83	1.24	0.72	47.5	151.9
Tamil Nadu	1.83	1.35	0.61	35.5	200.2
Karnataka	1.50	1.21	0.47	23.3	219.0
Average	1.93	1.34	0.79	44.0	144.3

**Relates for kharif season only.*

Source: ICAR AICRPS 2002/03 - 2003/04

ranges from 53% to 213% with an average of 91% (Table 17). The average gap-2 of 70.3% was of relatively lesser magnitude. Yield gaps in rabi season depend upon limited irrigation which is very uncertain and gaps were still higher in AP, Gujarat, Maharashtra, T.N. and Karnataka (Table 17). This indicates that productivity of Sorghum can be enhanced significantly in these Sorghum producing States by rainwater harvesting for limited irrigation. Since its demand is declining, some area can be spared for the cultivation of pulses and oil seeds for preventing their import. Dual purpose sweet Sorghum for fodder and distilling alcohol is also an emerging challenge to its supplies as food grain because of its better technologies and higher profit as carbon neutral fuel production.

7.4 Pearl millet (Bajra)

Bajra (pearl millet) is the major kharif crop for Rajasthan, UP, Gujarat, Maharashtra, Haryana and Karnataka. There are high yielding hybrids and seed replacement rate is high due to promotion by private seed companies. Growth rate

Table 18: Grain Yield gap analysis in pearl millet (Bajra) t/ha

Year	*No. of demons-trations	Grain Yield		
		Improved Practice (I)	Farmers Demons-Trations (F)	% yield gap (I-F)
1998-1999	144	2.32	1.79	29.9
1999-2000	174	1.10	0.61	79.6
2000-2001	174	1.63	1.16	40.2
2001-2002	255	1.79	1.21	47.6
2002-2003	44*	2.11	1.65	28.1
2003-2004	454	1.81	1.25	44.5
1998-2004	791	1.79	1.28	39.4
Average	291	1.79	1.28	40.0

Source: AICPIPFLD 2005

in its productivity is highest and yield gap varied from 28.1% to 79.6% with an average of 40% (Table 18). After removing grains, stover is a major and traditional source of fodder for livestock contributing as much as 36% of farm income especially in Western Rajasthan. However, its preference for human consumption is declining and distress sales are common especially during good rainfall years like 2003 and 2010. Broken seeds and flour of pearl millet (bajra) have limited shelf life due to high fermentability of its high fat and carbohydrate contents. Bread making and cooking from coarse cereals like pearl millet (bajra) is difficult and women would prefer to go for MGNREGA employment rather than investing their time in almost

daily grinding and cooking chores. The States average productivity of Bajra is about one ton per ha. The frontline demonstrations conducted on farmers' field indicate that productivity can be enhanced in the range of 29 to 79% with an average of 40% with the adoption of improved technology (Table 18). Diversification of pearl millet into summer season pulses may happen if suitable varieties and quality inputs become available.

8. Diversification into non-food and non-PDS Crops

Diversification provides alternative opportunities to the farmers and consumers as well as challenges to the food security. Diversification of demand, taste and preferences of food in favour of non-food grains and non-crop sector of India has been projected

A Stall of Fruits and vegetables in local market.

Table 19: Relative district level average productivity (Rs./ha/annum) of different cropping systems–three years average (2003-2005)

No.	Land Use	Produc-tivity Rs./ha/ annum	NIA %	Rainfall /mm	District	State
1.	Cereal	2909	7	266	Barmer	Rajasthan
2.	Cereal	3317	12	185	Jaisalmer	Rajasthan
3.	Cereal	4770	4	355	Churu	Rajasthan
4.	Cereal	6616	11	314	Jodhpur	Rajasthan
	Average	4403	8.5	280		
5.	Rice-wheat	69,145	98	900	Ludhiana	Punjab
6.	Vegetable	1,14,815	91	500	Howrah	West Bengal
7.	Hort.	1,35,950	31	957	Shimla	Himachal Pradesh
8.	Hort.	1,50,453	91	483	Lahaul & Spiti	Himachal Pradesh
	Average of Hort & Vegetable	**1,33,740**	**71**	**647**		

NIA = Net Irrigated Area, Hort. = Horticulture, Veg. = Vegetable
Productivity of horticulture/vegetable growing districts 2 to 30 times more than rice-wheat and coarse cereal growing districts/region

by Alagh (2011) due to market forces. A delicate balance among social welfare (food security), inclusive growth, farm income and private stakeholder-ship would be called upon in the open economy of India. Highest district productivity (Rupees/ha/annum) has been analysed in the seed potato, green peas and apple growing Lahaul and Spiti, Shimla and Kullu of Himachal Pradesh and vegetables growing Howrah district of West Bengal (Chand et.al. 2009). District level productivity is lowest in pearl millet (bajra) cultivating districts of Barmer, Jaisalmer and Churu of Rajasthan and in between in rice-wheat growing Punjab (Table 19). Economic returns in horticulture districts of Himachal Pradesh are 2 to 30 times more of irrigated rice-wheat district of Punjab and coarse cereal district of Rajasthan. Given the opportunity, farmers would like to diversify to non-food land uses at the cost of food crops wherever marketing and other possibilities exist. There are several other challenges of different nature summarized below:

8.1 After 1970s non-rice eating states of Punjab, Haryana and a few other pockets diversified into rice cultivation purely on market driven economic considerations and became major contributor to the marketed surplus, procurement and buffer stocks for public distribution system (PDS). However latest technological developments and export opportunities are in favour of fine and superfine rice and inclusion of *Basmati* for servicing of food entitlement at subsidized rate is financially deterring. Area and export of *Basmati* rice has increased and that of

Table 20: Trends of export of fine and superfine rice indicating replacement potentials of MSP and PDS ordinary rice with Basmati in India (2001-02 to 2009-10)

Year	Basmati Rice (Fine & superfine)		Non Basmati Rice (MSP and PDS targeted)		Total quantity (million tonnes)	Total value (Rs.crore)
	Quantity (million tonnes)	Value (Rs.crore)	Quantity (million tonnes)	Value (Rs.crore)		
2001-02	0.66 (30%)	1842.7	1.54	1331.3	2.20	3,174.0
2002-03	0.70 (14%)	2058.4	4.25	3772.7	4.95	5,831.1
2003-04	0.77 (23%)	1993.0	2.64	2174.9	3.41	4,167.9
2004-05	1.16 (24%)	2823.9	3.61	3945.0	4.77	6,768.9
2005-06	1.16 (23%)	3030.3	3.90	4144.0	5.06	7,174.3
2006-07	1.04 (22%)	2792.8	3.70	4243.1	4.74	7,035.9
2007-08	1.18 (18%)	4344.5	5.28	7410.0	6.46	11,754.5
2008-09	1.55 (63%)	9477.0	0.93	1687.3	2.48	11,164.3
2009-10	2.01 (94%)	10838.8	0.13	414.7	2.14	11,253.5
Total	10.23 (28.2%)*	39,201.4 (57.3%)	25.98 (71.8%)	29,123.0 (42.7%)	36.21 (100%)	68324.4 (100%)

** Values in brackets indicate relative percentages of Basmati and non-Basmati rice*
MSP = Minimum Support Price; PDS = Public Distribution System

non-*Basmati* rice decreased in the recent years (Table 20). During 2001 to 2008 rice export increased progressively and *Basmati* share in the export ranged from 14 to 30% with an overall average of 18%. After that *Non-Basmati* rice export was almost banned and *basmati* share jumped to 63% in 2008-09 and 94% in 2009-10. At the existing level of productivity, MSP of ordinary rice and export prices of fine quality, *Basmati* rice is returning Rs.10,000 to Rs.15,000 per hectare more to the farmers than *Non-Basmati* rice and that too with less consumption of water and short duration of growth. If this trend continues it will compete with entitled food supplies of ordinary rice. The current ban on the export of ordinary rice itself is an indication of tight supply position.

Table 21: Diversification of area and production in favour of vegetable crops in different States in India

Years	Area (mha)	Production (mt)	Productivity (t/ha)
1991-92	5.59	58.53	10.5
2007-08	7.80	125.89	16.14
% Growth/yr	2.50	7.20	3.40

Source: Agricultural Statistics at a Glance, 2009, DAC, Ministry of Agriculture, GOI

8.2 Area and production under vegetables have grown @ 2.5% and 7.2% after 1991-92 (Table 21). Similar is true for cultivation of fruits which have witnessed very good growth rate in the past (Table 22). Food prices showed maximum inflation of 18.32% in the end of December 2010 and 66% of inflation in food prices during January 2011 is being attributed to perishable fresh vegetables and fruits and diversification into sun rising commodity of horticulture at the cost of cereals is

Table 22: Diversification of area and production in favour of fruits in different States of India

Years	Area (mha)	Production (mt)	Productivity (t/ha)
1991-92	2.87	28.63	9.97
2007-08	5.77	63.50	11.00
% Growth/yr	6.20	7.60	

Source: Agricultural Statistics at a Glance, 2009, DAC, Ministry of Agriculture, GOI

happening at higher rates (Table 21 and 22). This trend will compete advantageously with the limited availability of land and other resources for food crops/PDS.

8.3 Bt. cotton is another important rainfed crop and has witnessed highest growth rate of 9.04% in productivity and 9.0% in production among all the crops and diversification both under irrigated and rainfed conditions is imminent. Similar kind of potentials exist for sweet sorghum for alcohol production of environmentally desirable zero carbon energy production.

8.4 Damaged and rotten grains of wheat are being diverted or redeployed for alcohol production. Similar diversion was noticed in 2010-11 even of the undamaged cheaply available pearl millet (bajra) which is highly fermentable after grinding due to its high oil and carbohydrate contents. It is being considered for cheap beer making because of lack of implementation of its MSP by the state, periodic over-production and crashing of market price. Millets should be included in the food entitlement and procurement be organised.

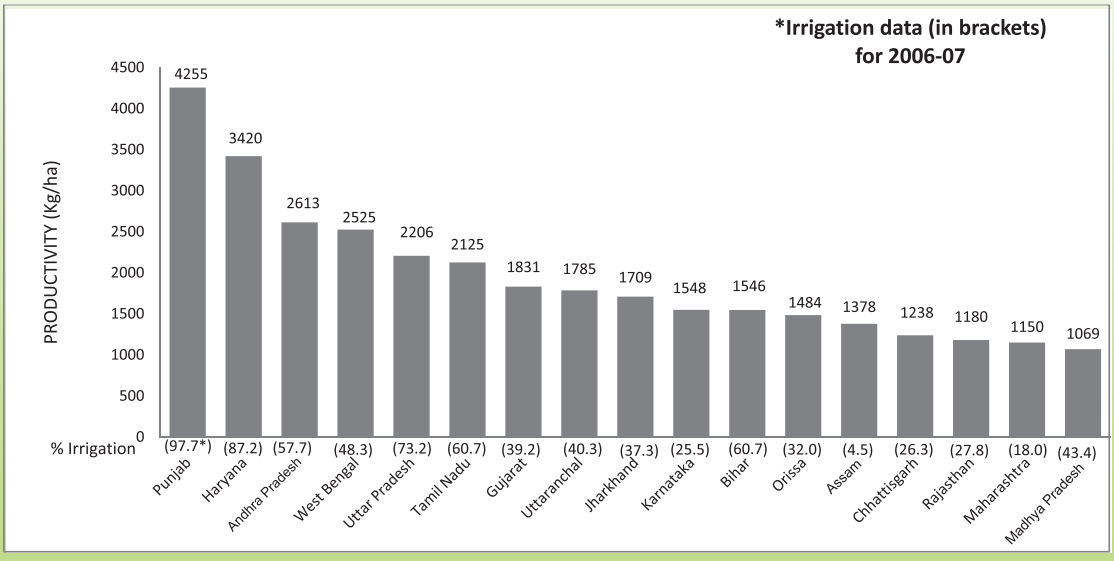
8.5 Soybean is another rain fed crop (only 2% irrigated) with area expansion from 0.03 million ha in 1971 to 10 million ha in 2009 (more than 300 times increase in 37 years). It has mostly replaced summer (Kharif) fallows, coarse cereals (sorghum, maize, pearl millet) and cotton in shallow soils. There are more than 200 oil mills in Madhya Pradesh alone and its oil meal (cake) is exported. Its foreign exchange earnings of Rs.5900 crore during 2006-07 have crossed Rs.12000 crores during 2009-10. Its protein costs about 15 times cheaper than that of paneer (milk product). Lack of food processing and marketing is depriving local consumers of cheap source of nutrition or protein being drained out.

8.6 Sugarcane and floriculture are other irrigated crops competing with food grains production.

9. Potentials of Rainfed Area

Productivity (Fig.7) of assured irrigated states of Punjab, Haryana etc. is very high as compared to predominantly rainfed States of M.P., Maharashtra, Rajasthan etc. Productivity of assured irrigated region is very close to the improved technological potential and factor productivity has declined whereas marginal responses and returns to water, energy, fertilizers etc. are much higher in limited irrigated rainfed regions. However, global warming during past 15 years has increased frequency and

Figure 7. Productivity of food grains viz- a- viz irrigation in Indian states 2007-08



intensity of extreme weather events afflicting various kind of losses to production, livelihood and food security (Samra 2006; Samra & Singh 2002, 2005; Samra et.al. 2003). Alternative and better safety nets are required to realize assured food supplies and income to the farmers.

About 60% (85 million ha) of cultivated land, supporting 40% of population, 60% livestock, contributing 40% of agricultural production is rain dependent. After having developed all water resources, 50% sown area shall still continue to be un-irrigated, complex, diverse, fragile, risky and distress prone. It is grossly under invested (13 to 16 times) @ Rs.12,000–Rs.15,000 per ha under watershed development programme as compared to the latest canal command development @ Rs.200,000 per hectare. Farmers are also very careful for adopting and investing in capital or input intensive modern improved technologies in risky rainfed production. Safety factors, somehow have not been able to manage inflation bouts for consumers and distress or even suicide by farmers in the semi arid region of the country. There are glaring differences or gaps among the improved technologies, their potentials demonstrated at farmers' fields, and State/district average production. These gaps can be bridged with the support of modern extension, providing quality inputs at right time, credit, insurance, efficient marketing, value addition etc.

In a detailed study of 604 districts of India for estimating productivity improvements in rainfed agriculture, Sharma et.al (2010) identified 27.5 M ha of rainfed area with good potential for runoff harvesting. A part of this amount of water is adequate to provide one supplemental irrigation of 10 cm depth to 20.65 M ha during sub-normal rainfall years and 25.8 M ha during normal years. It has been estimated that the water used in supplemental irrigation had the highest marginal productivity and rainfed production might be increased by about 50% over this area by applying single supplemental irrigation at crucial stage from harvested runoff and with some improvements in agricultural practices. The estimated additional production projections for different crop groups (rice, coarse cereals, oilseeds & pulses) under improved agricultural practices during normal monsoon and deficient rainfall season from above said 27.5 M ha rainfed area is about 9-10 mt (Table 23).

Table 23: Additional production estimate of proper management of rains in India

Crop Group	Traditional Production (M tons)	Additional Production (M tons) with limited irrigation	
		Normal Rains	Sub-normal rains
Rice	7.612	3.549	3.776
Coarse Cereals	8.300	4.410	3.415
Oilseeds	4.213	1.658	1.590
Pulses	3.717	1.152	1.078
Total	23.842	10.769	9.859

The above study also revealed that net benefits improved by about three fold for rice, four fold for pulses and six fold for oilseeds. Potentials of integrated watershed management have also been quantified by meta-analysis. Comprehensive assessment of watershed programmes in India has shown increase in agricultural productivity by 35% based on the findings of Meta analysis. These rainfed areas have typically low yield of about 1 t/ha with a vast yield gap of over 100-200%. Considering average productivity of 1 t/ha and a modest increase of about 25% in productivity as a result of soil and moisture conservation, watershed management and adoption of rainfed dryland technology in the remaining 57.5 M ha of cultivated rainfed area, an additional food production of about 14 Mt can be targeted by according higher priority and increased investments with effective delivery. The public investment rate of Rs.12,000–15,000/ha under watershed development schemes is 13 to 16 times less than Rs.2.0 lakh/ha under canal command development schemes. The under-invested rainfall areas have higher marginal productivity of water, investments, fertilizers, energy and other inputs and should be prioritized in the investment portfolio.

There are well known success stories of rainfed special attribute commercial crops and coarse cereals of castor, soybean, Bt cotton, horticulture, pearl millet and experience could be emulated for additional food production also. This would require innovative extension services, timely supply of quality inputs, seed banks, credit, in situ rainwater conservation, run off harvesting for most opportune limited irrigation, insurance against rainfall risks, integrated marketing, support prices, dedicated procurement, prompt payment and scientific storage to prevent post harvest damages/losses.

10. Tribal Area

There is a very unique food system of minor forest products, mixed cultivation of coarse cereals, agro forestry etc. Forest land rights to the tribals are being enforced and it will require very unique technologies, extension and inputs to enhance productivity without compromising environmentally benign principles.

11. Climate Change

Extreme weather events and climatic anomalies have major impacts on crop productivity and food security. Losses in production happen due to drought, flash floods, untimely rains, frost, hails and high temperatures and heat waves etc. during crop season. In recent years extreme weather and

A farmer visiting impact of drought in his field

climatic anomalies have increased manifold. This requires continuous efforts to develop and optimize agricultural technologies to cope up with emerging trend of climatic changes and vulnerability. It has been projected by the recent report of IPCC and other global studies that unless we adapt, there is probability of 10-40% loss in crop production in India by 2080-2100 due to global warming. There are few other Indian studies and they generally confirm a similar trend of agriculture decline with climate change. It is feared that there is possibility of 4 to 5 million tones losses in wheat production with every rise of 10C temperature in Indo-gangetic plains. In the year 2004, temperatures were higher in Indo-gangetic plains by 3-60C for few days. As a result, the maturity of wheat was advanced by 10 to 15 days with drop in wheat production by about 4 million tonnes (Samra and Singh, 2004). Other crops i.e. mustard, peas, tomatoes, onion, garlic and other fruits and vegetables also showed decline in production. Similarly, the recent droughts of 2002 and 2009 have brought down the total foodgrain production to substantial levels. An increase in these events could result in greater instability in food production and threaten our dream of food security. Climatic anomalies are also likely to impact the production of livestock, fisheries and poultry. Strong network of research to optimize the potential of agro-techniques will help in coping with the climatic variations. Efficient use of available water resources through drips and sprinklers, use of balanced fertilizers with supplementary micro-nutrients and appropriate simulation models for prediction of gains will enhance our ability to cope with new climatic challenges. New crop varieties tailor-made with appropriate crop duration to fit in a given cropping system will have large implications in enhancing production. Tools of biotechnology are likely to help in our endeavour to hasten the pace of development of new improved varieties for niche areas for better productivity in changing climatic scenarios.

12. References:

Alagh, Y.K. 2011. Challenges of a rural urban continues. Yojana 55: 5-11

Chand, R., Garg, S. and Pandey, L. 2009. Regional variation in agricultural productivity – A district level study. Publ. NCAP, DPS Marg, Pusa, New Delhi – 110012, India. pp 1-115.

Chand, Ramesh. 2007. Demand for Food grains. Economic and Political Weekly. pp 10-13.

GOI, NRAA, High Rainfall/Flood management strategies 2009. Position paper 4. Publ. NRAA, NASC Complex, DPS Marg, Pusa New Delhi – 110012, India pp 47

Samra, J.S. 2006. Droughts, risks, insurance and management assessment in India. Pages 1-22 in Drought Management Strategies in India. In Drought Management Strategies in India pp 1-277 (J.S. Samra, Gurbachan Singh and

J.C. Dagar, eds.). NRM Division, Indian Council of Agricultural Research, New Delhi, India.

Samra, J.S. and Singh, G. 2002. Drought Management Strategies. NRM Division, ICAR, Krishi Anusandhan Bhawan-II, Pusa, New Delhi – 110 012, India pp. 1 to 68.

Samra, J.S. and Singh, G.B. 2004. Heat Wave of March, 2004: Impact on Agriculture, ICAR., New Delhi, India. pp 32

Samra, J.S. and Singh, G. 2005. Heat Wave of March, 2004 –Impact on Agriculture. NRM Division, ICAR, Krishi Anusandhan Bhawan-II, Pusa, New Delhi – 110 012, India

Samra, J.S., Singh, G. and Ramakrishna, Y.S. 2003. Cold Wave of 2002- 03 – Impact on Agriculture. NRM Division, ICAR, Krishi Anusandhan Bhawan-II, Pusa, New Delhi-110012, India pp. 1-49

Samra, J.S., Ramakrishna, Y.S., Desai, S., Subba Rao, A.V.M., Rama Rao, C.A., Y.V.R., Rao GGSN, Victor, U.S., Kumar, Vijaya., Lawande, K.E., Srivastava, K.L., Prasad, Krishna. 2006. Impact of excess rains on yield, market availability and prices of onion. Information bulletin – Hyderabad : Central Research Institute for Dryland Agriculture (ICAR) 52 p

Sharma, B.R., Rao, K.V., Vittal, K.P.R., Ramakrishna, Y.S. and Singh, Amar (2010). Estimating the potential of rainfed agriculture in India. Prospects of water productivity improvements. Agril. Water Mngt. 97, pp 23-30

Annexure- 1(i)

Year-wise production, marketed surplus ratio (MSR), marketed surplus (MS) market arrival (MA) and actual procurement of rice

Year	Production (mt)	MSR %	MS (mt)	MA (mt)	Procurement (mt)	Procurement as % of		
						Production	Marketed surplus	MA
PUNJAB								
2001-02	8.82	95.60	8.43	-	7.28	82.54	86.34	-
2002-03	8.88	-	-	8.13	7.94	89.41	-	97.7
2003-04	9.60	98.74	9.48	9.29	8.66	90.21	91.36	93.2
2004-05	10.44	97.70	10.20	9.39	9.10	87.16	89.22	96.9
2005-06	10.19	98.12	10.00	9.24	8.85	86.85	88.51	95.8
2006-07	10.14	98.66	10.00	8.42	7.82	77.12	78.17	92.9
2007-08	10.49	98.06	10.29	8.48	7.90	75.31	76.80	93.2
2008-09	11.00	-	-	8.81	8.54	77.64	-	96.9
2009-10	-	-	-	9.47	9.27	-	-	97.9
Avg.	**9.94**	**97.81**	**9.73**	**8.90**	**8.37**	**83.28**	**85.07**	**95.7**
U.P.								
2001-02	12.85	79.20	10.18	-	1.94	15.10	19.06	-
2002-03	8.11	-	-	2.24	1.36	16.77	-	60.7
2003-04	13.00	90.52	11.77	4.61	2.55	19.62	21.67	55.3
2004-05	9.56	46.51	4.45	4.67	2.97	31.07	66.80	63.6
2005-06	11.13	38.93	4.33	5.28	3.15	28.30	72.70	59.6
2006-07	11.12	79.62	8.85	4.46	2.10	18.88	23.72	47.1
2007-08	11.78	36.30	4.28	2.26	2.89	24.53	67.58	127.9
2008-09	13.10	-	-	4.63	3.61	27.56	-	78.0
2009-10	-	-	-	2.79	2.62	-	-	93.9
Avg.	**11.33**	**61.84**	**7.31**	**3.86**	**2.57**	**22.73**	**45.26**	**70.3**
W.B.								
2001-02	15.26	61.50	9.38	-	0.05	0.31	0.51	-
2002-03	14.39	-	-	-	0.13	0.90	-	-
2003-04	14.62	55.60	8.13	-	0.92	6.29	11.32	-
2004-05	14.88	60.39	8.99	-	0.94	6.32	10.46	-
2005-06	14.51	48.51	7.04	1.33	1.27	8.75	18.04	95.5
2006-07	14.75	68.40	10.09	0.27	0.56	3.80	5.55	207.4
2007-08	14.72	64.45	9.49	0.82	1.50	10.19	15.81	182.9
2008-09	15.04	-	-	0.83	1.45	9.64	-	174.7
2009-10	-	-	-	0.56	0.97	-	-	173.2
Avg.	**14.77**	**59.80**	**8.85**	**0.76**	**0.86**	**5.78**	**10.28**	**157.2**

Source : Agricultural Statistics at a Glance. (2001-2009), DAC, Min of Agriculture, GOI

Annexure 1(ii)

Rice

Year	Production (mt)	MSR %	MS (mt)	MA (mt)	Procurement (mt)	Procurement as % of		
						Production	Marketed surplus	MA
Haryana								
2001-02	2.73	89.80	2.45	-	1.48	54.21	60.37	-
2002-03	2.47	-	-	2.06	1.32	53.44	-	64.1
2003-04	2.70	94.86	2.56	2.39	1.33	49.26	51.93	55.6
2004-05	3.02	98.22	2.97	2.45	1.66	54.97	55.96	67.7
2005-06	3.21	96.82	3.11	2.95	2.05	63.86	65.96	69.5
2006-07	3.37	99.05	3.34	1.93	1.77	52.52	53.03	91.7
2007-08	3.61	95.18	3.44	1.76	1.57	43.49	45.69	89.2
2008-09	3.30	-	-	1.48	1.42	43.03	-	95.9
2009-10	-	-	-	1.88	1.81	-	-	96.3
Avg.	**3.05**	**95.65**	**2.98**	**2.1**	**1.60**	**51.85**	**55.49**	**76.7**
A.P.								
2001-02	11.39	80.30	9.15	-	6.43	56.45	70.30	-
2002-03	7.19	-	-	0.006	2.62	36.44	-	436.7
2003-04	8.90	85.17	7.58	5.69	4.23	47.53	55.80	74.3
2004-05	9.60	83.06	7.97	4.42	3.90	40.63	48.91	88.2
2005-06	11.70	80.00	9.36	6.73	4.97	42.48	53.10	73.8
2006-07	11.87	84.46	10.03	7.29	5.32	44.82	53.07	73.0
2007-08	13.32	91.99	12.25	9.00	7.60	57.06	62.03	84.4
2008-09	14.24	-	-	12.47	9.06	63.62	-	72.6
2009-10	-	-	-	10.05	4.47	-	-	44.5
Avg.	**11.00**	**84.16**	**9.39**	**6.9**	**5.40**	**48.63**	**57.20**	**71.1**
T.N.								
2001-02	6.58	73.50	4.84	-	0.85	12.92	17.58	-
2002-03	5.71	-	-	-	0.10	1.75	-	-
2003-04	3.20	78.08	2.50	-	0.20	6.25	8.00	-
2004-05	5.06	78.44	3.97	-	0.65	12.85	16.38	-
2005-06	5.22	74.54	3.89	0.92	0.92	17.62	23.64	100.0
2006-07	6.61	80.03	5.29	1.07	1.07	16.19	20.23	100.0
2007-08	5.04	83.80	4.22	0.96	0.96	19.05	22.73	100.0
2008-09	5.18	-	-	1.20	1.19	22.97	-	99.2
2009-10	-	-	-	1.24	0.98	-	-	79.0
Avg.	**5.32**	**78.06**	**4.12**	**1.07**	**0.76**	**13.70**	**18.09**	**95.5**

Source : Agricultural Statistics at a Glance. (2001-2009), DAC, Min of Agriculture, GOI

Annexure 1(iii)

Rice

Year	Production (mt)	MSR %	MS (mt)	MA (mt)	Procurement (mt)	Procurement as % of		
						Production	Marketed surplus	MA
Chhattisgarh								
2001-02	5.07	-	-	-	1.92	37.87	-	-
2002-03	2.55	-	-	-	1.29	50.59	-	-
2003-04	5.56	-	-	-	2.37	42.63	-	-
2004-05	4.38	-	-	-	2.83	64.61	-	-
2005-06	5.01	-	-	2.40	3.26	65.07	-	135.8
2006-07	5.81	-	-	2.39	2.86	49.23	-	119.7
2007-08	5.43	-	-	3.99	2.74	50.46	-	68.7
2008-09	4.39	-	-	3.86	2.84	64.69	-	73.6
2009-10	-	-	-	3.91	3.06	-	-	78.3
Avg.	**4.77**	**-**	**-**	**3.31**	**2.57**	**53.14**	**-**	**89.4**
Orissa								
2001-02	7.15	61.50	4.40	-	1.25	17.48	28.43	-
2002-03	3.24	-	-	-	0.89	27.47	-	-
2003-04	6.43	61.85	3.98	-	1.37	21.31	34.45	-
2004-05	6.47	65.43	4.23	-	1.59	24.57	37.56	-
2005-06	6.86	59.08	4.05	0.81	1.78	25.95	43.92	219.7
2006-07	7.34	67.91	4.98	1.77	2.00	27.25	40.12	113.0
2007-08	7.54	66.18	4.99	2.30	2.35	31.17	47.09	102.2
2008-09	6.81	-	-	2.82	2.80	41.12	-	99.3
2009-10	-	-	-	2.53	1.90	-	-	75.1
Avg.	**6.48**	**63.65**	**4.44**	**2.04**	**1.77**	**27.04**	**38.60**	**105.8**
Karnataka								
2001-02	3.23	78.00	2.52	-	-	-	-	-
2002-03	2.24	-	-	-	-	-	-	-
2003-04	2.50	79.48	1.99	-	-	-	-	-
2004-05	3.55	84.41	3.00	-	-	-	-	-
2005-06	5.74	94.35	5.42	-	-	-	-	-
2006-07	3.45	94.59	3.26	-	-	-	-	-
2007-08	3.72	85.47	3.18	-	-	-	-	-
2008-09	3.80	-	-	-	-	-	-	-
2009-10	-	-	-	-	-	-	-	-
Avg.	**3.52**	**86.05**	**3.23**	**-**	**-**	**-**	**-**	**-**

Source : Agricultural Statistics at a Glance. (2001-2009), DAC, Min of Agriculture, GOI

Annexure 1(iv)

Rice

Year	Production (mt)	MSR %	MS (mt)	MA (mt)	Procurement (mt)	Procurement as % of		
						Production	Marketed surplus	MA
M.P. 2001-02	1.69	57.60	0.97	-	0.27	15.98	27.74	-
2002-03	0.90	-	-	-	0.15	16.67	-	-
2003-04	1.70	65.44	1.11	-	0.11	6.47	9.89	-
2004-05	1.17	65.09	0.76	-	0.04	3.59	5.52	-
2005-06	1.66	69.11	1.15	0.11	0.13	7.83	11.33	118.2
2006-07	1.37	63.04	0.86	0.07	0.07	5.40	8.57	100.0
2007-08	1.46	78.98	1.15	0.11	0.07	4.73	5.98	63.6
2008-09	1.56	-	-	0.21	0.24	15.38	-	114.3
2009-10	-	-	-	0.17	0.16	-	-	94.1
Avg.	**1.43**	**66.54**	**1.00**	**0.13**	**0.13**	**9.51**	**11.50**	**103.0**

Source : Agricultural Statistics at a Glance. (2001-2009), DAC, Min of Agriculture, GOI

Annexure- 2(i)

Year-wise production, marketed surplus ratio (MSR), marketed surplus (MS) market arrival (MA) and actual procurement of wheat

Year	Production (mt)	MSR %	MS (mt)	MA (mt)	Procurement (mt)	Procurement as % of		
						Production	Marketed surplus	MA
Punjab								
2001-02	15.50	80.50	12.48	-	10.56	68.13	84.64	-
2002-03	14.18	-	-	9.4	9.88	69.70	-	105.1
2003-04	14.49	83.07	12.04	9.05	8.93	61.63	74.19	98.7
2004-05	14.70	81.34	11.96	9.47	9.24	62.87	77.29	97.6
2005-06	14.49	76.46	11.08	9.25	9.01	62.17	81.31	97.4
2006-07	14.60	81.33	11.87	8.09	6.94	47.55	58.46	85.8
2007-08	15.72	90.58	14.24	7.87	6.78	43.13	47.62	86.1
2008-09	15.70	-	-	10.58	9.94	63.31	-	93.9
2009-10	-	-	-	10.98	10.72	-	-	97.6
Avg.	**14.90**	**82.21**	**12.28**	**9.33**	**9.10**	**59.81**	**70.58**	**95.7**
Haryana								
2001-02	9.44	79.70	7.52	-	6.40	67.82	85.09	-
2002-03	9.19	-	-	5.89	5.88	64.00	-	99.8
2003-04	9.11	75.80	6.91	5.13	5.12	56.18	74.11	99.8
2004-05	9.06	74.64	6.76	5.2	5.11	56.41	75.58	98.3
2005-06	8.86	66.24	5.87	4.59	4.52	51.03	77.04	98.5
2006-07	10.06	72.46	7.29	2.97	2.22	22.08	30.47	74.7
2007-08	10.24	81.53	8.35	3.73	3.35	32.73	-	89.8
2008-09	10.80	-	-	5.33	5.23	48.43	-	98.1
2009-10	-	-	-	6.93	6.92	-	-	99.8
Avg.	**9.60**	**75.06**	**7.11**	**4.97**	**4.97**	**49.83**	**68.46**	**96.5**
U.P								
2001-02	25.50	74.40	18.97	-	2.44	9.57	12.86	-
2002-03	23.60	-	-	2.12	2.11	8.94	-	99.5
2003-04	25.50	55.48	14.15	1.72	1.21	4.75	8.55	70.3
2004-05	22.50	50.21	11.30	2.06	1.74	7.73	15.40	84.5
2005-06	24.00	35.00	8.40	0.56	0.56	2.33	6.67	100.0
2006-07	25.00	53.63	13.41	0.98	0.05	0.20	0.37	0.5
2007-08	25.68	29.90	7.68	1.48	0.54	2.10	7.03	36.5
2008-09	28.50	-	-	3.13	3.13	10.98	-	100.0
2009-10	-	-	-	3.88	3.88	-	-	100.0
Avg.	**25.00**	**49.77**	**12.32**	**1.99**	**1.73**	**5.83**	**8.48**	**83.0**

Source : Agricultural Statistics at a Glance. (2001-2009), DAC, Min of Agriculture, GOI

Annexure- 2(ii)

Wheat

Year	Production (mt)	MSR %	MS (mt)	MA (mt)	Procurement (mt)	Procurement as % of		
						Production	Marketed surplus	MA
M.P.								
2001-02	6.00	55.30	3.32	-	0.29	4.83	8.74	-
2002-03	4.90	-	-	0.86	0.43	8.78	-	50.0
2003-04	7.30	67.29	4.91	0.42	0.18	2.47	3.66	43.0
2004-05	7.10	74.54	5.29	0.63	0.34	4.79	6.42	54.0
2005-06	5.90	54.76	3.23	0.98	0.48	8.14	14.86	49.0
2006-07	7.30	65.57	4.79	0.86	-	-	-	-
2007-08	6.00	75.95	4.56	1.30	0.06	0.95	1.25	0.5
2008-09	6.52	-	-	2.72	2.41	36.96	-	88.6
2009-10	-	-	-	2.39	1.96	-	-	82.0
Avg.	**6.40**	**65.56**	**4.35**	**1.27**	**0.76**	**9.56**	**6.99**	**58.0**
Bihar								
2001-02	4.30	72.00	3.10	-	0.04	1.00	1.39	-
2002-03	4.00	-	-	-	0.04	1.03	-	-
2003-04	3.60	62.04	2.23	-	0.00	0.03	0.04	-
2004-05	3.20	70.12	2.24	-	0.02	0.47	0.67	-
2005-06	3.24	59.27	1.92	-	0.00	0.03	0.05	-
2006-07	3.90	66.55	2.60	-	-	-	-	-
2007-08	4.40	73.58	3.24	-	0.01	0.18	0.25	-
2008-09	4.40	-	-	-	0.50	11.36	-	-
2009-10	-	-	-	-	0.49	-	-	-
Avg.	**3.90**	**67.26**	**2.55**	**-**	**0.13**	**2.01**	**0.48**	**-**
Rajasthan								
2001-02	6.39	62.90	4.02	-	0.67	10.49	16.67	-
2002-03	4.88	-	-	0.76	0.16	3.28	-	21.0
2003-04	5.80	73.03	4.24	0.46	0.25	4.31	5.90	54.3
2004-05	5.70	27.20	1.55	0.52	0.27	4.74	17.41	51.9
2005-06	5.80	49.25	2.86	0.39	0.15	2.59	5.25	38.5
2006-07	7.00	62.61	4.38	0.46	0.00	0.03	0.05	0.0
2007-08	7.10	64.38	4.57	0.82	0.38	5.35	8.31	46.3
2008-09	7.30	-	-	1.14	0.93	12.74	-	81.6
2009-10	-	-	-	1.38	1.15	-	-	93.3
Avg.	**6.20**	**56.56**	**3.60**	**0.74**	**0.44**	**5.44**	**8.93**	**56.2**

Source : Agricultural Statistics at a Glance. (2001-2009), DAC, Min of Agriculture, GOI

Three year average area, production, productivity and growth rate of total rice 1984-86 to 2007-09

Year	Area (mha)	Production (mt)	Productivity (t/ha)	Growth Rate		
				Area %	Production %	Productivity %
1984-86	41.18	60.76	1.47	-0.12	3.06	3.46
1987-89	40.57	62.64	1.54	0.68	7.89	7.15
1990-92	42.50	74.18	1.75	0.57	0.75	0.17
1993-95	42.38	78.32	1.85	1.23	5.96	4.68
1996-98	43.24	80.42	1.86	0.71	3.54	2.83
1999-01	44.89	86.91	1.94	-0.10	-0.64	-0.52
2002-04	42.89	84.56	1.97	-2.61	-2.61	-0.05
2005-07	43.13	89.43	2.07	2.24	5.97	3.64
2007-09	44.36	96.40	2.17	1.74	3.05	1.28
2009-10*	-	89.30	-	-	-	-

**Single year figures*

Source : Agricultural Statistics at a Glance. 2009, DAC, Min of Agriculture, GOI

Annexure-4

Three year average area, production, productivity and growth rate of wheat 1984-86 to 2007-09

Year	Area (mha)	Production (mt)	Productivity (t/ha)	Growth Rate		
				Area %	Production %	Productivity %
1984-86	23.74	45.53	1.92	-3.44	1.71	5.36
1987-89	23.43	48.20	2.07	2.10	10.49	6.57
1990-92	23.64	53.56	2.27	-0.51	5.70	6.24
1993-95	25.15	60.94	2.42	2.23	7.22	4.87
1996-98	25.87	65.93	2.55	3.32	3.37	0.04
1999-01	26.91	72.45	2.69	-3.31	-1.14	2.25
2002-04	26.05	70.23	2.70	0.49	-0.42	-0.89
2005-07	26.95	71.27	2.64	3.01	5.09	2.02
2007-09	27.97	78.32	2.80	-0.20	3.10	3.32
2009-10*	-	80.71	-	-	-	-

**Single year figures*

Source : Agricultural Statistics at a Glance. 2009, DAC, Min of Agriculture, GOI

Annexure-5

Three year average area, production, productivity and growth rate of coarse cereals 1984-86 to 2007-09

Year	Area (mha)	Production (mt)	Productivity (t/ha)	Growth Rate		
				Area %	Production %	Productivity %
1984-86	40.13	30.42	0.76	-2.72	-12.09	-9.63
1987-89	38.32	28.22	0.74	-1.34	8.30	9.81
1990-92	35.81	31.15	0.87	-5.83	-13.53	-8.14
1993-95	33.14	32.43	0.98	-3.32	-9.63	-6.52
1996-98	31.17	31.18	1.00	-0.08	2.33	2.42
1999-01	29.65	30.92	1.04	1.56	-0.42	-1.94
2002-04	29.10	32.35	1.11	2.15	6.13	3.90
2005-07	28.93	33.82	1.17	-0.55	0.67	1.25
2007-09	28.27	38.05	1.35	-1.92	7.88	9.95
2009-10*	-	33.77	-	-	-	-

**Single year figures*
Source : Agricultural Statistics at a Glance. 2009, DAC, Min of Agriculture, GOI

ACRONYMS

AICRIP	-	All India Coordinated Rice Improvement Project
APMC	-	Agriculture Produce Marketing Committee
CAP	-	Covered and plinth
DAC	-	Department of Agriculture and Co-operation
FAO	-	Food and Agriculture Organization
FCI	-	Food Corporation of India
FLD	-	Front Line Demonstration
GOI	-	Government of India
ICAR	-	Indian Council of Agricultural Research
IPCC	-	Inter governmental Panel for Climate Change
IWMP	-	Integrated Watershed Management Programme
MA	-	Market Arrival
MGNREGS	-	Mahatma Gandhi National Rural Employment Guarantee Scheme
MM	-	Millimeter
MS	-	Marketed Surplus
MSP	-	Minimum Surplus Price
MSR	-	Marketed Surplus Ratio
MT	-	Million Tonne
NIA	-	Net Irrigated Area
NRAA	-	National Rainfed Area Authority
PDS	-	Public Distribution System
R&D	-	Research and Development