State of Indian Agriculture 2011-12

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List of Abbreviations/Acronyms

Abbreviation	Meaning
A.I.	Artificial Insemination
AAS	Agro-Meteorological Advisory Service
ACA	Additional Central Assistance
ACABC	Agri-Clinics and Agri-Business Centres
ADB	Asian Development Bank
ADWDRS	Agricultural Debt Waiver and Debt Relief Scheme
AFC	Agricultural Finance Corporation
AIC	Agricultural Insurance Company
AICVIP	All India Co-ordinated Vegetable Improvement Project
AIR	All India Radio
Al	Aluminium
AMDP	Accelerated Maize Development Programme
AMFUs	Agro-Met Field Units
AMIGS	Agricultural Marketing Infrastructure, Grading and Standardization Scheme
AMIS	Agricultural Market Information System
APMC	Agricultural Produce Marketing Committee
ARU	Audience Research Unit
ASEAN	Association of South East Asian Nations
ATMA	Agriculture Technology Management Agency
BB	Bacterial Blight
BCM	Billion Cubic Meters
BGREI	Bringing Green Revolution in Eastern India
BIMSTEC	Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation
BISA	Borlaug Institute of South Asia
BMC	Bulk Milk Cooler
BRICS	Brazil, Russia, India, China & South Africa
Bt	Bacillus thuringenesis
BTT	Block Technology Team
Ca	Calcium
CAA&A	Controller of Aid Accounts & Audit

CACP	Commission for Agricultural Costs & Prices
CAFT	Centre of Advanced Faculty Training
CAGR	Compound Annual Growth Rate
CDAP	Comprehensive District Agriculture Plan
CECA	Comprehensive Economic Cooperation Agreement
CEPA	Comprehensive Economic Partnership Agreement
CFBs	Corrugated Fibreboard Boxes
CFDO	Central Fodder Development Organization
CFSPF	Central Fodder Seed Production Farm
CGMS	Cytoplasmic Male Sterility
CIB&RC	Central Insecticides Board & Registration Committee
CIL	Central Insecticides Laboratory
CIMMYT	International Maize and Wheat Improvement Centre
CIPMC	Central Integrated Pest Management Center
CMTP	Central Minikit Testing Programme
CMU	Central Monitoring Unit
CORD-M	Centre for Organizational Research & Development in Management
CSC	Central Seed Committee
CSO	Central Statistical Organisation
CSTLs	Central Seed Testing Laboratories
CV	Coefficient of Variation
CWWG	Crop Weather Watch Group
DAAPs	District Agriculture Action Plans
DAC	Department of Agriculture and Cooperation
DAHDF	Department of Animal Husbandry, Dairying & Fisheries
DAP	Di-ammonium Phosphate
DARE	Department of Agricultural Research and Extension
DDP	Desert Development Programme
DEDS	Dairy Entrepreneurship Development Scheme
DES	Directorate of Economics and Statistics
DFQF	Duty Free Quota Free
DG	Director General
DHA	Docosahexaenoic Acid
DLC	District Level committees

DPAP	Drought Prone Area Programme
DPPQ&S	Directorate of Plant Protection, Quarantine & Storage
DPQS	Production and Distribution of Quality Seeds
DSS	Decision Support System
DVCF	Dairy Venture Capital Fund
EAPs	Externally Aided Projects
EDP	Entrepreneurship Development Programmes
EFTA	European Free Trade Agreement
EOU	Export Oriented Unit
EPA	Eicosapetaenoic Acid
EPCG	Export Promotion Capital Goods Scheme
ERFS	Extended Range Forecast System
ESVHD	Establishment and Strengthening of existing Veterinary Hospitals and Dispensaries
et al.	et alia (and others)
ETT	Embryo Transfer Technology
EXIM	Export Import
F&V	Fruit and Vegetables
FAO	Food and Agriculture Organization
FASAL	Forecasting Agricultural Output using Space, Agro meteorology and Land based observations
FCO	Fertilizer Control Order
FDI	Foreign Direct Investment
Fe	Ferous/Iron
FFDA	Fish Farmers Development Authority
FFSs	Farmers' Field Schools
FI	Financial Institution
Fig.	Figure
FLD	Frontline Demonstration
FM	Frequency Modulation
FMD	Foot & Mouth Disease
FPO	Farmer Producer Organizations
FPTC	Food Processing Training Centres
FQCL	Fertilizer Quality Control Laboratories
FTAs	Free Trade Agreements

FYM	Farm Yard Manure
FYP	Five Year Plan
GAPs	Good Agricultural Practices
GCF	Gross Capital Formation
GDP	Gross Domestic Product
GHGs	Green House Gases
GHP	Good Horticultural Practice
GIS	Geographical Information System
GM	Genetically Modified
GMP	Good Manufacturing Practice
GPS	Ground Positioning System
GR	Gypsum Requirement
GSDP	Gross State Domestic Product
GTZ	German Technical Cooperation
HACCP	Hazard Analysis and Critical Control Points
HMNEHS	Horticulture Mission for North East & Himalayan States
HRD	Human Resource Development
HYVs	High Yielding Varieties
IBSA	India, Brazil, South Africa
ICAR	Indian Council of Agricultural Research
ICRISAT	International Crops Research Institute for Semi-Arid Tropics
ICT	Information and Communication Technology
IDA	International Development Agency
IDWG	Inter-Departmental Working Group
IFAD	International Fund for Agriculture Development
IGPB	Indian Grape Processing Board
IICPT	Indian Institute of Crop Processing Technology
IIPR	Indian Institute of Pulses Research
IISS	Indian Institute of Soil Science
IMD	Indian Meteorological Department
IPM	Integrated Pest Management
IPPC	International Plant Protection Convention
IPRs	Intellectual Property Rights
IRIWI	International Research Initiative for Wheat Improvement

ISO	International Organisation of Standardisation
ISOPOM	Integrated Scheme of Oilseeds, Pulses, Oil palm and Maize
ITDP	Institute of Transportation and Development Policy
IVR	Interactive Voice Response
IWDP	Integrated Wastelands Development Programme
IWMP	Integrated Watershed Management Programme
JFMCs	Joint Forest Management Committees
JICA	Japan International Cooperation Agency
JRF	Junior Research Fellowship
K	Potassium
KCC	Kisan Call Centre/ Kisan Credit Cards
kg	kilogram
LPA	Long Period Average
LWO	Locust Warning Organization
MANAGE	National Institute of Agricultural Extension Management
MAS	Molecular Marker-assisted Selection
MBM	Meat-cum-Bone Meal
MEROCOSUR	Mercado Comun del Cono Sur / is a Spanish Acronym meaning Southern Common Market
MF	Military Farms
MFPS	Mega Food Parks Scheme
Mg	Magnesium
MGNREGA	Mahatma Gandhi National Rural Employment Guarantee Act
mha	Million hectares
MIP	Market Intervention Price
MIS	Market Intervention Scheme
MMA	Macro Management of Agriculture
MNAIS	Modified National Agricultural Insurance Scheme
Mo	Molybdenum
MoA	Ministry of Agriculture
MOETT	Multi Ovulation Embryo Transfer Technology
MoFPI	Ministry of Food Processing Industries
MOP	Muriate of Potash

MRIN	Market Research Information Network
MRP	Mixed Recall Period
MSP	Minimum Support Price
MTCs	Model Training Courses
N	Nitrogen
NAAS	National Academy of Agricultural Sciences
NABARD	National Bank for Agricultural and Rural Development
NABL	National Accreditation Board for Testing and Calibration Laboratories
NADRS	National Animal Disease Reporting System
NAFED	National Agricultural Cooperative Marketing Federation
NAIS	National Agricultural Insurance Scheme
NAMA	Non Agricultural Market Access
NAPCC	National Action Plan on Climate Change
NARP	National Agricultural Research Project
NBSSLUP	National Bureau of Soil Survey and Land Use Planning
NCAP	National Centre for Agricultural Economics and Policy Research
NCDC	National Cooperative Development Corporation
NCIPM	National Centre for Integrated Pest Management
NDC	National Development Council
NDDB	National Dairy Development Board
NeGP-A	National e Governance Plan in Agriculture
NFSM	National Food Security Mission
NHM	National Horticulture Mission
NIC	National Informatics Centre
NIFTEM	National Institute of Food Technology, Entrepreneurship & Management
NIPHM	National Institute of Plant Health Management
NLAs	National Level Agencies
NMAM	National Mission on Agricultural Mechanisation
NMPPB	National Meat and Poultry Processing Board
NMPS	National Mission for Protein Supplements

NMSA	National Mission for Sustainable Agriculture
NPCBB	National Project for Cattle and Buffalo Breeding
NPIL	National Pesticides Investigational Laboratory
NPMSH&F	National Project on Management of Soil Health & Fertility
NPPTI	National Plant Protection Training Institute
NPRR	National Pesticide Reference Repository
NPSD	New Policy on Seed Development
NRC	National Research Centre
NRCE	National Research Centre on Equines
NSC	National Seeds Corporation
NSRTC	National Seed Research and Training Centre
NSS	National Sample Survey
NSSO	National Sample Survey Office
NTIs	Nodal Training Institutes
NWDPRA	National Watershed Development Project for Rainfed Areas
OECD	Organization for Economic Cooperation and Development
OFT	On Farm Trial
OPAE	Oil Palm Area Expansion
OPDP	Oil Palm Development Programme
OPP	Oilseeds Development Programme
OTS	One Time Settlement
PACS	Primary Agricultural Credit Societies
PCR	Polymerase Chain Reaction
PDS	Public Distribution System
PFDC	Precision Farming Development Centre
PG	Post Graduation
PHM	Post Harvest Management
PHTM	Post Harvest Technology and Management
PKS	Polyketide Synthase
PMTs	Project Management Teams
PPP	Public Private Partnerships
PPR	Peste des Petits Ruminants
PPV&FR	Protection of Plant Varieties and Farmers' Rights

PQSs	Plant Quarantine Stations
PSCs	Phytosanitary Certificates
PSS	Price Supports Scheme
PTAs	Preferential Trading Agreements
PUFAs	Polyunsaturated Fatty Acids
QTL	Quantitative Trait Loci
R& D	Research and Development
RADP	Rainfed Area Development Programme
RBH	Rural Business Hubs
RC	Registration Committee
RDIMS	RKVY Database and Management Information System
RIDF	Rural Infrastructure Development Fund
RKVY	Rashtriya Krishi Vikas Yojna
RPQS	Regional Plant Quarantine Stations
RPTLs	Regional Pesticides Testing Laboratories
RRBs	Regional Rural Banks
RSFP&D	Regional Stations for Forage Production and Demonstration
RTPCR	Rapid or Real Time Polymerase Chain Reaction
RVP & FPR	River Valley Project & Flood Prone River
SAARC	South Asian Association for Regional Cooperation
SAMCs	State Meteorological Centres
SAMETI	State Agricultural Management & Extension Training Institutes
SAUs	State Agricultural Universities
SCH	Single Cross Hybrids
SDA	Scheduled Desert Area
Se	Selenium
SEWP	State Extension Work Plan
SFCI	State Farms Corporation of India
SHPIs	Self Help Promoting Institutions
Si	Silicon
SLC	State Level Committees
SLSC	State Level Sanctioning Committee
SLUB	State Land Use Board
SNPs	Single Nucleotide Polymorphisms
SOC	Soil Organic Carbon

SRF	Senior Research Fellowship
SRR	Seed Replacement Rates
SSCAs	State Seed Certification Agencies
SSCs	State Seed Corporations
SSGs	States Specific Grants
SSM	Special Safeguard Mechanism
STCCS	Short Term Cooperative Credit Structure
STLs	Soil Testing Laboratories/ Seed Testing Laboratories
SW	South West
TAR	Technology Assessment and Refinement
TERI	The Energy & Resources Institute
TFGs	Tenant Farmers Groups
TMNE	Technology Mission for Integrated Development of Horticulture in North Eastern States including Sikkim
TMO	Technology Mission on Oilseeds
TN	Tamil Nadu
TPDS	Targeted Public Distribution Scheme
TVEs	Town and Village Enterprises
UG	Under Graduate
UNESCAP	United Nation Economic and Social Commision for Asia and the Pacific
UP	Uttar Pradesh
URP	Uniform Recall Period
UT	Union Territory
VAT	Value Added Tax
WB	West Bengal
WBCIS	Weather Based Crop Insurance Scheme
WDPs	Watershed Development Programmes
WDPSCA	Watershed Development Project in Shifting Cultivation Areas
WFP	World Food Programme
WHO	World Health Organisation
WPI	Wholesale Price Index
WTO	World Trade Organisation
SDR	Special Drawing Rights

CHAPTER 1

Indian Agriculture: Performance and Challenges

1.1 Agriculture is a critical sector of the Indian economy. Though its contribution to the overall Gross Domestic Product (GDP) of the country has fallen from about 30 percent in 1990-91 to less than 15 percent in 2011-12, a trend that is expected in the development process of any economy, agriculture yet forms the backbone of development. An average Indian still spends almost half of his/her total expenditure on food, while roughly half of India's work force is still engaged in agriculture for its livelihood. Being both a source of livelihood and food security for a vast majority of low income, poor and vulnerable sections of society, its performance assumes greater significance in view of the proposed National Food Security Bill and the ongoing Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) scheme. The experience from BRICS countries indicates that a one percentage growth in agriculture is at least two to three times more effective in reducing poverty than the same growth emanating from non-agriculture sectors. Given that India is still home to the largest number of poor and malnourished people in the world, a higher priority to agriculture will achieve the goals of reducing poverty and malnutrition as well as of inclusive growth. Since agriculture forms the resource base for a number of agro-based industries and agro-services, it would be more meaningful to view agriculture not as farming alone but as a holistic value chain, which includes farming, wholesaling, warehousing (including logistics), processing, and retailing. Further, it may be noted that in the last two Five Year Plans, it is clearly mentioned that for the economy to grow at 9 per cent, it is important that agriculture should grow at least by 4 per cent per annum.

1.2 Achieving an 8-9 percent rate of growth in overall GDP may not deliver much in terms of poverty reduction unless agricultural growth accelerates. At the same time 'growth with inclusiveness' can be achieved only when agriculture growth accelerates and is also widely shared amongst people and regions of the country. All these factors point to just one thing: that agriculture has to be kept at the centre of any reform agenda or planning process, in order to make a significant dent on poverty and malnutrition, and to ensure long-term food security for the people.

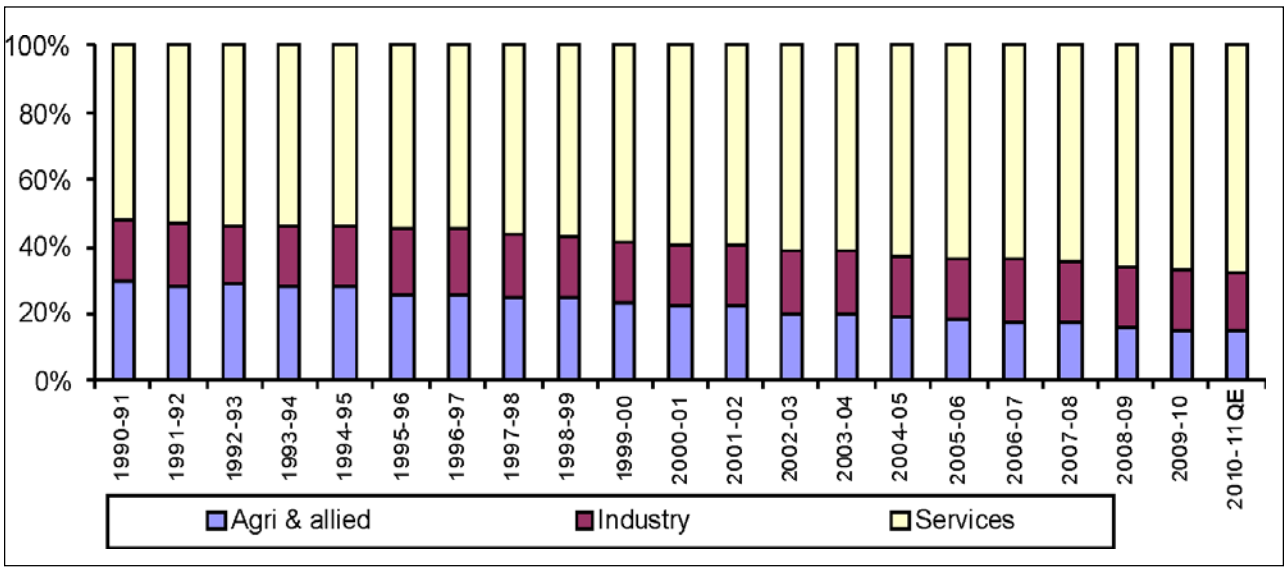
1.3 This chapter briefly reviews the status and performance of agriculture, especially during the last two decades, and also presents what could be the way forward, given our objectives of accelerated growth, inclusiveness and the reducing of poverty and hunger.

Structure and Structural Transformation of Indian Agriculture

1.4 The agriculture sector in India has undergone significant structural changes in the form of decrease in share of GDP from 30 percent in 1990-91 to 14.5 percent in 2010-11

indicating a shift from the traditional agrarian economy towards a service dominated one (Fig 1.1). This decrease in agriculture's contribution to GDP has not been accompanied by a matching reduction in the share of agriculture in employment. About 52% of the total workforce is still employed by the farm sector which makes more than half of the Indian population dependant on agriculture for sustenance (NSS 66th Round). However, within the rural economy, the share of income from non-farm activities has also increased.

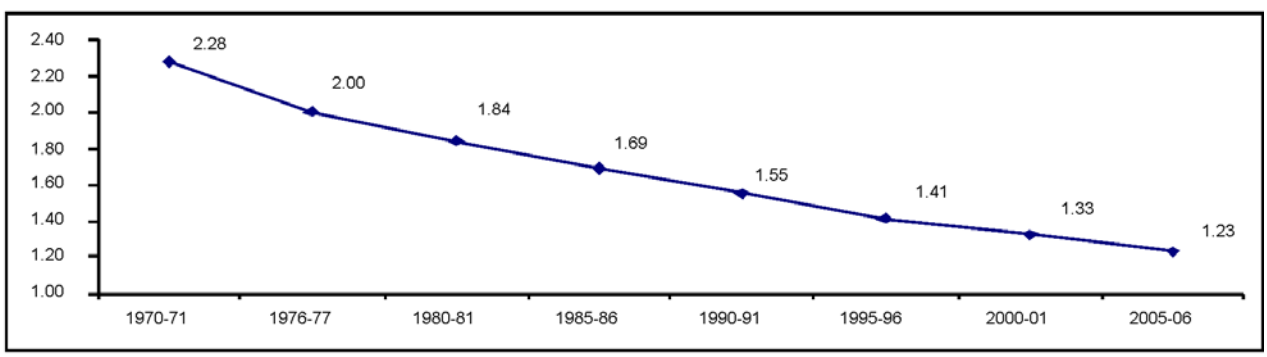
Fig 1.1: Sectoral Composition of GDP



Source: CSO

1.5 The average size of operational holdings in India has diminished progressively from 2.28 ha in 1970-71 to 1.55 ha in 1990-91 to 1.23 ha in 2005-06 (Fig. 1.2). As per Agriculture Census 2005-06, the proportion of marginal holdings (area less than 1 ha) has increased from 61.6 percent in 1995-96 to 64.8 percent in 2005-06. This is followed by about 18 percent small holdings (1-2 ha.), about 16 percent medium holdings (more than 2 to less than 10 ha.) and less than 1 percent large holdings (10 ha. and above).

Fig 1.2: Average size (ha) of holdings as per different Agriculture Census (for all size groups)



Source: Department of Agriculture and Cooperation, Agricultural Census Division, Ministry of Agriculture.

1.6 With the declining share of agriculture to GDP, the continuing high pressure of population on agriculture and the increasing fragmentation of land holdings leading to decreasing availability of cultivated land area per household, the agriculture sector alone would hardly be in a position to create additional employment opportunities to sustain the livelihood of the rural households. This calls for creation of additional employment opportunities in the non-farm and manufacturing sector, especially in agro based rural industries which have area specific comparative advantage in terms of resources endowment and development possibilities. This would require suitable skill development of the people so as to gainfully employ them in non-farm activities. This alone would be able to make agriculture viable in a sustainable manner. In addition, by creating more employment and absorbing some of the surplus labour in agriculture, this will contribute to achieving our objective of inclusive growth.

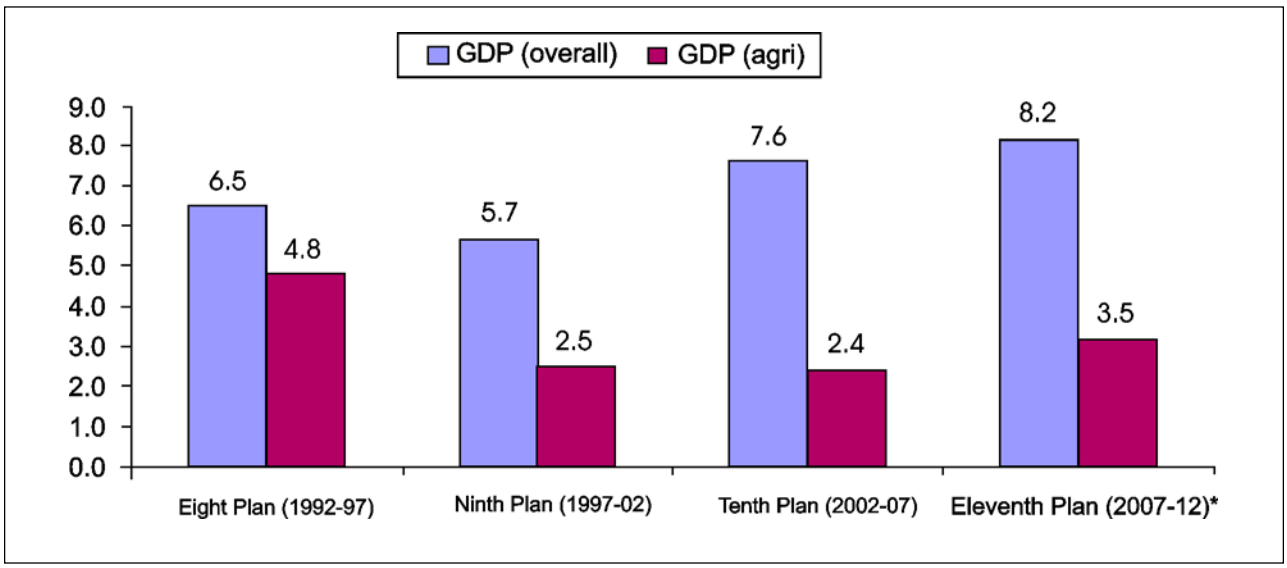
1.7 Fragmentation of operational holdings has widened the base of the agrarian pyramid in most states. Empirical studies have, however, demonstrated that agricultural productivity is size neutral. Factors that determine productivity favourably include among others an easy and reliable access to modern inputs, access to suitable technology tailored for specific needs, the presence of support infrastructure and innovative marketing systems to aggregate and market the output from such small holdings efficiently and effectively. In agricultural technology, the use of high yielding varieties as in the case of Bt cotton and maize, economy in input use, the availability of quality seeds and farming techniques such as system of rice intensification enabled finally by marketing links all have high potential to improve yield.

Growth Performance of Agriculture

Overall Growth

1.8 The growth performance of the agriculture sector has been fluctuating across the plan periods (Fig 1.3). It witnessed a growth rate of 4.8 per cent during the Eighth plan period (1992–97). However, the agrarian situation saw a downturn towards the beginning of the Ninth plan period (1997–2002) and the Tenth plan period (2002–07), when the agricultural growth rate came down to 2.5 percent and 2.4 percent respectively. This crippling growth rate of 2.4 percent in agriculture as against a robust annual average overall growth rate of 7.6 per cent for the economy during the tenth plan period was clearly a cause for concern. The trend rate of growth during the period 1992-93 to 2010-11 is 2.8 percent while the average annual rate of growth in agriculture & allied sectors-GDP during the same period is 3.2 percent.

Fig. 1.3: Growth Rates: GDP (overall) and GDP (Agriculture & Allied Sectors)

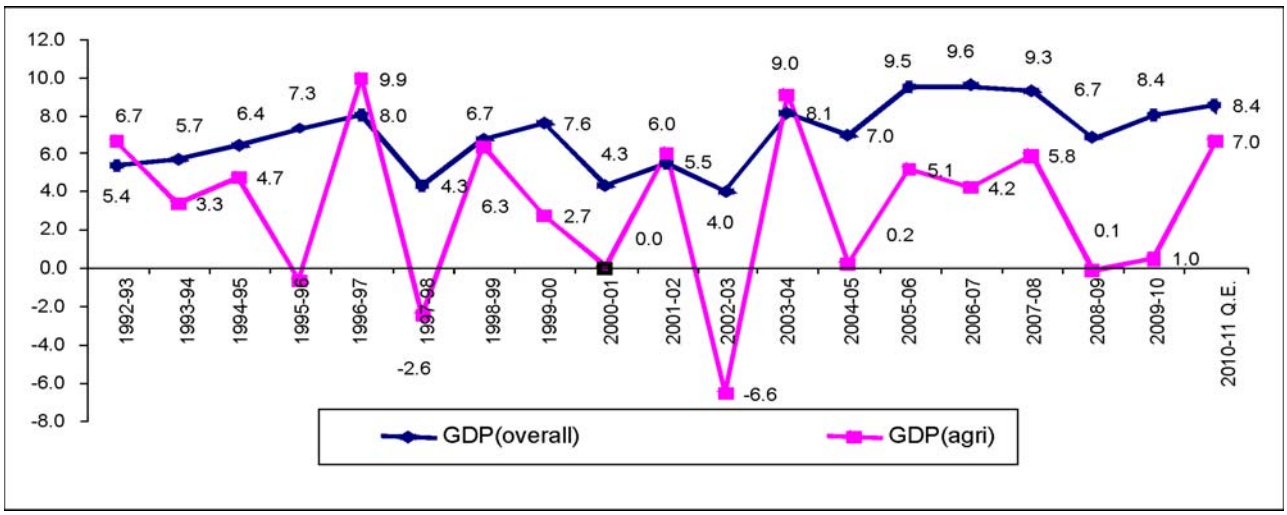


*Note: * Figures for the Eleventh Plan show growth rates for the first four years of the Plan.*
Source: CSO.

1.9 The Eleventh Plan had sought to reverse the deceleration of agricultural growth which occurred in the Ninth Plan and continued into the Tenth Plan. It has had some success in that foodgrain production touched a new peak of 250.42 million tonnes in 2011-12. Agricultural GDP growth has accelerated to an average 3.9 percent growth during 2005-06 to 2010-11, partly because of initiatives taken since 2004. As per the latest advance estimate of National Income released by the Central Statistics Office (CSO), agriculture and allied sectors are likely to grow at 2.5 percent during 2011-12 as against 7 percent during the previous year at constant (2004-05) prices. The Approach Paper to Twelfth Plan drafted by Planning Commission estimates that with a revision of the farm sector GDP growth rates for 2010-11 and the expected good harvest in 2011-12, the average growth in agriculture & allied sectors in the Eleventh Plan may be higher at 3.3-3.5 percent per year against a target of 4 percent.

1.10 The increasing divergence between the growth trends of the total economy and that of agriculture & allied sectors suggests an under performance by agriculture (Fig 1.4). It is also significant that unlike the overall economic growth pattern, agricultural performance in India has been quite volatile (the Coefficient of Variation (CV) during 2000-01 to 2010-11 was 1.6 compared to 1.1 during 1992-93 to 1999-2000). This is almost six times more than the CV observed in the overall GDP growth of the country indicating that high and perhaps increasing volatility is a real challenge in agriculture, which is likely to increase in the years to come in the wake of climate change.

Fig 1.4: Comparative Performance of Growth of GDP and Agri-GDP

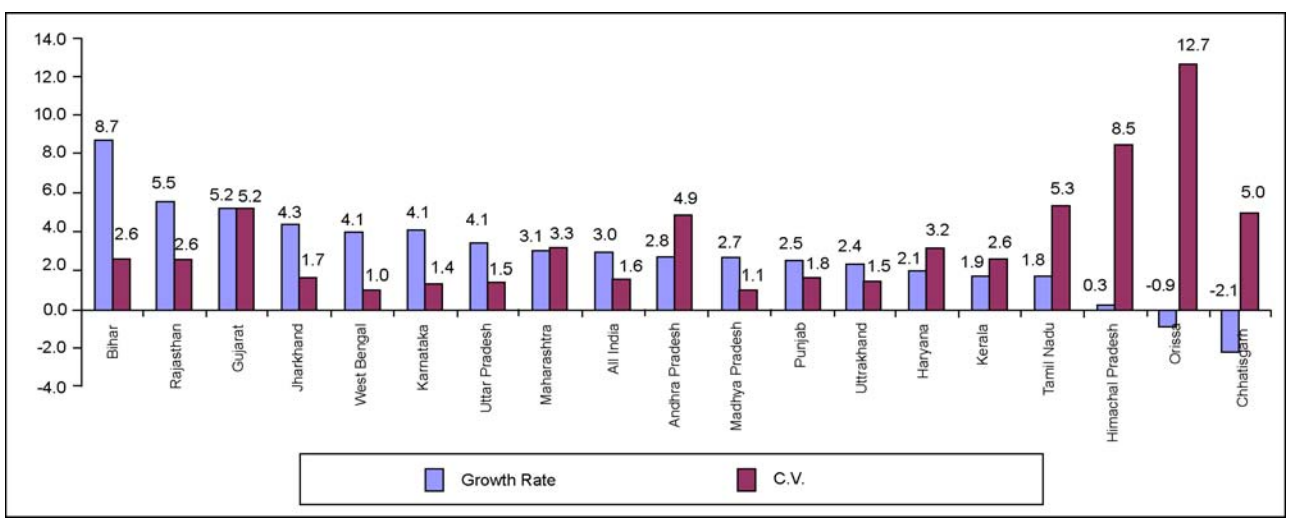


Note: Figures are at 2004-05 prices.
Source: CSO.

Regional Variations in Growth

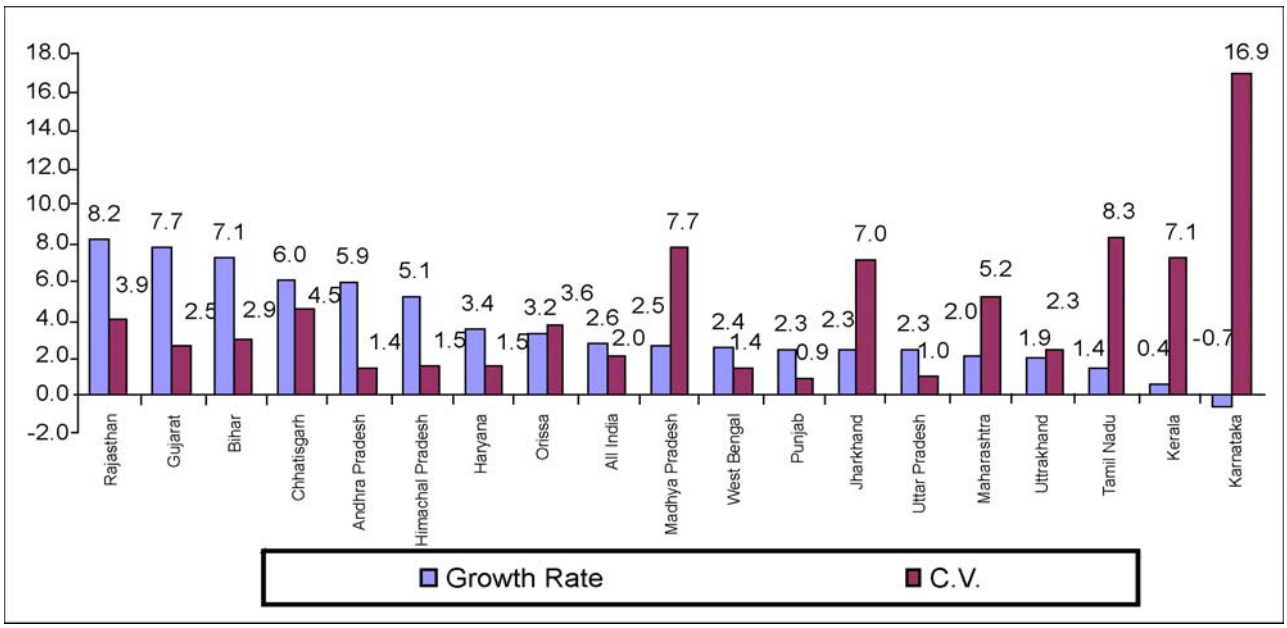
1.11 The Indian agriculture growth pattern has been highly varied at the state level. Since agriculture is a state subject, the overall performance of the agriculture sector in India largely depends on what occurs at the state level. There is a wide variation in the performance of different states. During 2000-01 to 2008-09, the growth performance of agriculture in Rajasthan (8.2%), Gujarat (7.7%) and Bihar (7.1%) was much higher than that of Uttar Pradesh (2.3%) and West Bengal (2.4%). The recent dynamics of erstwhile poor performing states like Orissa, Chhattisgarh and Himachal Pradesh showing strong growth in agriculture can be seen from Fig. 1.5 & 1.6.

Fig. 1.5: Average Annual Growth Rate (%) of Gross State Domestic Product from Agriculture & Allied Sector, 1994-95 to 1999-2000



Source: CSO.
Note: GSDP estimates are at 1993-94 prices.

Fig 1.6: Average Annual Growth Rate (%) of Gross State Domestic Product from Agriculture & Allied Sector, 2000-01 to 2008-09



Source: CSO.
Note: GSDP estimates are at 1999-2000 prices.

Crop-Specific Growth

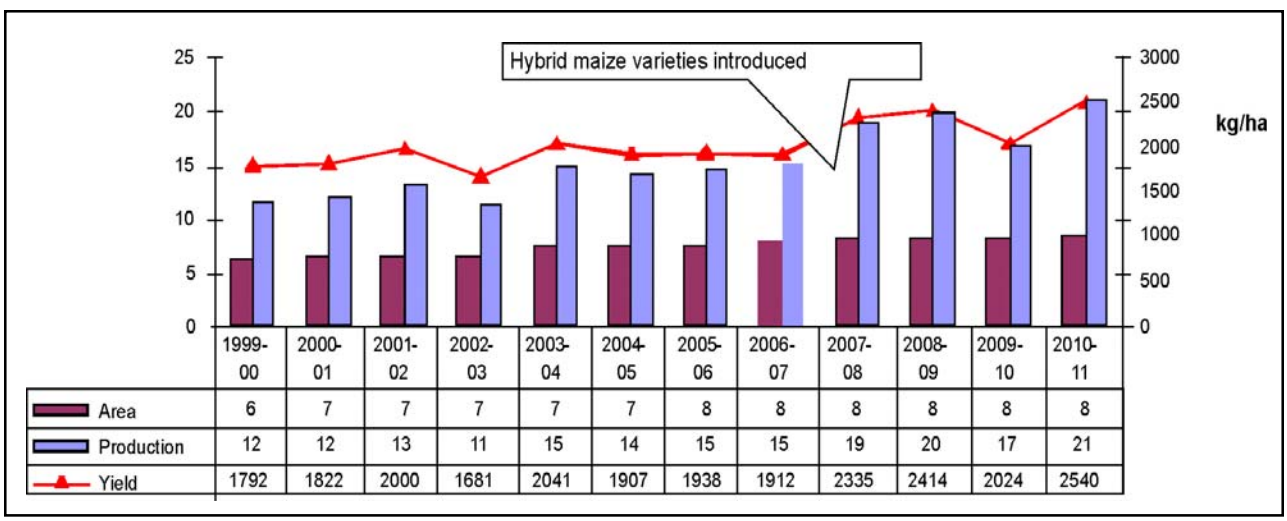
1.12 During 2010-11, foodgrains production was 244.78 million tonnes, comprising of 121.14 million tonnes during Kharif season and 123.64 million tonnes during the Rabi season. Of the total foodgrains production, production of cereals was 226.54 million tonnes and pulses 18.24 million tonnes. As per 2nd advance estimates for 2011-12, total foodgrains production is estimated at a record level of 250.42 million tonnes which is 5.64 million tonnes higher than that of the last year production. Production of rice is estimated at 102.75 million tonnes, Wheat 88.31 million tonnes, coarse cereals 42.08 million tonnes and pulses 17.28 million tonnes. Oilseeds production during 2011-12 is estimated at 30.53 million tonnes, sugarcane production is estimated at 347.87 million tonnes and cotton production is estimated at 34.09 million bales (of 170 kg. each). Jute production has been estimated at 10.95 million bales (of 180 kg each). Despite inconsistent climatic factors in some parts of the country, there has been a record production, surpassing the targeted production of 245 million tonnes of foodgrains by more than 5 million tonnes during 2011-12.

1.13 Growth in the production of agricultural crops depends upon acreage and yield. Given the limitations in the expansion of acreage, the main source of long-term output growth is improvement in yields. A comparative picture in average annual growth rates of area,

production, and yield of different crops for two periods 1990-91 to 1999-2000 and 2000-01 to 2010-11 is given in Table 1.1. In the case of wheat, the growth in area and yield have been marginal during 2000-01 to 2010-11 suggesting that the yield levels have plateaued for this crop. This suggests the need for renewed research to boost production and productivity.

1.14 All the major coarse cereals display a negative growth in area during both the periods except for maize, which recorded an annual growth rate of 2.68 per cent in the 2000-01 to 2010-11 period. The production of maize has also increased by 7.12 percent in the latter period (Fig. 1.7). In pulses, gram recorded a growth of 6.39 percent in production during the same period driven by expansion in the area under cultivation. Soyabean has recorded a high rate of growth in production in both the periods, driven primarily by expansion in area under cultivation. In fact oilseeds as a group have shown some significant changes in the two decades: the production growth rate has more than doubled in the decade of 2000s over the previous decade, driven both by productivity gains (eg. groundnut and soyabean) as well as by area gains. The average annual growth rates of production and productivity of groundnut during 2000-01 to 2010-11 are abnormally high due to high fluctuations in the production and productivity during the years 2002-03, 2006-07 & 2007-08. The trend growth rates in the production and productivity of groundnut during 2000-01 to 2010-11 work out to 1.66 per cent and 2.63 per cent respectively. Fruits & vegetables have shown a higher growth in production and area in 2000-01 to 2010-11 as compared to 1990-91 to 1999-2000.

Fig 1.7: Area, Production & Yield of Maize

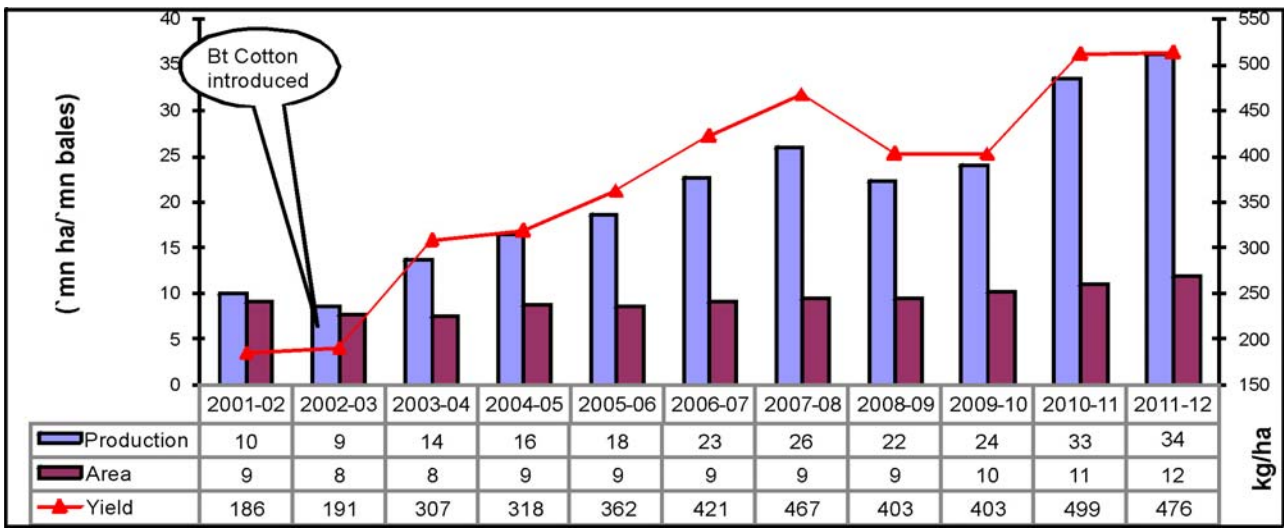


	1999-00	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11
Area	6	7	7	7	7	7	8	8	8	8	8	8
Production	12	12	13	11	15	14	15	15	19	20	17	21
Yield	1792	1822	2000	1681	2041	1907	1938	1912	2335	2414	2024	2540

Source: Directorate of Economics & Statistics, Ministry of Agriculture.

1.15 The biggest increase in the growth rates of yields in the two periods, however, is in groundnut and cotton. Cotton has experienced significant changes with the introduction of Bt cotton in 2002 (Fig. 1.8). By 2011-12, almost 90 percent of cotton area is covered under Bt. cotton, production has more than doubled (compared to 2002-03), yields have gone up by almost 70 percent, and export potential for more than Rs 10,000 crore worth of raw cotton per year has been created. More such revolutions to accelerate agri-growth are needed.

Fig. 1.8: Area, Production & Yield of Cotton



Source: Directorate of Economics & Statistics, Ministry of Agriculture.

Table 1.1: All India Average Annual Growth Rates of Area, Production and Yield of Principal Crops (%)

Crops/Crop Groups	1990-91 to 1999-2000			2000-01 to 2010-11		
	A	P	Y	A	P	Y
Rice	0.70	2.09	1.36	-0.39	1.32	1.47
Wheat	1.62	4.52	2.87	0.57	1.39	0.73
Maize	0.85	2.24	1.37	2.68	7.12	4.13
Coarse Cereals	-2.42	-0.08	2.03	-0.13	5.0	4.64
Total Cereals	-0.12	2.29	2.38	-0.09	1.82	1.69
Gram	0.88	3.86	2.97	4.31	6.39	1.19
Tur	-0.45	1.89	2.03	2.58	1.89	-0.65
Total Pulses	-0.91	1.06	1.82	2.30	4.02	1.21
Total Foodgrains	-0.27	2.19	2.43	0.34	1.95	1.37
Groundnut	-2.25	-2.40	-0.30	-1.08	13.13	12.76
R & M	2.28	4.82	2.96	2.76	6.26	2.72
Soyabean	11.01	16.37	4.67	4.15	8.31	4.17
Oilseeds	0.75	2.53	1.76	1.27	7.00	5.18
Sugarcane	2.25	3.16	0.91	1.95	2.12	0.03
Cotton	1.42	0.93	-0.54	2.66	12.12	9.15

Note: *A: Area, P: Production, Y: Yield*
Source: Directorate of Economics & Statistics, Ministry of Agriculture.

1.16 Structural change in the composition of agriculture leading to a diversification of Indian agriculture into horticulture, livestock and fisheries since the 1990s is a landmark development with great challenges and unlimited opportunities. The share of livestock in

total output from the agriculture and allied sectors has increased from 20% in Triennium Ending (T.E.) 1990-91 to 25% in T.E. 2009-10 (at 2004-05 prices). Currently foodgrains constitute about one fifth of the total value of output from the agriculture & allied sector which is less than the contribution from the livestock sector and almost equal to that of the horticulture sector (Fig. 1.9 & 1.10).

Composition (%) of Output of Agriculture & Allied Sectors

Fig. 1.9: T.E. 1990-91

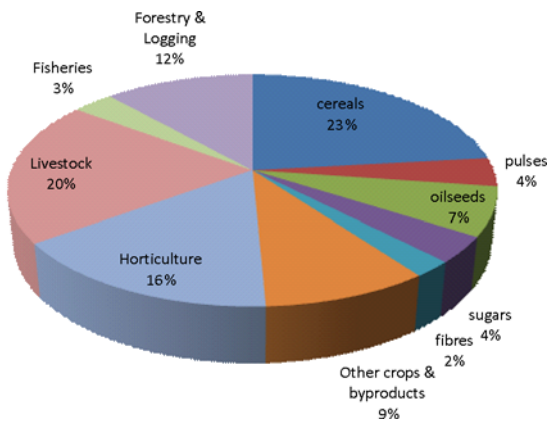
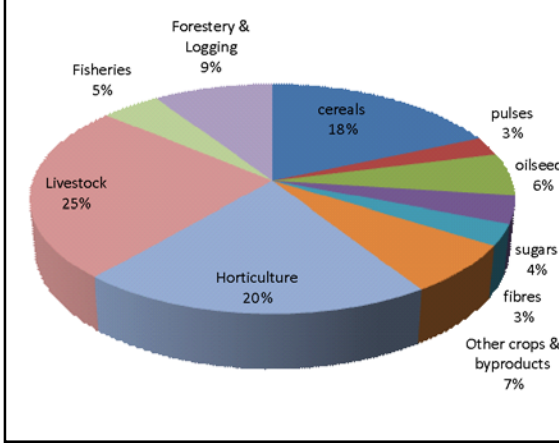


Fig. 1.10: T.E. 2009-10



Source: CSO

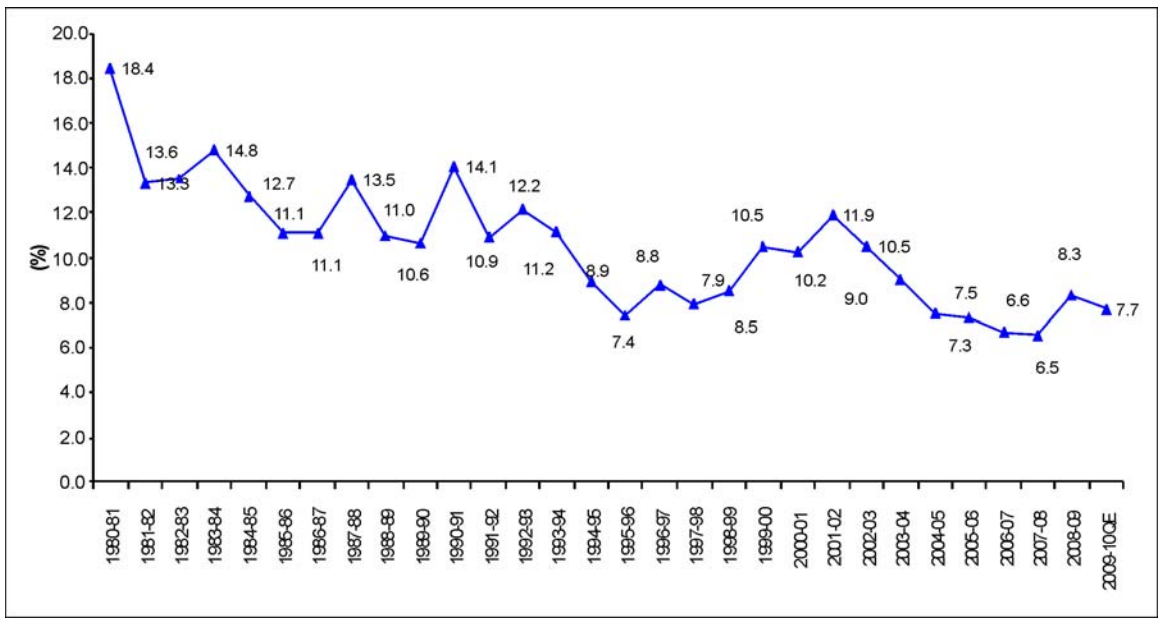
1.17 The shares of fruits & vegetables and livestock have shown an increasing trend in recent years implying that they have been growing at a much faster rate than the traditional crops sector. Given the rising share of high value commodities in the total value of agricultural output and their growth potential, this segment is likely to drive agricultural growth in the years to come. Being highly perishable in nature, this segment requires faster and better linkages between farms and firms in terms of logistics, processing and organised retailing. This would entail institutional changes that can incentivise entrepreneurs to invest in building efficient and faster value chains that reduce wastages, and increase the incomes of the farmers at the bottom of the chain.

Drivers of Growth in Agriculture

Investment

1.18 In recent years, the share of Gross Capital Formation (GCF) of agriculture & allied sector in total GCF has hovered between 6 to 8 percent whereas it was around 18 percent during the early 1980s (Fig 1.11). This indicates that the non-agriculture sectors are receiving higher investment as compared to agriculture & allied sector over the plan periods resulting in growth disparities. Though this is in line with the overall falling share of agriculture in the overall GDP, and also conforms to the development process observed elsewhere in the developing world, yet keeping in view the high population pressure on agriculture for their sustenance, there is need for substantial increase in investment in agriculture.

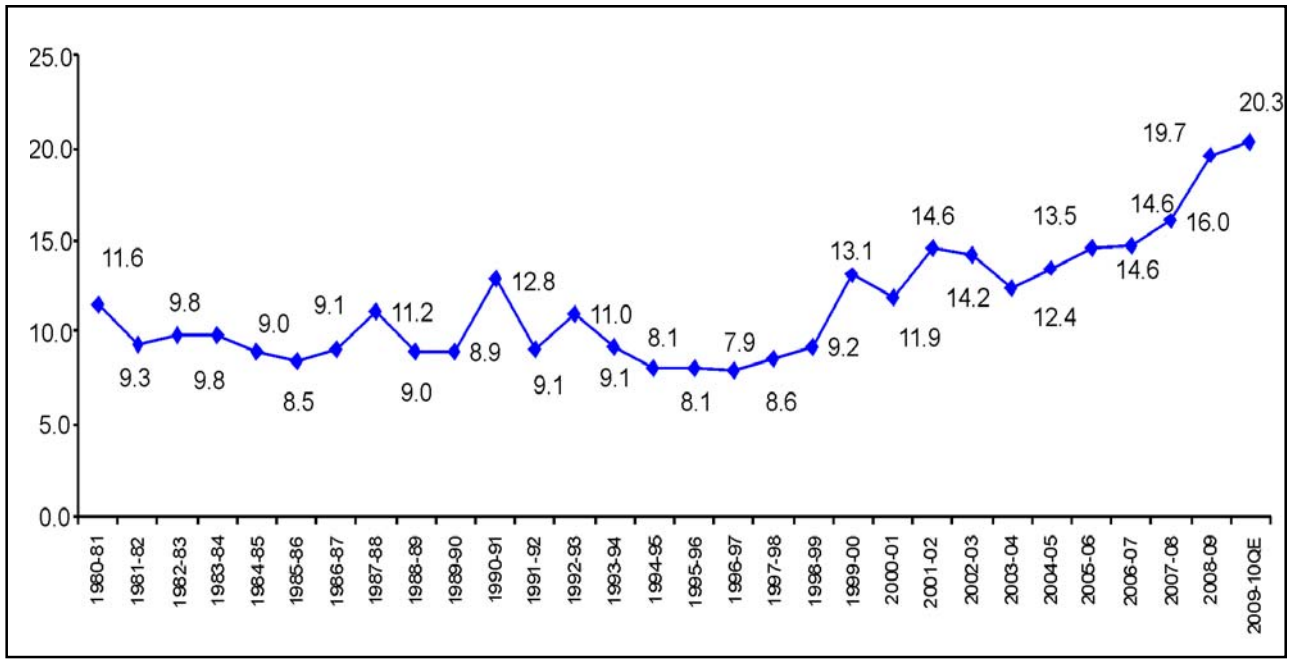
Fig. 1.11: Per cent Share of Agriculture & Allied Sector in Total Gross Capital Formation



Note: All the figures are at 2004-05 prices.
Source: CSO.

1.19 The key indicator in drivers of agri-growth is GCF in agriculture as a percentage to agri-GDP. This indicator, GCF in agriculture & allied sector as percentage of agri-GDP, increased from 7.0% during the First Plan (1951-56) to 10.8% during the Fifth Plan (1974-79) after which it followed a declining trend up to Eighth Plan (1992-97); when it came down to 8.8 percent. From the Ninth Plan (1997-2002) onwards, a reversal in trend has been achieved partly due to the efforts of government schemes and programmes, resulting in an increase in GCF to 13.9 percent of GDP (agri) during the Tenth plan (2002-07). It has further risen to 18.7 percent of agri-GDP during the first three years of the Eleventh Plan. Thus, as a percentage of agri-GDP, the GCF (agri) has more than doubled during the last decade (Fig. 1.12). Yet, the agriculture GDP growth has not accelerated commensurately, though it has improved over the growth rates achieved in the Ninth and Tenth Five Year Plans.

Fig. 1.12: GCF (Agri) as a (%) of GDP (Agri)

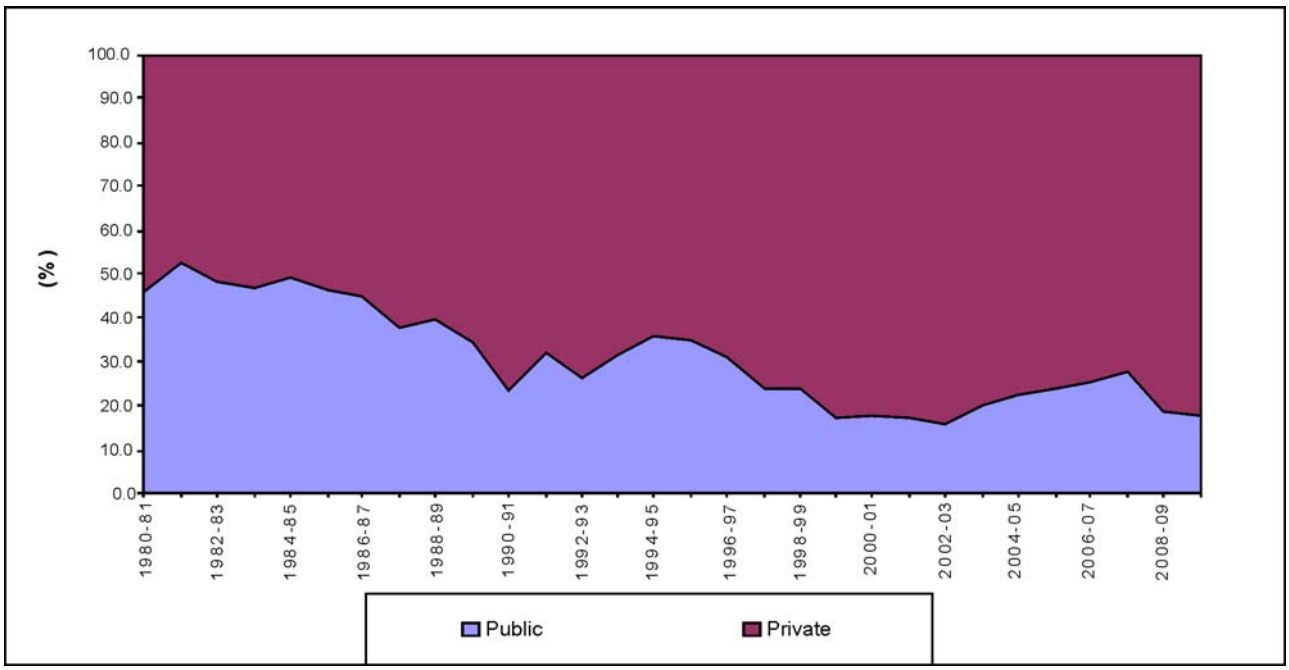


Note: All the figures are at 2004-05 prices.
Source: CSO.

1.20 While the GCF as percentage of agri-GDP has improved substantially, there has not been a commensurate improvement in the rate of growth of the agriculture sector. Another aspect, which impacts agricultural development relates to subsidies. The biggest of all these input subsidies is the fertilizer subsidy, and there are clear indications that it has led to an imbalanced use of N, P and K in states like Punjab and Haryana and has also contributed to deteriorating soil conditions. The expenditure on subsidies crowds out public investment in agriculture research, irrigation, rural roads and power. Lower public investment due to more emphasis on provision of subsidy will only further deteriorate the quality of public services like uninterrupted power supply, in some cases involving macroeconomic inefficiencies such as private investment in diesel generating sets. This leads to under utilization of power capacity due to poor distribution and maintenance.

1.21 There are some research studies available to show that the marginal returns evident in terms of poverty alleviation or accelerating agricultural growth are much lower from input subsidies than from investments in rural roads or agri-R&D or irrigation (Sheggen Fan et al., 2008). There is always a trade-off between allocating money through subsidies or by increasing investments. The investment option is much better than subsidies for sustaining long-term growth in agricultural production and also to reduce poverty faster.

Fig. 1.13: Share (%) of Public and Private Investment in Agriculture & Allied Sectors



Source: Directorate of Economics & Statistics, Ministry of Agriculture & CSO.

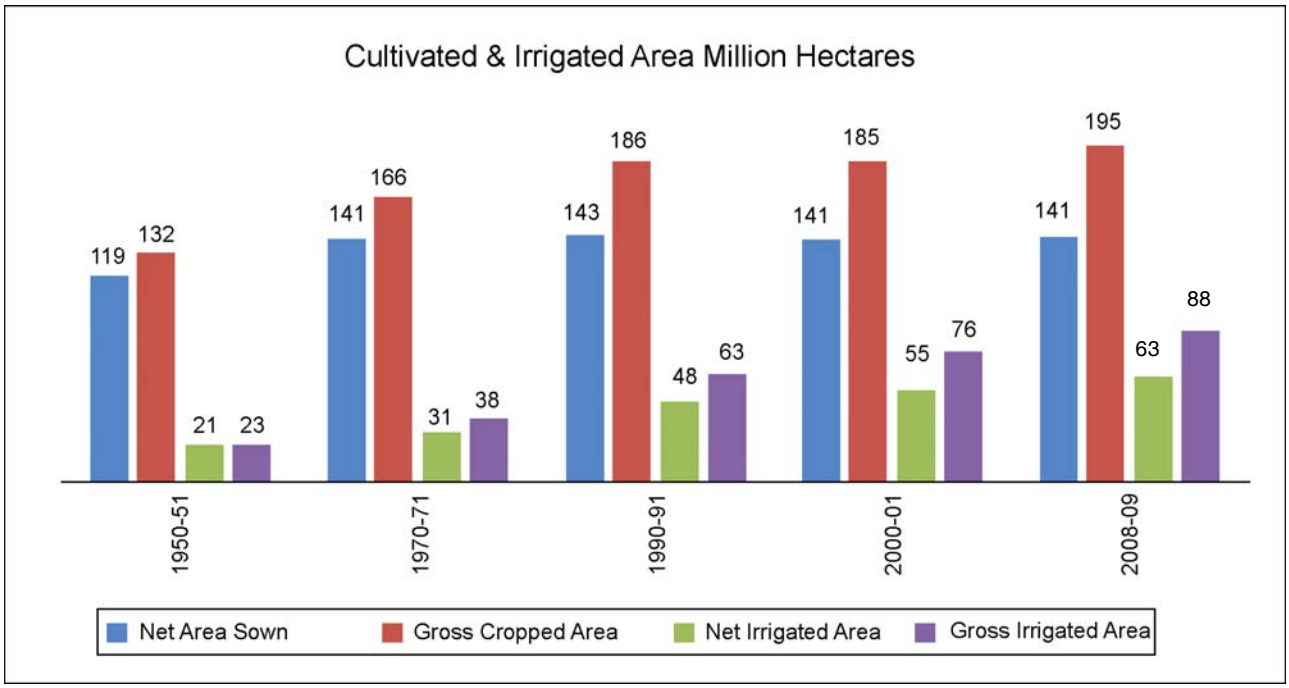
1.22 It is interesting to note that while public investment in agriculture is critical and important, in actual terms, it forms about 20 percent of the total investment in agriculture; 80 percent comes from the private sector (Fig. 1.13). In the early 1980s, for example, the share of the public sector and private sector (including household sector) in gross capital formation in agriculture was roughly equal, but by the early 2000s, the share of the private sector was four times larger than the share of the public sector at 2004-05 prices. Moreover, the private sector responds much better and faster to the incentive structures in agriculture. Hence, along with bringing in greater public investment in agriculture, there is a need for bringing in reforms in the incentive structure.

Irrigation, Seeds, Fertilizers and Credit

1.23 There is no doubt that the overall size, quality, and efficiency of investment are always the key drivers of growth in any sector. In case of *public* investments in agriculture, as defined in the National Accounts Statistics, more than 80 percent is accounted for major and medium irrigation schemes. Even in the case of *private* investments in agriculture, almost half is accounted for by irrigation (minor, primarily through groundwater, but also now increasingly drip, etc.). So irrigation remains the most dominant component in the overall investment in agriculture. Without proper use of water, it is difficult to get good returns on better high yielding seeds and higher doses of fertilizers. Water will remain a critical input for agriculture in the decades to come until science develops seeds that can thrive in dry climate with very little water. The net sown area has remained around 141 million hectares during the last 40 years. The cropping intensity, i.e., the ratio of gross cropped area to

net cropped area, has however, gone up from 118 per cent in 1970-71 to 138 percent in 2008-09.

Fig. 1.14: Movements in the gross cropped area, net sown area, net irrigated area and gross irrigated area, 1950-51 to 2008-09

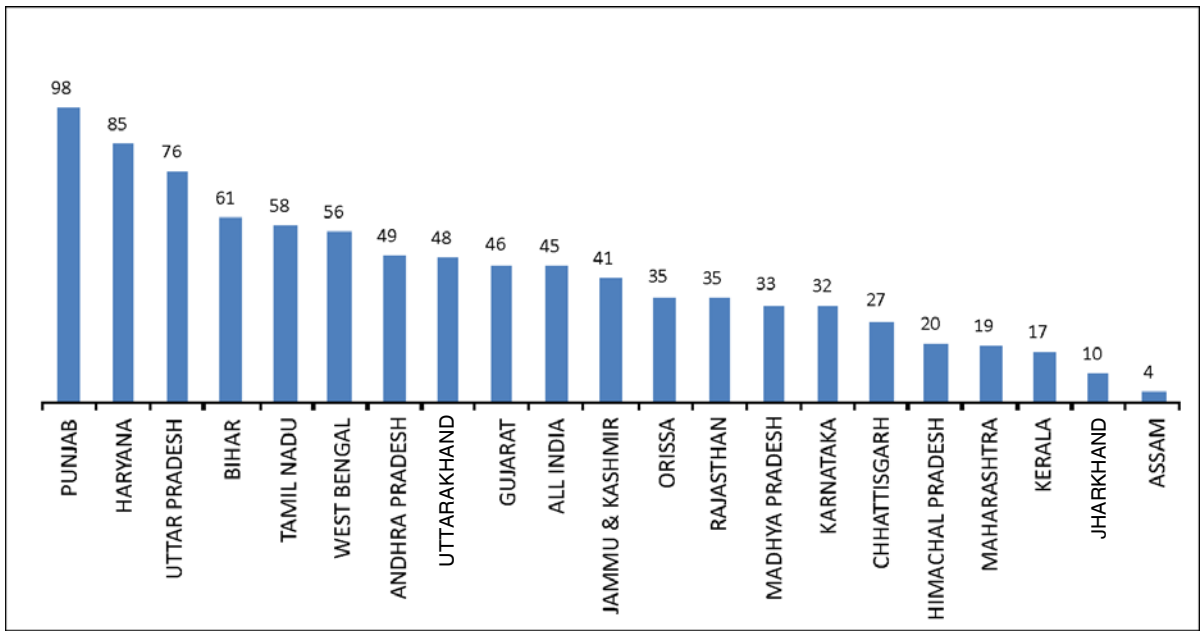


1.24 India currently has an overall irrigation potential in the country of 140 million hectares, out of which only about 109 million ha have been created, and around 80 million ha utilized. The current efficiency levels of public surface irrigation schemes (major and medium irrigation schemes) can be substantially improved through appropriate institutional reforms, better management and incentive environment. It may involve engaging water user associations, or some other groups and agencies, and even by unbundling the large surface schemes into storage (dams), transmission (main canals) and retail distribution of water (distribution at the farmer level). Groundwater irrigation, which is a bigger source of irrigation today, suffers from over-exploitation in most of the states, particularly in the north-west where the water table is depleting drastically. Free or low pricing of power for irrigation has primarily contributed to this problem. Major reforms in the power sector, improvement in the quality of power and availability of power are a precondition for improving the overall groundwater situation in the country.

1.25 Gross Irrigated area as a per cent of Gross Cropped area has increased from 34 percent in 1990-91 to 45.3 percent in 2008-09. However, there are wide variations in irrigation coverage across states and across crops as can be seen from Figs 1.15 and 1.16, respectively.

Fig. 1.15: State-wise Irrigation coverage 2008-09.

(Percent)

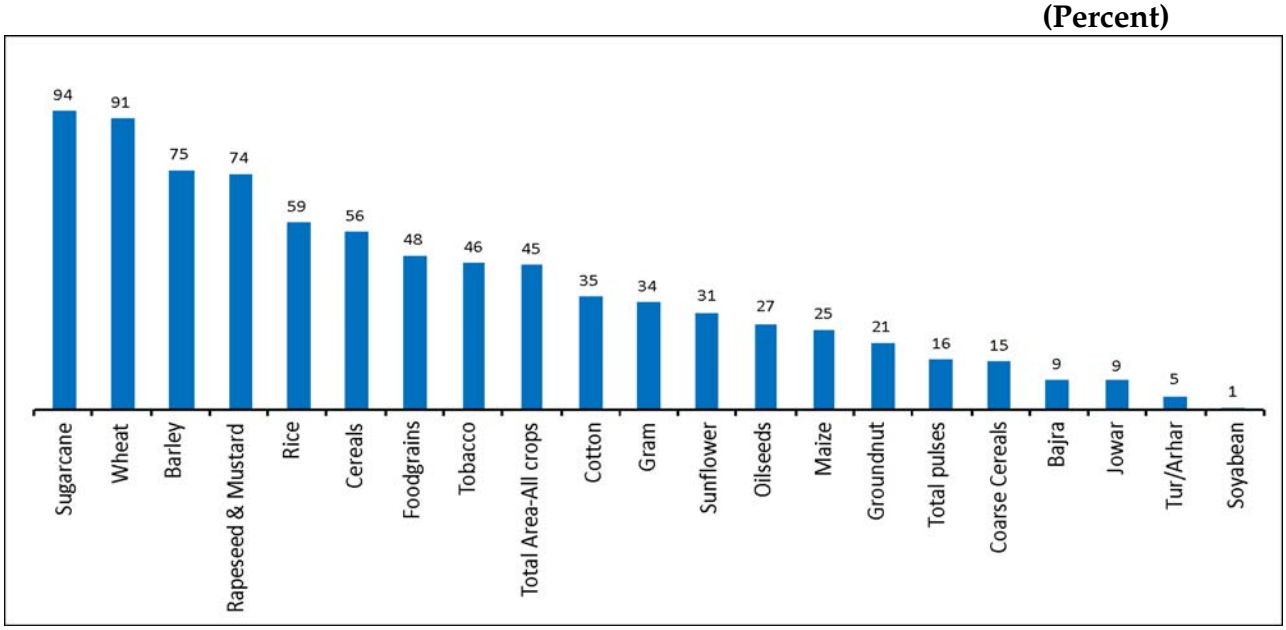


Source: Directorate of Economics and Statistics, DAC.

1.26 While Punjab (98), Haryana (85), Uttar Pradesh (76), Bihar (61), Tamil Nadu (58) and West Bengal (56) have more than half of the cropped area under irrigation, Odissa, Rajasthan, Madhya Pradesh, Karnataka, Chhattisgarh, Himachal Pradesh, Maharashtra, Kerala, Jharkhand and Assam have very low acreage under irrigation. Among crops, the major coarse cereals, pulses and most of the oilseeds are grown under rainfed conditions.

Fig 1.16: Crop-wise Irrigation coverage, 2008-09

(Percent)

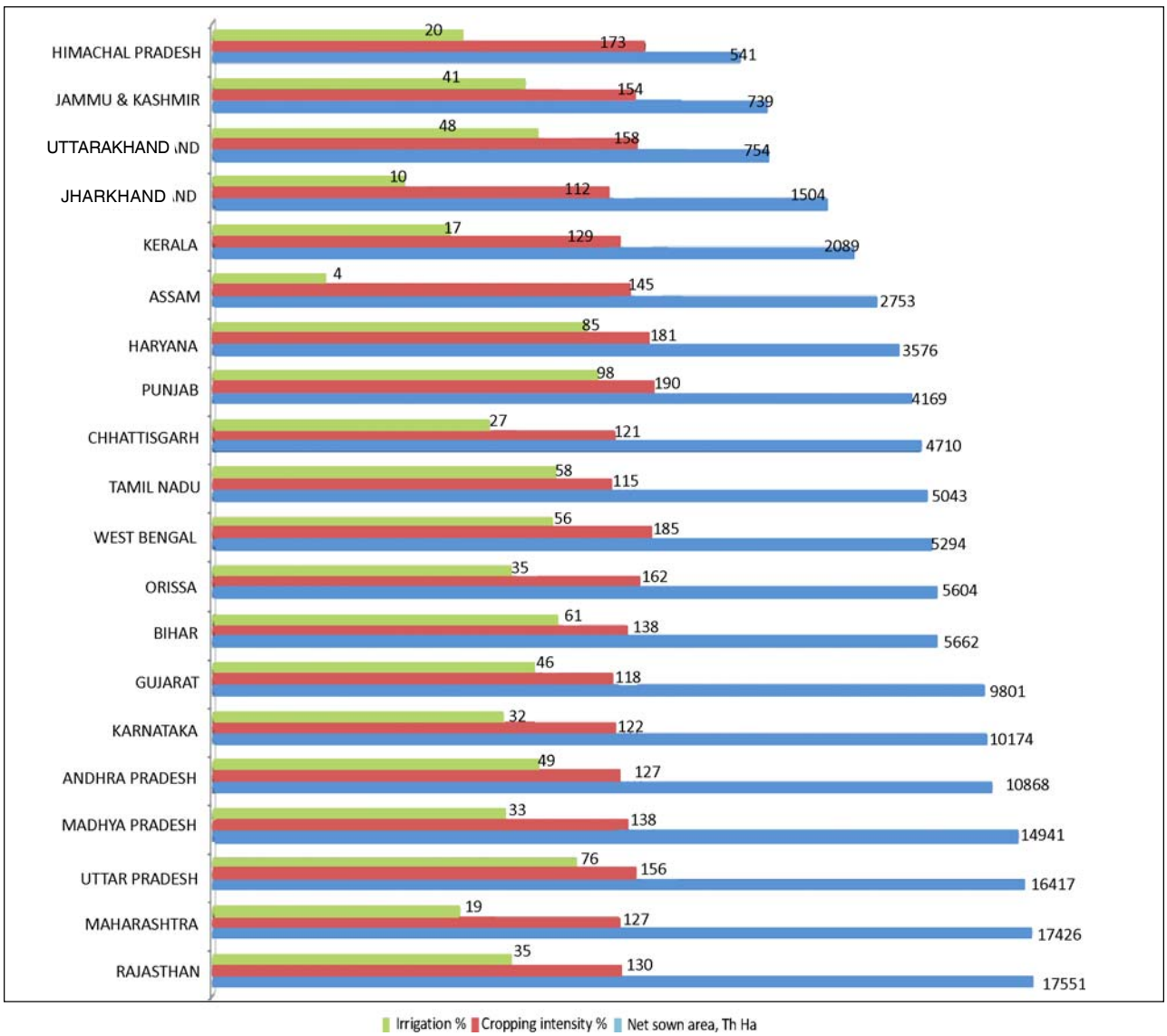


Source: Directorate of Economics and Statistics, DAC

1.27 An analysis of the net sown area, extent of irrigation and cropping intensity (Fig 1.17) reveals that Uttar Pradesh, Bihar, Andhra Pradesh and Tamil Nadu have ample scope to increase their cropping intensity as they have fairly large acreage under irrigation. States with high irrigation can have higher cropping intensity with a suitable change in cropping pattern by growing crops and varieties with durations that suit the crop growth and fit into the crop sequence.

Fig 1.17: Net Sown Area, Extent of Irrigation and Cropping Intensity

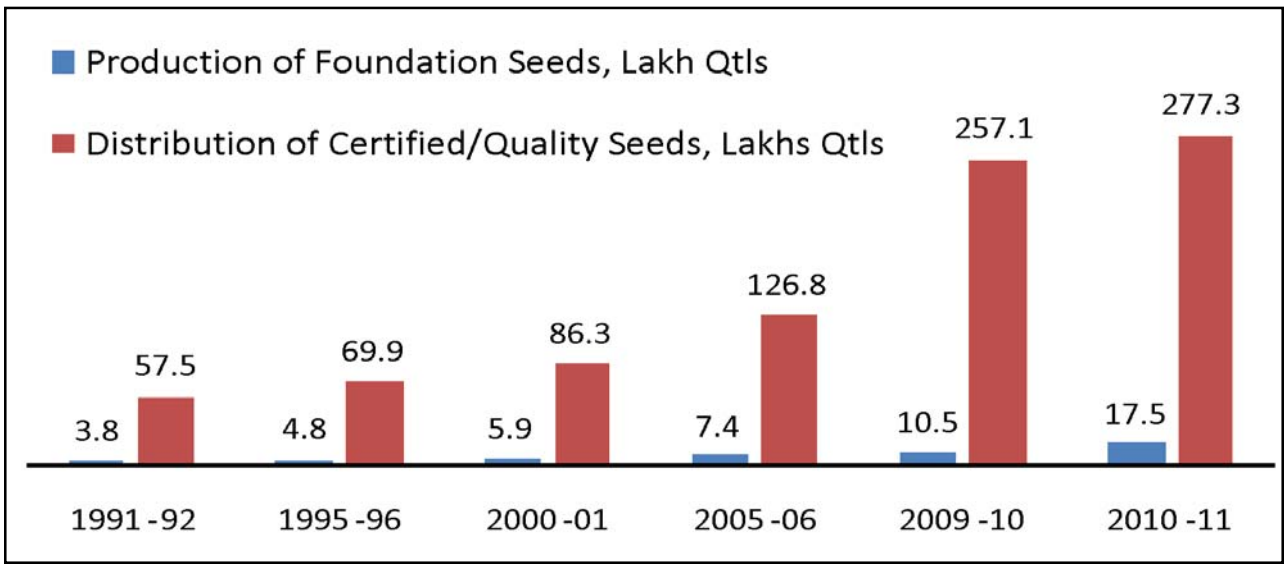
Net Sown Area, Irrigation & Cropping Intensity in major States in 2008-09



1.28 Seed is considered to be a catalyst of change in agriculture. The Green Revolution in India during the late sixties and seventies bears witness to this truth. And lately, during the decade of 2000s, Bt cotton seeds and hybrid maize seeds have shown spectacular results. The major difference in the two periods is that earlier these high yielding seeds came from public institutions, but lately they are increasingly coming from the private sector in selected crops. The Seeds Bill seeks to answer some

of these concerns, while increasing the level of public investment in domestic R&D, along with institutional reforms that can deliver. Overall, the seed replacement rate has been improving, but much more can be done in this regard to give a boost to productivity through seed improvement.

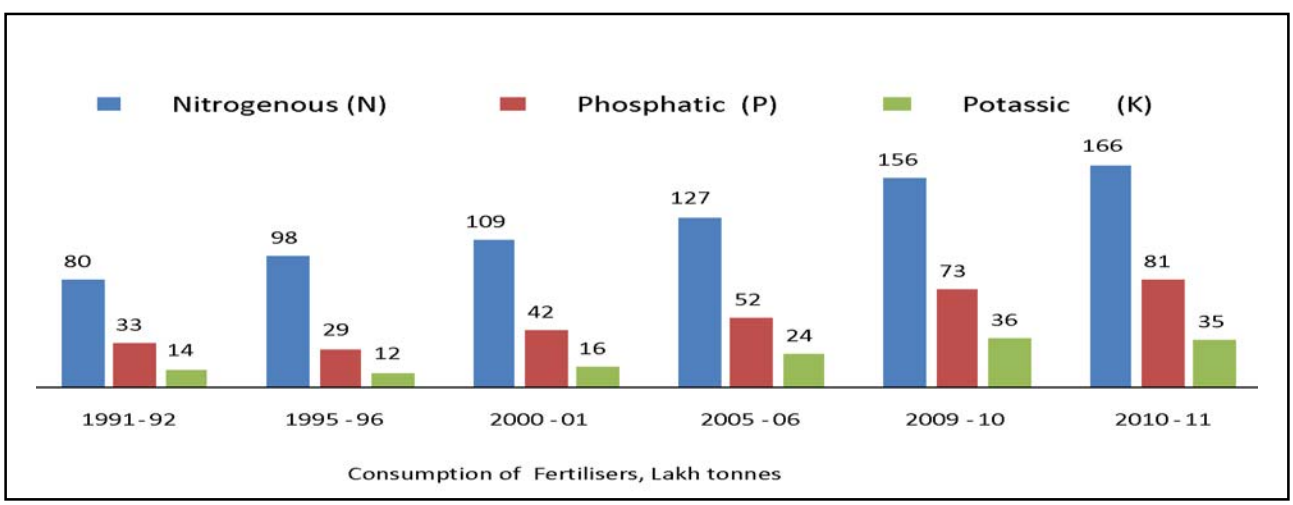
Fig. 1.18: Production and Distribution of Seeds in India



Source: Directorate of Economics and Statistics, DAC.

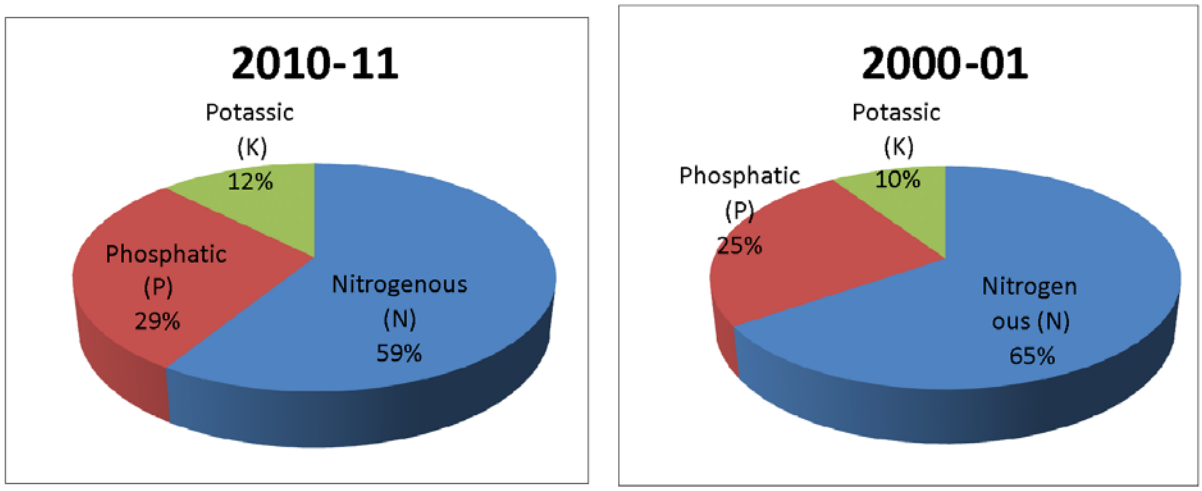
1.29 Fertilizer forms another important input in agriculture growth. While the overall consumption of fertilizer has increased from 70 kg per ha in 1991-92 to 144 kg per ha by 2010-11, (Fig. 1.19 & 1.20) the N, P, K balance particularly, in high fertilizer use areas(e.g. northwest) is seriously distorted. It is apparent that an integrated nutrient management approach is required to enable a balanced use of fertilizers for optimum results. Also, the setting up of adequate capacity for soil testing needs to be continued.

Fig. 1.19: Consumption of Fertilisers in India



Source: Directorate of Economics and Statistics, DAC.

Fig. 1.20: Share of Nitrogen, Phosphatic, and Potassic Fertilizers in total fertilizer consumption during 2000-01 and 2010-11



1.30 Credit to buy modern inputs for farming operations, is a facilitator in this change. While the overall credit to agriculture has been growing phenomenally during the last five years or so, and the interest rates for farmers have also been reduced to 7 percent (4 percent after taking into account the 3 percent subvention in interest for timely repayment of crop loans), yet the biggest challenge remains in terms of increasing access to credit, particularly for the bottom 40 percent. More innovative models are needed to reach this category as they rely largely on the informal sector for credit with high rates of interest.

Emerging Demand—Supply Imbalances

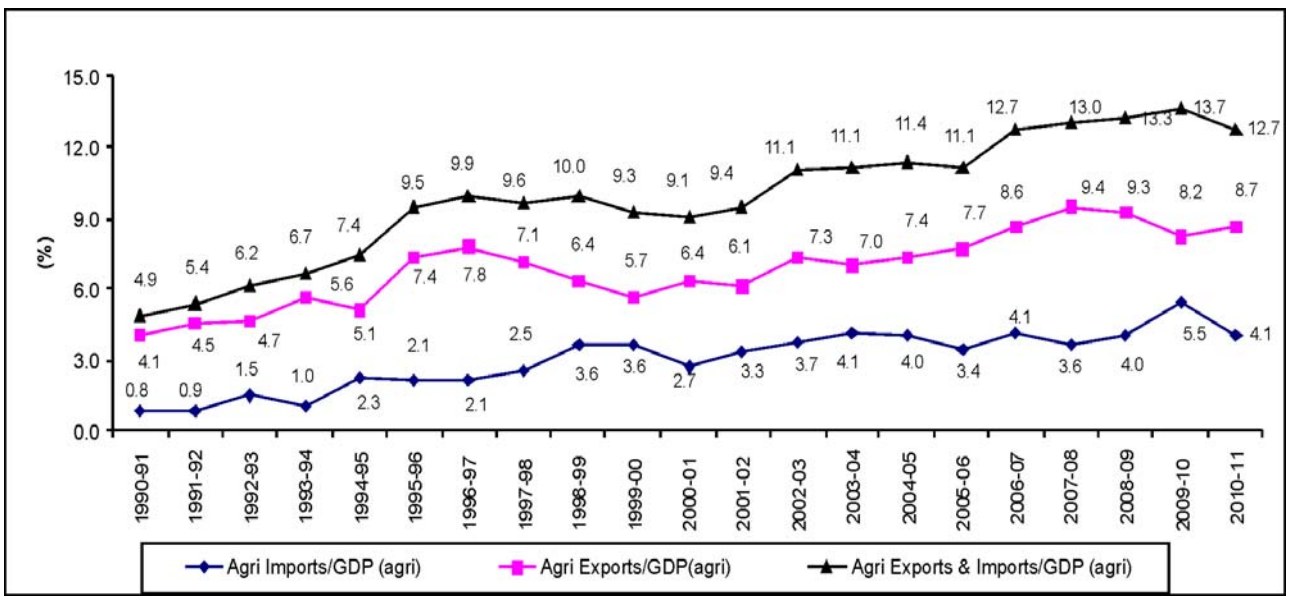
1.31 With the Indian economy growing at 8 percent and higher expenditure elasticity of fruits & vegetables and livestock as compared to cereals, there is an increasing pressure on the prices of such high value perishable commodities. The per capita monthly consumption of cereals has declined from 14.80 kg in 1983-84 to 12.11 kg in 2004-05 and further to 11.35 kg in 2009-10 in the rural areas. In the urban areas, it has declined from 11.30 kg in 1983-84 to 9.94 kg in 2004-05 and to 9.37kg. in 2009-10. The agricultural production basket is still not fully aligned to the emerging demand patterns.

Trade in Agricultural Commodities

1.32 The policy reforms of the 1990s more or less eliminated the bias against agriculture by lowering industrial tariffs and correcting for the overvalued exchange rates which lead to an improvement in the terms of trade in favour of agriculture. This was followed by a calibrated liberalization of agri- exports and imports. As a result, Indian agriculture has increasingly been opened to global agriculture with the ratio of agricultural exports and imports as a percent of Agricultural GDP rising from 4.9 percent in 1990-91 to 12.7 percent in

2010-11. (Fig 1.21) This is still low as compared to the share of India's total exports and imports as a percent of India's GDP at 55.7 percent India is a net exporter of agricultural commodities with agricultural exports constituting 11 percent of India's total exports. However, the share of agricultural exports in India's overall exports has been declining from 18.5 percent in 1990-91 to 10.5 percent in 2010-11.

Fig 1.21: Trend in Trade of agricultural commodities



Source: CSO, DGCI&S.

1.33 Bringing in reforms to streamline domestic markets and expanding the infrastructure and institutions to connect local markets with national and global markets, will go a long way in improving India's competiveness and the benefits from trade liberalization.

Public-Private Participation in Indian Agriculture

1.34 The private sector involvement in Indian agriculture is a recent development. This is apparent in initiative such as infusion of new technologies like BT cotton, hybrid seed technology in maize; in a mainstreaming of the fragmented small holders by integration of rural business/ service hubs (RBHs) at the back end and agro-processing industry and organized retailing at the front end. Successful examples like Bt cotton, hybrid maize, pusa basmati rice, etc. suggest beneficial outcomes comes from public sector partnership with the private sector farmer groups and the like. The government has to play a more proactive role as coordinator, facilitator and also as a regulator. Higher investment in basic infrastructure like roads, canal waters, watersheds, check dams, etc. will attract private investment in other areas of the supply chain.

1.35 Future breakthrough technologies in agriculture will come increasingly from the private sector, and India's private sector has the strength to multiply those technologies and to reach millions of farmers (big and small) in the fastest possible way. There is a need to

channelize these sources in an orderly manner, so that in the process, apart from the private sector profitability, the farming community is also benefited. This will assist in pushing Indian agriculture to a higher and more sustainable growth which would be the most powerful engine for poverty reduction. For areas where the private sector has not shown much interest such as rainfed areas, tribal areas, natural resource management, pulses, millets, the role of public research system would continue to be critical.

Price Policy

1.36 Though with economic liberalization and gradual integration with the world economy, relaxation of export controls on several agricultural products since 1991 have helped agricultural exports, there are still occasional interventions by the government (for example, export bans on wheat and rice, or limits on the stocking of grains by private trade that dissuade the private sector players from investing in the agri-system. However, one of the main government interventions in the agricultural markets currently is its policy of minimum support prices (MSP) for agricultural commodities. For procurement of horticultural commodities which are perishable in nature and not covered under the Price Support Scheme, with a view to protect the growers of these commodities from making distress sale in the event of bumper crop during the peak harvesting periods when the prices tend to fall below the economic cost of production, a Market Intervention Scheme (MIS) is implemented on the request of a State /UT Government which is ready to bear 50 percent loss (25 percent in case of North-Eastern States), if any, incurred on its implementation.

Marketing and Warehouse Facilities

1.37 In the context of foodgrains policy, concern has been raised about simultaneous occurrence of high food inflation and large foodgrains stocks in our granaries. It has been argued (Kaushik Basu, 2011) that, in creating a better foodgrains policy, it is imperative that the entire system of foodgrains production, procurement, release and distribution is looked at. Besides improving storage facilities there is a need to redesign the mechanics of procurement and release of foodgrains to the market to ensure that the impact on prices is substantial in the desire direction. An improvement in marketing conditions and encouragement to private sector participation can be achieved by reforming the Agricultural Produce Marketing Committee (APMC) Acts. Appropriate changes in the APMC Acts can boost private sector investment in developing regularized markets, logistics and warehouse receipt systems, futures markets, and in infrastructure (such as cold storage facilities, quality certification, etc.) for imports and exports. This is particularly relevant for the high value segment that is currently hostage to high post-harvest losses and weak farm-firm linkages. The introduction of the Model Act in 2003 was directed towards allowing private market yards, direct buying and selling, and also to promote and regulate contract farming in high value agriculture. Although many states have adopted the new Model Act, with modifications, its impact on farmers in terms of better prices for their produce and a reduction in the high differences between farm harvest prices and consumer prices is not yet visible.

Land and Credit Markets

1.38 The linking of small and fragmented farms with large-scale processors and retailers remains a challenge in the high value sector, and restricted land (lease) markets tend to compound the problem. Allaying the fears of a farmer regarding possible alienation from his own land because of leasing it out to the retailer/processor require the freeing up of land lease markets. Legalizing lease markets also protects the interests of the retailer/processor, and enables him to undertake larger investments. In this context, it may be helpful to ensure the registration of land deeds and the computerization of land records for bringing about greater transparency and reliability. Some states have made a beginning in computerizing the land records, but most others have a long way to go. The land and credit markets are intricately linked, and improving the marketability of land will enhance access of farmers to institutional credit that requires the pledging of collaterals.

The Way Forward

1.39 The significance of agriculture sector in India is not restricted to its contribution to GDP, but that on account of its complementarity with other sectors. It has far reaching ability to impact poverty alleviation and rural development. There are several areas of importance for the agriculture sector growth. These include, among others, enhancing public sector investment in research apart from effective transfer of technology along with institutional reforms in the research set up to make it more accountable and geared towards delivery, conservation of land, water and biological resources, the development of rainfed agriculture, the development of minor irrigation, timely and adequate availability of inputs, support for marketing infrastructure, an increase in flow of credit particularly to the small and marginal farmers.

1.40 Achievement of food and nutrition security and alleviation of poverty and unemployment on a sustainable basis depend on the efficient and judicious use of natural resources (land/soil, water, agri-biodiversity and climate). Inefficient use and mismanagement of productive resources, especially land, water, energy and agro-chemicals has vastly reduced fertility and damaged the physical, chemical and biological properties of the soil. The limit of land availability for agriculture has already reached. Our continued inability to judiciously use these non-renewable natural resources can have serious implications.

1.41 The transition from traditional to high value agriculture will be primarily driven by private investments, which are three fourths of total investments in agriculture. However, to ensure that this happens smoothly and rapidly, government policy needs to act as a catalyst by way of providing greater investments in R&D, roads and public irrigation.

1.42 A strategic vision for agriculture must factor in three important elements: (a) India's comparative advantage; (b) efficient markets at home and freer trade; and (c) environmental sustainability. The agriculture sector calls for major reforms, from marketing to investment and institutional change, especially in water management, new technologies, land markets and creation of efficient value chains.

1.43 The subsequent chapters give in detail the progress made in each component and various programmes of agriculture, and the way forward.

CHAPTER 2

Natural Resource Management

Land use

2.1 Changes in land use in India have intensified in the recent years under pressure of population, economic forces, livestock pressure and weakening of various types of institutions that regulate land use formally or informally. Natural factors have also caused some change in the land use pattern. In the absence of any well thought out plan and policy, indiscriminate change in land use has several implications that impinge upon sustainable and optimum use and result in a haphazard development devoid of economic, social, environmental and aesthetic sense.

2.2 Land use classification based on different type of uses shows that of a total land mass of 328.73 million ha in the country, the reported area for land utilization has been 306 million ha. This includes 141 million ha (about 46 percent of the reported area) net sown area, 70 million ha (23 percent) under forest, 26 million ha under non-agricultural uses, 25 million ha fallow land, 17 million ha barren and unculturable land, 13 million ha culturable waste land, 10 million ha under permanent pasture and other grazing land, and 3 million ha under miscellaneous tree crops and groves. Over the years there has been a gradual increase in area put to non-agricultural uses. During the last forty years (1970-71 to 2008-09) the net sown area has remained, by and large, constant at 141 million ha. Area under non-agricultural uses has increased from 16 million ha to 26 million ha, while the area under barren and unculturable land has come down from 28 million has in 1970-71 to 17 million ha in 2008-09. However, the gross cropped area has increased from 166 million ha. in 1970-71 to 195 million ha in 2008-09. As a normal process of urbanization and development, the area under non-agricultural uses is increasing, but due to efforts of the government, land has been reclaimed for cultivation from barren and culturable waste land category. The cropping intensity has increased from 118 percent to 138 percent during the same period. Owing to a burgeoning population, it is estimated that per capita total land availability which was 0.32 ha in 2001 against the world average of 2.19 ha will decrease to 0.23 ha in 2025 and 0.19 ha in 2050. Further, it is reported that about 120 million ha land is degraded in India, and about 5334 million tonnes of soil is lost annually through soil erosion. Out of 120 million ha degraded area, water erosion accounts for 68 per cent, chemical degradation 21 per cent, wind erosion 10 per cent and the rest physical degradation. Effective land management policies are required to address these issues in addition to other concerns such as small size and fragmented holdings, tenancy, ceiling limits, acquisition and diversion of productive land, land records and inventories, climate change and land use change.

Fig 2.1: Land-use pattern in India, 1970-71

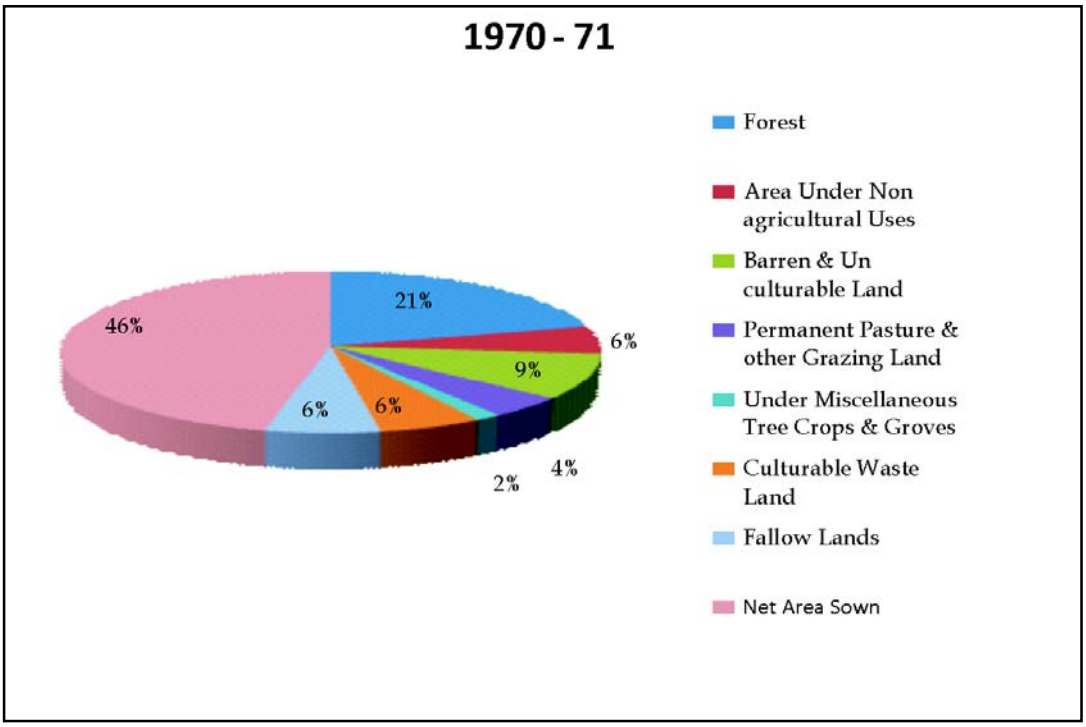
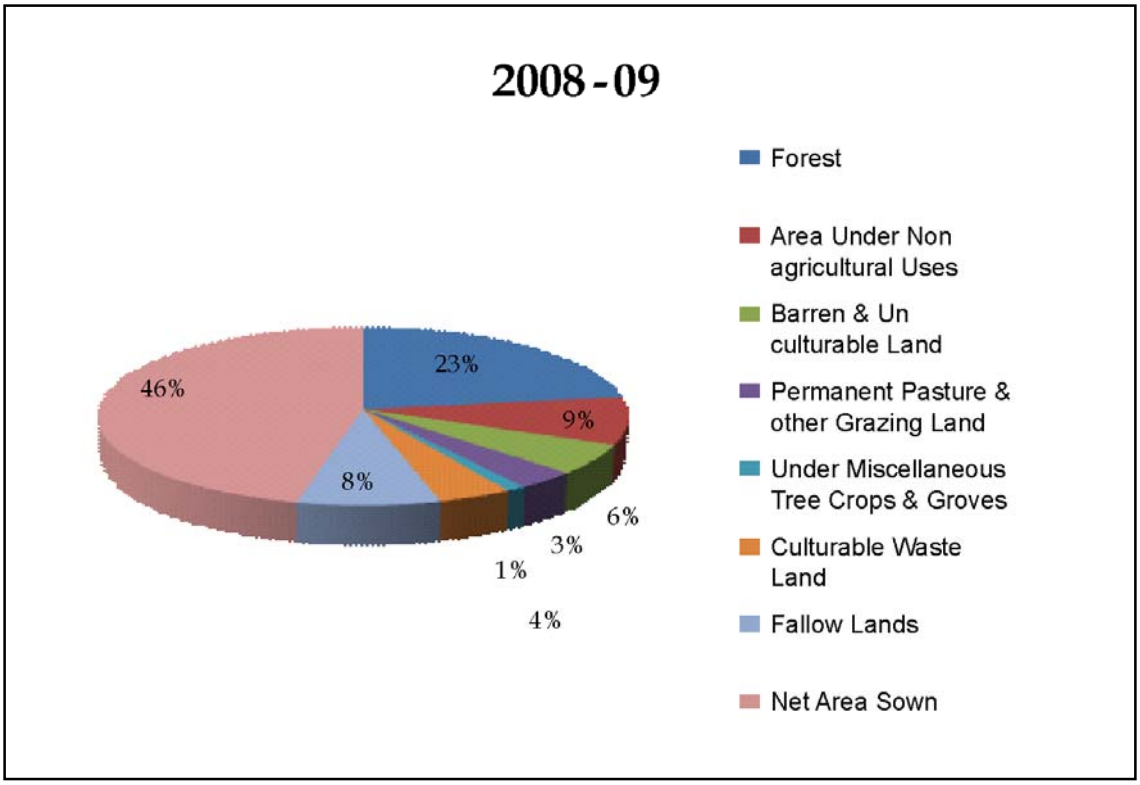


Fig 2.2: Land-use pattern in India, 2008-09



Challenges

2.3 The scope to expand the area available for cultivation as the demand for industrialization, urbanization, housing and infrastructure is forcing conversion of agricultural land to non – agricultural uses is limited. With an increasing pressure of population and a decreasing per capita availability of cultivable land, there is a need to enhance cropping intensity without compromising land productivity. After independence till the 1970s, Indian agriculture was characterized by intensive agriculture practices in favorable ecologies through an integrated use of HYVs, irrigation, fertilizer, pesticide use and technologies with mining of natural resources to meet the food security needs. Since the 1980s, the adverse effects and limitations of the green revolution technologies were realized and the emphasis shifted to appropriate/alternative and sustainable land use systems and to improving the efficiency of resources and inputs.

The Way Forward

2.4 For achieving a sustainable land use in the agricultural sector the following initiatives may be considered:

- Plan and manage all resources including land in an integrated manner for maximization of environmental, social and economic factors apart from ensuring livelihood and equity;
- Prepare comprehensive land inventories;
- Prepare a perspective plan for treating degraded lands;
- Develop infrastructural facilities and strengthen the technology support system;
- Develop proper computerized, updated, on-line information system on land records;
- Develop and use advanced methodologies for land use planning;
- Invest in capacity building, education and awareness on the importance of conservation and optimum use of all natural resources;
- Continuously monitor and assess the impact of climate change on land use and take/suggest appropriate remedial measures.

Soil

2.5 The soil is a highly complex, multi-component system of water, air, rock strata and living materials. Interactions among these determine properties of soil. They are classified into types, orders, groups and sub-groups. It is reported that 90 percent of soils are low to medium in nitrogen (N), 80 percent in phosphorus (P) and 50 percent in potassium (K). Incidences of micronutrient deficiencies are also increasing. Soil health from the agricultural point of view refers to the capacity of soil to ensure proper physical, chemical and biological activities and processes for sustaining higher crop productivity.

Good soil would ensure proper retention and release of water and nutrients, promote and sustain root growth, maintain soil biotic habitat, respond to management and resist degradation.

2.6 As land resources are stagnant, an increase in food production has to come from increase in productivity. The quality of Indian soils is gradually deteriorating at the farm and eco-system level. The major threats to soil quality come from a loss of organic carbon, erosion, nutrient imbalance, compaction, salinization, water-logging, decline in soil bio-diversity, urbanization, contamination with heavy metals and pesticides and from an adverse impact of climate change.

2.7 The Department of Agriculture & Cooperation has introduced a new scheme namely "National Project on Management of Soil Health & Fertility" (NPMSH&F) to promote a soil test based balanced and judicious use of chemical fertilizers in conjunction with organic manures like Farm Yard Manure (FYM), vermi compost and green manure to maintain soil health and fertility. It also provides for the preparation of Geo-Referenced Soil Fertility Maps including an interlinking of soil fertility status with Soil Test Crop Response data to generate site- specific recommendations in 19 major States.

Box 2.1: 'Apni Mitti Pahachane Abhiyan' of Uttar Pradesh

There are 73 district-level soil testing laboratories in the state. In addition, there are 182 sub-division/ tehsil level soil testing laboratories and 18 mobile soil testing laboratories. So far 27.91 lakh soil samples have been collected and 21.22 lakh soil samples analysed. A total of 18.25 lakh soil health cards have already been distributed amongst farmers.

The initiative for collection of soil samples is called, "Apni Mitti Pahachane Abhiyan" and is organized separately in *Kharif* and *Rabi* seasons.

2.8 A soil test based application of fertilizers is essential to improve soil health and productivity. In 2010-11, there exist 1049 soil testing laboratories in the country with a soil analysing capacity of 106 lakh soil samples per annum. A soil Health Card is available which contains details of soil fertility, level of macro and micro nutrients and the problems related to soil. This information allows the farmer to adopt agricultural practices accordingly, including appropriate nutrient mix. The state governments are being encouraged to seek financial assistance under the "Rashtriya Krishi Vikas Yojna" (RKVY) and the scheme for Macro Management of Agriculture (MMA) for issuing soil health cards to the farmers. State governments have issued 408 lakh Soil Health Cards to the farmers up to October, 2011. The year-wise physical achievement of targets in the

scheme for the setting up, as well as strengthening of soil-testing laboratories (STL) and fertilizer quality control laboratories (FQCL) sanctioned is given in the Table 2. 1 below:

Table 2.1: Status of Soil-Testing Laboratories

(Number of laboratories)

Sl. No.	Component/year	11th Plan Target	Achieve-ment 2008-09	Achieve-ment 2009-10	Achieve-ment 2010-11	Achieve-ment Total (2008-09 to 2010-11)
1.	New Static STLs	500	42	66	16	124
2.	New Mobile STLs	250	44	62	10	116
3.	Strengthening of existing STLs	315	39	107	9	155
4.	New FQCLs	20	2	11	1*	14
5.	Strengthening of FQCLs	63	19	19	1	39
	Total	1148	146	265	37	448

Note: * For advisory purpose on PPP Mode.
STLs - Soil Testing Laboratories.
FQCL - Fertilizer Quality Control Laboratories.

Box 2.2: STLs in Gujarat

- There are 20 soil-testing laboratories which include 2 mobile vans.
- Six labs have micronutrient analysis facilities.
- Total sample analyzing capacity is 2,40,000 / annum.
- Under the RKVY, 61 soil-testing laboratories were sanctioned to be set up during 2009-10 under various Agriculture Produce Marketing Committees.
- Other agencies like State Agricultural University, Gujarat Land Development Corporation and Gujarat State Seed Corporation have been involved in the soil- testing programme.
- During 2010-11, a total of 15 STLs were sanctioned to be set up by various sugar cooperatives.
- The soil-test based fertilizer use recommendations are communicated to the farmers 'online'.
- Based on national-level and state-wise soil fertility assessment (2002), nitrogen status is medium while phosphorous is low and potassium is high.
- Zinc is widely deficient in the State. On the basis of 30,152 soil samples analyzed, it is found that 24 percent samples are deficient in zinc, while only 2 percent samples are deficient in Boron.

2.9 Degradation which is one of the biggest challenges is evident in increased soil erosion, decline in soil fertility, water-logging, secondary salinization and contaminations of soils with toxic elements.

Table 2.2: Degraded Lands in India

(Million ha)

S. No.	Type of Degradation	Arable land (Mha)	Open forest (<40percent Canopy) (Mha)
1.	Water erosion (>10 t/ha/yr)	73.27	9.30
2.	Wind erosion (Aeolian)	12.40	-
	Sub Total	85.67	9.30
3.	Chemical degradation	17.45	7.23
4.	Physical degradation	1.16	
	Total	104.28	16.53
	Grand total (Arable land and Open forest)		120.81

Source: National Bureau of Soil Survey and Land Use Planning 2008.

2.10 The organic carbon content of Indian soils is very low on account of removal of the crop residues, low and imbalanced nutrient use and erosion. Most of the plant biomass is removed from the field to be used as forage, fuel or building material and stubbles are burnt to hasten land preparation for next crop. An estimated 29.4 million ha of Indian soil is experiencing a decline in fertility which is likely to increase in future. Nutrient imbalance and micronutrient deficiency is serious in our soils. The fertilizer use efficiency is generally reported to be 50 percent for N; 30 percent for P; 50 percent for K and 20 percent for micronutrients even with best management practices. There is a decline in soil bio-diversity, about 3.1 million ha of agricultural land is water logged (because of improper drainage, imbalance in surface and ground water use, and seepage and percolation from unlined channels) while about 4.1 million ha of agricultural land is affected by salinity. Non-judicious use of pesticides, dumping of municipal solid and industrial wastes containing large amounts of heavy metals and toxic substances affect soil quality as also activities of the biological system in the soil. In the future, global climate change will further lead to increase in temperature resulting in drier soils with more irrigation demands, a lowering of the ground water table, salt accumulation in upper soil layers, a rise in sea level, decrease in Soil Organic Carbon (SOC), etc. The changes in rainfall volume and frequency, as well as wind velocity may alter the severity, frequency, and extent of soil erosion.

2.11 The states in which more than half of the area is degraded due to soil erosion are Chhattisgarh, Jharkhand, Madhya Pradesh, Uttar Pradesh, Uttarakhand and the North Eastern Hill states. The area under very severe soil erosion (more than 40 tonnes per ha per year) constituted about 11 percent. In quantitative terms, about 5.3 billion tonnes of soil are eroded in India at an average rate of 16.3 tonnes per ha per annum. While 61 percent of eroded sediments get redistributed on the land, nearly 29 percent are lost permanently to the sea. The remaining 10 percent are deposited in reservoirs reducing

their holding capacity by 1 to 2 percent annually. About 8 million tonnes of plant nutrients are also washed away along with eroded sediments.

2.12 The country also suffers from a heavy loss of rainfed agricultural produce grown under the three major soil groups of alluvial, black and red soils due to erosion by water. Thus, adoption of appropriate soil and water conservation measures following the watershed approach is essential for protecting the lands from soil erosion in different agro-ecological regions of the country. About 12 million ha area is waterlogged and flood prone in India, wherein the productivity of arable crops is severely affected. In Madhya Pradesh and Maharashtra, nearly 12 and 0.53 million ha of rainfed Vertisols, respectively are left fallow due to temporary waterlogging during *kharif* and are cropped only in the post rainy season. The waterlogged alluviums in eastern India have water stagnating above the ground for over six months in a year. The adverse physical conditions allow only one anaerobic paddy crop with a very low yield potential of less than one tonne per ha. Integrated farming systems with better water productivity could convert water abundance into greater opportunities of income generation, employment enhancement and nutritional security in this region.

2.13 Salt affected soils are not fit for cultivation due to the prevalence of high sodicity (pH > 9.5) and/or salinity. Application of gypsum as soil or water amendment along with Farm Yard Manure (FYM) could alleviate the adverse effects of soil sodicity and allow the growing of rice and wheat in these areas. Using sodicity tolerant rice and wheat varieties, the rate of application of gypsum could be brought down to 25 percent GR (Gypsum Requirement) without compromising the crop yield. For soil suffering from salinity, leaching of salts with good quality water and disposal of drainage effluent through a well laid out horizontal sub-surface drainage system and its integration with bio-drainage could be beneficial. Acid soils are characterized by low P availability and high P fixation capacity due to high exchangeable Aluminum (Al^{+++}). Besides, these soils are also deficient in molybdenum (Mo), nitrogen (N), calcium (Ca) & magnesium (Mg). About 11 million ha of arable acidic soils with pH < 5.5 suffer from deficiencies as well as toxicities of certain nutrients and have very low productivity. Liming at the rate 2 to 4 quintals per ha along with half of the recommended fertilizers raises the potential to double the productivity especially for oilseeds and pulses in the acid soil regions of the country. In the case of acid sulphate soils, application of limestone to neutralize all the potential acidity will be very expensive. A more practical solution may be to encourage the oxidation of pyrite followed by leaching of acids and then to counteract the residual acidity through liming.

2.14 An inadequate and imbalanced nutrient use coupled with neglect of organic manures has resulted in multi-nutrient deficiencies in Indian soils. These deficiencies are becoming more critical for sulphur, zinc and boron. As the nutrient additions do not keep pace with nutrient removal by the crops, the fertility status of Indian soils has been declining fast under intensive agriculture and are now showing signs of fatigue, especially in the Indo-Gangetic plain. The soils in India possesses having a net a negative balance of about 8-10 million tonnes of NPK at the country level. The potassium (P) is the most mined nutrient from soils with the rate of its removal being 7 metric tonne and

in proportion to an addition of only one metric tonne. Sulphur deficiencies are also showing up in all parts of the country being more rampant in the southern region. The deficiencies could be assumed to be occurring in 40-45 percent of districts covering about 60 million ha of net sown area. State – wise soil fertility status and extent of micro nutrient deficiencies in Indian soils are given in Tables 2.3 and 2.4, respectively.

Table 2.3: State-wise Soil Fertility Status

Name of the State	Category of Fertility Status		
	Nitrogen	**Phosphorus**	**Potassium**
East Zone			
Assam	Medium	Medium	Medium
Arunachal Pradesh	High	Low	High
Manipur	Low	Low	Medium
Meghalaya	High	Low	Medium
Mzoram	High	Low	Medium
Nagaland	High	Medium	Low
Orissa	Low	Low	Medium
Tripura	Medium	Medium	Medium
West Bengal	Medium	Medium	Medium
West Zone			
Gujarat	Medium	Low	High
Goa	High	Medium	High
Madhya Pradesh	Medium	Medium	High
Maharashtra	Low	Low	High
North Zone			
Haryana	Low	Low	Medium
Himachal Pradesh	High	Medium	Low
Jammu & Kashmir	Medium	Low	Low
Punjab	Medium	Medium	High
Uttar Pradesh	Low	Low	Medium
South Zone			
Andhra Pradesh	Low	Low	High
Andaman & Nicobar Island	Low	Low	Low
Karnataka	Medium	Medium	High
Kerala	Low	Medium	Medium
Pondicherry	Low	Low	Medium
Tamil Nadu	Low	Medium	High
All India	Low	Medium	High

Source: Motsara, M.R.(2002), Available nitrogen, phosphorus, and potassium status of Indian Soil as depicted by Soil Fertility Maps : *Fertilizer News*, Vol.47 (8), 2002.

2.15 Zinc deficiency is recognized as a nutritional disorder in rice on sodic and calcareous soils that have a high pH. The iron (Fe) deficiency has been noticed in rice on coarse-textured soils. Similarly, the deficiency of manganese (Mn) is increasingly appearing in wheat when it is grown after rice on coarse textured alkaline soil having low organic matter content, high available P or silicion (Si) and high Mg:Ca ratio. Boron deficiency is becoming more widespread in red and lateritic, acidic, coarse textured alluvial soil. The limiting nutrients do not allow for the full expression of other nutrients, thereby, lowering the fertilizer responses and crop productivity. Soil-test based balanced and integrated nutrient management through conjunctive use of both inorganic and organic sources of plant nutrients is the ideal solution to prevent such deterioration of soil health. In addition, split application, placement of fertilizer, use of slow releasing N-fertilizers and nitrification inhibitors and inclusion of leguminous crop in crop rotation are also advocated.

Table 2.4: Extent of Micronutrient Deficiency in Indian Soils

Name of State/Union Territory	No. of samples	Percent Samples Deficient					
		Zinc (Zn)	Copper (Cu)	Ferus (Fe)	Manganese (Mn)	Boron (B)	Molybdenu (Mo)
Andhra Pradesh	8,158	49	<1	3	1	-	-
Assam	12,166	34	<1	2	20	-	-
Bihar	19,214	54	3	6	2	38	-
Delhi	201	20	-	-	-	-	-
Gujarat	30,152	24	4	8	4	2	10
Haryana	21,648	60	2	20	4	0	28
Himachal Pradesh	155	42	0	27	5	-	-
Jammu &Kashmir	93	12	-	-	-	-	-
Karnataka	27,860	73	5	35	17	32	-
Kerala	650	34	3	<1	0	-	-
Madhya Pradesh	32,867	44	<1	7	1	22	18
Maharashtra	515	86	0	24	0	-	-
Meghalaya	95	57	2	0	23	-	-
Orissa	16,040	54	-	0	0	-	-
Pondicherry	4,108	8	4	2	3	-	-
Punjab	16,483	48	1	14	2	13	-
Rajasthan	183	21	-	-	-	-	-
Tamil Nadu	28,087	58	6	17	6	21	-
Uttar Pradesh	26,126	46	1	6	3	24	-
West Bengal	6,547	36	0	0	3	68	-
All India	2,51,547	48	3	12	5	33	13

Source: Project Report: Coordinated Micronutrient Research Project, Indian Institute of Soil Science (IISS), Bhopal

GIS-based Soil Fertility Maps showing deficiency of nitrogen, phosphorous, potassium, zinc and sulphur are given in Figs. 2.3, 2.4, 2.5, 2.6 & 2.7, respectively.

Fig 2.3: GIS-based Soil Fertility Map of India showing Deficiency of Nitrogen

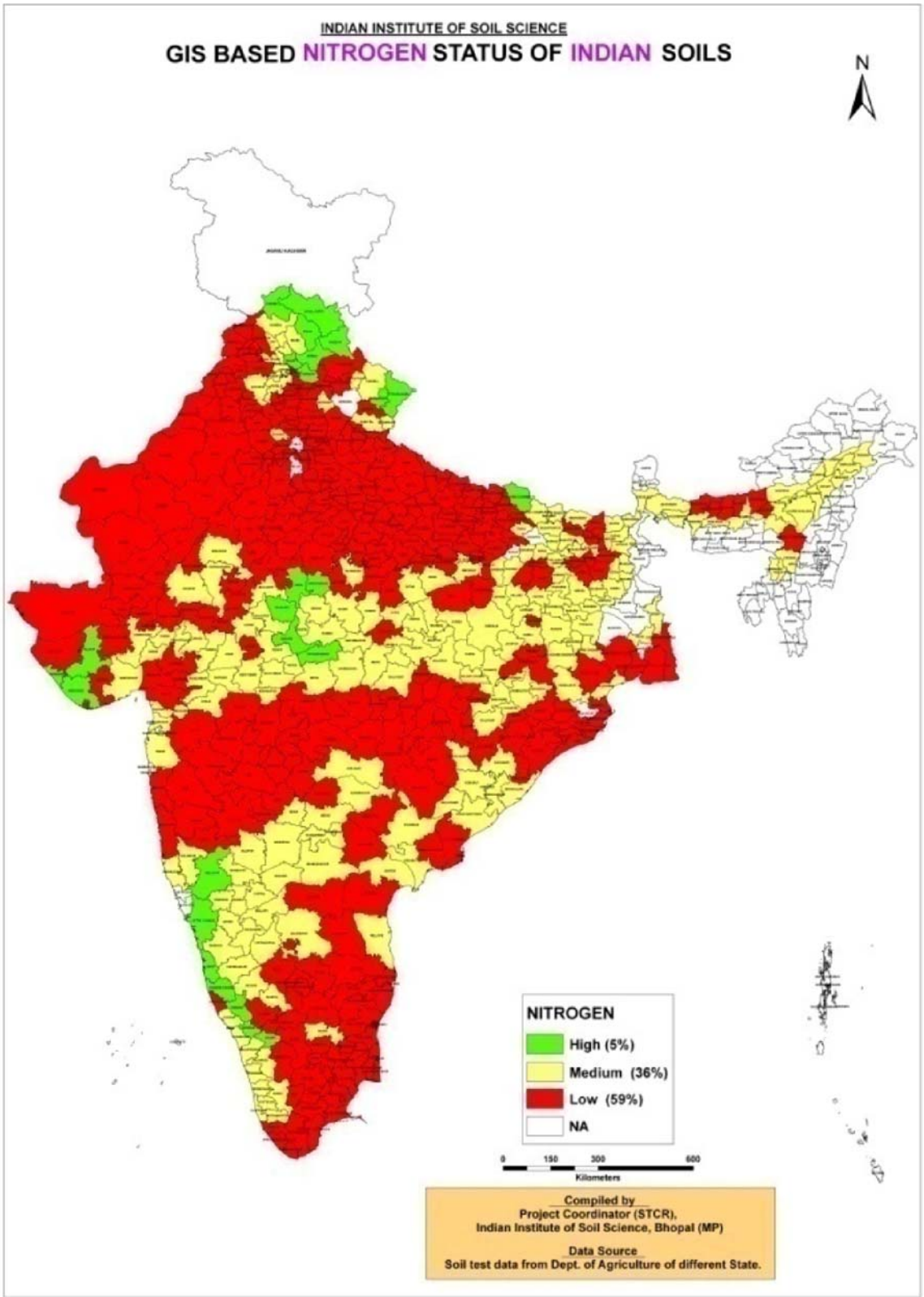


Fig 2.4: GIS-based Soil Fertility Map of India showing Deficiency of Phosphorus

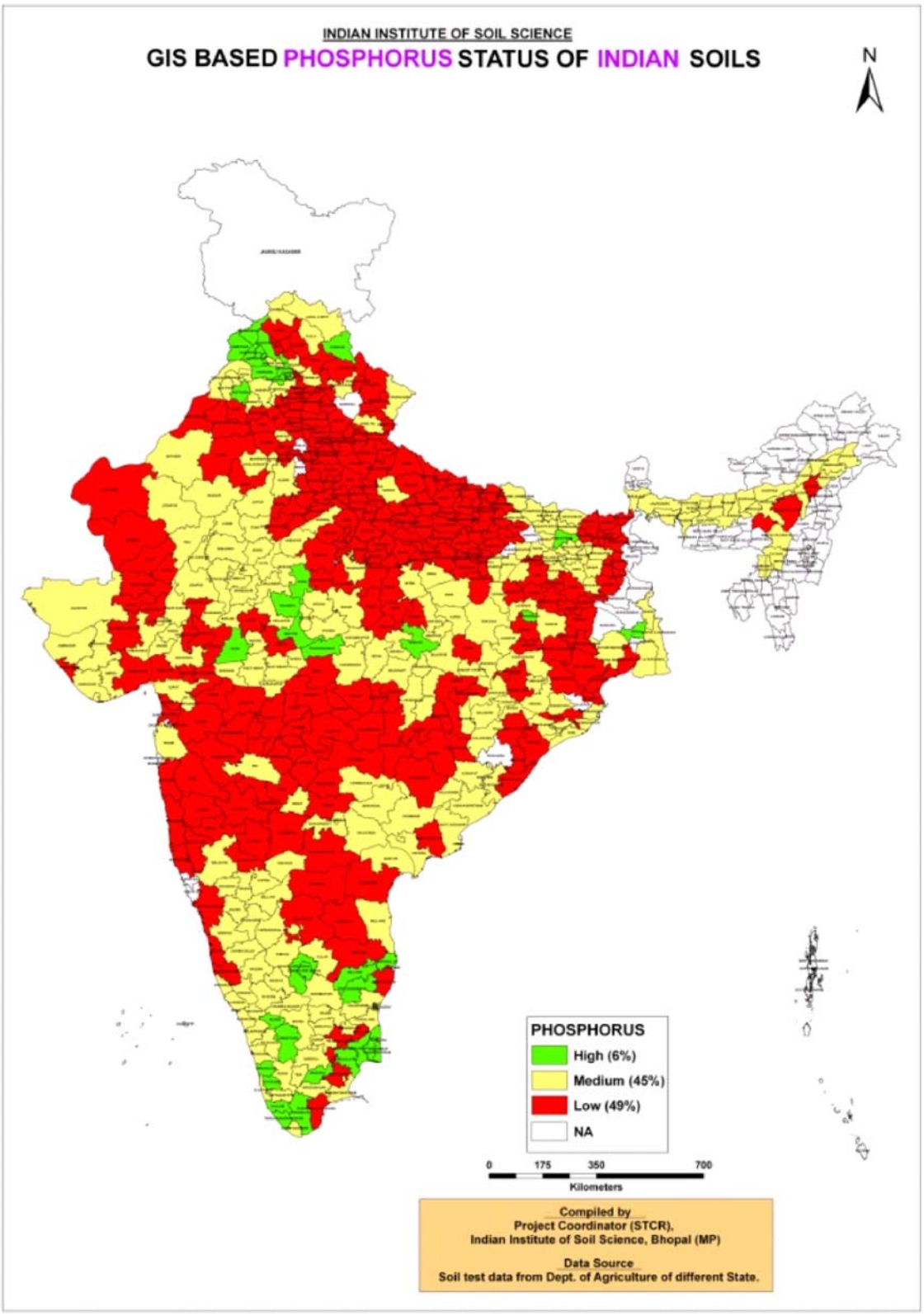


Fig 2.5: GIS-based Soil Fertility Map of India showing Deficiency of Potassium

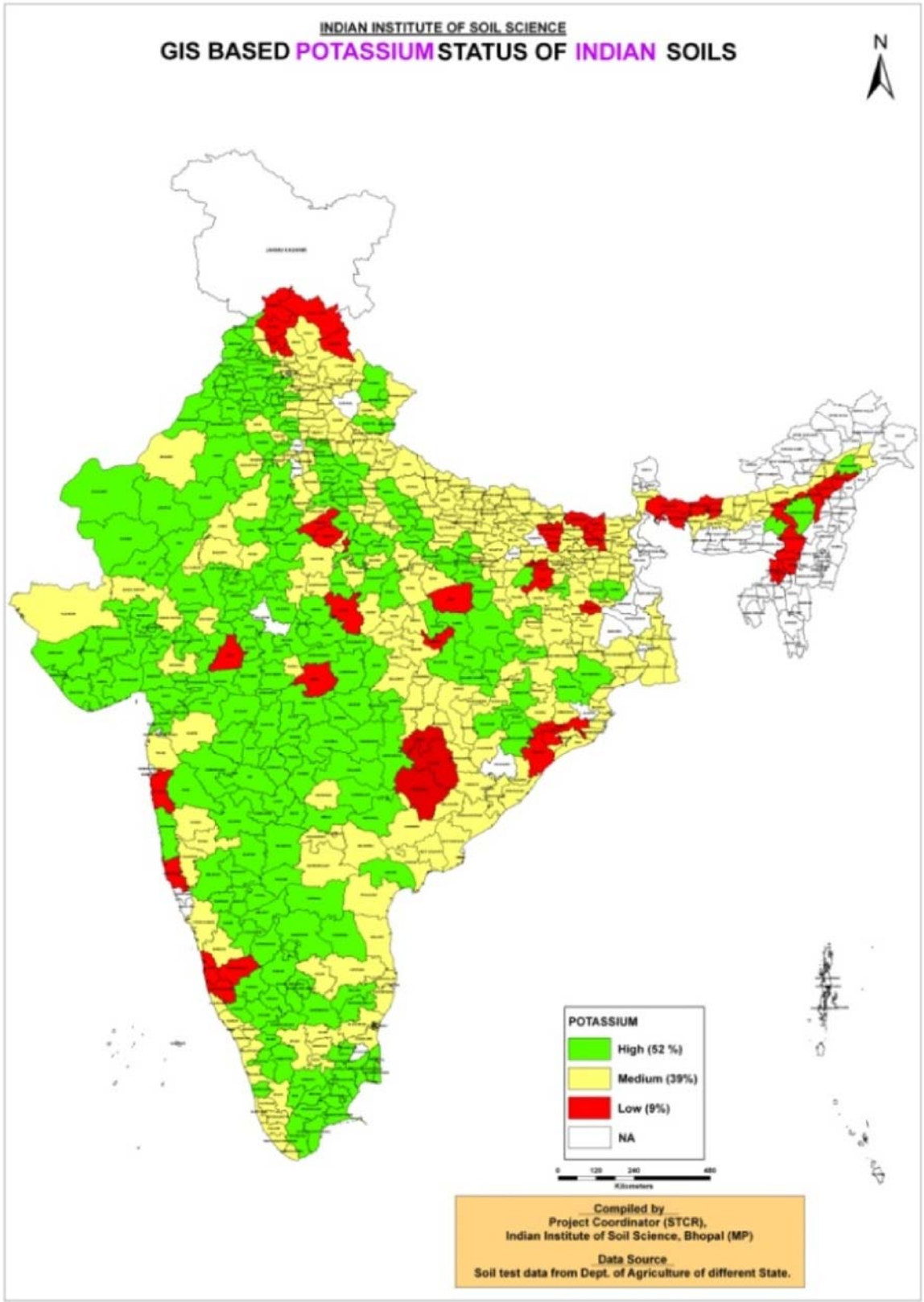
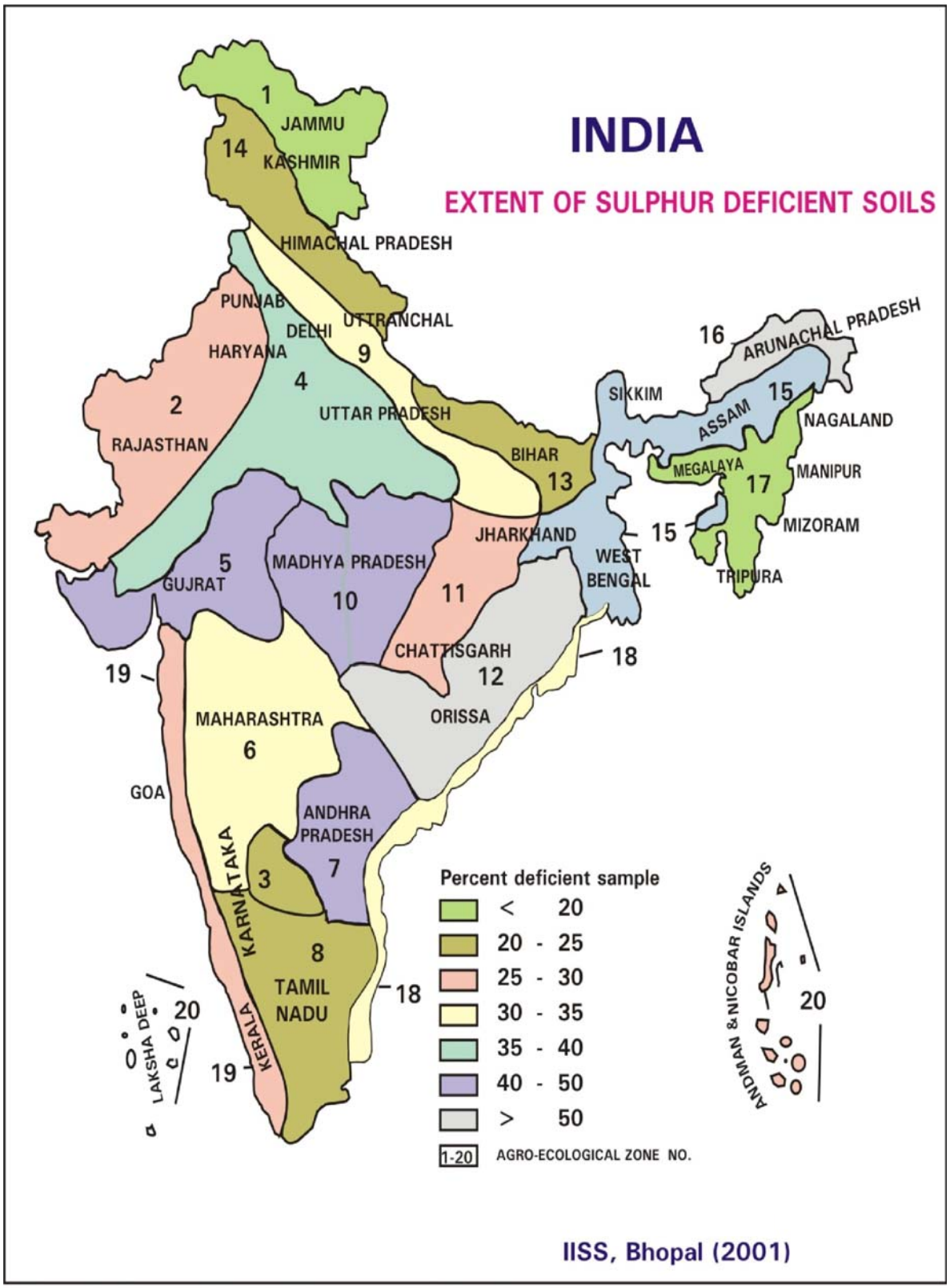


Fig 2.6: GIS-based Soil Fertility Map of India showing Deficiency of Zinc

Fig 2.7: GIS-based Soil Fertility Map of India showing Deficiency of Sulphur



2.16 Soil organic carbon has a role in the carbon cycle, release of green house gases (GHGs) in the atmosphere and in influencing the physico-chemical-biological environment of the soils. The earlier generalization of reduction of productivity of the rice-wheat system in the Indo-Gangetic Plain (IGP) was linked with declining soil organic matter contents.

2.17 Arsenic contaminated soil receives its arsenic from geogenic sources. Oxygenated decomposition of pyritic sediments containing high amounts of arsenic then release sulphuric acid that solubilizes arsenic. The solution moves down to aquifers, polluting the groundwater. As per World Health Organization (WHO) standards, an arsenic concentration in ground water above 0.01 mg per litre is considered to be unsafe from the health point of view. The pollutants enter the food chain and become a potential health hazard to humans and animals. Selenium contaminated soil contain a selenium content many times higher than the permissible limit of 5 mg selenium per kg of produce. The intake of contaminated food causes chronic selenosis (selenium poisoning) in animals and human beings. The problem of selenium toxicity could be successfully tackled with a one time application of gypsum of 0.8 tonne per ha to wheat in a wheat-rice sequence. The other options could be to grow of selenium resistant crops and/or the adoption of a maize-wheat cropping sequence instead of rice-wheat which requires lesser irrigation.

The Way Forward

2.18 Soil should be managed to optimize its multiple functions especially, related to crop productivity and environmental protection on a sustainable basis. Conservation agriculture, integrated nutrient management, carbon sequestration, erosion control, saline and alkaline soils management, soil testing, legislation for soil protection, development of remote sensing and Global Positioning System (GPS)-based Decision Support System (DSS) and amelioration of polluted soil should be undertaken on a priority basis to rejuvenate deteriorated soils.

Water

2.19 Freshwater resources are a critical input for agriculture as well as for many other economic activities. It is estimated that about 3 million ha in the country are covered under ponds, reservoirs, brackish water, lagoons, rivers and canals. Water shortage is going to be a major problem in the coming years due to spatial and temporal variations, high evaporation, continuous droughts and the competing demands of water among different sectors coupled with climate change.

2.20 The National Water Development Agency has developed a plan for inter-basin water transfer that comprises broadly: (i) the Himalayan component with 14 river links, and (ii) the peninsular component with 16 links. About 141 Billion Cubic Metre (bcm) can be transferred through the peninsular links and 33 bcm through the non-peninsular

links. Much of the transfer in the Himalayan component is from the Ganga basin to western India. The huge amounts of surplus flows in the Brahmaputra cannot, however, be tapped, because of their lower elevation relative to the Ganga basin. The total additional water resources available (174 bcm) by this is less than the combined water that can be made available (about 300 bcm) through water conservation, groundwater recharge and recycling.

2.21 It is estimated that by 2050, about 22 percent of the geographic area and 17 percent of the population will be under absolute water scarcity. The per capita availability of water which was about 1704 cubic metres in 2010 is projected to be 1235 cm in 2050. Therefore priority to efforts is needed in water development as also management in multiple areas as policy, governance, regulation as well as management with science and technology backup. Of the total annual precipitation of 4000 bcm, the utilizable water is only 1123 bcm (28 percent), after adjusting for evaporation and runoff. The present water use is 634 bcm and the projected water by 2025 is 784-843 bcm. Owing to increasing demand for industrial and drinking water and for the energy sector, there will be a substantial fall in the availability for agriculture with serious implications for meeting the food production targets. Further, water quality has been a serious concern in the last two decades. Discharge of untreated municipal waste and industrial toxicants is a major threat to the quality of surface water. Ground water quality is affected by arsenic, iron, fluoride content, overdraft, fertilizers and pesticides use, and saline water intrusion in the coastal regions.

2.22 A watershed development approach employing suitable soil and water conservation measures has resulted in transforming agriculture production and productivity in the semi-arid and rain fed areas of the country. Various Watershed Development Programmes (WDPs) are being implemented by the Ministry of Agriculture and Ministry of Rural Development for development of degraded lands. The Department of Agriculture & Cooperation has been implementing programmes such as the National Watershed Development Project for Rainfed Areas (NWDPRA), Soil Conservation in the Catchments of River Valley Project & Flood Prone River (RVP & FPR) and Watershed Development Project in Shifting Cultivation Areas (WDPSCA). Till the end of third year of eleventh Plan, about 20.81 million ha area has been developed under these programmes.

2.23 The Department of Land Resources has been implementing three area development schemes viz., Drought Prone Areas Programme (DPAP), Desert Development Programme (DDP) and Integrated Wastelands Development Programme (IWDP) on watershed basis since 1995-96. Projects covering a total area of 32.31 million ha have been sanctioned under these programmes. The DDP is being implemented in 235 blocks of 40 districts in 7 States. Since 1995-96, a total of 15746 projects covering 7.87 million ha have been sanctioned, on a watershed basis under this programme. The DPAP is actively on the

ground in 972 blocks of 195 districts in 16 states. Since 1995-96, a total number of 27,439 projects covering an area of 13.72 m ha have been sanctioned, on a watershed basis under DPAP. The projects under IWDP are generally sanctioned in areas not covered by the DDP and DPAP. The programme is being implemented in 470 districts in 28 States of the country. Under the programme, 1877 projects covering a total area of 10.72 million ha have been sanctioned on a watershed basis since 1995-96. To give enable completion of these projects, no fresh projects under these programmes were sanctioned from 2007-08.

Table 2.5: Programme-wise Number of Projects completed/closed under IWMP

Pre-IWMP Programmes	No. of Projects sanctioned during 1995-96 to 2005-06	Projects completed/closed 2010-11	Project completed as Percentage of project sanctioned
DPAP	27,439	20,580	75.0
DDP	15,746	10,998	69.8
IWDP	1,877	917	48.9
Total	**45,062**	**32,495**	72.1

Source: Department of Land Resources

Fig. 2.8: Check Dams ; Watershed Harvesting Structure

2.24 The Department has reviewed the ongoing pre-IWMP projects and has taken a conscious decision to complete them by fixing timelines. The timeline for completion of all pre-Hariyali projects sanctioned before 2003-04 was 31 March 2011. Accordingly, all the pre-Hariyali projects have been completed or closed except for 326 projects being implemented in snow-bound areas. All Hariyali projects sanctioned during 2003-04 to 2006-07 are to be completed by 31 December 2012, with the exception of projects located in snow-bound areas where the actual working season is limited to three to four months in a year. For these areas, a grace period of three years beyond the cut- off date would be considered on furnishing a certificate to this effect by the state government.

Box 2.3: Parthasarathy Committee

The Ministry of Rural Development set up a Technical Committee on DPAP, DDP and IWDP chaired by Shri S. Parthasarathy in 2005 to address all major issues in the watershed programmes and to recommend viable strategies and mechanisms for effective implementation of these programmes. The Parthasarathy Committee Report, 2006 analysed a wide range of statistics to show that dry land farming has suffered neglect, even as irrigated agriculture appears to be hitting a plateau. The report concluded that the productivity of dry land agriculture needs to be developed if food security demands of the year 2020 are to be met. The report recommended that a greater focus of watershed development programmes to increase productivity of lands in rain-fed areas might hold the key to meet the challenge of food security in the years to come.

The other main recommendations of the Committee include - provision of dedicated institutions to implement the watershed programmes; raising of cost norms; provision of flexibility in project duration; implementation of the project in three phases i.e., (i) Preparatory Phase, (ii) Resource Augmentation and (iii) Institution Building Phase and Sustainable Livelihoods and Productivity Enhancement Phase; separate budget provision for monitoring and capacity building; provision for ensuring transparency and accountability; provision for productivity enhancement and livelihoods; etc.

2.25 The provisions in the Common Guidelines and the observations of the Parthasarthy Committee (Box 2.3) have necessitated modifications in the watershed schemes of the Department of Land Resources. Accordingly, DPAP, DDP and IWDP of the Department of Land Resources have been integrated and consolidated into a single modified programme known as the Integrated Watershed Management Programme (IWMP) that has come into being since 26 February 2009. This consolidation is for optimum use of resources, sustainable outcomes and integrated planning.

Box 2.4. IWMP Objectives

- to harvest rain water and recharge ground water table
- to prevent soil run-off
- to improve production systems (crops, livestock) through improved technologies
- to increase productivity of rainfed/ degraded land through the process of integrated watershed management
- to promote livelihoods in watershed project areas

2.26 The salient features of IWMP include provisions of development of micro-watersheds on a cluster basis; reduced number of installments; delegation of power to the states; for sanction of projects; dedicated institutions; capacity building of stakeholders; monitoring & evaluation; specific budget provision for detailed project report preparation; livelihood for asset less people; and production system & micro-enterprises. Projects under the IWMP are being implemented since 2009-10 in keeping with the common guidelines for Watershed Development Projects, 2008 for treatment of rainfed/ degraded areas.

2.27 A target of 22.65 million ha of new areas has been fixed under the watershed development programmes by the Department of Land Resources during the 11th Five Year Plan period. During the first two years of the Plan no projects under IWMP were sanctioned. Projects covering a total area of 15.13 million ha were sanctioned to 23 states in the country during 2009-10 and 2010-11, as given below. A target for sanction of new projects covering a total area of 25 million ha (5 million ha being added each year) has been fixed under IWMP for the 12th Plan.

Table 2.6: Physical Progress under IWMP during 11th Plan period

Year	Area to be taken up for development (m. ha.)	
	Target	Achievement
2009-10	5.41	6.31
2010-11	8.5	8.82
2011-12	8.74	-
Total	22.65	15.13

2.28 To achieve these objectives, provisions for carrying out diverse activities, ranging from institution building, human resource development, watershed development activities, livelihood activities, coordination with other schemes and management of already created assets after the withdrawal of the project from the area are embedded in the guidelines governing IWMP.

Box 2.5: Impact of Watershed Development Project- ICRISAT

A study on "Comprehensive Assessment of Watersheds programmes in India" during 2008 had been assigned to International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Hyderabad to critically assess the impact of various watershed development programmes in India and to identify the positive factors leading to a reduction of wastelands. This study evaluated the impact of watershed programmes with the help of 636 micro-level studies to get more authentic and realistic results. The study *inter alia* reported namely that:

- Soil loss of 1.1.tonne/ha/year was prevented due to interventions of the watershed programme
- Additional water storage capacity of about 38 ha–metre was created in a 500 ha watershed as a result of the watershed programme.
- There was an increase of 52 percent in area under irrigation, while the cropping intensity increased by 35.5 percent
- Benefits of the watershed programmes were more apparent in the low-income regions as compared to high-income regions and also the benefits were more pronounced in the rainfall regions ranging between 700 mm and 1000 mm with the available technologies
- Most of the watershed programmes were not sensitive to the needs of small & marginal farmers, women & landless labourers and these were left out of the watershed-related decision-making process
- There was lack of an appropriate institutional arrangement to attain the potential benefits of the watershed programmes
- People's participation is the key determinant in the success of the watershed programmes. The benefit cost ratio was greater in watersheds where people's participation was higher
- The macro-watershed (area more than 1000 ha) performed better than a micro-watershed area below 500 ha

The results of the meta-analysis further revealed that the watershed programme is providing multiple benefits in terms of augmenting rural employment, increasing crop yields, reducing run-off (45 percent), augmenting groundwater, building social capital and reducing poverty.

2.29 Apart from the regular periodical monitoring mechanisms, the Department has awarded a pilot project for technology support for developing GIS based monitoring system to monitor the IWMP projects being implemented in Bhilwara District of Rajasthan to Madhya Pradesh Forest Department (MPFD) during July 2010. The system would enable the Department to monitor the watershed development projects on near real time basis. The MPFD has developed useful GIS based monitoring system for the pilot project in Bhilwara, Rajasthan. Looking at the success of GIS based monitoring

system, the matter has been taken up with the MPFD to implement the system in Jaipur District of Rajasthan and three Districts of Nagaland viz. Kohima, Dimapur and Peren also.

Box 2.6: Watershed Projects Impact-TERI

The Energy & Resources Institute (TERI) prepared a compendium in 2004 which summarizes the major impacts due to the intervention caused by watershed projects in 230 districts of 16 states by independent institutions and bodies. Some of the estimated yields and economic implications as derived by TERI are:

- Overall improvement in land use - Increase in the net sown area, gross cropped area and area sown more than once, Increase in the number of irrigation options in all the areas of watershed projects
- Increase in fuel wood and fodder availability
- An increase in agriculture-related employment opportunities among beneficiaries and in other sectors for non-beneficiaries — Emergence of fishery potential following the development of tanks and other water bodies
- Marked preference for improved breeds after the project.

Challenges

2.30 The concerns for future trends and scenarios should centre on enhanced water efficiency, sustainability of irrigated eco-systems, livelihood and intergenerational equity. Several parts of India are already facing water shortages and the problem will become acute by 2050 with nearly all the estimated available water put to use as a result of increasing population and food demand.

2.31 Currently, reuse and recycling of wastewater is not practised on a large scale in India, and there is a considerable scope to use this alternative. 'Reuse' applies to wastewaters that are discharged from municipalities, industries and irrigation and then withdrawn by users other than the dischargers.

2.32 Studies on the likely impacts of increased climate variability and climate change on the water resources have been limited. Under a changed climatic scenario, a number of chain events like the melting of glaciers, sea-level rise, submergence of islands and coastal areas, and deviant rainfall patterns, are likely to occur. Their likely impacts would include a greater annual variability in the precipitation levels, leading to some parts of India getting wetter while others becoming drought-prone. Sea-level rise will increase saline-intrusion of groundwater, rendering it unsuitable for use. All of these will have a direct impact on surface and groundwater resources. Thus, the major water-related future

challenges to Indian agriculture will include the growing menace of ground water pollution, soil salinization and gradual decline in productivity especially in those areas, which witnessed the green revolution.

The Way Forward

2.33 The availability and use of knowledge-based inputs need to be applied more extensively to overcome these problems. Specifically for example

- More rigorous understanding and integration of biophysical and socio-economic processes involved in water-resources generation and agricultural production is required. These include, climatic, hydrologic, hydraulic and soil-water processes, ground recharge, crop growth, and economic processes at farm, regional and global levels. Extensive field, laboratory and theoretical simulation research of high precision is required to make forecasts or predictions that can be incorporated into the resource management decision making processes.

- Extensive data, information and knowledge systems at various spatial and temporal scales need to be generated and shared among wide-and-diverse networks.

- Improved understanding of system behavior needs to be accompanied by efficient methods of water control and application in the conveyance and field application systems.

- Coping strategies would be needed that consider social, economic, and institutional factors to reduce vulnerability and to enhance adaptation to climate-related developments and events in the water sector. Groundwater may play an important role in ameliorating the worst effects of climate change on water resources. However, it must be recognized that if groundwater quality is affected (by sea water intrusion or for other reasons), recovering groundwater resources would require vast amounts of funds and time.

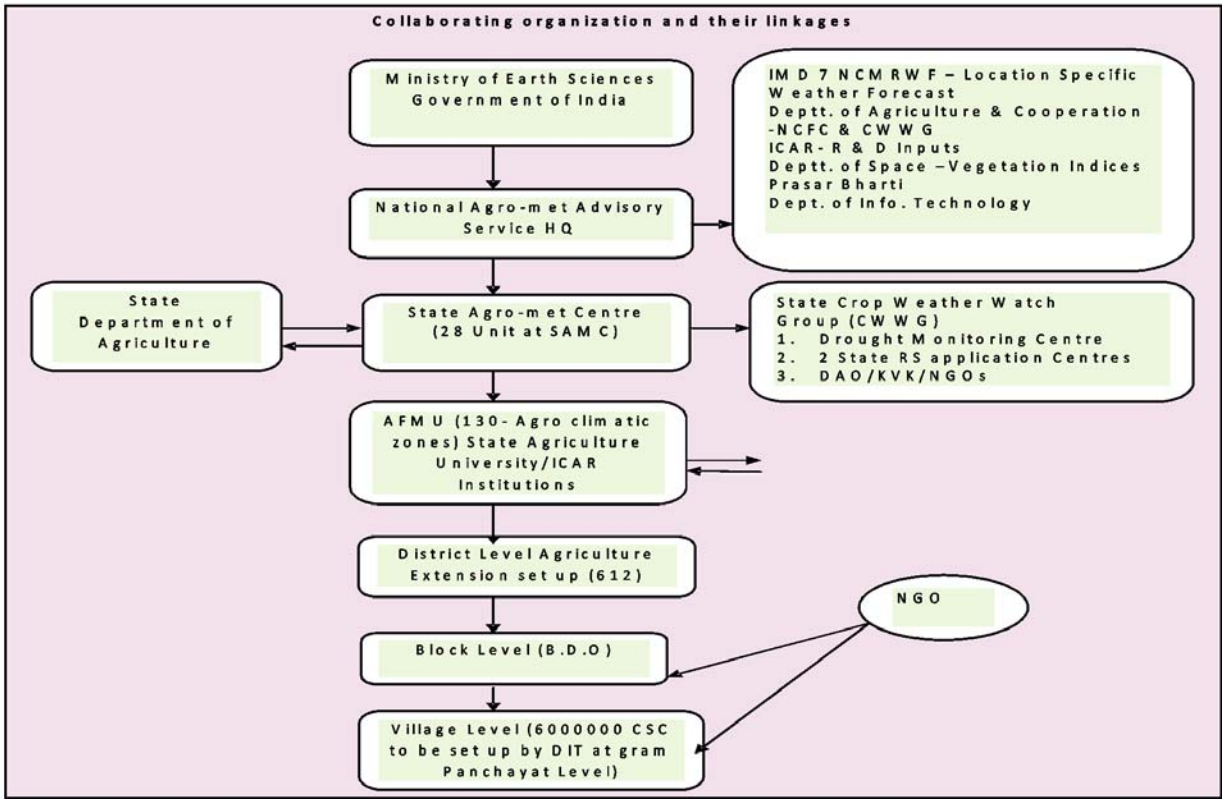
- Development of recharge measures and prudent use of efficient methods like micro irrigation are important.

Weather and Climate

2.34 Weather and climate variability, covering the quantity and temporal and special distribution of rainfall during June to September, are very important determinants of agricultural performance during the *kharif* season. Indian agriculture benefitted from favorable weather and climate conditions consecutively for about ten years during 1990

to 2000. But in the last 10 years, weather and climate variability have increased. In 2009, the nation had witnessed its driest monsoon season in over three decades. To reduce the vulnerability of agriculture to increasing weather and climate variability, the government has put in place since the 11th Five Year Plan an Agro-Meteorological Advisory Service (AAS) at the district level for weather proofing (enhancing adaptive capacity and increasing resilience) of farm production. The main emphasis of the AAS system is to collect and organize climate and weather, soil and crop, pest and disease information and to amalgamate this with the weather forecast to assist farmers in taking on farm strategic and tactical management decisions. Under the AAS, the weather forecasts are made up to five days with the outlook for rainfall given for the remaining two days of the week. The products comprise of quantitative forecasts for seven weather parameters, namely, rainfall, maximum temperature, minimum temperature, wind speed, wind direction, relative humidity and cloudiness. In addition, a weekly cumulative rainfall forecast is also provided. Indian Meteorological Department (IMD) generates these products using the Multi Model Ensemble Technique based on forecast products available from a number of models in India and other countries. After adding value to these products using a synoptic interpretation of model output, they are communicated from the Regional Meteorological Centres and Meteorological Centres of IMD in different States (SAMCs) to 130 Agro-Met Field Units (AMFUs) located at State Agricultural University (SAUs) and Indian Council of Agricultural Research (ICAR) Institutions on every Tuesday and Friday. The Agro-Met Advisory Bulletins are issued at the district, state and national levels. The district-level bulletins issued by Agro-Met Field Units (AMFUs) include location and crop specific advisories in the local language on field crops, horticulture crops and livestock. Agricultural scientists at AMFUs have started using crop simulation models as a decision support tool to make weather forecasts. A broad spectrum of advisories include for example: weather sensitive farm operations such as sowing and transplanting of crops; quantity and timing of fertilizer application based on wind condition and intensity of rain; pest and disease control; intercultural operations; quantity and timing of irrigation; timely harvest and post harvest operations of crops; etc. These advisories suggest measures and practices to minimize the losses and also, to optimize input in the form of irrigation, fertilizer or pesticides. An inter-disciplinary group of agricultural and extension specialists at the AMFUs formulate these advisories. (Fig. 2.9)

Fig 2.9: Collaborating Organizations and their Linkages under Integrated Agro-met Advisory Service



2.35 At present, district-level bulletins are issued for 550 districts in the country. The state-level bulletin is jointly prepared by SMCs of all the states with inputs from AMFUs for use by the state government functionaries, fertilizer industry, pesticide industry, irrigation department, Seed Corporation, transport organizations which provide critical inputs to agriculture. This bulletin is a significant input to the state-level Crop Weather Watch Group (CWWG) meeting. The National Agro-Met Advisory Bulletins are prepared by National Agro-Met Advisory Service Centre and Division of Agricultural Meteorology, IMD, Pune using inputs from various states. The Ministry of Agriculture, GOI, uses these bulletins to take important decisions in CWWG meetings at the national level. These services are provided in collaboration with a number of other organizations. A collaborative programme sponsored by MOA on the development of Extended Range Forecast System (ERFS) is being pursued jointly by IMD, Nation Centre for Medium Range Forecast of Weather (NCMRFW), DAC, ICAR, SAC, IITD and IRI to provide spatially and temporally differentiated weather information with a lead time of one month for providing input support services to farmers.

2.36 Information on agro-advisory is disseminated through multi-modes of delivery including mass and electronic media like AIR, television, print media, internet as well

as group and individual relationships through e-mail, telephone, SMS and IVR (Interactive Voice Response Technology), etc. A number of private firms like Reuter Market Light, Handygo, IFFCO Sanchar Limited, Nokia are disseminating the agro-met advisories generated under the Agro-Meteorological Advisory Service (AAS) through SMS and IVR in 15 states and in Maharashtra in collaboration with the State Department of Agriculture, Government of Maharashtra.

2.37 The Agro meteorological Advisory Service (AAS) has demonstrated the critical role of weather forecast in increasing the overall preparedness of farmers, leading to substantially better outcomes. For more effective approaches to deliver climate and weather information to farmers through a participatory, cross-disciplinary approach, farmer's awareness programmes also known as roving seminars are organized that bring together research and development institutions, relevant disciplines, and farmers as equal partners. They are jointly organized by IMD, ICAR, SAUs, local NGOs, and other stake holders. In order to improve the linkage with the AAS system and develop a local (village) level rain measuring network, 5 rain guages made of plastic were distributed to the selected group of progressive farmers during the meeting. So far such seminars have been organized at AMFUs. IMD in collaboration with partners has published an Agromet Brochure providing all the details about AAS and its implementation by all concerned.

2.38 In the year 2011-12, there was normal South-West monsoon rainfall (June-September) in India. At the meteorological sub-division level, 33 out of 36 met sub-divisions received excess or normal rainfall and three met sub-divisions namely, Assam & Meghalaya (-24 percent), Arunachal Pradesh (-32 percent) and NMMT (-27 percent) received deficit rainfall during this period. The country as a whole received 899.9 mm of rainfall against a normal rainfall of 887.5 mm which represents a deviation of 1 percent more than the Long Period Average (LPA). Out of 603 districts for which rainfall data were available, 144 districts (24 percent) received excess rainfall, 315 districts (52 percent) received normal rainfall, 137 districts (23 percent) deficit rainfall and only 7 districts (1 percent) received scanty rainfall.

2.39 During the post-monsoon season (1 October to 7 December, 2011), the country received 48 percent less rainfall than the LPA. Out of 36 meteorological sub-divisions, one received excess rainfall, 05 received normal rainfall, 06 received deficient rainfall, 23 received scanty rainfall and one met sub-division received no rainfall. The Northeast monsoon seasonal rainfall over the southern peninsula was 14 percent lesser than the LPA. Rainfall in major met-sub-divisions covered by the North-East monsoon was Coastal Andhra Pradesh (-46 percent), Telangana (-85 percent), Rayalseema (-22 percent), Tamil Nadu & Pondicherry (25 percent), Coastal Karnataka (1 percent), North Interior Karnataka (-43 percent), South Interior Karnataka (2 percent), and Kerala (-9 percent).

National Mission for Sustainable Agriculture

2.40 The National Mission for Sustainable Agriculture (NMSA) is one of the eight Missions under the National Action Plan on Climate Change (NAPCC). It seeks to address issues on 'Sustainable Agriculture' in the context of risks associated with climate change by devising appropriate adaptation and mitigation strategies for ensuring food security, enhancing livelihood opportunities and contributing to economic stability at the national level.

2.41 NMSA acknowledges that risks to the Indian agriculture sector due to climatic variabilities and extreme events would be felt at the levels of crop or livestock, farm or cropping system and food system. Further, the adverse impact on agriculture production is likely to be severe in the absence of appropriate adaptation and mitigation measures with far reaching consequences in terms of shortage of food articles and rising prices thereby endangering the food and livelihood security of our country.

2.42 This Mission, therefore, seeks to transform Indian agriculture into a climate resilient production system through suitable adaptation and mitigation measures in the domains of both crops and animal husbandry. These measures would be mainstreamed in research and development activities, absorption of improved technology and best practices, creation of physical and financial infrastructure and institutional framework, facilitating access to information and promoting capacity building. While promotion of dryland agriculture would receive prime importance by way of developing suitable drought and pest resistant crop varieties and ensuing adequacy of institutional support, the Mission for sustainable agriculture would also expand its coverage to rainfed areas for integrating farming systems with livestock and fisheries, so that agricultural production continues to grow in a sustainable manner.

2.43 The Department of Agriculture & Cooperation has already initiated the process for incorporating and dovetailing NMSA interventions along with its physical deliverables as well as financial outlays into the "intended XII Plan Schemes" of the Ministry. In the meantime a Climate Change Cell has been set up in the Department to supervise and monitor strategies in the context of climate change.

Challenges

2.44 Increase in the atmospheric temperature, due to a rise in greenhouse gas levels such as carbon dioxide, methane and nitrous oxide, is the prime driver of climate change. Climate change is likely to exacerbate the current stresses and increase the vulnerability of food production and livelihoods of the farming community. Hence, the world community, by and large, has agreed to reduce the levels of greenhouse gases in the atmosphere in a time bound manner. Early signs of increasing climatic variability are gradually becoming more visible in the form of an increasing melting of Himalayan glaciers, flash floods, and intense rainfall over short periods. In the Indian context, climate

change is likely to exacerbate the current stresses and increase the vulnerability of food production and livelihoods of the farming community. The warming will be more pronounced over land areas, with the maximum increase occurring over northern India. Increase in sea and river water temperatures is likely to affect fish breeding, migration, and harvests.

The Way Forward

2.45 These issues should be looked at in totality in totality to develop effective strategies to increase our adaptive capacity. The capacity to withstand climatic extremes such as drought by establishing buffer food and fodder stocks, strengthening the irrigation infrastructure, and developing agricultural insurance schemes are some of the adaptive strategies that need consideration. A key requirement is to substantially increase the capital investment in agriculture, irrigation infrastructure, development of climate resilient crop varieties and livestock breeds, forewarning systems, capacity building of scientists and farmers and transfer of adaptive technologies.

2.46 The weather forecast has to be prepared at a level smaller than the district (block level with village level outreach). The temporal range of weather forecast needs to be extended along with aggressive extension, outreach, and agro-met advisory dissemination system. In this context, there is a proposal to establish the Gramin Krishi Mausam Sewa in the country during the 12th FYP by setting up District Agromet Units in the KVKs in the country. Dissemination of right information at the right time to each and every farmer through Common Service Centres, NABARD, ITC e-Choupal, etc. is also to be strengthened. All FM channels of AIR and news casting centres of Doordarshan under Prasar Bharati would also be included in this effort.

Disaster and Calamity Management

2.47 Water, land and agro-biomass are the main natural resources for agriculture. Precipitation influenced by climate is the ultimate source of water that decides the aggregate agricultural production and biomass. The climate of the Indian sub-continent is tropical monsoon and it is distinguished by the departure from normal rainfall both in quantity and distribution. India's climate is classified as being as varied its landscape with its alpine conditions, arid deserts and tropical regions.

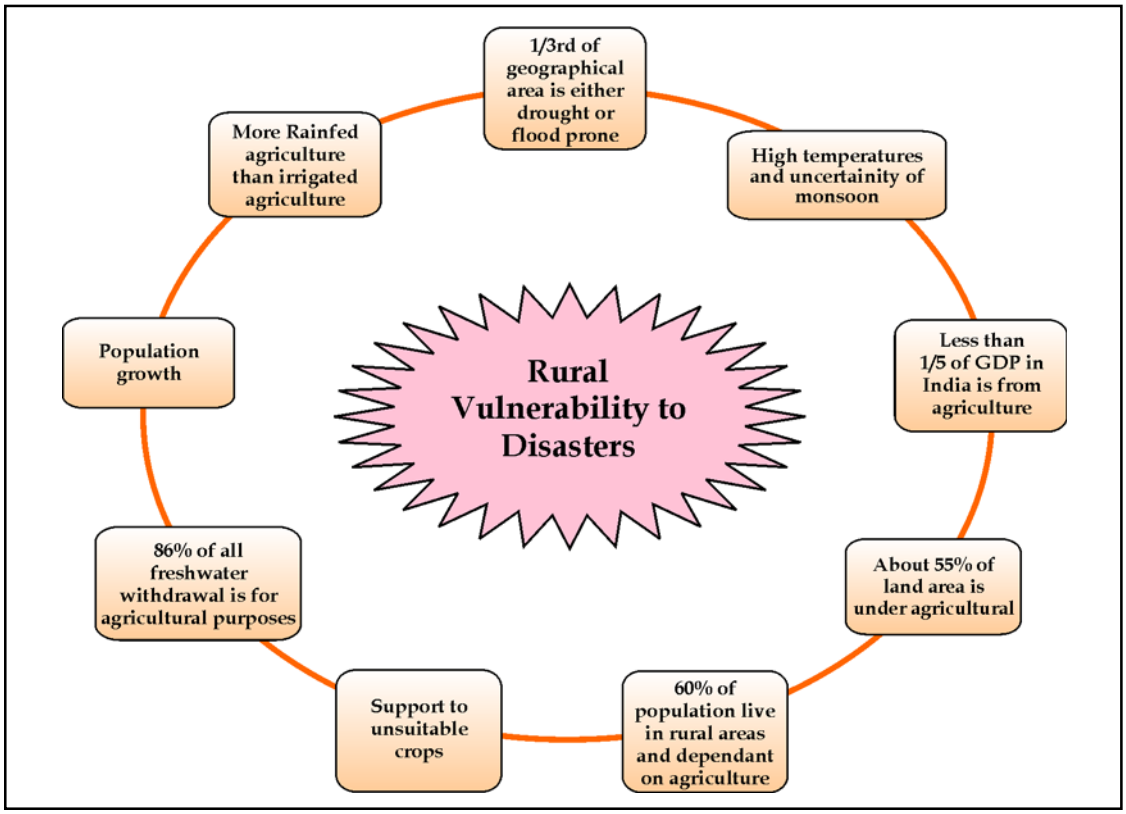
2.48 There are two types of monsoon systems operating in India namely, (a) South-West or summer monsoon, (b) North-East or the winter monsoon. The South-West monsoon accounts for around 70 percent of the annual rainfall in the country, but there is a large variability in the monsoon rainfall on both space and time scales. The precipitation variability in the four broader regions of the country namely, north, east & north eastern, central and south peninsular results in drought or flood in some parts of the country almost every year. While Orissa experiences more flood incidents, Gujarat

and Rajasthan experience more drought like conditions. A good monsoon heralds a bountiful harvest, food and financial security. But when the monsoon is in excess or deficit, the human suffering and economic loss can be widespread as happened during the drought of 2009. Varied climate is a source of both misery and prosperity for much of rural India. India is already experiencing the effects of climate variability.

2.49 The Department of Agriculture and Cooperation is entrusted with the responsibility of coordinating relief measures necessitated by drought, hailstorm and pest attacks. The Department monitors the progress of the South-West Monsoon in the country in close coordination with the India Meteorological Department and Central Water Commission. It keeps a close watch on the signs of any deficit rainfall and hydrological conditions. Though the primary responsibility for taking necessary measures in the wake of drought is the domain of the state governments concerned, this department constantly remains in touch with the States to alert and assist them in tiding over the situation.

2.50 The government of India has recognized the significance of climate variability leading to frequent natural disaster and calamity events on the growth and development of the nation and accordingly launched a range of programmes, policies and institutions to moderate the impacts of climate-related risks. The long-term centrally sponsored programmes have contributed much to enhance the development potential of agriculture and have helped build resilience to climate shocks.

Fig 2.10: Rural Vulnerability to Disasters



2.51 The government of India's disaster management programme has been ranked among the most comprehensive programmes in the world and has achieved considerable success in countering the effects of severe and extreme events like the Tsunami of 2004, Cyclone of 1999 and the droughts of 2002 and 2009. In the event of floods and droughts, the elaborate relief machinery set up in various departments of the central and state governments swing into operation with rapidly arranged protective policies and programmes like employment schemes, food distribution, special schemes for vulnerable sections of the society and emergency health care.

2.52 However, this extensive relief system comes at a substantial cost to the public exchequer. The state governments affected by natural disasters spend a significantly higher amount on relief and damages. With the forecast of increasing frequency of extreme events on account of climate change, the ongoing relief measures and their financing may not be adequate and sustainable, particularly if droughts and floods concomitantly become more severe. Besides strengthening the existing relief efforts to mitigate the impact of disasters, there is an imperative need for bolstering the fiscal growth and development to strengthen the climate resilience of the rural economy by addressing the root causes of vulnerability.

2.53 During 2009, the country faced a rainfall deficit in South-West monsoon leading to drought or drought like conditions in 338 districts in 14 States. It affected agricultural production in approximately 300 lakh ha across the country with widespread shortage of drinking water, fodder, etc. Government also took many steps to counter the situation by releasing additional funds under the flagship scheme – RKVY. Other steps were for example special measures to ensure availability of seeds, implementing a diesel subsidy scheme, providing additional credit and insurance cover, distribution of fertilizers, ensuring power supply, supply of additional fodder to the animals, arranging alternative employment opportunities and special package to Haryana & Punjab. All these steps helped the government to minimize the adverse effects of drought.

Challenges

2.54 Agricultural production in India is dominated by small and marginal farmers and rainfed conditions, and, therefore, is largely dependent on natural events mainly seasonal and annual rainfall. Besides, pest attack also causes significant damage to agriculture production. The frequency and intensity of extreme weather events like drought, flood, heat or cold wave, cyclone, delayed or early onset of monsoon, long dry spells, early withdrawal of monsoon, floods in drought-prone areas and drought in flood-prone areas and increased pest attacks have increased during the last two decades due to the global climate change effect caused by the warming of the earth. About 8 percent of the total area in the country is prone to cyclones and 68 percent of the area is susceptible to drought. Most of the drought prone areas lie in the arid (19.6 percent), semi-arid (37 percent) and sub-humid (21 percent) areas of the country that occupy 77.6 percent of its total land area of 329 million has. It is estimated that the flood-affected area has more

than doubled in size from about 5 percent (19 million has) to about 12 percent (40 million has) in the past five decades. This has led to an increase in spending on varieties of flood protection programmes.

The Way Forward

2.55 Each and every natural disaster affecting Indian agriculture requires special and newer approaches. For instance:

- Advancing *rabi* sowing to offset kharif losses, additional power for supplementary irrigation depending upon the requirement of states or even a diesel subsidy scheme.
- Strengthening climate risk information and tools to match needs should be accorded top priority to minimize the crop losses on account of disasters. This would require building up the capacity of climate assessment agencies.
- An alternative mechanism is needed to deliver support to farmers more effectively, with the resulting savings being used to increase public investment in ways that reduce the exposure to climate risks.
- Convergence and synergy between the ongoing developmental programmes with the various ministries / departments in government of India.
- Fine tuning of the Debt Relief policy of the government with alternatives like the weather-based insurance schemes.
- Better water management approaches like water budgeting, water conservation, artificial recharging of water, development of community ponds, etc.
- Positioning of inputs and review of its availability.
- To achieve targets in agricultural production, priority investments would be required in building up climate resilience of vulnerable rural communities with a portfolio of adaptation options that can address climate risks.

CHAPTER 3

Farm Inputs and Management

3.1 The phenomenal growth in agricultural production since independence has been triggered by higher input use, particularly purchased inputs as well as technology induced productivity enhancement. The key inputs which changed the complexion of agriculture include HYV (High Yielding Variety) seeds, chemical fertilizers, irrigation, pesticides, farm machinery and equipments, credit and labor.

Seeds/Planting/ Breeding Material

3.2 Seed is a critical and basic input for enhancing agricultural production and productivity in different agro-climatic regions. Efficacy of other agricultural inputs such as fertilizers, pesticides and irrigation is largely determined by the quality of seed. Seed quality is estimated to account for 20-25percent of productivity. It is, therefore, important that quality seeds are made available to the farmers.

3.3 The Indian seed programme largely adheres to a limited generation system for seed multiplication in a phased manner. The system recognizes three generations, namely breeder, foundation and certified seeds and provides adequate safeguards for quality assurance in the seed multiplication chain. The Indian seed programme includes the participation of Central and State Governments, the Indian Council of Agricultural Research (ICAR), State Agricultural Universities (SAUs), public sector, co-operative sector and private sector institutions. The seed sector in India consists of two national- level corporations *i.e.* National Seeds Corporation (NSC) and State Farms Corporation of India (SFCI). At the State level, there are State Seed Corporations (SSCs). Besides, there are private seed companies. The Seeds Act, 1966; Seeds Rule, 1968; Seed Control, 1983; National Seeds Policy, 2002; and New Policy on Seed Development, 1988 provide the framework for seed development . The Central Seed Committee (CSC), Central Seed Certification Board are apex agencies set up under the Seed Act. Under the Act, State Seed Certification Agencies (SSCs),State Seed Testing Laboratories (STLs),Central Seed Testing Laboratories (CSTLs), Seed Law Enforcement Authorities (at the state level) and National Seed Research and Training Centre (NSRTC) have been set up to deal with all matters relating to quality regulation of seeds. In recent years, the private sector has started to play a significant role in the production and distribution of seeds. The organized sector (including both private and public sector companies) account for about 15 to 20 percent of the total seed distributed in the country. The unorganized sector comprising mainly of farm- saved seeds accounts for the remaining portion. New opportunities have opened up for export of seeds of several varieties of crops, particularly those varieties in which India has a competitive edge.

Protection of Plant Varieties and Farmers' Rights Authority (PPV&FR)

3.4 Varieties of crops can have proprietary or Intellectual Property Rights (IPRs) on them through either patent or plant variety protection or a combination of both. Legislation for Protection of Plant Varieties and Farmers' Rights was enacted in 2001. The legislation provides

for the establishment of a *sui generis* and an effective system for both the protection of plant varieties, the rights of farmers and plant breeders on the one hand and to encourage the development of new varieties of plants on the other. The PPV&FR Authority registers plant varieties to protect plant breeder's rights, thereby stimulating R&D investment in development of new plant varieties. It also protects the rights of the farmers in respect of their contribution made at any time in conserving, improving and making available plant genetic resources. A total number of 54 crops have, so far, been notified for registration purposes of the Authority.

New Policy on Seed Development (NPSD)

3.5 New Policy on Seed Development (NPSD), 1988 was formulated with a view to provide the best planting material available abroad to Indian farmers. The policy has, over the years facilitated import of seeds under various categories such as coarse cereals, pulses, seeds of vegetables, flowers, etc. to improve agricultural production and productivity. The policy permits an initial import of small quantity of cereals, oilseeds, pulses, etc. for in-house trial by importer and multi location testing under All India Coordinated Trials of ICAR. Based on satisfactory result of multi location trials, importers are permitted for bulk imports.

National Seeds Policy, 2002

3.6 The National Seeds Policy, 2002 was formulated keeping in view the rapid changes that had been taking place in the national economic as well as agricultural sector and also the changes in the international markets. The policy aims at enhancing food production targets achievable by enhancing significantly, the Seed Replacement Rates (SRR). Hence, while a boost is to be given to the private seed industry, the public sector also needed to be strengthened. The policy aims at creating an enabling climate for growth of a competitive and vibrant seed industry, encouraging import of useful germplasm and boosting exports. The thrust areas are varietal development and plant variety protection, seed production, quality assurance, creation of infrastructure for seeds, transgenics, import of planting material, export of seeds and promotion of domestic seed industry. The policy also aims at removing unnecessary regulations while ensuring that gullible farmers are not exploited by unscrupulous elements.

Amendment to NPSD

3.7 In order to harmonize NPSD, 1988 with the National Seed Policy, 2002, the former, has been revised in 2011 to streamline the procedures for import of seeds and planting material. The amended policy allows import of wheat and paddy seeds under prescribed conditions. A need was felt to achieve a quantum increase in the production and productivity of wheat and paddy and thereby move towards food security of the country. As per the revised policy, now a small quantity of wheat or paddy seeds can be imported into the country for trials under ICAR or on such farms which are accredited by the ICAR. After trial and evaluation for one crop season and satisfactory results therein, the importer can apply for bulk import of such seeds. The policy has also been revised with regard to coarse cereals,

pulses and oilseeds. Under the changed scenario, trial and evaluation can also be done on farms operated by the importer provided they follow the procedure and protocol developed by ICAR, and is under ICAR monitoring and supervision. The above mentioned revisions in NPSD, 1988 will usher in an enabling environment for speedy trial and evaluation of seeds, thereby facilitating timely imports

OECD Seed Scheme

3.8 The objective of the Organization for Economic Cooperation and Development (OECD) Seeds Scheme is to encourage use of seeds of consistently high quality in participating countries. The scheme authorizes the use of labels and certificates for the seed produced and processed for international trade according to OECD guidelines. India's participation in the OECD Seed Scheme was accepted by the OECD in 2008 in respect of five seed schemes viz. (i) Grasses and Legumes ;(ii) Cereals;(iii) Crucifers and other oil and fiber species, (iv) Maize and Sorghum and (v) Vegetables. Ten Designated Authorities have been selected representing the State Seed Certification Agencies of Maharashtra, Tamil Nadu, Uttarakhand, Uttar Pradesh, Haryana, Bihar, Assam, Andhra Pradesh, Karnataka and Rajasthan. The paddy basic seed programme has already been registered under the OECD Seed Scheme in Bihar.

3.9 Since 2005-2006, the Department of Agriculture and Cooperation is implementing a Central Sector Scheme known as 'Development and Strengthening of Infrastructure Facilities for Production and Distribution of Quality Seeds' (DPQS) to address the gaps in infrastructure and to increase availability of quality seeds for different crops through various interventions. The objective of the scheme is to ensure production and multiplication of high yielding certified and quality seeds of all crops in sufficient quantities and to make the seeds available to farmers, including those living in remote areas, not easily accessible by rail or road on time and at affordable prices. The requirement and availability of certified seeds during the last seven years is given in the following Table 3.1 below:

Table 3.1: Requirement & Availability of Seeds in India

(Quantity in lakh quintal)

Year	Requirement	Availability	Surplus (+)/Deficient (-)
2004-2005	110.83	132.27	+21.44
2005-2006	107.08	140.51	+33.43
2006-2007	128.76	148.18	+19.42
2007-2008	180.74	194.31	+13.57
2008-2009	207.28	250.35	+43.07
2009-2010	249.12	279.72	+30.60
2010-2011	290.76	321.36	+30.60
2011-2012	330.41	353.62	+23.21

Source: DAC, Seeds Division

Table 3.2: Production and Consumption of Seeds in India

	Type of Seed	1991-92	1995-99	2000-01	2005-06	2009-10	2010-11
(i)	Production of Breeder Seeds, Thousand Qtls	34.9	43.36	42.69	68.64	105	119.21
(ii)	Production of Foundation Seeds, Lakh Qtls	3.75	4.76	5.91	7.4	10.5	17.53
(iii)	Distribution of Certified/ Quality Seeds, Lakhs Qtls	57.5	69.9	86.27	126.75	257.11	277.3

Source: Directorate of Economics and Statistics, DAC

National Mission on Seeds

3.10 Although the existing scheme namely, "Development and Strengthening of Infrastructure Facilities for Production and Distribution of Quality Seeds" has contributed to doubling the availability of quality seeds in the last 5 years, the Scheme requires major changes and up-gradation to meet the challenges of a rapidly evolving seed sector and to ensure greater use of quality seeds. Hence, the existing Scheme can be upgraded into a Mission with a focused, time bound and integrated agenda to improve availability of quality seeds to farmers at reasonable prices. It is, therefore, proposed to launch the National Mission on Seeds by subsuming the components of the existing seed scheme.

Box 3.1: The Seeds Bill, 2004

The Seeds Bill, 2004 aims to regulate the quality of seeds and planting material of all agricultural, horticultural and plantation crops to ensure availability of true to type seeds to Indian farmers; curb the sale of spurious, poor quality seeds ; protect the rights of farmers; increase private participation in seed production , distribution and seed testing; liberalize import of seeds and planting materials while aligning with World Trade Organisation (WTO) commitments and international standards.

In response to the changes that have taken place in the seed sector , the existing Seeds Act , 1966 is proposed to be replaced by a suitable legislation. The Seeds Bill , 2004 was introduced in the Rajya Sabha on 9 December , 2004. It was referred to the Parliamentary Standing Committee on Agriculture for examination. The Standing Committee after ascertaining the views of various institutions, individual experts, organizations and the Department of Agriculture submitted its report on 12 October 2006. The recommendations of the Committee have been examined in the Department of Agriculture and Cooperation. Based on the recommendations of the Parliamentary Standing Committee, suggestions of Members of Parliament and consultations with stakeholders, the Department has moved Official Amendments to the Rajya Sabha for consideration and passing.

Challenges

3.11 There is a mismatch between the seed multiplication ratio from breeder seed to foundation seed and from foundation seed to certified seed, which needs to be addressed. The unorganized sector comprising a source mainly of farm-saved seeds accounts for nearly 80 percent of this seed supply. This requires attention. Comprehensive and authentic databases on seed production and trade in India by public and private sectors as required under the seed and plant variety laws need to be built up. The seed chain and the norms for quality control should be followed without any compromises or shortcuts. For horticulture crops which have a long gestation period , it is imperative to ensure that only such varieties are imported that are suited to Indian conditions . A number of transgenics particularly in cotton and vegetable crops, are sought to be introduced into the country. The potential loss of production on account of non introduction of transgenics has to be carefully balanced against the dangers that transgenics may pose to ecology. However if a crop is safe for environmental release and beneficial to the farmers, such transgenics may need to be taken up in order to ensure that food security in the country is achieved and maintained.

The Way Forward

3.12 Farmers will need a genetically diverse portfolio of improved crop varieties that are suited to a range of agro-ecosystems and farming practices, and resilient to climate change. Genetically improved cereal varieties accounted for some 50 percent of the increase in yields over the past few decades. Plant breeders must achieve similar results in the future. However, timely delivery to farmers of high-yielding varieties requires big improvements in the system that connects plant germplasm collections, plant breeding and seed delivery. Increased support to plant genetic material collection, conservation and utilization is crucial. Funding is also needed to revitalize public plant breeding programmes. Policies should help to link formal and farmer-saved seed systems, and foster the emergence of local seed enterprises.

3.13 Some important measures to strengthen the seed sector include, improving policies and legislation for variety development and release as well as seed supply; enactment of flexible variety release legislation, strengthening capacity by creating a new generation of skilled practitioners to support enhanced breeding; working with farmers to explore the ways in which crops and varieties contribute to successful intensification; revitalizing the public sector and expanding its role in developing new crop varieties; supporting the emergence of local, private sector seed enterprises through an integrated approach involving producer organizations; linkages to markets and value addition, etc.

Fertilizers and Manures

3.14 Fertilizer use was started in the country with the initiation of the planning process in the early fifties. However, only small quantities were consumed during the initial years. This changed during the green revolution era when the high yielding variety of seeds, irrigation, fertilizer and credit brought about increased food production. Consumption of nitrogenous (N), phosphatic (P) potassic (K) fertilizers has increased from 1.1 million tonnes in 1966-67, the year preceding the green revolution to 28.2 million tonnes in 2010-11, while the food grain production increased from 74 million tonnes in 1966-67 to 241.56 million tonnes in 2010-11.

3.15 India at present is the second largest producer of fertilizer-nitrogen in the world, and enjoys the third position for phosphate fertilizers. However, potash is totally imported. India is second only to China in nitrogen and phosphorus consumption. The consumption of chemical fertilizers (in terms of nutrients) during 2010-11 has been 282 lakh tonnes comprising of 166 lakh tonnes of Nitrogen, 81 lakh tonnes of phosphatic and 35 lakh tones of potassic fertilizer. The all-India average consumption of fertilizers has increased from 95 kg per ha in 2004-05 to 144 kg per ha in 2010-11. Very high variability has however, been observed in fertilizer consumption among the states. While per hectare consumption is 237.1 kg in Punjab and 225.7 kg in Andhra Pradesh, it is comparatively low in MP (81 kg/ ha), Orissa (58 kg/ha), Rajasthan (48.3 kg/ha) and Himachal Pradesh (54.8kg/ha) and below 5kg/ha in some of the North Eastern States.

Table 3.3: Production and Consumption of Fertilizers in India

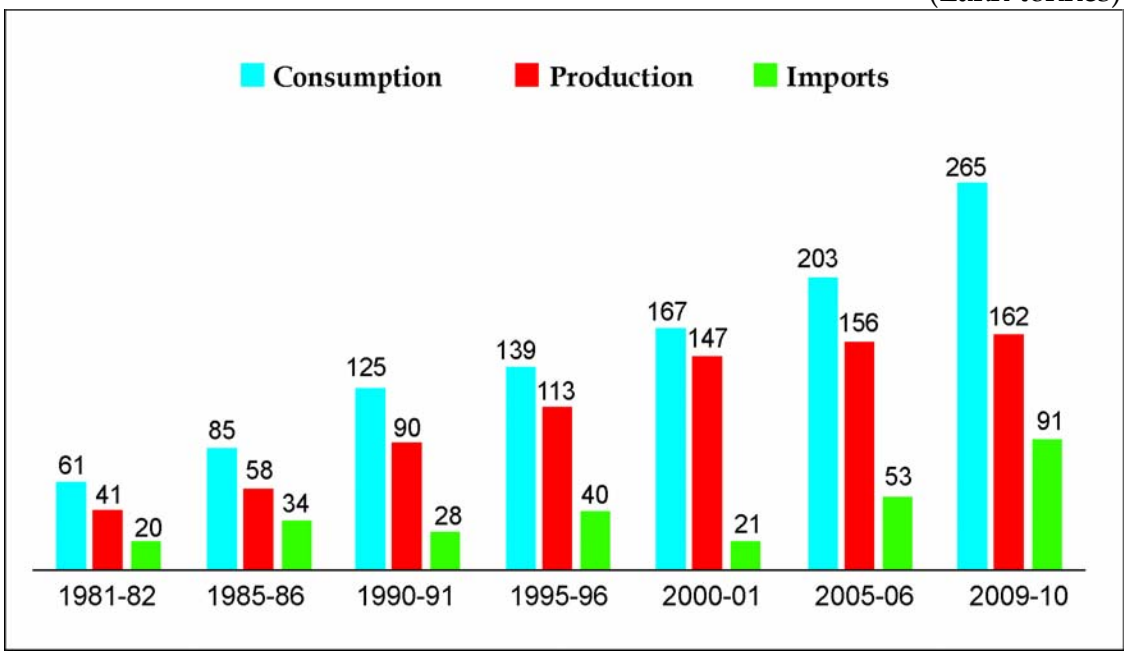
	1991-92	1995-96	2000-01	2005-06	2009-10	2010-11
1. Consumption of Fertilisers, Lakh tonnes						
Nitrogenous (N)	80.46	98.23	109.2	127.23	155.8	165.58
Phosphatic (P)	33.21	28.98	42.15	52.04	72.74	80.5
Potassic (K)	13.61	11.56	15.67	24.13	36.32	35.14
Total (N+P+K)	127.28	138.77	167.02	203.4	264.86	281.22
2. Consumption of Fertiliser, Kg / Ha.	69.84	74.02	89.63	105.5	135.76	144.14

Source: Directorate of Economics and Statistics, DAC

3.16 To ensure adequate availability of fertilizers, the Department of Agriculture and Cooperation (DAC) makes an assessment of the requirement for major fertilizers namely, Urea, DAP, MOP and Complex fertilizers before each cropping season viz. *Kharif* (1 April to 30 September) and *Rabi* season (1 October to 31 March) in consultation with all the states and concerned agencies. Further, to ensure the availability of an adequate quality to farmers, fertilizer was declared as an Essential Commodity and the Fertilizer (Control) Order (FCO) was promulgated to regulate the price, quality and distribution of fertilizers in the country. The FCO provides for compulsory registration of fertilizer manufacturers, importers and dealers; the specification of all fertilizers manufactured or imported and sold in the country; regulation of the manufacture of fertilizer mixtures; packing and marking on the fertilizer bags; appointment of enforcement agencies; setting up of quality control laboratories and prohibition on the manufacture and import and sale of non-standard or spurious or adulterated fertilizers.

Fig 3.1: Consumption, Production and Imports of Fertilizers in India

(Lakh tonnes)



Source : DAC

3.17 During 2010-11, the fertilizer inspectors of the central government inspected 1,254 ships of Urea, MOP, DAP and 100 percent water soluble Complex fertilizers and found 6 ships containing non-standard fertilizers. Presently there are 74 laboratories in the country (including 4 Central Government Laboratories) with a total annual fertilizer analyzing capacity of 1.31 lakh samples.

Box 3.2: Changes in Fertilizer (Control) Order, 1985

In recent years, measures have been taken to render FCO into a more dynamic instrument of nutrient management policy. Clause 20B has been added to allow for customized fertilizers in the interest of site-specific nutrient management. Customized fertilizers of 36 grades of have been included in FCO. To promote secondary and micro nutrients on a large scale, 9 fortified fertilizers have been included in the FCO and the procedure for their inclusion simplified. Procedure for inclusion of new fertilizers in the FCO has also been simplified by dispensing with the requirement of multi-location trials if the product is one of the variants of the products already included in FCO. Five bio-fertilizers (rhizobium, azotobacter, azospirillum, phosphate solubilizing bacteria and mycorrhizae) and three organic fertilizers (city waste compost, vermi-compost and castor de-oiled cake) have been included in the FCO to facilitate their use.

3.18 Intensive agriculture, while increasing food production, has at the same time caused second generation problems in respect of nutrient imbalance including greater mining of

soil nutrients depletion of soil fertility, emerging deficiencies of secondary and micronutrients, decline of the water table and quality of water, decreasing organic carbon content, and overall deterioration in soil health. Indian soils not only show a deficiency of primary nutrients (Nitrogen, Phosphorous and Potassium) but also of secondary nutrients (Sulphur, Calcium and Magnesium) and micro nutrients (Boron, Zinc, Copper and Iron etc.) in most parts of the country. Besides the three primary nutrients (N, P, K), deficiency of Sulphur and micro nutrients like Zinc and Boron in many of the states, and of Iron, Manganese and Molybdenum in some States, has become a limiting factor in increasing food productivity. In a comprehensive study carried out by ICAR through their Coordinated Research Project on Micronutrients, Toxic and Heavy Metals, based on an analysis of 2,51,547 soil samples from different states, it was found that 48 percent of these samples were deficient in Zinc, 33 percent in boron, 13 percent in Molybdenum, 12 percent in Iron, 5 percent in Manganese and 3 percent in Copper. Under micronutrient deficient situations, the application of major nutrients alone does not give expected results. During the eleventh Five Year Plan, a National Project on Management of Soil Health and Fertility (NPMSHF) was approved and was initiated in 2008-09. The scheme, provides for the setting up of new soil testing laboratories and a strengthening of the existing labs with micronutrient testing facilities. Apart from this project, assistance for soil testing laboratories is also being provided to states/UTs under the Rashtriya Krishi Vikas Yojana (RKVY). The number of soil testing labs in the country increased to 1,049 with an annual analyzing capacity of 10.7 million samples as on 31 March 2011. Based on the soil analysis, state governments have issued 408 lakh soil health cards upto October, 2011.

3.19 The National Academy of Agricultural Sciences has estimated (2009) that for meeting the food needs of the country by 2025, India may have to increase its plant nutrient supply to over 45 million tonnes from a current level of 25 million tonnes in 2008-09 through NPK fertilizers and from 4 to 6 million tonnes through organic manures. Out of this, 35 million tonnes should come from chemical fertilizer sources and the remaining 10 million tonnes from organic sources. According to ICAR estimates, there is a big gap of 10 million tonnes of nutrients annually added and drained from the soil by crop removal and erosion. However, average consumption of fertilizers in the country is low and, currently at 144 kg per hectare of arable land (2010-11). This is below countries such as Bangladesh (149.8 kg per hectare in 2008), Chile (269 kg per hectare), China (395.1 kg per hectare), Egypt (388.1 kg per hectare), Pakistan (174.1 kg per hectare) and Vietnam (195.5 kg per hectare).

3.20 The recent decisions by the central government on fertilizer policy have resulted in brought in major policy changes. These include for instance: (i) nutrient-based pricing and subsidy, (ii) allowing additional cost of fortification and coating on approved subsidized fertilizers to manufacturers (5-10 per cent above the MRP), (iii) paying freight subsidy for all subsidized fertilizers on an actual basis instead of uniform basis, and (iv) allowing higher rate of concession to single superphosphate (SSP) fertilizer to revive the SSP industry.

The Way Forward

3.21 Considering that an imbalanced use of fertilizers is seen as the main reason for a decline in the crop response ratio, soil test-based site-specific nutrient management is a way forward.

Therefore, initiatives on the setting up of adequate capacity for soil testing and for the adoption of information technology based systems to generate and communicate suitable advisories based on soil test crop response data to farmers in the country.

3.22 In order to meet the projected requirement of agricultural production, an increase in consumption of fertilizers would be combined with the integrated nutrient management approach. An emphasis on a balanced use of fertilizers for optimum results would simultaneously be promoted.

3.23 Increasing consumption of fertilizers would require suitable arrangements to secure supplies of fertilizers. There has been no significant addition to the urea production capacity in the last 10 years. While the requirement of di-ammonium phosphate (DAP) is met largely by imports, that of the muriate of potash (MOP) is met entirely by imports. With increasing consumption, the quantum of fertilizer imports has also been increasing. During 2010-11, India imported 66 lakh tonnes of urea, 74 lakh tonnes of DAP and 64 lakh tonnes of MOP. Instability in international prices of fertilizers with steep increases are a cause for concern. Measures to increase the domestic production of fertilizers as well as secure imports at stable prices are important.

Pesticides

3.24 In well managed farming systems, crop losses to insects can often be kept to an acceptable minimum by deploying resistant varieties, conserving predators and managing crop nutrient levels to reduce insect reproduction. Recommended measures against diseases include use of clean planting material, crop rotations to suppress pathogens, and eliminating infected host plants. Effective weed management entails timely manual weeding, minimized tillage and the use of surface residues. When necessary, lower risk synthetic pesticides should be used for targetted control, in the right quantity and at the right time. Integrated pest management can be promoted through farmer field schools, local production of biocontrol agents, strict pesticide regulations, and a removal of pesticide subsidies. With liberalization of trade, the threat of increased risk of introduction of exotic pests and weeds in the country with the potential to cause serious economic loss has to be countered effectively by the plant quarantine system.

3.25 Crop losses in the country due to various pests range from 10 to 30 percent each year depending upon the severity of pest attack. Pesticides play an important role in sustaining agricultural production of the country by protecting crops from pest attacks and by keeping the pest population under control. Availability of safe and efficacious pesticides and their judicious use by the farming community is critical to a sustained increase in agricultural production and productivity. Pesticides are also useful in health programmes for controlling vectors responsible for diseases like malaria. Per hectare consumption of pesticide in India is 381 g which is low as compared to the world average of 500 g. A low consumption in India can be attributed to the existence of fragmented land holdings, dependence on monsoons, insufficient awareness among farmers, etc. Only 25-30 percent of the total cultivated area in the country is under pesticide cover. India's consumption of pesticides is only 2 percent of the total world consumption.

Table 3.4: Consumption of Pesticides in India

	1991-92	1995-96	2000-01	2005-06	2009-10	2010-11
Consumption of Pesticides, Th Tonnes	72.13	61.26	43.58	39.77	41.82	55.54

Source: Directorate of Economics and Statistics, DAC

3.26 Pesticides have toxic properties and, therefore, need to be regulated. India has an established system to regulate the use of insecticides under the Insecticides Act, 1968. The import, manufacture, sale, transport, distribution and use of pesticides are regulated under the Insecticides Act and the Rules framed thereunder with a view to prevent risks to human beings and animals. Under the Insecticides Act, 1968, a Registration Committee (RC) has been constituted which registers pesticides for import and manufacture in the country. Presently, 230 insecticides stand registered for use in the country.

Box 3.3: Computerized Online Pesticide Registration System

A computerized online pesticide registration system was introduced in July 2008 in the Secretariat of Central Insecticides Board & Registration Committee (CIB&RC), Faridabad. The system enables pesticide companies to apply for registration of pesticide products and receive any query about deficiencies online. The status of the application is also visbile to the applicant online. The system is designed to increase efficiency and reduce transaction cost with greater transparency.

3.27 Quality of pesticides is monitored by the central and state insecticide inspectors who draw samples of insecticides from the market for analysis in the 68 State Pesticide Testing Laboratories (SPTLs) that have a total annual capacity of 68,110 samples in 23 States and one Union Territory. For the states which do not have facilities for testing pesticides, the facilities of testing samples are available at two Regional Pesticides Testing Laboratories (RPTLs), set up by the Central Government at Chandigarh and Kanpur. In case of disputes, the samples are referred to the Central Insecticides Laboratory (CIL), Faridabad.

Box 3.4: Accreditation of Pesticide Analysis Laboratories

To ensure greater quality assurance in the pesticide analysis by notified laboratories under the Insecticides Act, 1968, the Central Insecticides Laboratory and both Regional Pesticides Testing Laboratories have obtained accreditation from the National Accreditation Board for Testing and Calibration Laboratories (NABL). The State Governments have also initiated efforts to obtain NABL accreditation for State Pesticide Testing Laboratories.

Box 3.5: Strict Regulatory Regime

There are serious implications of pesticide use on safety as well as crop protection, therefore is a need for strict enforcement of pesticide regulations. The Pesticides Management Bill incorporates provisions for more effective regulation with punishment commensurate with the severity of offence. However, the Department of Agriculture and Cooperation has taken action against domestic as well as multi-national companies found flouting the existing regulations governing registration, import, manufacture and sale of pesticides, by cancelling certificates of registration of the products in question.

3.28 Pesticide residues in food commodities is an important food safety issue. To monitor pesticide residues in agricultural commodities for consumption, a central sector scheme entitled "Monitoring of Pesticide Residues at National Level" in food commodities and environmental samples has been in operation since October, 2006 with the participation of 21 laboratories functioning under the following: the Ministry of Agriculture, Indian Council of Agricultural Research, Ministry of Health and Family Welfare, Ministry of Environment and Forests, Council of Scientific and Industrial Research, Ministry of Chemicals and Fertilizer, Ministry of Commerce & Industry and State Agricultural Universities across the country. Under the scheme, participating laboratories collect samples of food commodities from various Agriculture Produce Marketing Committee (APMC) markets, the Public Distribution System (PDS) and irrigated water and soil samples from intensive agricultural fields across various parts of the country. The samples are analyzed for presence of pesticide residues in various food commodities such as vegetables, fruits, cereals, spices, pulses, milk, butter, fish, meat, tea etc. The reports are shared with state governments and the concerned Ministries and Organizations to take necessary action including intensifying promotion of an integrated pest management approach, which emphasizes a safe and judicious use of pesticides.

Box 3.6: Intensive Pest Surveillance and Management

In response to major pest attacks in recent years, some states have implemented intensive pest surveillance and management systems for major crops vulnerable to pests and diseases under Rashtriya Krishi Vikas Yojana (RKVY), e.g., Maharashtra in 2009 (for soybean and pulses) and Orissa in 2010 (for rice). The new strategy has proved to be effective and has been advocated for other States by the National Centre for Integrated Pest Management (NCIPM), New Delhi of ICAR.

3.29 The government is promoting Integrated Pest Management (IPM) as the main plank of a plant protection strategy for safe and judicious use of pesticides. IPM involves use of cultural, mechanical, biological methods and the use of pesticides as a last resort for controlling insects-pests, diseases and weeds. Under a scheme titled "Strengthening & Modernization of Pest Management Approach in India", 31 Central IPM centres (CIPMCs) located across the country have the mandate under the Directorate of Plant Protection, Quarantine & Storage (DPPQ&S), Faridabad for pest and disease monitoring, production and release of bio-control agents and bio-pesticides, conservation of bio-control agents and human resource development in IPM by organizing Farmers' Field Schools (FFSs).

Box 3.7: Capacity Building - National Institute of Plant Health Management

Capacity building is an important area in plant protection. The National Plant Protection Training Institute (NPPTI), Hyderabad was converted into a society in 2008 to give it more autonomy for human resource development in bio-security. The institute, renamed as the National Institute of Plant Health Management (NIPHM), is headed by a Director General. Its facilities are being upgraded and the faculty expanded for augmenting capacity for training in plant health management. NIPHM is being developed as the premier institution for capacity building in the country as well as internationally.

3.30 Monitoring and control of locusts in 2 lakh sq. km of the Scheduled Desert Area (SDA) in parts of Rajasthan, Gujarat and Haryana is undertaken by the Locust Warning Organization (LWO) under DPPQ&S that has its Field Headquarter located in Jodhpur and a Central Headquarter at Faridabad. Wireless communication between Jodhpur (India) and Karachi (Pakistan) is also maintained every year from June to November for exchanging locust intelligence between the two countries and meetings on the border are held at regular intervals.

3.31 The objective of plant quarantine is primarily to prevent the introduction of exotic pests, diseases and weeds through imports of agricultural commodities or plant material into India and similarly, prevent introduction of indigenous pests, diseases and weeds in other countries through exports. The Plant Quarantine (Regulation of Import into India) Order, 2003 issued under the provisions of the Destructive Insects and Pests Act, 1914 (DIP Act) regulates imports. Post entry quarantine inspection is undertaken in case of propagation of plant material. Phytosanitary certificates (PSCs) are issued for exports as per the International Plant Protection Convention (IPPC), 1951 of the Food and Agriculture Organization (FAO). These functions are being discharged by 35 Plant Quarantine Stations (PQSs) functioning under DPPQ&S at various international airports, seaports and land customs stations across the country to facilitate international trade in agriculture products.

Box No 3.8: Upgrading Plant Quarantine Services

Upgradation of the plant protection regulatory framework is required to meet the emerging challenges of safeguarding the country's bio-security. As part of these efforts, the following major initiatives have been taken:

- Online plant quarantine services have been introduced in January 2011 to enable exporters to apply for a phytosanitary certificate and importers to apply for import permit and release order online. Of the plant quarantine work, 93 percent is now being conducted online.
- Round the clock (24x7) plant quarantine services have been introduced at Chennai, Mumbai and New Delhi.
- Phytosanitary certificates with standard format and enhanced security features have been introduced to prevent fraud.
- Five major Regional Plant Quarantine Stations (RPQS) located at Amritsar, Chennai, Kolkata, Mumbai and New Delhi have secured ISO 9001:2000 certification, an international standard for an organization's quality management system.

3.32 The existing legislation governing regulation of pesticide is old and needs to be replaced by new laws providing a more effective regulatory framework. The Pesticides Management Bill, which is intended to replace the Insecticides Act, 1968, has been introduced in the Parliament. New and emerging factors including globalization, genetic engineering, climate change, bio-terrorism and transboundary diseases have profound implications on plant and animal health as well as environment and possessing strong connections with human health. To counter these threats, a strengthening of existing the systems is required. Efforts to upgrade capacity in plant protection need to be continued.

The Way Forward

3.33 Enactment of new legislation on pesticide management would provide more effective regulation of pesticides in the future.

3.34 An Agricultural Biosecurity Bill is being prepared to replace the Destructive Insects and Pests Act, 1914 and for enabling together plant, animal and marine protection and quarantine set ups under a high powered body with adequate powers to safeguard the country's agricultural biosecurity.

3.35 Establishment of a National Pesticide Reference Repository (NPRR) to address the issues of supply of reference standards and variation in analysis of pesticide samples is planned. Further, for detecting the presence of chemical pesticides in microbial bio-pesticides and products, the setting up of a new laboratory at the national level namely, the National Pesticides Investigational Laboratory (NPIL) is planned. This laboratory will also have a Technical Audit Division to the monitor work of the pesticides testing laboratories. NPRR and NPIL, alongwith accreditation of laboratories would help bring about a distinct change in the standard of testing of pesticides.

3.36 Intensive pest surveillance and management systems for major crops vulnerable to pests and diseases would have to be adopted by states taking advantage of the funding available under the Rashtriya Krishi Vikas Yojana.

3.37 The National Institute of Plant Health Management, Hyderabad would be developed further to assist in upgradation of capacity in plant health management as well as biosecurity not only in the country but also internationally.

Farm Machinery and Equipment

3.38 Farm mechanization saves time and labor, cuts down crop production costs in the long run, reduces post-harvest losses and boosts crop output and farm income. Empirical evidence confirms that there is a strong correlation between farm mechanization and agricultural productivity. States with a greater availability of farm power show higher productivity as compared to others.

Table 3.5: Level of Mechanization of Different Operations in Indian agriculture

Operation	Percentage
Soil working and seed bed preparation	40
Seeding and planting	29
Plant protection	34
Irrigation	37
Harvesting and threshing	60-70 percent for wheat and rice and <5percent for others

Source: Singh *et al.*

3.39 Currently increasing the threat to natural resources, notably land and water, has further necessitated a switching over to machine assisted resource-conservation techniques such as zero-tillage, raised-bed planting, precision farming, drip or sprinkler irrigation, etc. Farm mechanization has now become more relevant in mitigating the effect of climate change by readjusting crop sowing schedules. For example, the climate change-driven early onset of summers in the northern states has often resulted in wheat yield dropping by 1.5 quintal per hectare with every one week's delay in its planting after mid-November. This loss can be averted by sowing wheat early, which is possible only if the previous paddy crop is harvested mechanically and wheat is planted with zero-till seed drills that do not require ploughing the land. A greater degree of farm mechanization can also address the issues of scarcity of farm labor during peak agricultural seasons of sowing and harvesting with the implementation of the Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA).

3.40 More recently, the financial reforms in the 1990s, easy availability of institutional financing and capital subsidy especially on tractors initially propelled growth in farm mechanization. However, since 2007-08, there has been a slowdown, which many believe is due to financial institutions becoming cautious and adopting more stringent lending norms. The reason for increasing defaults on such loans, among others, is the 'unviable' nature of individual ownership of 'high value agriculture equipment' like tractors, power tillers, etc. Structural issues like high procurement cost, adverse economies of scale, lower credit worthiness, etc. have resulted in an automatic 'exclusion' of the majority of small and marginal farmers in India from the benefit of farm mechanization. As a result, farm mechanization has developed a stronger bias towards larger land holdings (NSSO 2005).

3.41 Presently, India is the largest manufacturer of tractors in the world, accounting for about one-third of the global production. Power tillers are becoming popular in lowland flooded rice fields and hilly terrains. Steady growth was observed in manually operated tools, animal operated implements, and equipments operated by mechanical and electrical power sources. In manually operated equipment, the number of sprayers has almost doubled since 1992. After liberalization and with development of prototypes of machines, manufacturing got a big boost particularly in Haryana, Punjab, Rajasthan, Madhya Pradesh and Uttar Pradesh. About 700-800 combines are sold annually. Tractor operated combine harvester, costing only 25-30 percent of the self propelled combine, has been a good innovation by manufacturers of Punjab; and this machine can be owned individually by farmers. The self propelled combines are largely owned by custom-hiring contractors. Standardization and quality of implement manufacturing is ensured mainly by BIS and over 500 standards on agricultural machinery are prescribed. Since the early seventies, the composition of the relative share of different sources of power for farming operations has undergone significant change as can be seen from Table 3.6. According to a study (Singh *et al.*), the share of agricultural workers and draught animals have come down from 63.5 percent in 1971-72 to 13.67 percent in 2009-10 whereas that of tractors, power tillers and diesel engines and electric motors has gone up from 36.51 percent to 86.33 percent during the same period.

Table 3.6: Percentage share of different farm power sources in Indian agriculture

Year	Agricultural workers	Draught animals	Tractors	Power tillers	Diesel engines	Electric motors	Power, kW/ha
1971-72	10.64	52.86	8.45	0.11	17.16	10.79	0.424
1981-82	9.20	33.55	18.46	0.11	22.85	15.82	0.592
1991-92	7.22	20.50	26.14	0.16	21.14	24.84	0.907
2001-02	5.70	11.76	36.77	0.36	19.10	26.31	1.352
2005-06	5.39	9.97	38.45	0.44	20.09	25.66	1.498
2009-10	5.12	8.55	41.67	0.52	19.01	25.13	1.658

Source : Singh *et al.*

3.42 The Department of Agriculture and Cooperation, Ministry of Agriculture, has been providing financial assistance on agricultural equipment and implements to all categories of farmers under its various Central Sector Schemes. This has been instrumental in bringing level of farm power from 1.35 Kw per ha from beginning of Tenth Five year plan to 1.66 Kw per ha by the end of 2009-2010. Simultaneously, the farm equipment industry has also witnessed robust sales growth in tractors and power tillers (Table 3.7)

Table 3.7: Sales of Tractors and Power Tillers in India

Year	Tractors Sales (Nos.)	Power Tillers Sales (Nos.)
2004-05	2,47,531	17,481
2005-06	2,96,080	22,303
2006-07	3,52,835	24,791
2007-08	3,46,501	26,135
2008-09	3,42,836	35,294
2009-10	3,93,836	38,794
2010-11	5,45,109	55,000
2011-12 (Upto December 2011)	4,19,270	39,900

Source: Department of Agriculture and Cooperation

3.43 Concerted efforts of state and central government have seen greater adoption of mechanization in land preparation or tilling, harvesting and rice transplantation. Some of the agricultural equipments/farm machinery which are gradually becoming popular are given in Fig 3.2.

Fig 3.2: Popular Agricultural Equipments

(a) Gender-friendly Reaper cum binder

(b) Combine Harvester

(c)Tractor operated Seed cum fertilizer drill

(d) Gender-friendly Rice transplanter

(e) Laser Land Leveller

Challenges

3.44 Farm mechanization in India, was able to achieve a meagre growth rate of less than 5 percent in last two decades. The average farm power availability in the country is at a low level compared to other countries like China and Korea. Farm Mechanization in India is still in its early stages. Farm mechanization has become a dire necessity in view of significant reduction in supply of labor for agricultural operations in recent years.

3.45 Mechanizing small and non-contiguous group of lands is against 'economies of scale' especially in operations like land preparation and harvesting. With continued shrinkage in average farm size, more and more farms will fall into the adverse category thereby making individual ownership of agricultural machinery progressively more uneconomical. Moreover, farm mechanization is capital intensive and thus it remains beyond the reach of small and marginal farmers. Custom Hiring Centres could have been an alternate option. But, these centres need a minimum scale for efficient operation as the activity is capital intensive. They also have a longer gestation period due to lower asset utilization on account of the seasonal nature of agriculture demand.

3.46 Higher risk due to 'uncertain demand' and 'immature market' has barred seasoned business entities from entering this segment. First generation entrepreneurs willing to establish these centres face a significant 'entry barrier' on account of non availability of financing either in the form of venture capital or institutional loans. With the level of Non-Performing Assets (NPAs) continuing to remain significant, it is unlikely that the risk perception of financial institutions will change in the near future. Further, non-availability of the much needed technical and institutional support and after sales has further prevented this segment from developing and maturing. Small or first generation entrepreneurs even if they are enterprising enough to establish custom hiring centres, do not usually qualify for bank loans for want of collaterals or credit guarantees. As a result, there is virtually a 'complete market failure' in this segment. Intensive research on farm mechanization is also not adequate as it is a very capital intensive activity.

The Way forward

3.47 Recognizing the need to spread the benefits of farm mechanization among all strata of farmers especially small and marginal farmers, the Department of Agriculture & Cooperation (DAC) proposes to formulate one integrated National Mission on Agricultural Mechanization (NMAM).

National Mission on Agricultural Mechanization (NMAM)

3.48 NMAM will put 'Small and Marginal Farmers' at the core of the interventions with a special emphasis on 'reaching the unreached', i.e. bringing farm mechanization to those villages where the technologies deployed are decades old. Besides, the Mission also proposes to cater to 'adverse economies of scale' by promoting 'Custom Hiring Services' through 'the rural entrepreneurship' model.

3.49 The Mission will aim at catalyzing an accelerated but inclusive growth of agricultural mechanization in India by way of the following:

- Increasing the reach of farm mechanization to small and marginal farmers and to the regions where availability of farm power is lower;
- Offsetting adverse 'economies of scale' and 'higher cost of ownership' of high value farm equipments by promoting 'Custom Hiring Centres' for agricultural machinery;
- Passing on the benefit of hi-tech, high value and hi-productive agricultural machinery to farmers through creation of hubs for such farm equipments;
- Promoting farm mechanization by creating awareness among stakeholders through demonstration and capacity building activities; and
- Ensuring quality control of newly-developed agricultural machinery through performance evaluation and certification at designated testing centres located all over the country.

3.50 The following components are envisaged in the Mission for accelerated and inclusive growth of farm mechanization in India:

- Promotion and strengthening of Agricultural Mechanisation through Training, Testing and Demonstration;
- Post Harvest Technology and Management (PHTM);
- Financial Assistance or Procurement Subsidy for Agriculture Machinery and Equipments;
- Establishment of Farm Machinery Banks for Custom Hiring;
- Establishing a Hi-Tech, High Productive Equipment Hub for Custom Hiring; Enhancing Farm Productivity at the village level by introducing appropriate farm mechanisation in selected villages; and
- Creating ownership of appropriate farm equipment among Small and Marginal farmers in the eastern/north eastern region:

Irrigation

3.51 In about five decades of Independence, the major controls on management of water resources have changed hands from communities (tanks and small water structures) to government (major and medium irrigation projects) to the private domain (ground water). Additional net irrigated area (approximately 84 percent in the past two decades) has come from private groundwater development, the net area irrigated by private tube wells is double than that by canals (NAAS, 2009). Groundwater provides about 70 percent of irrigation and 80 percent of the drinking water supplies. The ultimate irrigation potential in the country is estimated at about 140 million hectares. Of this, about 58.5 million ha is from major and

medium irrigation sources, and 81.5 million ha is from minor irrigation sources (about 64.1 million ha from groundwater irrigation and 17.4 million ha from surface water).

Challenges

3.52 Across all states, there is a persistent gap between the assessed ultimate irrigation potential and the actual potential that has been put to use. Water scarcity will intensify in future with increase in population and demand for food, and the current water use practices cannot be sustained over the longrun. Inefficient water use in irrigation is also leading to environmental degradation via waterlogging and induced salinity.

3.53 The irrigation efficiency in the systems needs to be upgraded from the present level of 35 percent to about 60 percent in the surface water system and from 65 percent to 75 percent in the groundwater system. Even a rise of 5 percent irrigation efficiency can increase the irrigation potential by 10-15 million ha. New micro-irrigation technologies include drip and trickle systems, surface and subsurface drip tapes, micro-sprinklers, sprayers, microjets, spinners, rotors, bubblers, etc. Despite wide promotion, only about 0.5 million ha currently are under micro-irrigation (NAAS 2009).

The Way Forward

3.54 Irrigation has been an integral part of our monsoon-dependent agriculture and the aggravating groundwater crisis in many States has resulted in the government adopting measures to control it. Modern techniques such as micro-irrigation, watershed management, rainwater harvesting and groundwater recharging will be vital in utilizing the existing resources and expanding irrigation in a viable manner. The public sector has been spending funds to increase the net irrigated area without commensurate success. This indicates the need for demand and supply oriented reform measures to ensure an equitable distribution and efficient use of the available water resources. For this, a major exercise involving reform in water management (especially demand side), in the pricing of water and power, and institutional aspects related to farmer participation are important. Major investments in research and development that enhance water use efficiency will be required to grow the right quality and quantity of agricultural produce. Extension services that reach out to farmers will help boost the speed of technology-adoption as well as develop specialized skills and knowledge related to water application and high value agriculture.

Labour and Agricultural Wages

3.55 At the all-India level, approximately 60 percent of the rural labour force and 45 percent of the urban labour force is self-employed. Rural casual labour constitutes the single largest segment of the total workforce in India. Among rural casual labourers, agricultural labourers occupy a predominant position. Most of the workers engaged in agriculture are highly under-employed with very low levels of income. Agricultural Wages reflect the well being of labour in rural India. The rural agricultural wage rate, hence, is considered as one of the most robust indicators of economic well-being, not only of agricultural labourers, but also of the overall rural population.

3.56 Agriculture is a labour intensive activity. Cost of cultivation data shows that labor accounts for more than 40 percent of the total variable cost of production in most cases. Therefore, availability of labour to work in agriculture is crucial in sustaining agricultural production. Raising the wage levels of casual workers both in agriculture and non-agriculture sectors needs adequate policy attention. In this regard, stricter implementation of the Minimum Wages Act, 1948 and targeted employment generation programmes are important.

3.57 NREGA, renamed as Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA), enacted on September, 2005 provides for the enhancement of livelihood security of the households in rural areas of the country by providing at least one hundred days of guaranteed wage employment in every financial year to every household whose adult members volunteer to do unskilled manual work. A very significant feature of this Act is that if a worker who has applied for work under MGNREGA is not provided employment within 15 days from the date on which work is requested, an unemployment allowance shall be payable by the state government at the rate prescribed in the Act. The Scheme is working as a social safety net. It has prevented distress migration and helped in empowerment of women. Some studies carried out in recent years have shown that while MGNREGS has assisted in renovation of ponds and canals, water conservation and water harvesting structures, drought proofing and tree plantation, flood control, micro and minor irrigation works and land development which will have a positive impact on agricultural productivity, it has also led to a substantial increases in the wage rates of agricultural and non-agricultural laborers, reduced the availability of labour for agricultural operations and increased the cost of cultivation.

3.58 Agricultural wages have been traditionally low due to low productivity, large disguised unemployment in agriculture due to lack of sufficient employment opportunities elsewhere. However, in recent years there is a perceptible change in this trend due to rapid economic growth and adoption of policies for employment generation including promotion of self employment opportunities. Major policy measures influencing the wage increase are MNREGA and Minimum Wages Act implemented by the government.

3.59 There is a steady increase of agricultural wages in all major the states of India in recent years. The annual average wage in Andhra Pradesh for unskilled agricultural labor has increased by 28.6 percent in 2009 compared to 2008 and further increased by 22.5 percent in 2010. Similarly in Orissa the wage increase has been 20 percent in 2009 over 2008 and 30.7 percent in 2010 over 2009. In Punjab the increase has been 22.2 percent in 2009 and 20.3 percent in 2010. In Tamil Nadu the increase has been 20.4 percent and 27.6 percent, respectively, in 2009 and 2010 in comparison to the respective previous years. Similar trend has prevailed in all the other States with double digit growth in wages even exceeding the rate of inflation that prevailed during this period. Rural wages in Kerala were the highest in the country in the range of Rs.216-305 during 2008-10, followed by Tamil Nadu, Andhra Pradesh and Karnataka in that order in the Southern Region. In the Northern region, Haryana recorded the highest agricultural wages in the range of Rs.121-182 during 2008-10 period followed by Punjab in the range of Rs 110-162, and Rajasthan in the range of Rs.105-139. West Bengal and Uttar Pradesh followed in that order.

3.60 Employment opportunities under MGNREGA have made a significant impact in the rural areas by providing assured minimum employment and increasing the rural wages. Wages for rural households under the MGNREGA have increased in Maharashtra from Rs.47 to Rs.72, in Uttar Pradesh from Rs.58 to Rs.100, in Bihar from Rs.68 to Rs.100, in West Bengal from Rs. 64 to Rs. 100, in Madhya Pradesh from Rs.58 to Rs.100, in Jammu & Kashmir from Rs.45 to Rs.100 and in Chhattisgarh from Rs.58 to Rs.100 to name a few states during 2007-10. At the national level, the average wages paid under the MGNREGA have increased from Rs.75 in 2007-08 to Rs.93 in 2009-10. In order to optimize synergies to bring convergence between MGNREGA and schemes of Ministry of Agriculture guidance have been issued to all State Governments.

Credit and Insurance

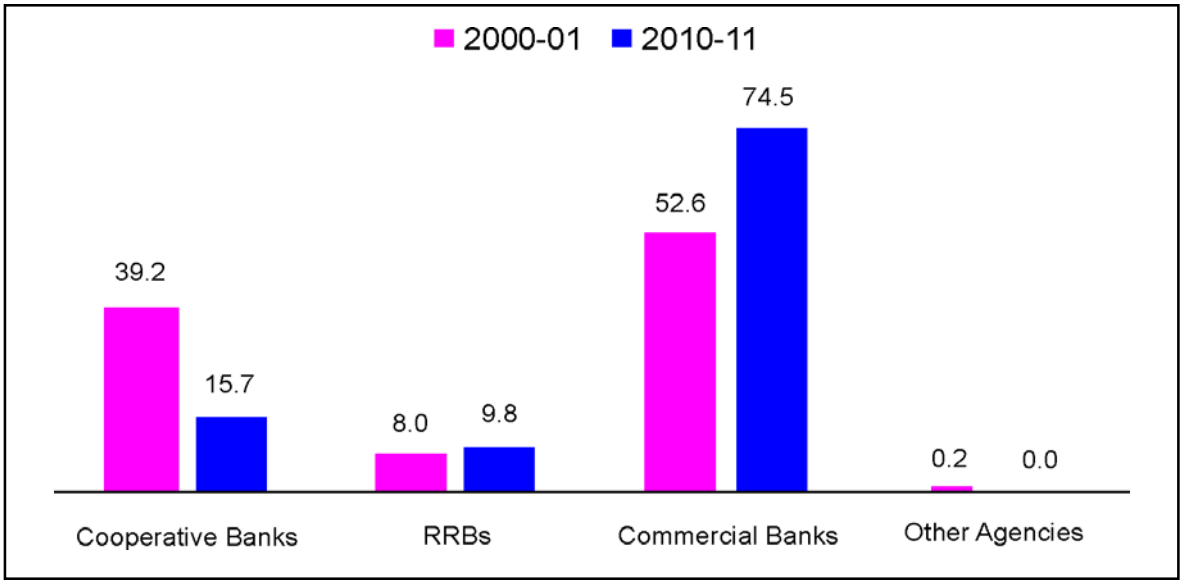
3.61 Agriculture credit plays an important role in maintaining agricultural production by allowing producers to meet their credit need during the entire cycle of crop production and at the same time provides funds for investment purposes. With increased commercialization of agriculture and increase in the use of modern inputs, the amount and share of purchased inputs in the total production is increasing rapidly. Besides, private investment in different types of assets like irrigation equipments, farm machinery, and land improvements are required for efficient production and for maintaining faster agricultural output growth. Farmers have to avail credit either from institutional sources or from non- institutional sources like private money lenders. Loans from non-institutional sources though very common, are often exploitative, with very high interest rate, and from such sources the borrowers often fall into debt trap. Realizing these difficulties, the government has initiated several measures to galvanize the institutional credit system to make it more responsive to the needs of farmers.

3.62 The objective of the Agricultural Credit Policy in India since Independence has been gradual replacement of moneylenders by institutional sources and a lowering of interest rates. Until banks were nationalized, cooperative institutions were the only source of institutional credit in rural areas. Since nationalization, scheduled commercial banks and regional rural banks (RRBs) have also been part of the formal credit system. The share of commercial banks has substantially increased from 53 percent in 2000-01 to 74.5 percent in 2010-11 (Fig 3.3) As percentage of agricultural GDP, institutional credit to agriculture has increased from 2.56 percent in 1970–1971 to 7.11 percent in 1980–1981 to 11.47 percent in 2000–2001, and 32.21 percent in 2010-11, although studies do suggest asymmetries in distribution of credit across farm size and across regions. But small farmers continue to resort to informal lenders (despite Kisan credit cards), as the current system of institutional credit to farmers suffers from non-farmer friendly practices, delays in credit delivery and collateral problems.

3.63 Keeping in view the importance of flow of credit to agriculture, in particular to the smaller borrowers who may not have the necessary assets as collateral, the banks have been advised to waive margin and security requirements for agricultural loans up to Rs.100, 000.

The "No Due Certificate" for small loans to SF/MF, share croppers, etc. have been dispensed with and instead banks have been instructed to obtain self declaration from the borrowers.

Fig 3.3: Sources of Institutional Agricultural Credit
Percentage



Source: Department of Agriculture and Cooperation

3.64 One of the major challenges in the sector has been ensuring the provision of timely and adequate credit to the farmers. An innovative strategy conceived in 1999 by the GOI created the Kisan Credit Cards (KCC) through which farmers could avail short-term loans for crops from banks. The scheme was initiated in consultation with the Reserve Bank of India and National Bank for Agricultural and Rural Development (NABARD) and by the end of October, 2011, 10.78 crore KCC were issued to eligible farmers all over India. All cooperative banks, scheduled commercial banks and regional rural banks were given annual targets and their progress was monitored at every step by NABARD.

3.65 The Kisan credit card is essentially a type of revolving cash credit facility with withdrawals and repayments to meet the production credit needs, cultivation expenses and the contingency expenses of the farmers. Recently, banks have also extended credit towards working capital requirements for other activities such as cattle breeding and poultry farming through this scheme. Each farmer is given a passbook and is sanctioned a credit limit, which can be modified depending on his performance and repayment record, thereby maintaining a working relationship between him and the bank. While the limit of credit is decided on the basis of operational landholding, cropping pattern and scale of operations, the full year's credit requirement of the borrower is taken care of and each card is valid upto five years. With minimum paper work and simplification of documentation for withdrawal of funds from the bank, not only has availability of credit been made easier but the system has also been made straightforward to operate and farmers have been given sufficient freedom to

decide how to use their credit. The card also carries some insurance cover at a nominal premium.

3.66 The implementation of the scheme has resulted in an increase in the flow of credit to the agriculture sector and a substantial reduction in borrowing from the informal sector for short-term needs. The programme has benefited both farmers and bankers as there has been a significant saving in time and cost of credit delivery, reduction in transaction costs, better recoveries and reduction in the workload of bank branches. However, the sanctioning of lower credit limits, low awareness levels about insurance features and the tendency to treat the card as a term loan facility rather than as a cash credit facility still remain areas of concern.

3.67 Banks have now begun taking advantage of the popularity of the cards by enhancing the features of the card in making the card ATM-compatible, issuing chip-based smart cards which will contain embedded information pertaining to land records, limit sanctioned, amount withdrawn against bank account, etc. With near-universal coverage, the Kisan credit card has met all its objectives and is on its way to becoming a powerful tool in consolidating the banker-farmer relationship.

3.68 NABARD has formulated a scheme to provide loans to tenant farmers and oral lessees for raising crops. NABARD would facilitate the formation and financing of groups of Tenant Farmers by organizing them into Tenant Farmers Groups (TFGs). The objective of the scheme is to provide crop loans through institutional agencies to Tenant Farmers, Oral Lessees and share croppers, who are not being extended credit support due to their inability to provide tangible securities and/ or are unable to produce the documents regarding their rights on the land. NABARD would extend refinance support to RRBs and State Cooperative Banks (SCBs)/ District Central Cooperative Banks DCCBs to the extent of 100 percent of the loans provided by the banks to the TFGs. NABARD is facilitating implementation of SHG-Bank Linkage Programme through Commercial Banks, RRBs, Cooperative Banks and Self Help Promoting Institutions (SHPIs), like NGOs, State Government departments, Farmers Clubs, Individual Rural Volunteers, etc since 1992 onwards. The programme basically aims at linking the self help groups with the formal banking structure in the country to obtain the credit for meeting their emergent production and consumption needs. On the basis of recommendations made by the Vaidyanathan Committee Task Force, the government of India had approved a Revival Package for Short Term Cooperative Credit Structure (STCCS) aimed at making it a well managed and vibrant structure to best serve the credit needs of Rural India. The revival Package envisages an outlay of Rs.13, 597 crore for recapitalization of STCCS, capacity building & training and computerization subject to legal reforms by the State Governments. The Revival Package seeks namely, to (i) provide financial assistance to bring the system to an acceptable level of health; (ii) introduce legal and institutional reforms necessary for their democratic, self-reliant and efficient functioning; and (iii) take measures to improve the quality of management as an integrated package. As on May, 2011 an amount of Rs.8993.08 crore has been released by NABARD as Government

of India share for recapitalization of 53,026 Primary Agricultural Credit Societies (PACS).

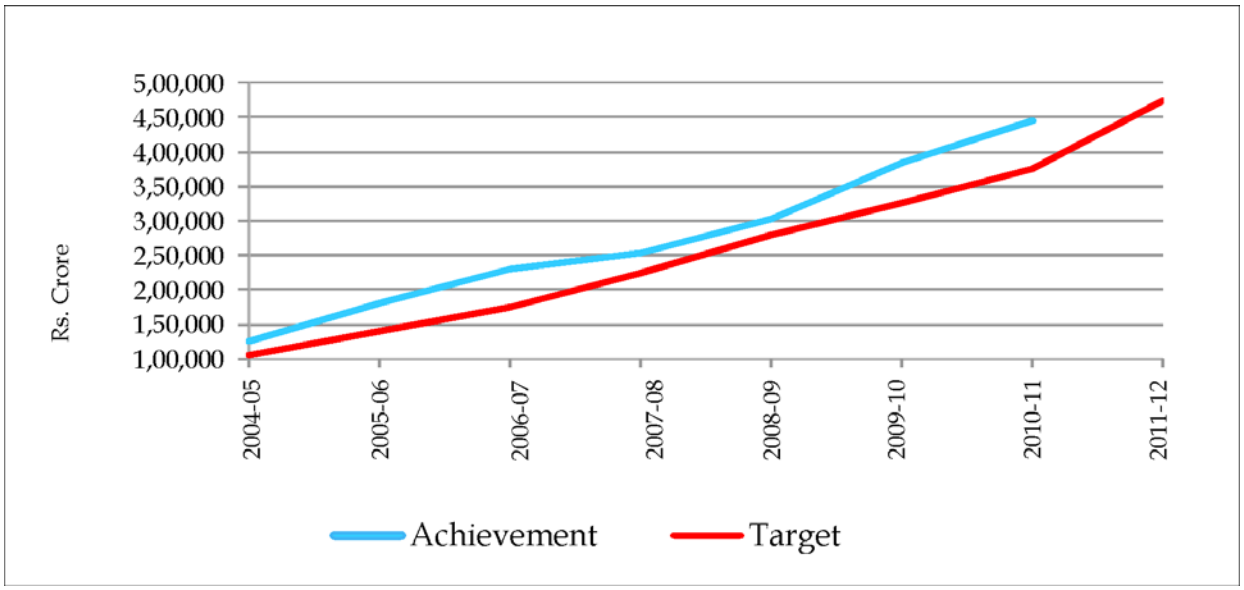
3.69 The Government of India's Agricultural Debt Waiver and Debt Relief Scheme (ADWDRS), 2008 aimed at de-clogging the lines of credit that were choked due to the debt burden on the farmers and to entitle these farmers for fresh credit. All agricultural loans disbused by Public Sector Banks, Private Sector Banks, Cooperative Banks, Local Area Banks and Regional Rural Banks between 1 April, 1997 to 31 March, 2007 to farmers, overdue as on 31 December, 2007 and remaining unpaid upto 28 February, 2008 were eligible for Debt Waiver Debt Relief. For marginal farmers (i.e., holding upto 1 hectare) and small farmers (1-2 hectare), there was complete waiver of all loans that were overdue on 31 December, 2007 and which remained unpaid until 29 February, 2008. In respect of other farmers, there was a provision for One Time Settlement (OTS) scheme for all loans that were overdue on December 31, 2007 and which remained unpaid until February 29, 2008. Under the OTS, a rebate of 25 per cent has been given against payment of the balance of 75 percent. In case of the revenue districts covered under DPAP, DDP and PM special relief package, other farmers were given an OTS rebate of 25 percent of the eligible amount or Rs.20,000 whichever is higher subject to the condition that the farmer pays the balance of the eligible amount. Debt Waiver portion of the Scheme was closed on 30 June 2008.

3.70 As per the provisional figures, a total of 3.01 crore small and marginal farmers and 67 lakh 'other farmers' have benefited from the Scheme involving debt waiver and debt relief of Rs. 65,318.33 crore. Against this, the total amount of claims eligible for reimbursement from the government after the permitted inclusions and exclusions in the Guidelines is expected to be about 15 percent lower than the above figure because lending institutions were neither to claim from the central government, nor recover from the farmer for instance (i) interest in excess of the principal amount, (ii)unapplied interest, (iii) penal interest,(iv) legal charges, (v) inspection charges and (vi) miscellaneous charges, etc. All such interest/charges will be borne by the lending institutions. As on 31 August 2011, the Government of India (GoI) has released an amount of Rs.51,340.47 crore to the lending institutions as reimbursement under the Scheme.

3.71 As a result of various steps taken by the government the flow of institutional credit to agricultural sector has recorded a tremendous growth especially after 2000-01. Short-term institutional credit met about two-thirds of total cost of inputs (excluding labor) used in agriculture during 2005-06. During the same year, the level of production credit exceeded 15 percent of the value of agricultural output while term credit reached a level of 11 percent of the output. On 18 June, 2004, GOI announced a comprehensive farm credit package which, *inter-alia*, envisaged doubling of farm credit flow in three years with 2003-04 as the base year. The flow of agriculture credit since 2004-05 has consistently exceeded the target (Fig 3.4). Against a credit flow target of Rs.3, 25, 000 crore during 2009-10, the achievement was Rs.3, 84, 514 crore forming 118 percent of the

target. The target for 2010-11 was Rs.3,75,000 crore while the achievement on March, 2011 is Rs.4,46,779 crore. The agriculture credit flow target for 2011-12 has been set at Rs.4,75, 000 crore and the achievement as on 30 September 2011 is Rs. 2,23,380 crore.

Fig 3.4: Target and Achievement of Agricultural Credit from 2004-05 to 2011-12



3.72 Since *Kharif* 2006-07, farmers are receiving crop loans upto a principal amount of Rs. 3 lakh at 7 percent rate of interest. During 2010-11, Government provided an additional 2 percent interest subvention as incentive to those farmers who repay short- term crop loans as per schedule. The government has raised this subvention for timely repayment of crop loans from 2 percent to 3 percent from the year 2011-12. Thus the effective rate of interest for such farmers will be 4 percent in the year 2011-12.

3.73 Agricultural production and income from farming is highly risky on account of natural disasters like droughts, floods, cyclones, uncertain rainfall, temperature variations, attack of pests and diseases, fire, sale of spurious seeds, fertilizers and pesticides, and market failures. With the growing commercialization of agriculture, the magnitude of risks and loss is increasing. Agricultural insurance is a step to protect farmers by minimizing the impact of such losses. But agricultural insurance has not made much headway in India as yet.

3.74 Agricultural insurance is primarily covered under the National Agricultural Insurance Scheme (NAIS) implemented by the Agricultural Insurance Company (AIC) of India Ltd. This scheme is available to both loanees and non-loanees. During 2010-11, the Crop Insurance Schemes covered about 25 percent farmers and crop area in the country. Further, there is a heavy regional and crop bias in its coverage. Since the beginning of the scheme in 1999, till the *rabi* season of 2010-11, 176 million farmers were extended insurance cover. Out of these, 15.90 percent were in Maharashtra, 14.20 percent in Andhra Pradesh, 12.5 percent in Madhya Pradesh, 10.60 percent in Uttar Pradesh, 8.55 percent in Rajasthan, 6.5 percent in Orissa, 6.30 percent in Gujarat and 6.25 percent in Karnataka. These eight States accounted for 76 percent

of the total insurance claims, and 80 percent of insured area under the NAIS. The private sector has come out with financially viable insurance products in agriculture based on weather parameters such as the weather index. One such product is the rainfall insurance which has been developed by the ICICI- Lombard General Insurance Company and by the IFFCO- Tokio General Insurance Company.

3.75 Efforts have been made to bring more farmers under the fold of Crop Insurance by introducing a Weather-based Crop Insurance Scheme (WBCIS) from the *Kharif*, 2007 season in selected areas on a pilot basis. WBCIS is intended to provide insurance protection to the farmers against adverse weather incidence, such as deficit and excess rainfall, high or low temperature, humidity, etc. which are deemed to impact adversely the crop production. It has the advantage of settling the claims within the shortest possible time. Apart from Agricultural Insurance Company (AIC) of India Ltd. the private insurance companies with experience in rural insurance and possesing good infrastructure have been allowed to undertake Pilot WBCIS. Since the *Kharif* 2007 season, 13 million farmers have been covered under the Scheme.

3.76 A Joint Group was constituted to study the improvements required in the existing crop insurance schemes and to develop broad parameters of an appropriate and farmer friendly crop insurance scheme. The Group made an indepth study of crop insurance and risk mitigation programmes and submitted its report in December, 2004. Based on the recommendations of the Joint Group and views and comments of various stake-holders, a Modified National Agricultural Insurance Scheme (MNAIS) has been approved by the government of India for implementation on a pilot basis in 50 districts during the remaining two years of the 11th five year plan from the *Rabi* 2010-11 season. It has improved features over NAIS as for example: actuarial premium with subsidy in premium ranging from 40 percent to 75 percent offered to all farmers; only upfront premium subsidy being shared by the central and state governments on a 50 : 50 basis; all claims liability to be on the insurance companies; unit area of insurance reduced to village and village panchayat level for major crops; indemnity for prevented sowing and planting risk & for post harvest losses due to cyclone; on account payment up to 25 percent advance of likely claims as immediate relief; more proficient basis for calculation of threshold yield; minimum indemnity level of 70 percent instead of 60 percent; underwriting by private insurance companies along with AIC.

Challenges

3.77 Despite the increase in supply of institutional credit, its share in total credit for cultivator household was only 61 percent in 2002. This shows that the cultivator households are not able to come out of the clutches of money lenders and other non-institutional sources. It is also reported that only 27 percent of the total number of cultivator households received credit from formal sources while 22 percent dependent on informal sources. The remaining households, comprising mainly small and marginal farmers, had no credit outstanding. This calls for initiating measures to check the financial exclusion of large segment of small and marginal farmers from the institutional financial system. Another issue with institutional finance is that the flow of agricultural credit is skewed across states and regions. Even within

states, there are sharp differences in credit flow to developed regions, regions with greater access to physical infrastructure and regions closer to urban centres as compared to under-developed districts or regions. Despite various agricultural insurance schemes launched from time to time in the country, these have served in a limited way. The coverage in terms of area, number of farmers and value of agricultural output is very small and most of the schemes are yet to prove their viability.

The Way Forward

3.78 Comprehensive new measures are needed in terms of innovative products and services to increase access to institutional credit. Complex documentation processes and high transaction cost in taking loans require attention. It is highly desirable to provide a KCC to all farmers in the country and to raise credit the limit, from time to time as needed.

CHAPTER 4

Agricultural Production and Programmes

4.1 Increasing agricultural production for achieving food security for all has been the central focus of India's agricultural development strategy since independence. Food security will always remain a very sensitive issue in India as the country has the largest concentration of poor in the world. Food security implies food as well as nutrition security. A food and nutritional security scenario may be analyzed under four perspectives namely, food availability, economic access, absorption and stability in food systems. Food production is a direct mandate of the Ministry of Agriculture whereas providing economic access through Public Distribution System (PDS) and stability in supply through provision of buffer stocks is the direct mandate of Department of Food and Public Distribution. Absorption or provision of nutrition through mid-day meals and Integrated Child Development Scheme (ICDS), etc come within the purview of the Ministry of Women and Child Development and Ministry of Health. After achieving near self sufficiency in staple food, the Indian government has launched a number of programmes for increasing production (supply side) through the Department of Agriculture and Cooperation as also distribution and consumption (demand side) through the Department of Food and Public Distribution. Currently, around half of India's population is covered by one or other scheme of the public distribution system, in which subsidized staple food is made available to the people.

4.2 Over the years, there have been significant dietary changes leading to diversification in food towards fruit and vegetables (F&V), milk, meat, egg and fish. This diversified food basket has led to more diversification at the farm level. India has made considerable headway in improving food security at all levels. Economists have analyzed price inflation in terms of primary food articles such as cereals, pulses, F&Vs, milk, meat, fish, spices etc., and manufactured food articles like sugar, dairy products, vegetable oils, prepared food stuff and other processed products. The fast growth in F&Vs, milk, meat, egg and fish have filled the demand gap to some extent in these commodities. But in recent months, soaring prices in these food articles have been a major concern of the government. Application of modern agricultural technology combined with hard work by farmers and supportive policies and special programmes of the government (popularly called green revolution) have provided the much needed strength to minimize the adverse impact of rainfall and Indian agriculture has attained some degree of resilience.

Food Supply

4.3 Due to the challenge of feeding our vast population soon after independence and the experience of food shortages in the pre-independence era, 'self reliance' in food grains has been the cornerstone of our policies in the last 60 years. Food grains dominate the share of total crop output though their relative share has decreased from 42 percent in TE 1990-1991 to 34 per cent in TE 2009-2010. India has made substantial progress in terms of overcoming national food insecurity by giving priority to self-sufficiency in food grain production by following an agricultural strategy well known by the name 'green revolution'. As a result of the new strategy, the food grain production increased from 82.02 million tonnes in 1960-61 to 250.42 million tonnes (2nd advance estimate) in 2011-12.

4.4 The horticulture sector comprises of fruits, vegetables, potato, onion, other tuber crops, ornamental crops, medicinal and aromatic crops, spices and plantation crops. New enterprises like mushroom, bamboo and bee-keeping are added to further expand the scope of horticulture. Horticulture has emerged as an indispensable part of agriculture, offering a wide range of choices to the farmers for crop diversification and much needed nutrition to the people. It also provides ample opportunities for sustaining a large number of agro-industries which generate substantial employment opportunities. Changing dietary habits of the Indian population with an improved standard of living has increased the demand for horticultural products. Gross returns per unit of area from fruits, vegetables and flowers are much higher than for most of the other crop groups. Growth in the horticulture sector has facilitated crop diversification, even in small farmer holdings during the last decade. A huge growth potential in horticulture has attracted corporate houses to venture into the sector by developing innovative models, linking farm to fork. Livestock and fisheries are an integrated part of the food supply system. These are discussed separately in Chapter 7.

Foodgrains

4.5 By the end of the Tenth Plan, India could achieve a total foodgrains production of 217.28 million tonnes. As a result of good monsoon performance for four consecutive years 2005-06 to 2008-09 and focused promotional efforts backed by remunerative price policy support, foodgrains production recorded an increasing trend touching a record level of 234.47 million tonnes in 2008-09. In 2009-10, due to severe drought in various parts of the country, the total foodgrains production sharply declined to 218.11 million tonnes. However, during 2010-11, the food grain production has increased to 244.78 million tonnes and during 2011-12 it is estimated at 250.42 million tonnes, an all time high so far. Krishi Karman awards were given to the states (**Box 4.1**) in recognition of their meritorious work in achieving the record production in 2010-11.

Box 4.1: Krishi Karman Awards

State Governments were recognized for the meritorious work in achieving their highest ever production of foodgrains for the year 2010-11 through Krishi Karman Awards. These awards were instituted for the first time by the Ministry of Agriculture in different categories – Total Foodgrains for big, medium and small States, Wheat, Rice, Coarse Cereals and Pulses. They carried a cash award, trophy and a citation.

Following awards were presented on 16th July, 2011 by the Prime Minister of India

Krishi Karman Award for the total food grains production

Big State category – **Punjab and Uttar Pradesh**

Medium State Category – **Orissa and Assam**

Small State Category - **Tripura**

Krishi Karman Award for the Rice Crop **- Chhattisgarh**

Krishi Karman Award for the Wheat Crop **- Haryana**

Krishi Karman Award for the Pulses Crops **– Maharashtra and Rajasthan**

Krishi Karman Award for the Coarse cereals crops **- Karnataka**

Rice

4.6 As a result of various initiatives taken by the Government of India in the implementation of a number of Crop Development Schemes, the productivity of rice has increased from 1984 kg per hectare in 2004-05 to 2314 kg per hectare in 2011-12. The production of rice has shown an upward trend during the period 2005-06 to 2008-09 and it reached a record level of 99.18 million tonnes in 2008-09. The production of rice which declined to 89.09 million tonnes in 2009-10 due to long spells of drought has increased to 102.75 million tonnes in 2011-12, the highest ever. All India Average annual growth rate of yield of rice has shown a growth of 1.47 per cent per annum during 2000-01 to 2010-11 compared to 1.36 per cent during 1990-91 to 1999-2000. The turn around seems to be in the eastern belt where the government is implementing the 'Bringing Green Revolution to Eastern India' (BGREI) scheme since 2010-11.

Box 4.2: Bringing Green Revolution in Eastern India

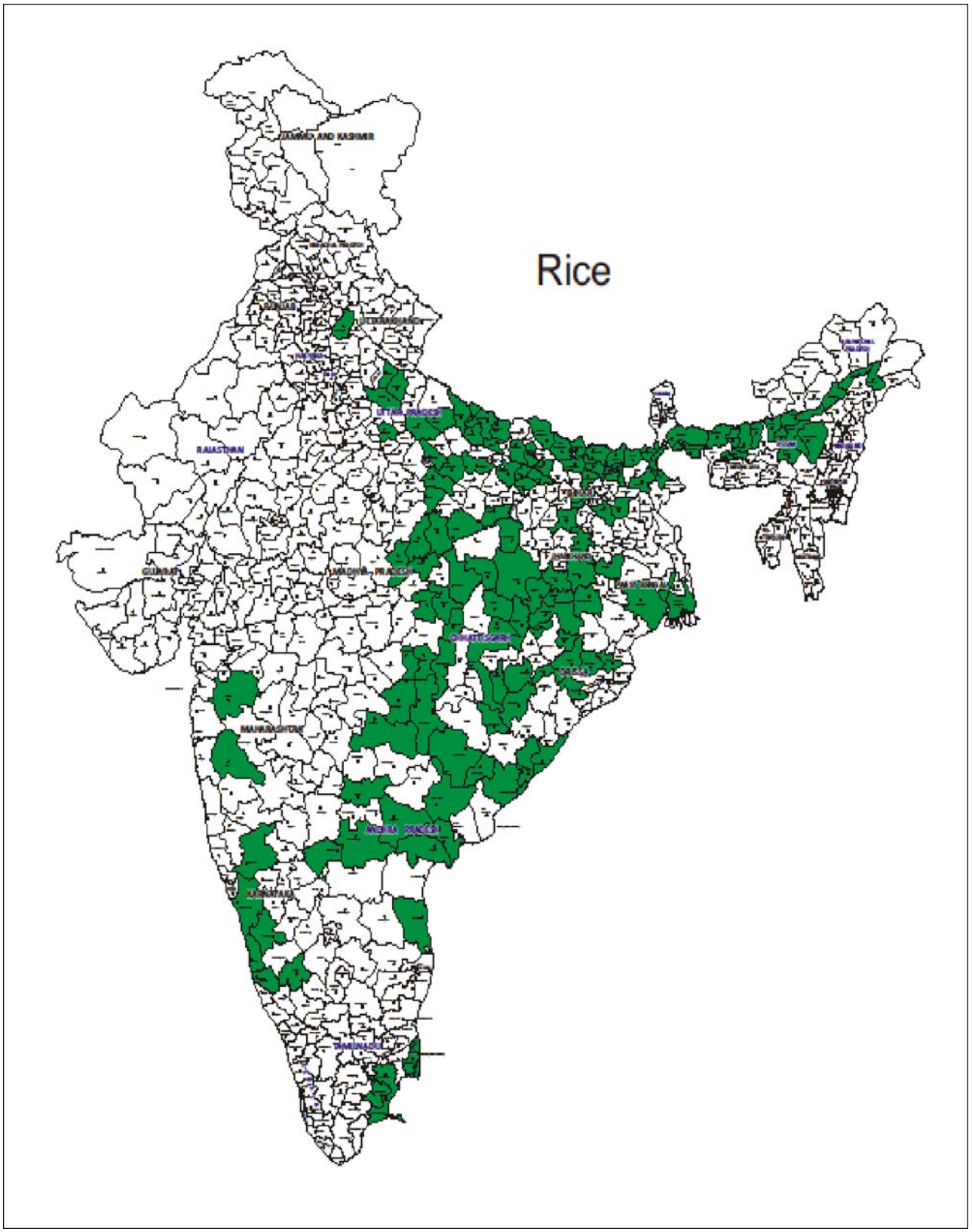
In order to meet the growing food requirement and to reduce over exploitation of natural resources in the North-West region, a new strategic initiative 'Bringing Green Revolution in Eastern India' (BGREI) has been started.

Eastern India with 2-3 times more rainfall compared to North-West States, unexploited good quality groundwater, aquifers and vast resources of social capital possess a relative advantage for sustainable production of foodgrains.

In order to harness the potential of East Indian plains, under the Rashtriya Kristi Vikas Yojana BGREI was announced in the Union Budget 2010-11 with an allocation of Rs. 400 crore. Its objective is to increase the productivity of rice based cropping system mainly rice, wheat, maize, pulses through promotion of recommended production technologies and addressing the underlying key constraints of different agro-climatic sub regions. The programme is under implementation in the states of Assam, Bihar, Chhattisgarh, Jharkhand, Orissa, Eastern Uttar Pradesh and West Bengal. The programme is continuing during 2011-12 with the same allocation.

4.7 Resource conservation technologies such as the System of Rice Intensification (SRI) that conserve water and reduce the use of chemical fertilizers while maintaining higher crop production are being promoted under the Crop Development Schemes. Ninety thousand demonstrations of SRI have been organized over an area of more than 37,000 ha during the last five years under the National Food Security Mission (NFSM)-rice. Besides, hybrid rice technology is being disseminated on a massive scale through supply of minikits of hybrid seed and organizing demonstrations on farmers' fields. About 50,000 demonstrations on hybrid rice have been organized over an area of 20,000 ha during last five years under NFSM-rice for productivity improvement. A Task Force has also been set up to oversee promotion of hybrid rice particularly, in the Eastern Region of the country. Stress tolerant varieties like *Sahbhagi Dhan* for drought and *Swarna Sub-1* for flood are also being promoted to mitigate situations of drought and floods. Salt tolerant varieties of rice like CSR 10, CSR 13, CSR 23, CSR 27, CSR 30 and CSR 36 are also in the seed chain for promotion to the farmers.

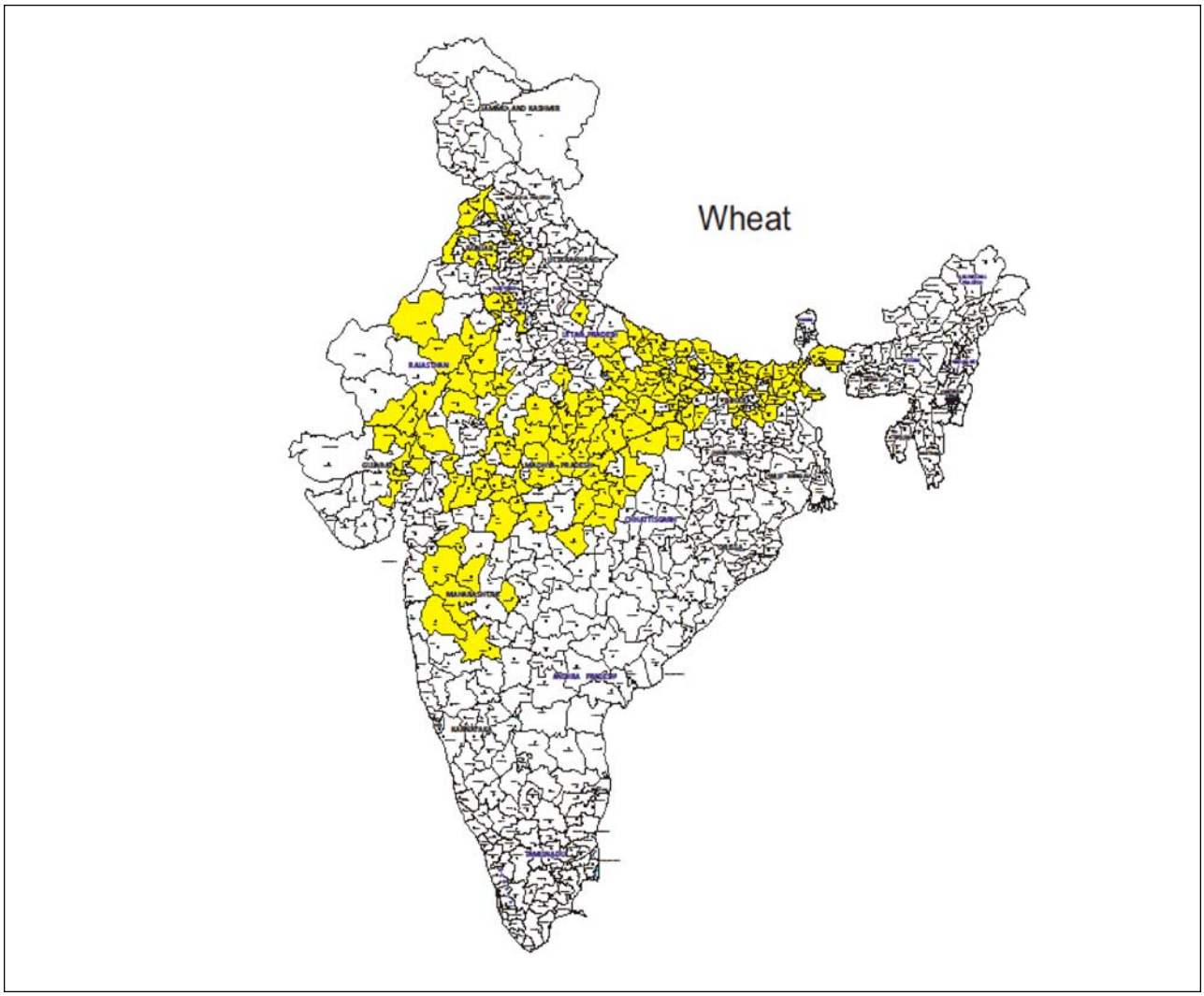
Fig. 4.1: Major Rice growing Districts



Wheat

4.8 The area coverage under wheat has shown an upward trend by increasing from 26.38 million hectares in 2004-05 to 28.89 million hectares in 2011-12. The significant increase in the Minimum Support Price (MSP) of wheat from Rs. 640 per quintal in 2004-05 to Rs. 1285 per quintal during 2011-12 seems to have provided the incentive to farmers to increase the area under wheat. The productivity of wheat which was 2602 kg/hectare in 2004-05 has increased to 3057 kg/hectare in 2011-12. The major increase in the productivity of wheat has been observed in the states of Haryana, Punjab and Uttar Pradesh. The production of wheat in the country has increased significantly from 68.64 million tonnes in 2004-05 to an all time high of 88.31 million tonnes in 2011-12. The increase in the production has been achieved in these years on account of higher area coverage and productivity. However, the average annual growth rates of area, production and yield during 1990-91 to 1999-2000 were 1.62%, 4.52% and 2.87%, respectively but declined to 0.57 per cent, 1.39 per cent and 0.73 per cent respectively during 2000-01 to 2010-11.

Fig. 4.2: Major Wheat growing Districts



Coarse Cereals

4.9 There has been a decline in the area coverage under coarse cereals from 29.03 million hectares in 2004-05 to 26.73 million hectares in 2011-12. However, the productivity of coarse cereals has increased significantly from 1153 kg per hectare in 2004-05 to 1572 kg per hectare in 2011-12. States showing a major increase in the productivity of coarse cereals are Uttar Pradesh, Maharashtra and Karnataka. The total production of coarse cereals which was 33.47 million tonnes in 2004-05 has jumped to the level of 40.03 million tonnes in 2008-09. Due to severe drought in various parts of the country in 2009-10, the production of coarse cereals declined to 33.55 million tonnes in 2009-10 but improved to 43.68 million tonnes in 2010-11 but declined marginaly to 42.08 million tonnes 2011-12. However, the average annual growth rate of area is still negative though it is relatively less negative as compared to growth in the 1990s. The average annual growth rate of yield during 2000-01 to 2010-11 has significantly increased (4.64%) leading to a significant improvement in production.

Cereals

4.10 With an increasing trend during the period 2004-05 to 2010-11, the area coverage and productivity of cereals has increased from 97.32 million hectares and 1903 kg per hectare in 2004-05 to 100.06 million hectares and 2330 kg per hectare, respectively in 2011-12. The overall production of cereals has gone up from 185.23 million tonnes in 2004-05 to 219.90 million tonnes in 2008-09. Like other crops, the production of cereals has drastically come down to 203.45 million tonnes in 2009-10 due to long spells of droughts in the country. Due to record level production of rice, wheat and maize on account of higher area coverage and productivity during 2011-12, the production of cereals has increased to 233.14 million tonnes.

Pulses

4.11 The government of India has taken several initiatives to motivate farmers to grow more pulses and to increase pulse production in the country. Increase in Minimum Support Price of pulses has also led to increase in the area coverage under pulses from 22.76 million hectares in 2004-05 to 25.43 million hectares in 2011-12. The productivity of pulses has significantly increased from 577 kg per hectare in 2004-05 to 679 kg per hectare in 2011-12. Pulses production strategies, along with a mix of policy and programmatic support (Box 4.3) have contributed significantly to the path breaking achievement of 18.24 million tonnes in 2010-11. Production of pulses is estimated marginaly lower at 17.28 million tonnes in 2011-12.

4.12 The revamped multi-pronged strategy on pulses implemented in 2010-11 has shown an immediate positive response in the quantum jump in production of pulses reaching a figure of 18.24 million tonnes during 2010-11 over an earlier stagnating production of about 14.5 million tonnes. Increased production was reflected in a reduced import of pulses that declined from 3.51 million tonnes during 2009-10 to 2.59 million tonnes during 2010-11.

4.13 The National Centre for Agricultural Economics and Policy Research (NCAP) has been assigned a study to examine the factors responsible for a higher production of pulses during 2010-11. The preliminary findings of NCAP study suggest a strong correlation between increased production and the revamped promotional strategy on pulses.

Box 4.3: Pulses Production Strategies contributing to Record Production.

Programmes were more sharply focused for better monitoring and assured delivery of planned inputs and services to the farmers. Minimum Support Price was increased by more than 30%. Budgetary allocation was increased three fold with the announcement of new initiatives.

Introduction of Special initiative of **Accelerated Pulses Production Programme (A3P)** in 2010 under NFSM pulses programme to boost the production of pulses (Red gram, green gram, black gram, Chick pea and lentil) by active promotion of production and protection technologies in 1000 clusters of 1000 hectares each with a hand holding approach.

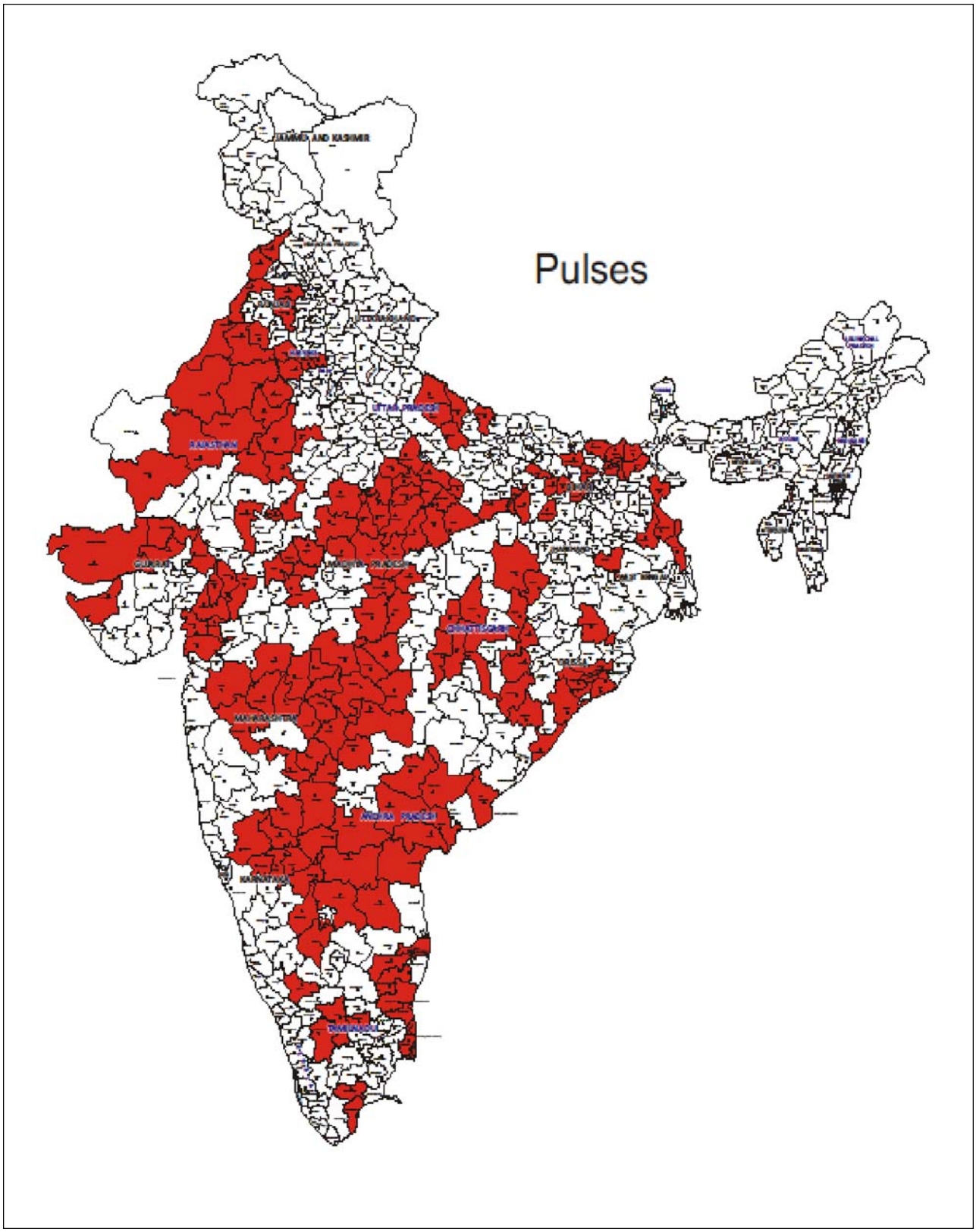
The e**-pest Surveillance programme** of **National Centre for Integrated Pest management (NCIPM**) conducted in 72 A3P units of pigeon pea and chick pea has been successful in controlling major pests and diseases and the same model has been adopted by states in other units also.

Initiation of new initiative of **Integrated Development of Sixty Thousand Pulse Villages Scheme** in 2010-11 to enhance pulses production in selected watershed areas in major pulses growing states. During 2011-12, 11 pulses growing states constituting nearly 90% of the pulses areas are provided funds for in-situ moisture conservation- new farm ponds with polythene lining and/or dug wells, seed minikits, A3P units, and market linked extension support through Small Farmers Agri-Business Consortium.

An **expert group** has been constituted under the Chairmanship of **Dr. Y.K. Alagh** to study the constraints and suggest measures for increasing the pulse production. The group is in the process of finalizing its report to comprehensively deal with pulses supply chain like identification of additional areas for pulses production; seed multiplication/ strategy/programme; identification of best agronomic practices; review of price, tariff and trade policies; communication strategies to reach out to farmers; researchable issues.

4.14 A major increase in the productivity of pulses has been noticed in the states of Maharashtra and Uttar Pradesh. The increase in total production of pulses has been on account of improvement in production levels of *tur, urad* and *moong*. The average annual growth rate of area, production and yield of pulses increased significantly during 2000-01 to 2010-11.

Fig. 4.3: Major Pulses growing Districts



Oilseeds

4.15 While the area coverage under oilseeds has slightly declined from 27.52 million hectares in 2004-05 to 27.22 million hectares in 2010-11, due to significant increase in productivity from 885 kg per hectare in 2004-05 to 1193 kg per hectare in 2010-11, the production of oilseeds has touched an all time high. Contributed to by improvement in production of soybean, groundnut and rapeseed & mustard, the total production of the oilseeds during 2010-11 has touched a record level of 32.48 million tonnes, registering an impressive increase over the previous year's production level of 24.88 million tonnes. Production of oil seeds is estimated at 30.53 million tonnes during 2011-12. The average annual growth rate of yield and area under oilseeds has shown a perceptible improvement during 2000-01 to 2010-11 as compared to the 1990s resulting in considerable increase in the production growth.

Sugarcane

4.16 The area under sugarcane has increased from 3.66 million hectares in 2004-05 to 5.08 million hectares in 2011-12. The increase in area coverage under sugarcane has been observed in the States of Uttar Pradesh, Maharashtra and Karnataka. The productivity of sugarcane has shown an upward trend during the period 2004-05 to 2010-11. The maximum productivity of 70,091 kg per hectare of sugarcane was achieved in 2010-11. Production of sugarcane after attaining a record level of 355.52 million tonnes during 2006-07, declined in the subsequent years but has started witnessing an increasing trend in recent years. The total production of sugarcane during 2010-11 was 342.38 million tonnes which is estimated at 347.86 million tonnes during 2011-12. The average annual growth rate of area declined marginally from 2.25% during the 1990s to 1.95% during the 2000s. The rate of growth in yield declined from 0.91% per annum during the 1990s to 0.03% during 2000-01 to 2010-11. However, the average annual growth rate of production declined from 3.16% during 1990-91 to 1999-2000 to 2.2% during 2000-01 to 2010-11.

Cotton

4.17 The area under cotton has shown an increasing trend during the period 2004-05 to 2010-11. It increased from 8.79 million hectares in 2004-05 to 12.18 million hectares in 2011-12. The productivity of cotton has shown an increasing trend during the period 2004-05 to 2010-11 from 318 kg per hectare in 2004-05 to 499 kg per hectare in 2010-11. An upward trend has been observed in the production of cotton from the year 2003-04 onwards. The production of cotton which was 13.73 million bales (of 170 kg each) in 2003-04 has more than doubled and touched a record level of 34.09 million bales in 2011-12. This significant increase is mainly due to significant improvement in the productivity level of cotton. The yield of cotton went up from 307 kg per hectare in 2003-04 to 499 kg per hectare in 2010-11. The average annual growth rate of yield increased significantly from -0.54 percent during 1990s to 9.15 percent during 2000-01 to 2010-11. The average annual growth rate of area

increased from 1.42 percent during the 1990s to 2.66 percent during the 2000s. The combined effect of increase in area and yield on average annual growth rate of production was significant, increase in growth from 0.93 percent during the 1990s to 12.12 percent during 2000-01 to 2010-11.

Jute and Mesta

4.18 The area under jute and mesta which was 0.92 million hectares in 2004-05 has slightly declined to 0.86 million hectares in 2010-11. The productivity of jute has shown an increasing trend during the period 2004-05 to 2011-12 by increasing from 2186 kg per hectare in 2004-05 to 2447 kg per hectare in 2011-12. The production of jute & mesta has increased from 10.27 bales (of 180 kg each) in 2004-05 to 11.82 bales (of 180 kg each) in 2009-10. The production of jute & mesta is estimated at 11.61 million bales (of 180 kg each) in 2011-12.

Special Initiatives/Programmes in Crop Sector

4.19 Since 2004-05, priority has been given to increasing production through five flagship programmes in the crop sector and three in the horticulture sector. A brief account of these programmes is provided below:

National Food Security Mission

4.20 National Food Security Mission (NFSM) aims at achieving an additional production of 10, 8, and 2 million tonnes of rice, wheat and pulses, respectively by the end of 2011-12. The scheme was launched in August, 2007 as a follow up to the special session of the National Development Council convened in May 2007. The scheme was approved with an outlay of Rs 4883 crore for the period from 2007-08 to 2011-12. A sum of about Rs. 3381 crores has been spent till 31 March, 2011.

Salient features of the Mission

4.21 The salient features of the NFSM are as under:

- The Mission has focused on districts in which the productivity of wheat and rice is below the state average. The total area targeted is about 20 and 13 million hectares for rice and wheat, respectively. On the other hand, districts with potential for area expansion and productivity enhancement have been covered under pulses.

- The Mission is being implemented in 480 districts of eighteen states, comprising 142 districts for rice in 15 states; 142 districts for wheat in 9 states and 468 districts for pulses in 16 states. Some of the districts have a common overlap for two or more crops.

- The Mission interventions consist of a judicious mix of proven technological components covering seeds of improved varieties, soil ameliorants, plant nutrients,

farm machines and implements and plant protection measures that are promoted through financial assistance to the farmers coupled with capacity building of farmers and use of innovative extension techniques such as Farmers' Field School and Field Demonstrations. Resource conservation technologies such as zero till seed-cum-fertilizer drill, sprinkler sets and system of rice intensification received special attention in the mission. In addition to these interventions there is provision of local initiatives to address the location specific problems in the district and need-based short and medium term applied and adaptive research projects. Similarly, there is provision for pilot projects on controlling the menace of blue bull and providing community generators in places where adequate ground water is available at shallow depth and the availability of electricity is inadequate.

- Dedicated Project Management Teams (PMTs) have been provided at district, state and national levels to facilitate delivery of planned interventions to farmers. Consultants and Technical Assistants are provided at each level as a part of PMTs.

- There is direct transfer of funds from the centre to a state level nominated autonomous Agency which in turn transfers the funds to the District Agriculture Technology Management Agency (ATMA).

- Publicity campaigns are organized at the national, state and district level through advertisements in print media, video clips on mass media, brochures, fairs, exhibitions, street plays, etc. for popularizing the components of the Mission among farmers and other stakeholders.

- Monitoring and Evaluation are an important and integral part of the Mission. Baseline survey, annual concurrent evaluation, regional workshops and midterm evaluations are required to be conducted for quantitative and qualitative assessment of the programme in a structured manner. National, state and district level monitoring teams are constituted to provide an oversight to the delivery of various planned interventions.

4.22 During the four years of its implementation since 2007-08, significant achievements under NFSM have been recorded in respect of use of new farm practices through 5.33 lakh demonstrations, 68,853 demonstrations on System of Rice Intensification (SRI), 36,554 demonstrations on hybrid rice, distribution of 130.27 lakh qtls of seeds of high yielding varieties of rice, wheat and pulses and hybrid rice, 28.4 lakh improved farm machineries including water saving devices, treatment of 97.74 lakh ha of area with soil ameliorants (gypsum/lime/micro nutrients) and 37.36 lakh ha under IPM practices. Capacity building of farmers has been encouraged by arrangement of 39,741 farmers' field schools (FFS) at the farm level.

Box 4.4: Achievements of NFSM

- **Contribution in record production of Foodgrains & Pulses**: The mission could accomplish the targeted additional production of 20 million tonnes within 4 years of its implementation. As per the 2nd advance estimate of 2011-12, total foodgrain production during 2010-11 (final estimate) was 244.78 million tonnes which have further increased to 250.42 million tonnes in 2011-12 against the pre-NFSM production of 217.28 million tonnes i.e. an additional production of 33.14 million tonnes has been achieved against the target of 20 million tonnes. There has been a record production of 18.24 million tonnes of pulses in 2010-11.

- **Performance of NFSM Rice Districts**: Out of 139 Districts covered under NFSM-Rice programme 83, 82 and 70 Districts recorded higher yields during 2007-08, 2008-09 and 2009-10, respectively when compared with the base year. The reduction in number of districts recording higher yield during 2009-10 was because of severe to moderate drought conditions during the year in many states including in Bihar, Jharkhand, Chhattisgarh, Madhya Pradesh, parts of Uttar Pradesh, Andhra Pradesh, Orissa and parts of Karnataka. The number of districts recording more than a 20% increase in yield were higher than those recording a marginal (0-10%) increase in yield.

- **Performance of NFSM Wheat Districts**: Out of the 141 districts covered under NFSM Wheat, 74, 96 and 82 districts recorded yield gain during 2007-08, 2008-09 and 2009-10, respectively. Number of districts recording yield increases upto 10% were more than those recording 10-20% or higher.

- **Performance of NFSM Pulses Districts**: Out of 171 Pulses Districts, 92, 112 and 103 Districts recorded enhanced yield during 2007-08, 2008-09 and 2009-10, respectively.

Table 4.1: Impact of Food Security Mission (in million tonnes)

Component	2006-07 Production (Pre-NFSM)	2007-08	2008-09	2009-10	2010-11	2011-12 (2nd Adv. Estimate)	Remarks
Rice	93.35	96.69	99.18	89.09	95.98	102.75	6 million tonnes additional production till 2008-09; despite successive droughts in 2009 and 2010, additional production of 9.40 million tonnes over pre NFSM production.
Wheat	75.81	78.57	80.68	80.80	86.87	88.31	Additional production of 12.5 million tonnes compared to 2006-07.
Pulses	14.20	14.76	14.57	14.66	18.24	17.28	Additional production of 3.08 million tonnes compared to 2006-07.
Total foodgrains	217.28	230.78	234.47	218.11	244.78	250.42	Additional production of 33.14 million tonnes compared to 2006-07.

4.23 Building on its strength of targeted interventions backed by direct fund transfers and a strong monitoring set up, the Mission aims to overcome the underlying weaknesses in the form of analytical understanding of some of the laggard districts. There is opportunity for the Mission to create more effective interventions by adopting a cropping system approach instead of restricting cultivation to specified crops. A convergence mechanism for getting support of institutions dealing in critical inputs like credit, water, power, and marketing through assured procurement needs to be created for sustaining gains from the intensive crop development work. Over the years, NFSM has developed functional linkages with R&D organisations involved in the development and popularization of scientific practices (crop varieties, nucleus and breeder seed, prototypes of improved farm and processing implements, machines, plant protection chemicals). This help it to keep abreast with the new technological innovations and their propagation in the field (Table 4.2).

Table 4.2: List of Institutions and Programmes under Sponsorship of NFSM

Organization	Programme
IIPR (ICAR)	Strengthening the breeder seed production and training infrastructure under NFSM-Pulses
	Evaluation and production of cytoplasmic male sterility (CGMS) based hybrids for enhancement of production and stability of yield in pigeon pea
	Front line Demonstrations on Pulses
NCIPM (ICAR)	Increasing chickpea and pigeon pea production through intensive application of Integrated Pest Management
International Rice Research Institute (IRRI)	Production of seed of drought and submergence tolerant rice varieties and their popularization
International Crop Research Institute for the Semi-Arid Tropics (ICRISAT)	Taking hybrid pigeon pea to doorsteps of farmers in India
	Enhancing chickpea production in rainfed rice fallow lands of Chhattisgarh and Madhya Pradesh
	Selection and utilization of water logging tolerant cultivars in pigeon pea
International Centre for Agricultural Research in the Dry Areas (ICARDA)	Enhancing lentil production for food and nutritional security and improved livelihood
	Pre breeding and genetic enhancement in breaking yield barriers in lentil and kabuli chickpea
	Enhancing grass pea production for safe human food, animal food and sustainable rice base production systems in India, Nutritional security and improved rural livelihood
National Bank for Agriculture and Rural Development (NABARD)	An approach to popularize system of rice intensification (SRI) on small and marginal lands
International Maize and Wheat improvement Center (CIMMYT)	To accelerate the pace of adoption and dissemination of cost effective tools and innovative techniques amongst farmers To reduce vulnerability of the risk prone farmers' for improved livelihoods

Macro Management of Agriculture Scheme

4.24 The Macro Management of Agriculture (MMA) Scheme is one of the centrally sponsored schemes formulated in 2000-01 with the objective to ensure that central assistance is spent through focussed and specific interventions for development of agriculture in the states. The scheme initially consisted of 27 Centrally Sponsored Schemes relating to Cooperatives, Crop Production Programmes (for rice, wheat, coarse cereals, jute, sugarcane), Watershed Development Programme (NWDPRA, RVP/FPR), Horticulture, Fertilizers, Mechanization and Seeds Production Programme. With the launching of National Horticulture Mission (NHM) in 2005-06, 10 schemes pertaining to horticulture development were taken out of the purview of this Scheme. The component relating to State Land Use Board (SLUB) has also been discontinued from 1 August, 2009.

Box 4.5. Salient Features of the MMA Scheme

- The practice of allocating funds to States/UTs on a historical basis has been replaced by a new allocation criteria based on gross cropped area and area under small and marginal holdings. The assistance is provided to the states/UTs as 100% grant.
- The subsidy structure has been rationalized to make the pattern of subsidy uniform under all the schemes implemented by the Department of Agriculture & Cooperation. The revised subsidy norms indicate the maximum permissible limit of assistance. States may either retain the existing norms, or increase them to a reasonable level provided that the norms do not exceed the revised upper limits specified.
- Two new components have been added namely, (a) Pulses and oilseeds crop production programmes for the areas not covered under the Integrated Scheme of Oilseeds, Pulses, Oil palm and Maize (ISOPOM), and (b) 'Reclamation of Acidic Soil' along with the existing component of 'Reclamation of Alkali Soil'.
- The permissible ceiling for new initiatives has been increased from the existing 10% to 20% of the allocation.
- At least 33% of the funds have to be earmarked for small, marginal and women farmers.
- Active participation of the Panchayati Raj Institutions (PRIs) of all tiers would have to be ensured in the implementation of the Revised MMA scheme including review, monitoring and evaluation at district and sub-district level.

4.25 In the year 2008-09, MMA was revised to improve its efficacy in supplementing and complementing the efforts of the states towards enhancement of agricultural production and productivity. The role of the scheme has been redefined to avoid overlapping and

duplication of efforts and to make it more relevant to the present agricultural scenario in the states to achieve the basic objective of food security and to improve the livelihood system for rural masses. The Revised MMA scheme comprises 11 sub-schemes relating to crop production and natural resource management.

Rashtriya Krishi Vikas Yojana

4.26 There was substantial deceleration in growth during the Ninth and initial few years of Tenth Plan in the agriculture and allied sectors (growth declined to 2.5% in Ninth plan and was as low as 0.87% during first three years of Tenth Plan, with agriculture and allied sector growth during Tenth Plan being only 2.4%). This was on account of, amongst other reasons, decline in public investment in agriculture which was at 5% of GDP in agriculture in 1980-85 and declined continuously to reach the lowest level of 1.8% in 2000-01, rising slowly thereafter to reach to 2% in 2002-03 and to 3.7 % in 2006-07. Concerned by these trends, the National Development Council (NDC), in its 53rd meeting on agriculture and related issues held on 29 May, 2007, resolved that current agricultural development strategies must be reoriented to meet the needs of the farmers and called upon the central and the state Governments to make fresh efforts to rejuvenate Indian agriculture so as to achieve 4% annual growth during the Eleventh Five Year Plan. To achieve this objective, the NDC, inter alia, resolved to launch the Rashtriya Krishi Vikas Yojana (RKVY) as an Additional Central Assistance Scheme (ACA) for Agriculture & Allied Sectors with an envisaged outlay of Rs.25,000 crore during the Eleventh Five Year Plan.

4.27 RKVY is primarily a project oriented scheme. However, RKVY provides for additional outlays on existing state and central schemes in non-projectized mode also. Accordingly, RKVY funds can be utilized by the States in two streams.

- **Stream-I:** A minimum of 75% of the RKVY fund is to be used for specific projects/ schemes/ programmes which have been approved as part of the state and district plans.
- **Stream-II:** A maximum of 25% of the total RKVY funds can be used in a year for strengthening the existing state sector schemes.

4.28 RKVY incentivizes the states to increase public investment in agriculture and allied sectors taking agro climatic conditions, natural resource issues and technology into account and integrating livestock, poultry and fisheries more fully while providing more flexibility and autonomy in planning and execution of schemes. RKVY funds allocation criterion builds in incentives for increased expenditure on agriculture and allied sector. It also directs allocations to the rainfed states and states with higher growth potential in agriculture. Allocation criterion is reproduced in Table 4.3.

Table 4.3: RKVY Allocation Criteria

RKVY Allocation Criteria Parameter	Weight
The percentage share of net un-irrigated area in a state to the net un-irrigated area of the eligible states. Eligible States are those States that become eligible to avail of the RKVY Scheme based on their baseline level of expenditure under the State Plan and preparation of District and State Agricultural Plans.	20%
The projected growth rates to a base year GSDP for agriculture and allied sectors (say, 2005-06) will be applied to the GSDPs to be attained by the end of the 11th Plan by the States. The parameter will be set in terms of inter-state proportion of these GSDPs projected to be reached by the State by the end of the 11th Plan.	30%
Increase in the total Plan expenditure in agriculture and allied sectors in the previous year over the year prior to that year.	50%

4.29 RKVY was initiated with a relatively small allocation of Rs. 1489.70 crore in the first year, i.e., 2007-08. However, allocation for the Scheme has been increasing year after year and in 2011-12, Rs. 7860 crore have been provided. States have taken up over 4000 projects under the RKVY all across agriculture and allied sectors that include the following: crops, horticulture, organic farming, farm mechanization, micro and minor irrigation, watershed development, agriculture marketing and storage, seed farms, soil and fertilizer testing laboratories, animal husbandry, dairy development, fisheries, extension and agricultural research, etc. Critical infrastructure such as State Seed Farms, Soil and Fertilizer testing laboratories, starved over the years due to paucity of funds, got a much needed dose of assistance across the states. RKVY does not prescribe any specific sector or intervention to be taken up under RKVY projects. States have the flexibility to choose those projects which, in their judgement, are likely to generate growth in agriculture and allied sectors and will contribute to the objectives of RKVY. RKVY guidelines contain only an indicative list of components/activities which States can take up. This is given in Box 4.6.

Box 4.6 Areas of Focus under RKVY

(i) Integrated development of major food crops such as wheat, paddy, coarse cereals, minor millets, pulses, oilseeds

(ii) Agriculture mechanization

(iii) Activities related to enhancement of soil health

(iv) Development of rainfed farming systems in and outside watershed areas, as also integrated development of watershed areas, wastelands, river valleys

(v) Support to State seed farms

(vi) Integrated Pest Management

Box 4.6 Areas of Focus under RKVY (contd.)

(vii) Encouraging non-farm activities
(viii) Strengthening of market infrastructure and marketing development
(ix) Strengthening of infrastructure to promote extension services
(x) Activities relating to enhancement of horticultural production and popularization of micro irrigation systems
(xi) Animal husbandry and fisheries development activities
(xii) Special schemes for beneficiaries of land reforms
(xiii) Undertaking 'concept to completion' projects
(xiv) Grant support to the state government institutions that promote agriculture/ horticulture
(xv) Study tours of farmers
(xvi) Organic and bio-fertilizers
(xvii) Innovative schemes

Some of the agricultural activities initiated or infrastructure created by states under RKVY Scheme are shown below:

Fig. 4.4. Low Cost Onion Storage – Maharashtra

Fig. 4.5. Farm Pond -Maharashtra

Fig. 4.6. Transplanter – Tamil Nadu

Fig. 4.7. Precision Farming-Banana– Tamil Nadu

4.30 The RKVY format has enabled the launch of new schemes and programmes keeping the states' flexibility and authority intact. The Finance Minister in the Budget Speech, 2011-12 announced five new special initiatives as part of the RKVY, with a continued sub-scheme of Bridging Green Revolution for Eastern India and a modified 60,000 villages integrated development scheme to limit it to pulses. Additionally, the Rainfed Area Development Programme (RADP) and Saffron Mission are also being implemented during 2011-12 as part of RKVY. Five new sub schemes taken up during 2011-12 include Vegetable Initiative for Urban Clusters, Initiative for Nutritional Security through Intensive Millets Promotion, National Mission for Protein Supplements and the Accelerated Fodder Development Programme. In all, nine special Programmes and schemes will be implemented as sub-schemes of RKVY in the current financial year with a total allocation of Rs.2500 crore as indicated below in Table 4.4

Table 4.4: New Sub-Schemes of RKVY, 2011-12

New Sub-Schemes of RKVY 2011-12		
Sl. No	**Sub Scheme**	**Allocation (Rs. in crore)**
i)	Bringing Green Revolution to Eastern Region (BGREI)	400
ii)	Integrated Development of 60,000 Pulses Villages in Rainfed Areas (60,000 Pulses Villages)	300
iii)	Special Programme on Oil Palm Area Expansion (Oil Palm)	300
iv)	Vegetable Initiative for Urban Clusters (Vegetable Clusters):	300
v)	Initiative for Nutritional Security through Intensive Millets Promotion (Nutri-cereals)	300
vi)	National Mission for Protein Supplements (Protein Supplements)	300
vii)	Accelerated Fodder Development Programme (AFDP)	300
viii)	Rainfed Area Development Programme (RADP)	250
ix)	Saffron Mission- Economic Revival of J&K Saffron	50
	Total	**2500**

4.31 The nine sub-schemes have very specific objectives.

1. ***Bringing Green Revolution to Eastern Region:-***Rs. 400 crore have been allocated for extending technologies to improve the productivity of the rice-based cropping system in the Eastern Region of the country. The programme is being implemented in seven Eastern States of Assam, West Bengal, Orissa, Bihar, Jharkhand, Eastern Uttar Pradesh and Chhattisgarh.

2. ***Integrated Development of 60,000 pulses villages in rainfed areas:- To a***ttain self-sufficiency in the production of pulses within the next three years, Rs.300 crore is to be made available annually to promote 60,000 pulses villages in rainfed areas for increasing crop productivity and strengthening of market linkages.

3. ***Promotion of Oil Palm:-*** To achieve a major breakthrough, special attention is being paid to oil palm as it is one of the most efficient oil crops. An amount of Rs. 300 crore is allocated to bring 60,000 hectares under oil palm plantation and for integrating the farmers with the markets.

4. ***Vegetable Initiative for Urban Clusters:- The g***rowing demand for vegetables will be met by the creation of vegetable production clusters around major cities and effective market linkage; an efficient supply chain is being established, to provide quality vegetables at competitive prices for which an outlay of Rs.300 crore is provided.

5. ***Nutri-cereals:-*** To promote balanced nutrition, a higher production of bajra, jowar, ragi and other millets are being promoted. Additionally, projects are being taken up to upgrade their processing technologies and create awareness regarding their health benefits. This initiative would provide market linked production support to ten lakh millet farmers in the arid and semi-arid regions of the country. The programme has been taken up in 1000 compact blocks covering about 25,000 villages. The outlay for this programme is also Rs. 300 crore.

6. ***National Mission for Protein Supplements:- This*** Mission was launched with an allocation of Rs.300 crore to take up activities to promote animal based protein production through livestock development, dairy farming, piggery, goat rearing and fisheries in selected blocks.

7. ***Accelerated Fodder Development Programme:- This aims t***o accelerate the production of fodder through intensive promotion of technologies to ensure its availability throughout the year. Rs.300 crore will be provided for this purpose targeting farmers in 25,000 villages

8. ***Rainfed Area Development Programme***: An allocation of Rs. 250 crore has been made for this. The basic premise of the scheme is to exploit the potential of different farming systems based upon the natural resource and endowments created either by the farmers or through schemes like MGNREGA, RKVY, NHM and Watershed Projects.

9. ***Saffron Mission*** has been launched to boost the production of saffron in the Jammu &Kashmir State with an allocation of Rs. 50 crore during 2011-12.

4.32 There is now good evidence to show that States have indeed stepped up allocation to agriculture and the allied sector. Allocation to agriculture and the allied sector was only Rs 6997 crore, i.e., 4.86% of total State Plan Expenditure in 2005-06. Revised Estimates for

2010-11 suggest that States' allocation increased to Rs.22467 crore which is 6.05% of the total State Plan. As reported in the electronic online system RKVY Database and Management Information System (RDMIS), a total of 4117 projects have been initiated and taken up by the states since the commencement of the RKVY in 2007-08. The RKVY may be seen as a quantum jump in evolution from the variegated schematic approach to a completely new approach which emphasizes decentralized agricultural planning. It envisages that states would prepare comprehensive district and State Agriculture Plans for building projects which are best suited to local conditions to catalyze the existing production scenario for achieving higher production in agriculture and the allied sector, thereby giving the required flexibility to the states. RKVY has emerged as a principal instrument for development of agriculture and the allied sector in states and has indeed accelerated the revival of agriculture.

Integrated Scheme of Oilseeds, Pulses, Oil palm and Maize (ISOPOM)

4.33 The Technology Mission on Oilseeds (TMO) was launched in May, 1986 with a view to increase the production and productivity of oilseeds to make the country self reliant in this vital sector. Subsequently pulses, oilpalm and maize were also brought into the ambit of the Technology Mission in 1990, 1992-93 and 1995-96, respectively. In order to provide flexibility to the states in implementation based on a regionally differentiated approach, to promote crop diversification and to provide focused approach to the programmes, the four erstwhile schemes of the Oilseeds Development Programme (OPP), Oil Palm Development Programme (OPDP), National Pulses Development Programme (NPDP) and Accelerated Maize Development Programme (AMDP) have been merged into a Centrally Sponsored Integrated Scheme of Oilseeds, Pulses, Oilpalm and Maize (ISOPOM) which is being implemented from 1 April 2004. The pulses component of ISOPOM scheme has been merged with the National Food Security Mission (NFSM) from 1 April 2010.

Fig. 4.8: BHOOCHETNA – Maize Intercropping with Red Gram – Karnataka

Table 4.5: Physical Targets & Achievements of Oilseeds, Pulses, Maize & Oil Palm during XI Plan

(Production in Lakh Tonnes)

Crops	2007-08		2008-09		2009-10		2010-11	
	Tar.	Ach.	Tar.	Ach.	Tar.	Ach.	Tar.	Ach.
Oilseeds	300.00	297.55	317.50	277.19	316.00	248.82	332.00	324.8
Pulses	155.00	147.61	155.00	145.67	165.00	146.62	165.00	182.4
Maize	160.00	189.55	195.00	197.31	205.00	167.19	214.00	217.8
Oil Palm*	29300	21329	31500	26178	46750	15841	28770	17925
*Area Expansion in Ha.								

Source: DES, MOA

Performance of Oilseeds Production Programme

4.34 The diverse agro-ecological conditions in the country are favourable for growing nine oilseeds which include seven edible oilseeds (groundnut, rapeseed & mustard, soybean, sunflower, sesamum, safflower and niger) and two non-edible oilseeds (castor and linseed). The oilseeds, raised mostly under rainfed conditions, are important for the livelihood of small and marginal farmers in arid and semi arid regions of the country. Consequent upon the setting up of Technology Mission on Oilseeds (TMOP) a major breakthrough in increasing oilseeds production was achieved through an integrated approach by introducing new crop technologies, better supply of inputs and extension services support for marketing and post harvest technologies and excellent coordination and cooperation between various organizations, departments and ministries. As a result of concerted efforts by the TMOP, the production of oilseeds increased from 10.83 million tonnes in 1985-86 to 25.19 million tonnes in 2003-04 (prior to ISOPOM). This was brought about not only by increase in area but also by improving the productivity from 570 kg to 1064 kg per hectare during that period.

4.35 Under ISOPOM, the states have been given the flexibility to implement crop development programmes of their choice, which has helped in sustainable increase in the area of oilseeds. Prior to ISOPOM, the average area of oilseeds (five year average) in the country was 22.97 million hectares which has increased to an average of 26.89 million ha till 2010-11 (seven year of ISOPOM). Improvement has also been achieved in production from an average of 19.97 million tonnes in the preceding five years of ISOPOM scheme to 27.03 million tonnes average during the seven years period of ISOPOM implementation. Similarly, the productivity of oilseeds in the five years preceding ISOPOM was at 866 kg per ha which has now increased to 1002 kg per ha. Due to concerted efforts under ISOPOM coupled with mostly favourable agro-climatic conditions, with the exception of drought in 2009-10, the enhancement of productivity resulted in a record production of 32.48 million tonnes during 2010-11.

Soybean

4.36 Soybean is a rain fed crop grown in the *Kharif* season only**.** The area under soybean has increased from 6.56 million ha in 2003-04 (before ISOPOM) to 10.19 million ha in 2011-12 The increase in production rose from 7.82 million tonnes in 2003-04 to a record of 12.74 million tonnes in 2010-11. The productivity of soybean has increased from 1193 kg per ha to 1327 kg per ha during the same period. However, due to unfavorable weather conditions during 2008-09 in states like Andhra Pradesh, Karnataka, Maharashtra and Rajasthan and drought in 2009-10, productivity of soybean declined from 1235 kg per ha in 2007-08 to 1041 kg per ha in 2008-09 and 1024 kg per ha in 2009-10.

Groundnut

4.37 About 86 percent cultivation of groundnut area is in *Kharif* season dependent on monsoon rains**.** The area under groundnut has increased from 5.99 million ha in 2003-04 (before ISOPOM) to 6.29 million ha in 2007-08 with an increase in production from 8.13 million tonnes in 2003-04 to a record of 9.18 million tonnes in 2007-08. The area under groundnut is hovering around 6.00 million hectares. The productivity of groundnut has increased from 1357 kg per ha in 2003-04 to 1459 kg per ha in 2007-08. However, due to unfavorable weather conditions during 2008-09 in states like Andhra Pradesh, Karnataka, Maharashtra and Rajasthan, and drought in many oilseeds growing states, the productivity of groundnut has not achieved the productivity level of 2007-08. The productivity of groundnut suffered a loss slipping from 1459 kg per ha in 2007-08 to 991 kg per ha in 2009-10 but this recovered to 1411 kg per ha in 2010-11 but declined marginally to 1337 in 2011.12.

Rapeseed and Mustard

4.38 Over 90 percent concentration of the rapeseed and mustard area is in six states *viz*; Rajasthan, UP, MP, Haryana, West Bengal and Gujarat. Rajasthan State alone contributes to the extent of 47% in area and 50% in the production of mustard. Area under mustard was 5.43 million ha in 2003-04 which was increased to 7.32 million ha in 2004-05, 7.28 million ha in 2005-06 and declined thereafter to 6.90 million ha in 2010-11 and to 6.70 in 2011-12. The area, production and yield of mustard suffered losses during 2007-08 due to unfavourable weather conditions in the mustard growing regions of Rajasthan, Haryana and Madhya Pradesh at the time of sowing and later due to a cold wave during winter in these areas. Average yield of mustard, during the preceding five years, prior to ISOPOM was at 866 kg per ha which increased to 1102 kg per ha during the seven years of ISOPOM implementation. This indicates a tangible impact by the efforts for productivity enhancement under ISOPOM. The decline and stagnation in production primarily reflects the stagnation and laggard improvement in area coverage in mustard growing states.

Performance of Maize Production Programme

4.39 During 2010-11, maize was grown on an area of 8.55 million hectares with an all time record production of 21.73 million tonnes. About 88 % of cultivated maize is *Kharif* rainfed. Maize is cultivated mainly for food, fodder, feed and industrial use. More than 3500 value added products of daily application are derived from maize. With the objective of enhancing

maize production and productivity in the country, it was included in the Technology Mission on Oilseeds & Pulses in May, 1995. Since then, the Accelerated Maize Development Programme (AMDP) has been in implementation on Mission Mode Approach up to 31 March, 2004. However, from 1 April, 2004, the Accelerated Maize Development Programme (AMDP) has been merged into ISOPOM for overall development of these crops in the country. Fifteen major maize growing states are covered under ISOPOM. Interesting approaches have been adopted in some states to promote Maize (Box 4.7).

Box 4.7: Golden Rays Project

For increasing the productivity of maize in tribal districts namely, Udaipur and Banswara, the State Government of Rajasthan launched a project called 'Golden Rays' from *Kharif*-2009 in the public private partnership mode. Under this project, quality seed grown by leading private sector companies was procured by the State Government for supply to the farmers. Extension support for adoption of the recommended package of practices and market support for assured procurement of the produce was provided by the private sector companies. More than one million farmers have benefitted under this scheme and the. productivity of maize has improved substantially in the project districts.

Table 4.6: Major Achievements in Area, Production & Productivity of Maize

Year	Area (Million ha.)	Production (Million Tonnes)	Yield (Kg/ha.)
1995-96 (TMO)	5.98	9.53	1595
2004-05 (ISOPOM)	7.43	14.17	1907
2005-06	7.59	14.71	1938
2006-07	7.89	15.10	1912
2007-08	8.12	18.96	2335
2008-09	8.17	19.73	2414
2009-10	8.26	16.72	2024
2010-11	8.55	21.73	2540
2011-12*	8.67	21.60	2492

*Note: *: 2nd Advance Estimates released on 3.2.2012*
Source: DES, DAC.

Oil Palm

4.40 Oil palm plantations exist mainly in the states of Andhra Pradesh, Kerala, Karnataka, Tamil Nadu, Orissa, Gujarat, Goa, Assam, Tripura and Mizoram. An area of 189,625 ha has been planted under OPDP up to 2010-11. There were some instances of uprooting of oil palm plants to the extent of 17,944 ha due to a sharp decline in prices, because of huge imports. The net area under oil palm plantations is now estimated at 171,681 ha up to the end of year 2010-11. During 2011-12, a provision of Rs. 300 crores has been made under

Rashtriya Krishi Vikas Yojana (RKVY) for bringing 60,000 hectares under oil palm during 2011-12. Under oil palm plantations, a strategy indicating state specific targets for area expansion, interventions, pattern of assistance, research and development components, institutional linkages, monitoring, initiatives for creating processing facilities in needy states have been highlighted to augment the production of palm oil after four to five years. Efforts are being made to expand the area under oil palm cultivation so that domestic production of edible oils is increased. Accordingly, the Department of Agriculture and Cooperation has formulated a new scheme namely, Oil Palm Area Expansion (OPAE) programme under RKVY. OPAE is being implemented in eight states in 2011-12.

Finance Commission Grants for Agricultural Projects

4.41 The Thirteenth Finance Commission has recommended States Specific Grants (SSGs) to address the needs of marginal areas or groups, provision for infrastructure in border areas, protection of certain monuments of historical or archaeological value, provision of safe drinking water, bridging of gaps in critical infrastructure for health, including care for children, and skill upgradation and police related requirements. For the agriculture sector, the Commission has recommended a total grant of Rs. 754 crore for eight states namely, Andhra Pradesh, Arunachal Pradesh, Gujarat, Jammu & Kashmir, Meghalaya, Nagaland, Orissa and Uttar Pradesh. Details are given in Table 4.7.

Table 4.7: Grants Recommended by Thirteenth Finance Commission for Agriculture Sector

Sl. No.	Name of State	Amount (Rs. in Crore)	Brief of Scheme
1	Andhra Pradesh	100	To increase production of seeds by replacing old machinery, providing new processing and storage facilities, etc.
2	Arunachal Pradesh	15	For construction of Public Distribution System (PDS) godowns at vulnerable locations to ensure transportation and storage of essential commodities for the PDS.
3	Gujarat	150	To address the problem of Ingress of Salinity in 10.69 lakh hectares of land affected in more than 600 coastal villages.
4	Jammu & Kashmir	15	Setting up of cold storage units at Leh Khaltsi and Nubra, as well as construction of godowns for storage of grains, setting up of vegetable cellars and promoting vegetable processing units.
5	Meghalaya	40	(i) Rs.38 crore for up-gradation of existing infrastructure to promote expansion in horticulture, including traditional horticulture and plantation crops. (ii) Rs.2 crore for construction of warehouses at Tura and Baghmara of West Garo Hills and South Garo Hills district, respectively.
6	Nagaland	20	For construction of warehouses for storage as well as development of horticulture markets in the state.
7	Orissa	60	Construction of 150 market yards to provide an efficient marketing structure at the block level.
8	Uttar Pradesh	354	For setting up 2101 agriculture marketing hubs, each of which would provide grain storage, farmer service centres, banks and primary processing units.
	Total	754	

4.42 The department of Agriculture & Cooperation has constituted a Committee under the chairmanship of Secretary (A&C) including, *inter alia*, Financial Adviser, DAC and a representative of the Department of Expenditure to review the working plans of states to ensure complementarities of activities to be undertaken from this grant and those under existing schemes and programmes of the central government, to avoid any duplication of expenditure, and to monitor progress in the implementation of the grants on a regular basis.

Externally Aided Projects (EAPs)

4.43 The following externally aided projects are being directly coordinated by the Department of Agriculture and Cooperation.

World Bank

4.44 Five agriculture sector projects relating to Watershed Development, Soil and Water Conservation measures, development of competitive agricultural marketing systems with an objective of overall agricultural development are being operated with the assistance of the World Bank. These projects, taken together, involve a total IDA credit of XDR 387 million. Cumulative drawals of the IDA credit assistance for the five ongoing projects since their commencement up to October 2011 aggregates to XDRs 184.43 million, which constitutes about 47.66% of their total committed IDA credit assistance. Details of these projects are given in Table 4.8.

Table 4.8: World Bank Assisted Agriculture Projects

Sl. No.	Project/States Covered	Effective Date of Operation	Closing Date of Operation	IDA Credit	World Bank assistance already utilized/ availed upto October 2011
				(In million XDRs)	(In million XDRs) IDA credit
1.	Assam Agricultural Competitiveness Project	14.01.2005	15.03.2012	105.00	83.01 (79.06)*
2.	Uttarakhand Decentralized Watershed Development Project(#)	30.07.2004	31.03.2012	47.40	46.27 (97.62)*
3.	H.P. Mid Himalayan Watershed Dev. Project	19.01.2006	31.03.2013	41.40	33.37 (80.61)*
4.	Uttar Pradesh Sodic Lands Reclamation Project-III	20.7.2009	31.12.2015	127.30	18.11 (14.22)*
5.	Maharashtra Agricultural Competitiveness Project	02.11.2010	31.12.2016	65.90	3.67 (5.57)*
	Total (1 to 5)			387.00	184.43 (47.66)

Note: *XDR = Special Drawing Rights, IDA = International Development Agency.*
* *Percentage utilization* vis a vis *credit amount.*
 # the project has also been provided with additional funding of XDRs 5.10 Million and till October 2011, XDR 1.18 million has been reimbursed.
Source: *Controller of Aid Accounts & Audit (CAA&A) of Department of Economic Affairs.*

International Fund for Agriculture Development (IFAD)

4.45 At present, this Department is implementing one IFAD assisted agricultural project *viz.* 'Convergence of Agriculture Interventions in Maharashtra's Distressed Districts'. The project became credit effective from 30 September 2009 and is scheduled to run till 30 June 2018. The project has assistance of XDRs 26.82 millions till October 2011. IFAD has reimbursed the project a sum of XDRs 1.67 million constituting 6.24 % of the loan amount.

Japan International Cooperation Agency

4.46 'Himachal Pradesh Crop Diversification Promotion Project' being implemented with Japan International Cooperation Agency(JICA) assistance of ¥5001 million became effective from 17 February 2011 and is scheduled to run upto 15 June 2021.

German Technical Cooperation

4.47 At present, this Department is implementing one project with German Technical Cooperation (GIZ) namely, 'Strengthening Capacity Building for Decentralised Watershed Development'. The objective of the project is to strengthen the capacities and networking of regional and state organisations for decentralised watershed management. The project is being implemented in the states of Karnataka, Rajasthan and Uttarakhand on a pilot basis. The project was launched in December 2006 and ended in November 2011. The total grant from GIZ being • 3.5 millions.

Challenges

4.48 Indian agriculture is mainly dependent on the monsoon. If the monsoon fails or a shift in its timing occurs, then the crops are damaged. More frequent occurrence of floods and droughts, predicted climate change, can cause extensive damage to crops and therefore impact food security. The reduction in yield from rain-fed crops is predicted as high as 50 percent in some locations. With climate change, a relatively sizable chunk of land is likely to become uncultivable due to water shortage and some land in the coastal belt is going to be inundated due to sea level rise. Although the Missions have met with commendable success in achieving the goals in terms of enhanced production and reaching out with quality inputs to the relatively weak districts, there is a lot which could be done to improve their implementation, monitoring and evaluation.

NFSM

- Some states did not deploy dedicated technical manpower provisioned for engagement in the Mission. This adversely affected the collection and analysis of data both at the district and state level.
- Better Coordination is desired between State Departments of Agriculture and input supplying agencies such as State Seed Corporation, State Agro-industries Corporation, and Agricultural Marketing Federation.
- Seed Replcement Rate (SRR) has been targeted without matching the seed production plan in some States. This approach is bound to delay adoption of latest improved varieties.

ISOPOM

Maize

- About 89% of the area under maize in the country is *Kharif* rainfed.
- The prevalence of local poor yielding varieties requires interventions.
- There is a need for varieties and hybrids of different maturity groups namely, long , medium and short duration hybrids and varieties with high yield potential suitable to various agro-climatic regions.
- Drought, pest and insect tolerant or resistant hybrids and varieties suitable to different agro-climatic zones are required.
- Poor resource farmers ability to spend on good quality seeds, fertilizers, pesticides and fungicides, etc. to be considered.
- Persistence of traditional cultivation practices in the interior and remote areas.

Oilseeds

- There is very high fluctuation in the production and productivity of oilseeds due to intermittent dry spells in *Kharif* season, insect pest infestation and aberrations due to various other factors in some areas and states.
- Despite increasing trend in production and productivity of oilseeds, the gap in demand and domestic supply of edible oils is widening every year resulting in pressure for immediate improvement of production and yield of oilseeds in the country. In 2009-10, the dependence on imported edible oils has been almost at 50% of the requirement of edible oils.

Oil Palm

- There is low availability of planting material in the country. State Governments are importing planting material from different oil palm growing countries.
- In India, cultivation of oil palm is carried out in small holdings and is mostly dependent on tube wells for irrigation.
- Lack of a proper package of practice for specific sites, i.e. oil palm being an exotic and new crop, very little data and management practices are available for its cultivation in various agro-climatic conditions.
- Synchronization of area expansion under oil palm vis à vis creation of processing facilities has to be devised.
- Socio–economic problems are palpable with small and marginal farmers. It needs immense courage from the farmer to spare land for at least 30 years for undertaking oil palm cultivation in his field which results in delayed decision making.
- Variation in import duty on edible oils on year to year basis results in major fluctuations in oil palm FFBs prices in the domestic markets.
- Oil palm has a long gestation period and restricts income flow to farmers for at least 4-5 years.

The Way forward

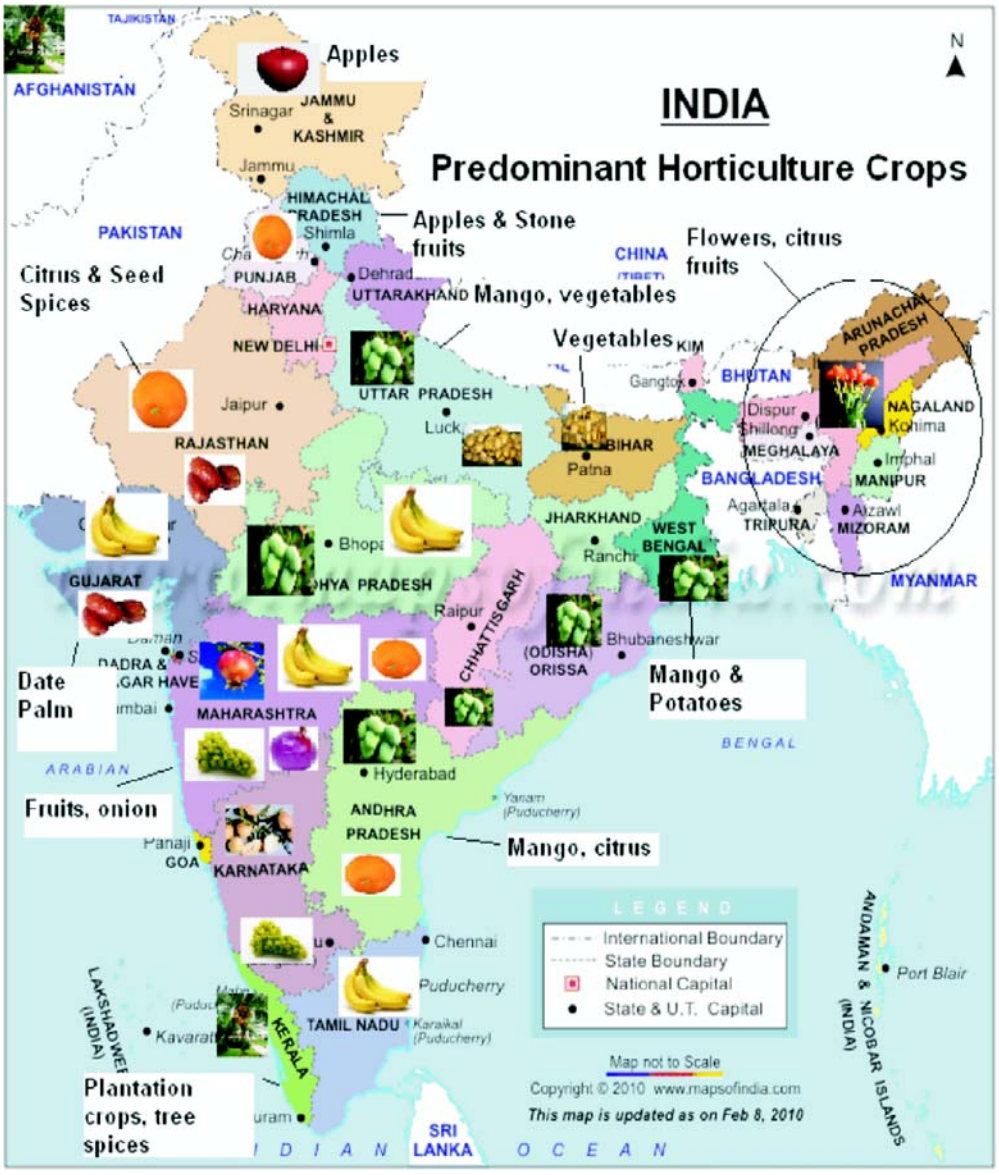
4.49 The measures to increase agriculture production and ensure food security include the following:

- The future of food security is highly dependent on two important and inter-related factors, first the ability to succeed and absorb the technology for raising agricultural productivity, and second effecting measures to successfully adopt to climate change. There is need for an increased, stable, low cost environmentally sustainable food production.
- In addition, agriculture needs to be diversified to meet the changing dietary preference and for realizing higher income for the farmers.
- SRR linked seed production plan should be developed for each state. The seed plan needs to be regularly monitored with the implementing agencies by the State Seeds Committee established under the Director of Agriculture.
- Area in NFSM states depends on rainfall, available land, water resources and socio-economic conditions which vary across states. There is a need to refine interventions in order to make them agro-climatic and region-centric. This approach will make the programme more scientific and effective in terms of its impact on productivity of the mandated crops. Development of district level action plans will have to be insisted upon which are based on the Comprehensive District Agriculture Plan (CDAP) already prepared for implementing the RKVY scheme.
- Further, the programme should focus on dominant cropping system rather than on a single crop. Rice, wheat and pulses-based cropping systems should be considered. The major cropping systems include: rice-rice, rice-chickpea, rice-wheat, wheat-chickpea and pulses-wheat. Such an approach would pay attention to companion crops of the system rather than focusing on one crop which in any case is dependent on the duration and practices of the other crop.
- There is demand to include Coarse Cereals also in the Mission crops that are part of the foodgrains category. This needs special attention considering that millets are being considered for inclusion in the proposed National Food Security Act.
- The component relating to Strategic Research is missing in the Mission formulation. The mission was conceived initially to promote proven technologies to the deficit districts. However, from experience it is felt that there is need to sponsor strategic and adaptive research to meet the site-specific requirements of low producing Districts. Such research could be sponsored through the ICAR, State Agriculture Universities and the CGIAR bodies working in India to cover the aspects relating to rapid development of products in plant breeding, control of pest and diseases, new farm machines to address different specific constraints faced by districts while extending technologies to farmers.

Horticultural Crops

4.50 Production of horticultural crops has increased considerably as compared to the situation a couple of decades ago. The area under horticulture crops has increased from 16.6 million ha in 2001-02 to 22.25 million ha in 2011-12 with a corresponding increase in production from 145.8 million tonnes to 247.54 million tonnes, with a productivity level of 8.8 to 11.13 tonnes per ha. Thus, there has been a phenomenal increase in area, production and productivity during this period amounting to 34 percent, 70 per cent and 26 percent, respectively. With the growth trend, horticulture is expected to play a dominant role in the overall development of agriculture in the country in the coming years. Fruits and vegetables, together, constitute about 92% of the total horticultural production in the country.

Fig. 4.9: Predominant Horticulture Crops



Fruits

4.51 During 2011-12, the area under fruit crops is at 6.58 million ha with a production of 77.52 million tonnes, which contributes to a 32% share in total production. While India is the second largest producer of fruits in the world, it is the largest producer of fruits like mango, banana, papaya, sapota, pomegranate and aonla.

Vegetables

4.52 Within horticulture, vegetable is a very important produce, which occupies 8.49 million ha with a total production of 149.61 million tonnes having a productivity of 17.42 tonnes per ha. The area under vegetables in India increased from 6 million ha in 2001-02 to 8.49 million ha during 2011-12. India is the second largest producer of vegetables after China and is a leader in the production of peas and okra. Besides, India occupies the second position in the production of brinjal, cabbage, cauliflower, onion, potato and is third in tomato production in the world. Vegetables that are produced in abundance are potato, onion, tomato, brinjal, okra, cucurbits, etc.

Flowers

4.53 India has made noticeable advancement in the production of flowers, particularly cut flowers, which have a high potential for exports. Floriculture during 2011-12 covered an area of 0.19 million ha with a production of 1.03 million tonnes of loose flowers and 69,027 million numbers of cut flowers.

Spices

4.54 India is the largest producer, consumer and exporter of spices and spice products in the world. Over 100 plants species are known to yield spices and spice products among which around 50 are grown in India. The spice production in India is currently at 5.73 million tonnes from an area of about 3.03 million ha.

Plantation crop

4.55 The total production of plantation crops during 2011-12 has been 12.99 million tonnes from an area of 3.35 million ha. Coconut accounts for the major share of the production of plantation crops, followed by cashew nut and areca nut. There has been substantial increase in foreign trade of cashew nuts, which provides good remuneration to the farmers.

Medicinal and aromatic plants

4.56 India is considered a treasure house of valuable medicinal and aromatic plants, which provide raw material for the formulation of indigenous medicines apart from exports. The Government of India has identified and documented over 9,500 plant species considering their importance in the pharmaceutical industry. Of these, about 65 plants have a huge and consistent demand in world trade. There has been an appreciable increase in the area and production of medicinal and aromatic plants over the years.

Exports

4.57 The Department of Agriculture and Cooperation has identified some of the fruits (mango, grapes, litchi, mandarins, kinnow, cashew, walnut, pomegranate, aonla), vegetables (potato, onion, chilli, bitter gourd, okra), spices (black pepper, ginger, turmeric, cumin, large cardamom) and floriculture crops and items (rose, cymbidium orchid, anthurium, cutgreens and dry flowers) for export promotion. In the processed products sector, mango pulp, canned mushroom and gherkins, banana puree, tomato puree, tomato paste, aonla, bael, cashew and apple juice are identified as having good export potentials.

Processing

4.58 In India, the level of processing has been low, being only 2 percent of fruits and vegetables. As processing is becoming increasingly important to help farmers to realize a better price, certain indigenous value added products like fruit drinks from lesser known fruits including health drinks have been developed.

Self sufficiency in F&Vs

4.59 As per the Indian Council of Medical Research and National Institute of Nutrition, Hyderabad, the per capita minimum requirement of fruit and vegetable is 92 g and 300 g per day, respectively. Thus a total requirement as per the 2011 census is 40.64 million tonnes of fruits and 132.52 million tonnes of vegetables per annum, in the country. Since the fruit and vegetable production in the country during 2010-11 was 77.52 million tonnes and 149.69 million tonnes, respectively, it indicates that the country has achieved self sufficiency in the minimum nutrition requirement of fruit and vegetable.

Special Initiatives/Programmes in Horticulture sector

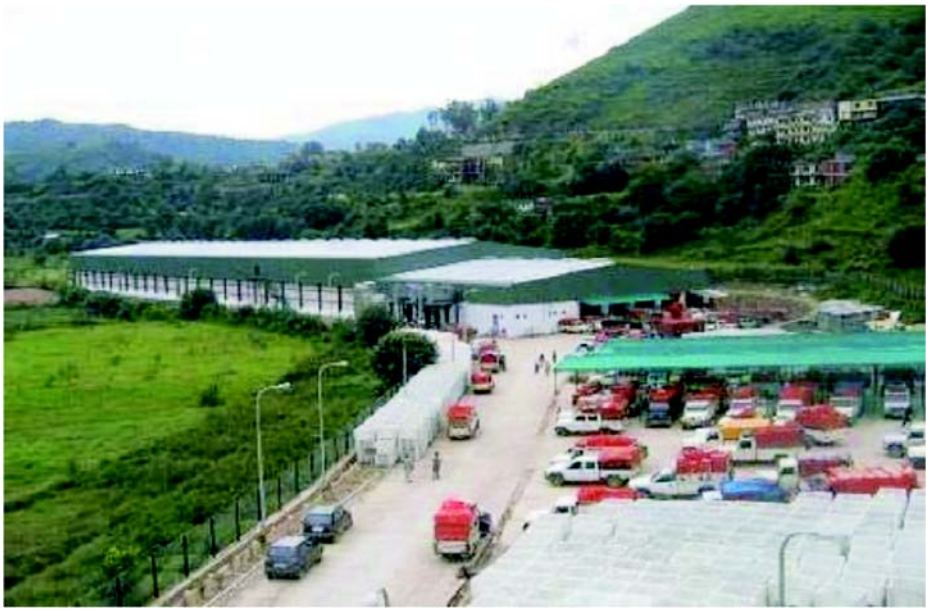
National Horticulture Mission (NHM)

4.60 The Centrally Sponsored Scheme on National Horticulture Mission (NHM) is being implemented in the country since 2005-06, for the holistic development of the horticulture sector duly ensuring forward and backward linkages by adopting a cluster approach, with the active participation of all the stakeholders. All the states and three union territories of Andaman Nicobar Islands, Lakshadweep and Puducherry are covered under the Mission with the exception of the eight North Eastern States including Sikkim and the States of Jammu & Kashmir, Himachal Pradesh and Uttrakhand, which are covered under the Horticulture Mission for North East & Himalayan States (HMNEHS). Apart from the states and union territories, 13 National Level Agencies (NLAs) have been included to provide support for the developmental efforts, which require inputs at the national level. All horticulture crops such as fruits, spices, flowers, medicinal and aromatic plants, plantation crops of cashew and cocoa are included for development, whereas, vegetables are covered through seed production, protected cultivation, INM/ IPM and organic farming. Development of horticulture clusters are aimed at developing a production base for providing raw material not only for fresh consumption but also for the setting up of infrastructure for post harvest management, processing and marketing.

4.61 The Mission envisages an end-to-end approach covering production, post harvest management, processing and marketing to assure appropriate returns to growers and producers; promote R&D technologies for production, post harvest management and processing; enhance acreage, coverage, and productivity in potential belts and clusters; adopt a coordinated approach and promote partnerships, convergence and synergy among R & D, processing and marketing agencies in public as well as private sectors at all levels; promote, where appropriate, the National Dairy Development Board (NDDB) cooperative model to ensure support and adequate returns to farmers and promote capacity- building and Human Resource Development.

4.62 In all, 372 districts have been included for development of various horticulture crops under NHM. The maximum number of crops covered are under the category of perennial fruits. Mango alone has been taken up for development in as many as 220 districts, which is followed by aonla (140 districts) and guava (139 districts). Among non perennial fruits, banana has been taken up for development in as many as 154 districts, followed by papaya (60 districts). A large number of seed spicies and tree spicies have been included. The maximum number of districts covered is for chillies, which have been taken up in 78 districts. Floriculture (149 districts), aromatic plants (99 districts) and plantation crops (cashew in 85 districts & cocoa in 17 districts) are the other horticultural crops taken up for development under NHM. The interventions under NHM could be categorized into eight broad groups such as: (i) Planting material related; (ii) Area related; (iii) Hi-tech related; (iv) Infrastructure support related; (vi) Ancillary support related; (vii) HRD related; and (viii) Mission Management related.

Fig. 4.10: Modern Cold Chain Storage, HP



4.63 An area of about 18.90 lakh ha has been brought under new gardens of various horticulture crops. An area of 8.65 lakh ha is under perennial fruits (including cost intensive fruits, high density and normal spacing) and non perennial fruits constitute 3.23 lakh ha, 1.26 lakh ha under flowers (cut and loose), 3.80 lakh ha under spices, 0.58 lakh ha under medicinal & aromatic plants and 1.30 lakh ha under plantation crops. An area of 3.26 lakh ha under old and senile plantations was rejuvenated. Besides, an area of 0.65 lakh ha has been covered under protected cultivation such as green house, plastic mulching, low tunnels, etc. An area of 1.40 lakh ha has been covered under organic farming and 1,16,539 Vermi Compost Units have been set up.

4.64 An area of 8.62 lakh ha has been brought under INM/IPM. Funds have been provided for the setting up of 2307 nurseries and 1571 IPM/INM infrastructure namely, 71 Disease Forecasting Units, 89 Bio Control Labs, 123 Plant Health Clinics and 72 Leaf and Tissue Analysis Labs. A total number of 21,339 community water harvesting tanks and ponds have been created for providing critical irrigation support to horticultural crops. Under the Post Harvest Management (PHM) component, funds have been provided for establishment of 2273 pack houses, 366 cold storage units, 12 CA storage, 21 refrigerated vans, 540 mobile and primary processing units, 216 low cost onion storage structures, 58 ripening chambers and 112 Pusa zero energy cool chambers. Under the market component, 23 whole sale markets, 173 rural markets, 113 functional infrastructure for collection, grading, etc., 17 retail markets and outlets and 30 mobile vending hand carts established which help in the proper handling and marketing of horticulture produce. A total number of 8.69 lakh farmers have been trained under various horticultural activities.

Horticulture Mission for North East and Himalayan States

4.65 For the development of Horticulture in the North East and Himalayan region of the country, the Ministry of Agriculture has been implementing a Centrally Sponsored Scheme 'Horticulture Mission for North East & Himalayan States (HMNEH)'. Earlier, since 2001-02 it was known as 'Technology Mission for Integrated Development of Horticulture in North Eastern States including Sikkim (TMNE)' and was implemented in all the eight North Eastern States namely, Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Tripura and Sikkim. During the Tenth Plan (2003-04), this Mission was extended to include three Himalayan states namely, Jammu and Kashmir, Himachal Pradesh and Uttarakhand. The Mission covers the entire spectrum of horticulture right from production to consumption through backward and forward linkages.

Mission Strategy

4.66 The strategy of the Mission is as follows:

- Adoption of end-to-end holistic approach covering production, protection, post harvest management and marketing to ensure appropriate returns to growers and producers
- Enhance acreage, coverage and productivity through, diversification from traditional crops to plantations, orchards, vineyards, flower and vegetable gardens, extension of appropriate technology to farmers for high-tech horticulture and precision farming methods, improvement of post harvest management and marketing infrastructure, promotion of technologies developed through R&D for improving quality of horticulture produce and adopt a coordinated approach

and promotion of partnership, convergence and synergy among R&D and marketing agencies in public as well as private sectors, at the national, regional, state and district level.

Box: 4.8. Components of the HMNEH Mission

Mini Mission-I: (Research)

- This Mini Mission is coordinated and implemented by Indian Council of Agricultural Research. This Mini Mission concentrates on technology generation appropriate to the region. Major components under MM-I are- supply of basic seed and planting material, technology standardization, refinement, on farm demonstration and training.

Mini Mission-II: (Production and Productivity)

- It is coordinated by the Department of Agriculture & Cooperation and implemented by State Departments of horticulture/Agriculture. This mini mission aims at increasing production and productivity of Horticulture crops by adoption of improved production Technologies.

Mini Mission-III (Post Harvest Management & Marketing)

- This Mini Mission is coordinated by the Department of Agriculture & Cooperation, implemented by Directorate of Marketing & Inspection and National Horticulture Board. It aims to create suitable infrastructure facilities for efficient post harvest management, integrated cool chain system, primary processing and value addition and marketing of horticulture produce. Market promotional activities will include dissemination of market information to farmers, processors, traders and consumers.

Mini Mission-IV (Processing & Value addition)

- Implemented by the Ministry of Food Processing Industries and includes promotion and establishing of new processing units, modernization and up- gradation of existing units, market promotion of processed horticulture products by brand building, quality assurance, entrepreneurial development, etc.

Progress under the Mission

4.67 A significant achievement has been made for overall development of horticulture since its inception in 2001-02 till 2010-11. During the period, an additional area of 5,79,558 ha has been brought under cultivation of various horticulture crops including fruits (3,16,064 ha), vegetables (1,15,140 ha), spices (82,572 ha), plantation crops (14,111 ha), medicinal plants (6,464 ha), aromatic plants (10,378 ha), roots and tubers (1,319 ha) and flower (33,510 ha). To restore the production potential of senile and unproductive orchards, 42,523 ha of orchards have been rejuvenated. Besides, 1023 nurseries, 12,654 community tanks, 14,583 tube wells, 27 tissue culture units, 39,72,805 sq. mt. green houses, 27 model floriculture centres, 27 mushroom units and 21,055 vermi-compost units have been established. Further, 2.93 lakh farmers and officers including women farmers have been trained in various aspects of horticulture. Moreover, 48 wholesale markets, 306 rural primary markets, 70 apni mandies, 18 state grading laboratories, 35 cold storage units and 81 processing units have been established.

Targets for 2011-12

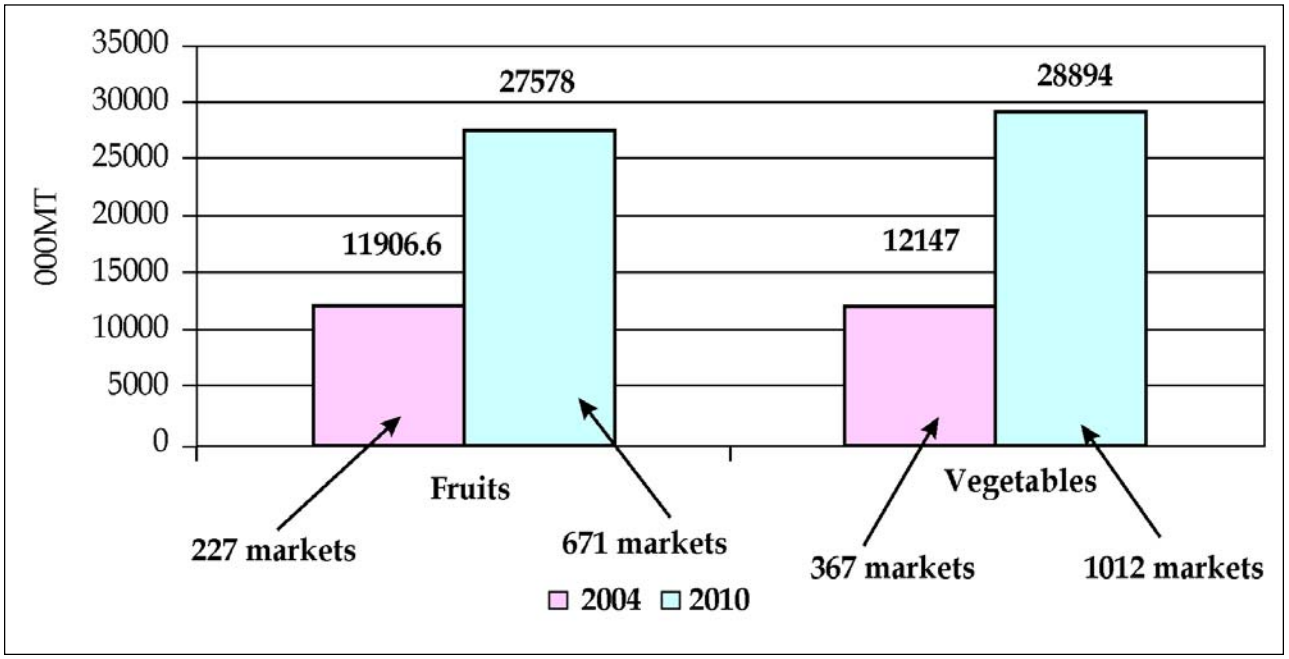
4.68 The physical targets fixed for the year 2011-12, plan an additional area of 57,904 hectare to be bought under different horticultural crops (fruits-26,227, vegetables-13,6l6, spices-13,9l1, aromatic plants-189 ha, flowers-3,96l ha. etc.). Besides, infrastructure for improving the production and productivity of crops such as creating 147 nursery units, 2344 water sources, 4446 Vermi Compost Units, training of 189656 farmers and establishing processing units, post harvest & marketing infrastructure is also envisaged.

Vegetable Initiative for Urban Clusters

4.69 A Scheme on Vegetable Initiative in Urban Clusters has been launched during 2011-12 with an outlay of Rs.300 crore, within the overall aegis of the Rashtriya Krishi Vikas Yojana (RKVY). The Scheme aims to cover one city in each state during the year 2011-12, which is either the state capital or any other city with a population of over one million. If in a state there is no city which satisfies this criteria, then any other urban cluster closer to one million population will be selected for the purpose. The Scheme covers all aspects relating to formation of farmers' association and groups, training and capacity building of farmers, linking farmers' groups with aggregators and markets, vegetable production and supply to urban centres starting from planting material to marketing to the retail level. The existing cost norms and pattern of assistance for individual components under the National Horticulture Mission (NHM)/ Horticulture Mission in North East and Himalayan States (HNNEH) form the guiding factors. Since the launch of the Scheme, Action Plans in respect of all the states have been approved by the State Level Sanctioning Committee (SLSC). Work on the base line survey and formation of Farmer Producer Organizations (FPO) has been taken up in most of the states. About 1.34 lakh farmers are being mobilized through FPOs.

4.70 The per capita availability of fruits in the country has increased from 115 gram per day in 2001-02 to 172 gram during 2010-11. Similarly, the per capita availability of vegetables over the same period has increased from 236 gram to 312 gram per day. This increase in production is reflected in the market arrival of fruits and vegetables, as depicted in Fig. 4.11.

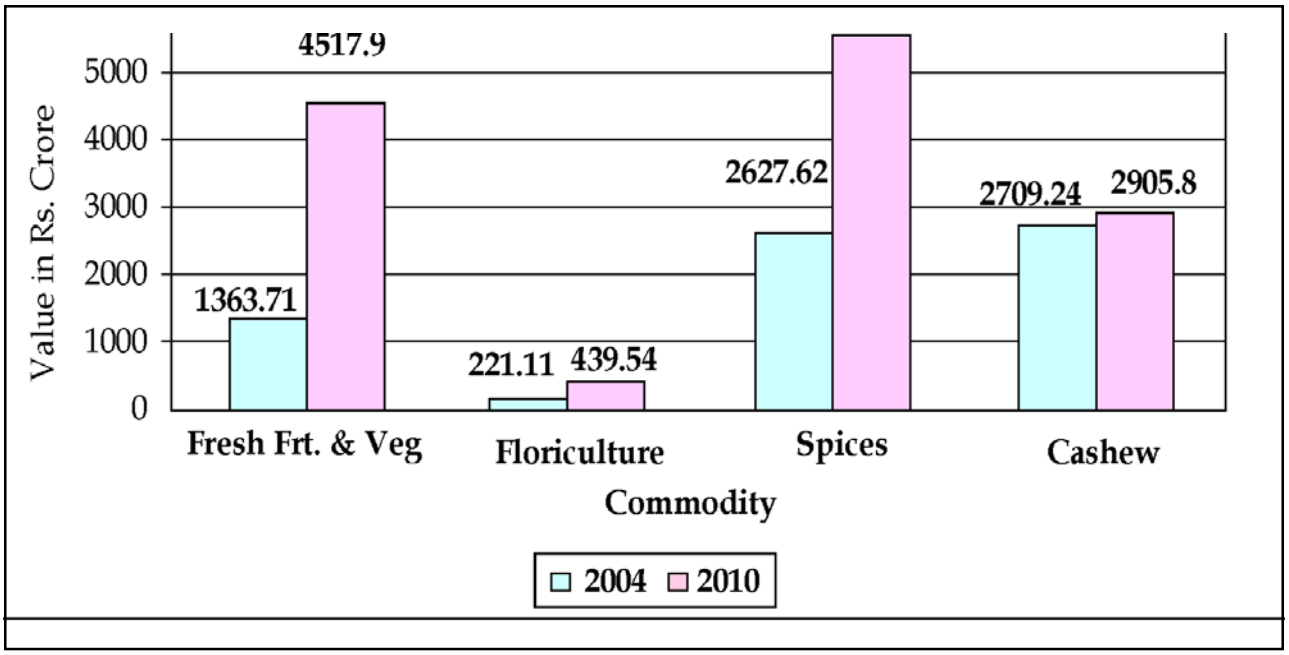
Fig. 4.11: Market Arrival of Fruits and Vegetables



Source: Horticulture Division, Department of Agriculture & Cooperation.

4.71 There has been significant improvement in the export of horticultural produce. In terms of value, the export earnings have increased from Rs. 6921.68 crore in 2004-05 to Rs. 13,423.74 crore in 2009-10. Commodity wise details are depicted in Fig. 4.12.

Fig. 4.12: Export of Horticultural Produce



Source: Horticulture Division, DAC.

Challenges

4.72 Although, there has been considerable improvement in production of various horticulture commodities across the country, there is a need for special attention to improve the supply chain for these commodities.

The Way Forward

4.73 The following measures are suggested to improve horticulture production, processing, value addition, marketing and supply chain management.

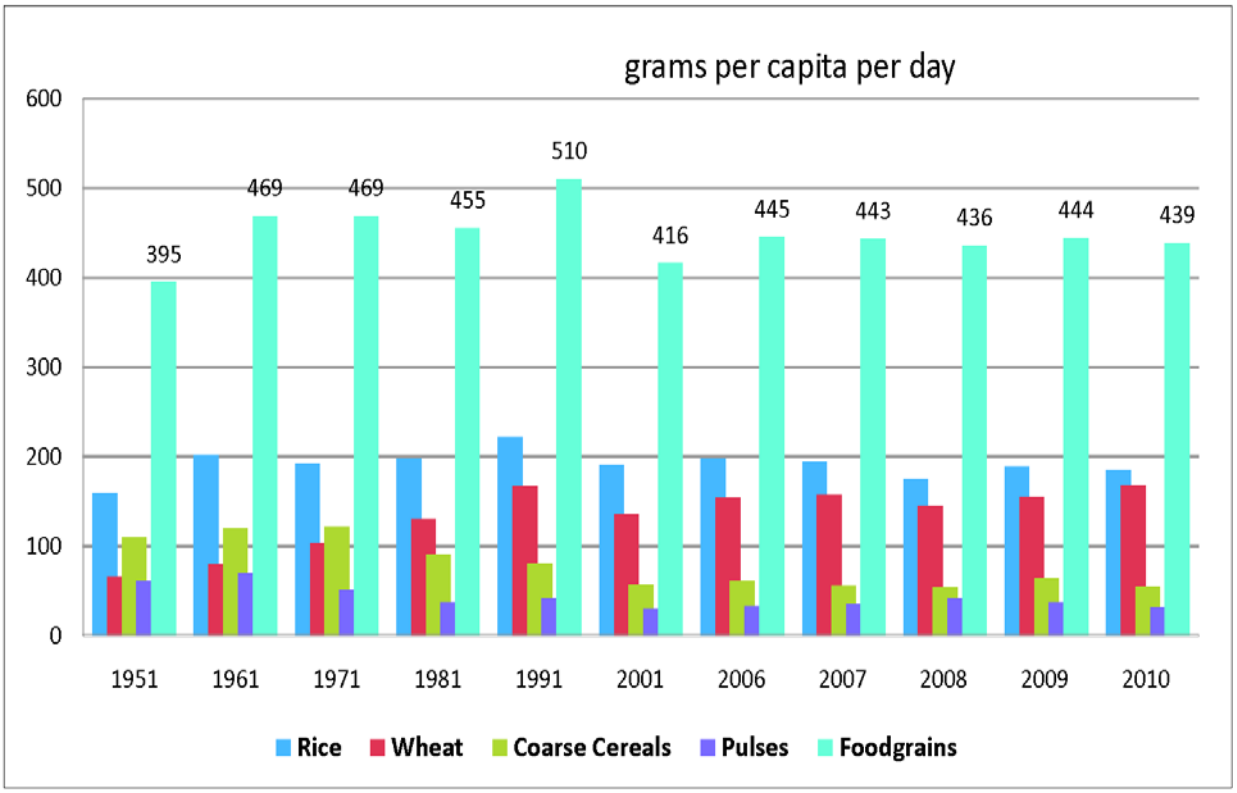
- The cluster-based approach has facilitated the development of horticulture clusters as the source for raw material of horticultural produce. The cluster-based approach needs to be strengthened in terms of dovetailing of programmes and schemes of other departments to ensure better connectivity to consumption centres and availability of uninterrupted power supply to local infrastructure like tissue culture units, labs and cold storage units.
- Establishment of infrastructure in terms of large nurseries, tissue culture units and vegetable seed production units is a welcome sign. This needs to be supplemented with a sound system for quality assurance of planting material and seeds being supplied to the farmers.
- The infrastructure for post harvest management and marketing needs to be strengthened commensurate with the production level. A sound cold chain infrastructure needs to be put in place.
- The concept of Terminal Market Complex has to be developed to promote transparency in marketing operations and for facilitating direct marketing of horticultural produce by the producers.
- State Horticulture Missions need to be supported with trained manpower at the state, district and block levels. Vacant posts need to be filled in a time bound manner and the existing staff needs to be trained in the latest developments in horticulture sector.

Food Demand

4.74 The world food crisis in 2007-08 lead to spiraling food prices worldwide but India was escaped it with least effects by suitably managing its agricultural trade and price policy to incentivize production and increase supplies. However, agricultural production was badly hit by a severe drought in 2009-10, one of the worst since 1972 leading to soaring food prices in the following period. The recent months have seen spiraling prices of food items, especially F&Vs, milk and milk products, eggs, meat and fish. Food inflation remains a sensitive issue, since an average Indian still spends more than 50 percent of his expenditure on food items.

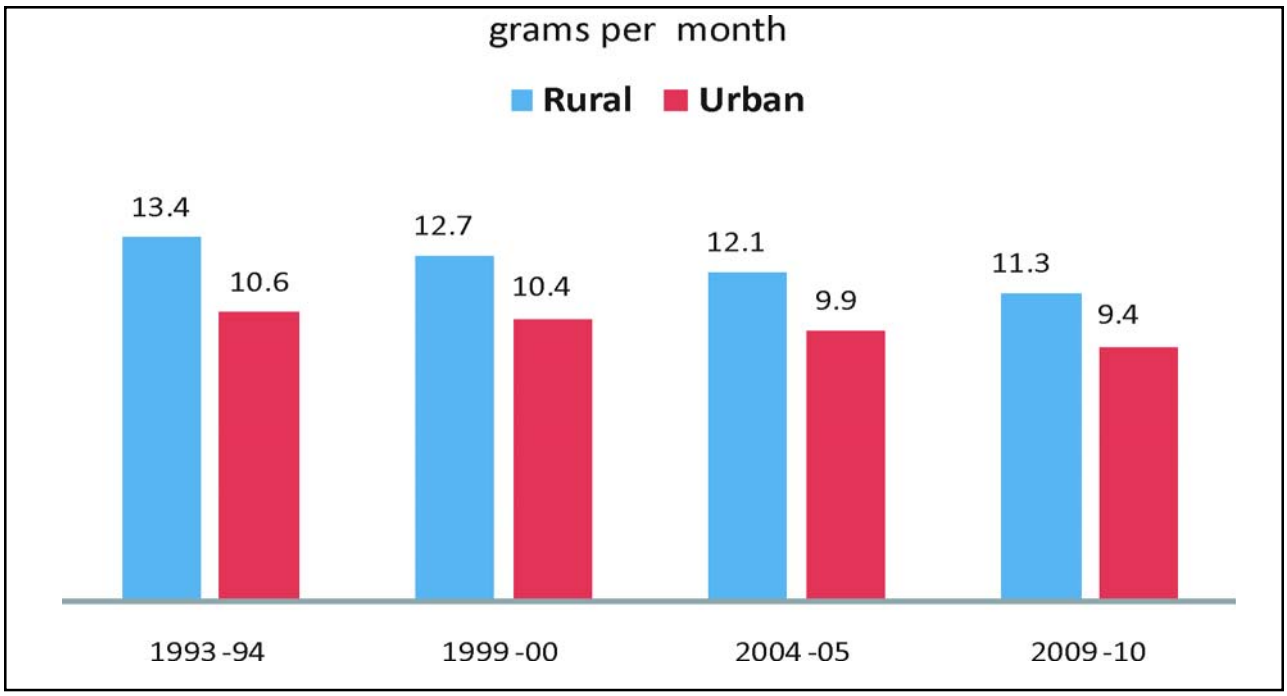
4.75 The per capita per day net availability (adjusted for exports, imports, seed feed and wastage and change in stocks) of cereals and pulses has declined since the early 1990s as can be seen from the Fig. 4.13. However, prices of cereals have remained, more or less, stable as there has been a gradual shift in consumer demand from cereals to high value items such as fruits and vegetables; milk and dairy products; and egg, meat and fish as revealed by the household consumption expenditure surveys of the National Sample Survey Office. There is significant shift in the share of consumer expenditure both in rural areas as well as urban areas from cereals to other products. For example, in rural areas, in respect of cereals, the share has significantly reduced from 26.3% in 1987-88 to 15.6% in 2009-10. The corresponding figures are 15% and 9%, respectively in case of urban areas. As regards changes in the per capita consumption of different commodities there has been a reduction in the case of rice in rural as well as urban areas. However, the consumption of coarse cereals has been considerably reduced particularly in rural areas. There has been increase in the consumption of banana, vegetables, milk, eggs, fish and chicken in both rural and urban areas. The per capita consumption of cereals, fruits and vegetables and milk as reported by the consumer expenditure surveys of NSSO are given in Figs. 4.14, 4.15 and 4.16, respectively.

Fig 4.13: Per Capita Availability of Cereals and Pulses



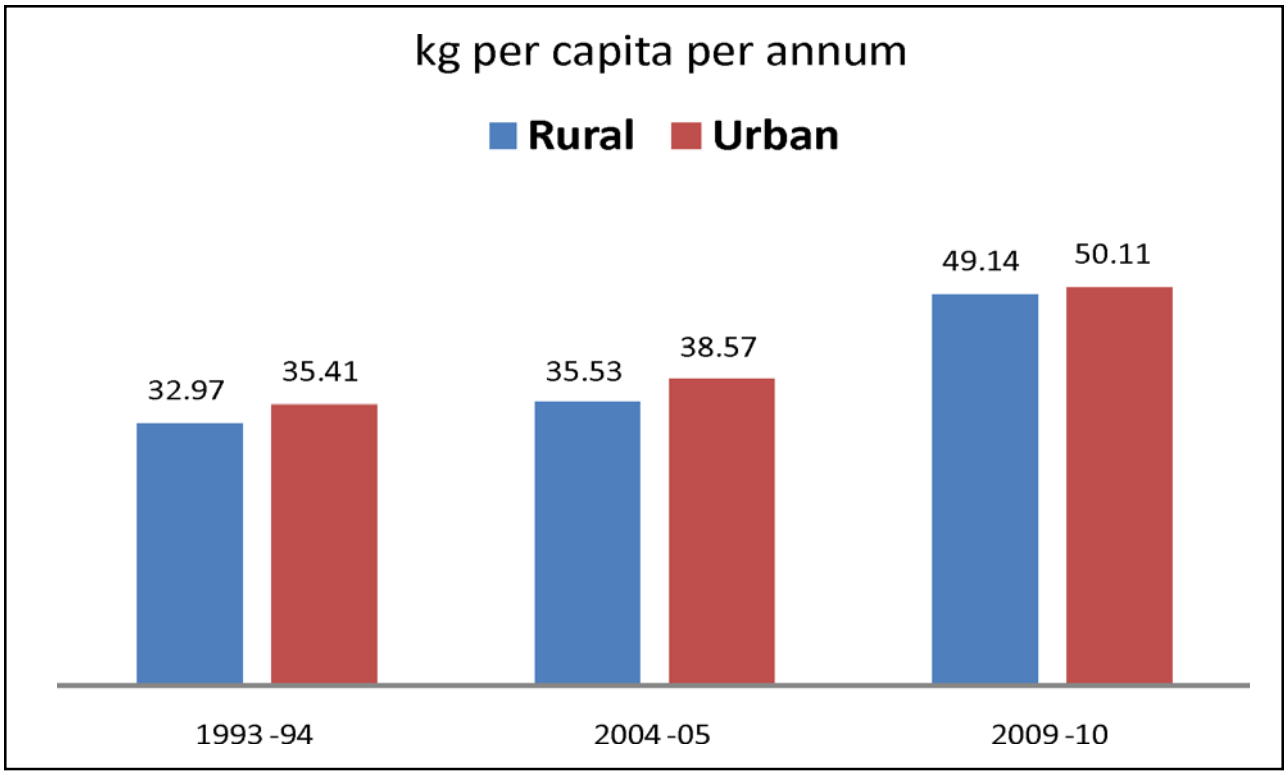
Source: DES, DAC.

Fig. 4.14: Per capita Consumption of Cereals



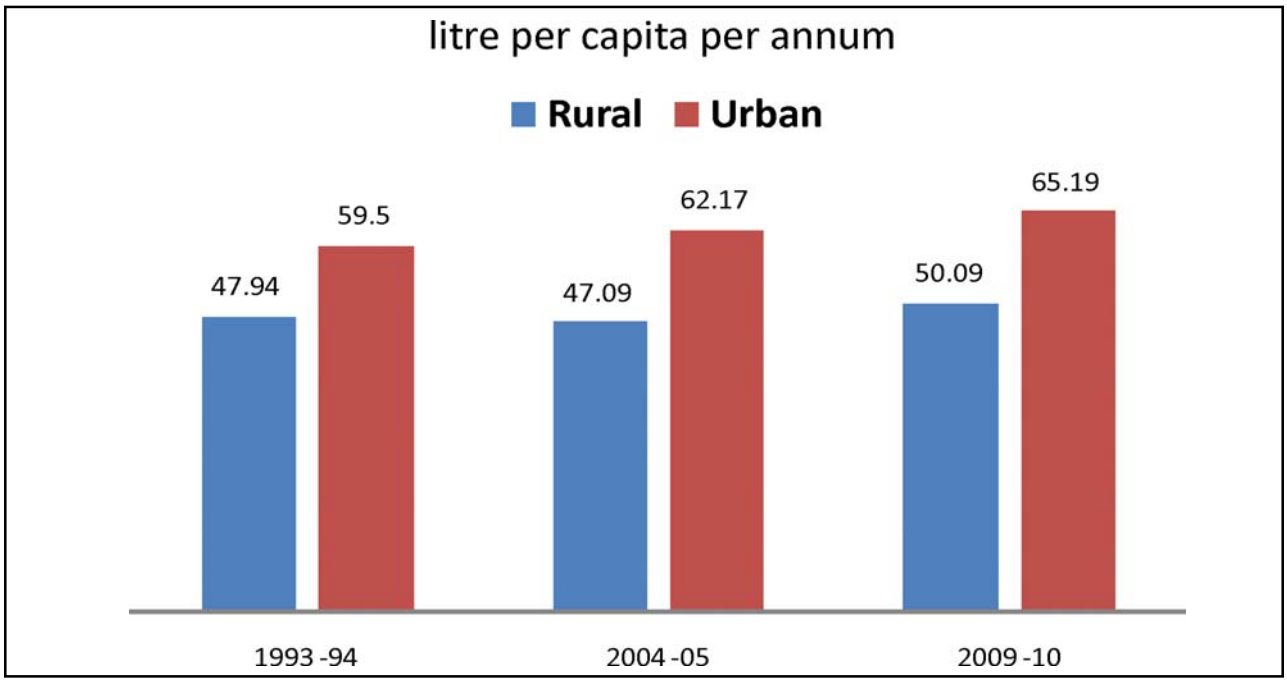
Source: NSSO, MOSPI

Fig. 4.15: Consumption of Fruits and Vegetables



Source: NSSO, MOSPI

Fig. 4.16: Consumption of Milk



Source: NSSO, MOSPI

4.76 India has been successful in increasing production of food over the past decades through the green revolution, of milk through the white revolution, of fish through the blue revolution and of F&Vs through the golden revolution. However, due to the changing pattern in consumer demand, there has been a high pressure on the prices of high value items despite a substantial increase in the per capita availability of theses items over the years.

Challenges

4.77 Apart from population pressures, there has been a slowing down of the rate of growth of yield and production of rice and wheat, especially in the former green revolution belt. The changing pattern of consumer demand calls for a diversification of the agriculture production system. There is need to substantially increase production of pulses, oil-seeds, fruits and vegetables.

The Way Forward

4.78 The following measures are suggested to improve production and availability of agricultural commodities.

- Bridging of yield gaps in low productivity regions by effective technology dissemination which can be combined with an efficient supply and service system and raising of the production frontier in high productivity regions by strengthening and reorienting agricultural R&D.

- More investment in agriculture, creating rural infrastructure, etc.
- Reducing regional disparities, targeting rain fed areas, emphasis on development of states in eastern India, etc.
- Strengthening rural non-farm enterprises and development of suitable skills to gainfully absorb rural labour.
- For efficient functioning of agricultural markets and *mandis*, implementation of the Model Agricultural Produce Market Committee Act is absolutely necessary. Similarly, introduction of VAT in place of taxation on primary agricultural commodities, creation of vibrant land (lease) and credit markets, use of innovative risk mitigation and insurance products need to be explored.
- Strengthening of monitoring and evaluation of all ongoing development programmes for making suitable mid course corrections.
- Linking nutrition with health, education and agriculture interventions.
- Ensure stability in food systems through optimal combination of food stocks and trade, and in co-ordination with price movements.

CHAPTER 5

Agricultural Prices and Markets

Agricultural Prices

5.1 Food and agricultural commodity prices in India are primarily determined by domestic demand and supply factors influenced by domestic price policy. The nature of markets facing the agricultural commodities and imperfections in these markets also influence the price transmission and the final consumer prices. India meets the bulk of its large food demand through domestic production, barring few commodities like edible oils and pulses.

5.2 Inflation and price rise of food items have become a major concern for policy makers worldwide and particularly for India and other developing countries. In India, the recent food inflation is largely due to an inadequate supply response to increasing demand, aggravated by various other logistic and market-related constraints. Inflation affects the poor disproportionately and adversely impacts the achievement of removal of poverty.

Food Articles

5.3 Data on wholesale prices show a continuous increase in Wholesale Price Index (WPI) for all commodities during the period April 2010 to October 2011. Food Articles have a weight of 14.34 in the wholesale price index. The increase in case of food articles however, showed a much higher increase in comparison to the index for all commodities. The increase in WPI of food articles moved in tandem with that of primary commodities during January-September 2010 and thereafter the WPI of food articles showed divergence from that of primary article prices showing a lower increase with substantial volatility. WPI for food articles peaked in January 2011, recording the highest increase of 16.68 percent during the period. Thereafter by March 2011 the prices declined to the level prevailing in September 2010. Between April and October 2011, the food prices maintained an upward trend though the increase is lower compared to the rise in primary commodities group.

5.4 Within the food items, there has been some variation in the importance of commodities accounting for food inflation. During April 2010 to October 2011, Eggs, Fish, Meat, Milk and Fruits have together consistently contributed more than 40 per cent of food inflation. Vegetables have contributed significantly during December 2010 to March 2011 and August 2011 to October 2011. Sugar was an important contributor to food inflation only at the beginning of 2010-11.

Fig 5.1: Trend in Inflation in All Commodities, Food Articles, Cereals and Pulses

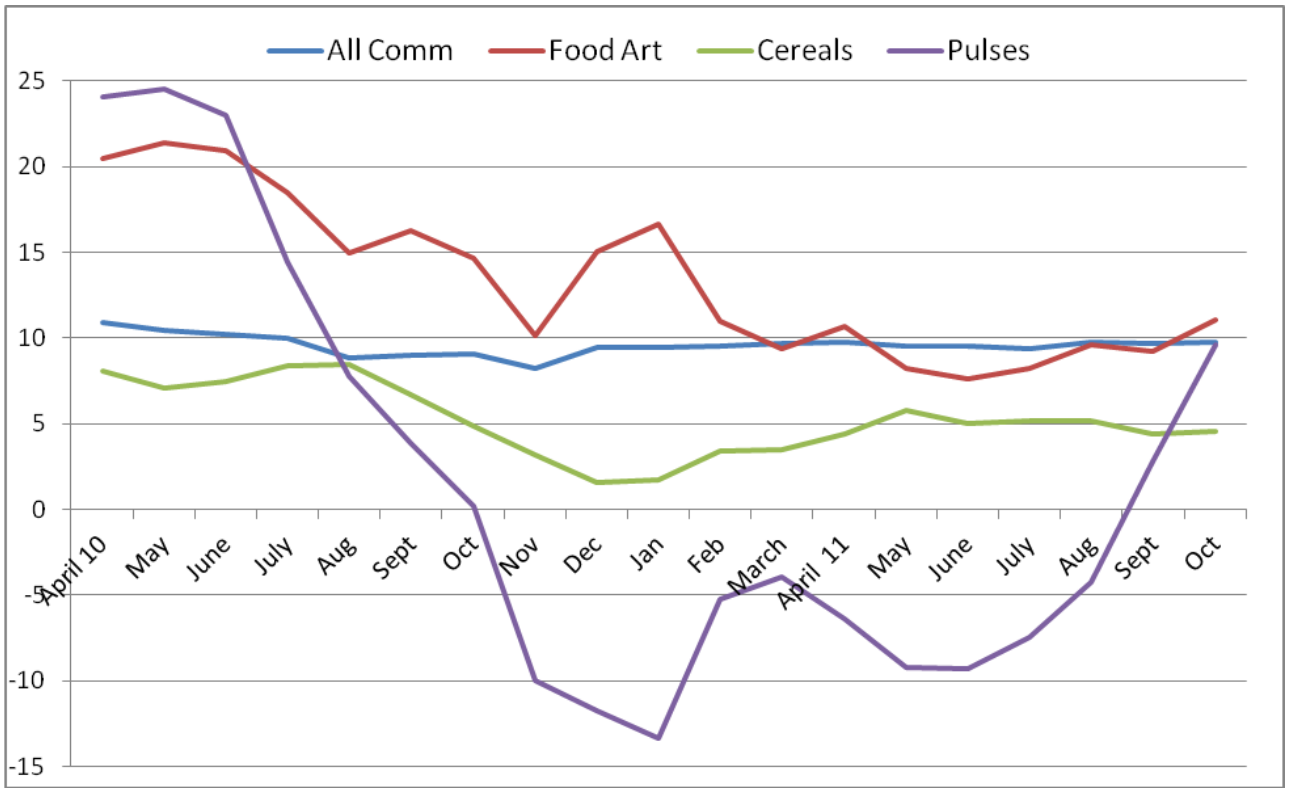


Fig 5.2: Trend in Inflation in All Commodities, Food Articles, Vegetables and Fruits

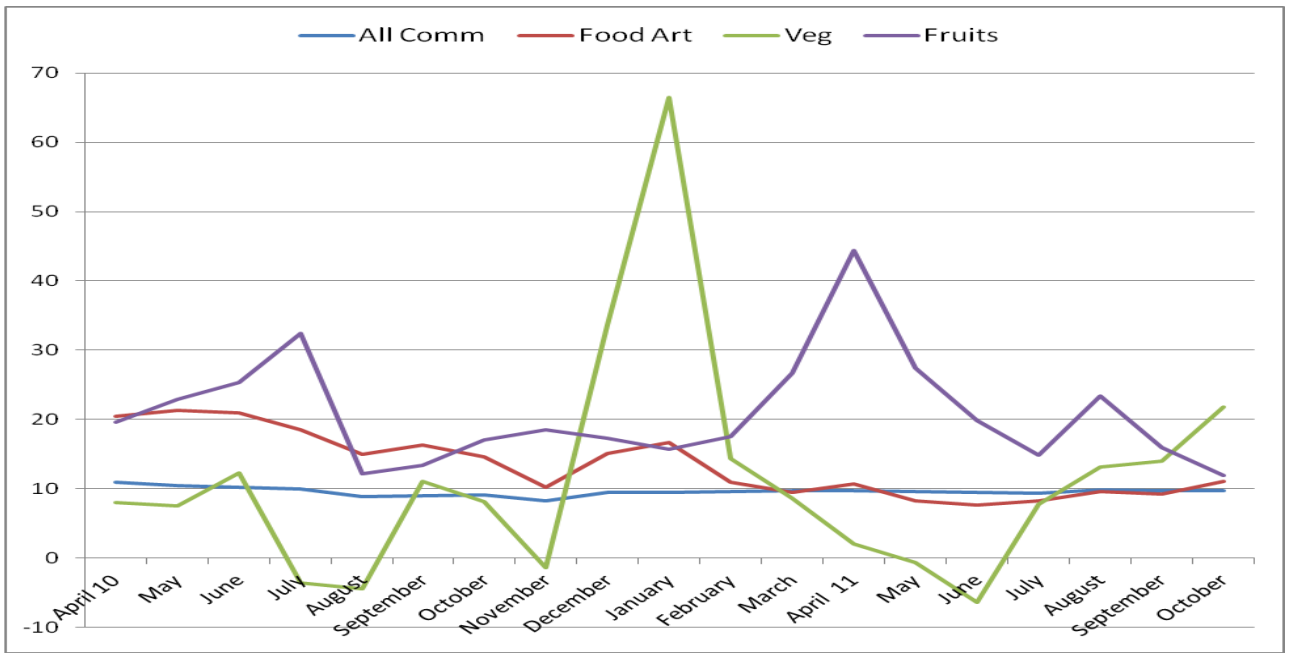


Fig 5.3: Trend in Inflation in All Commodities, Food Articles, Milk, Eggs, Meat and Fish (EMF)

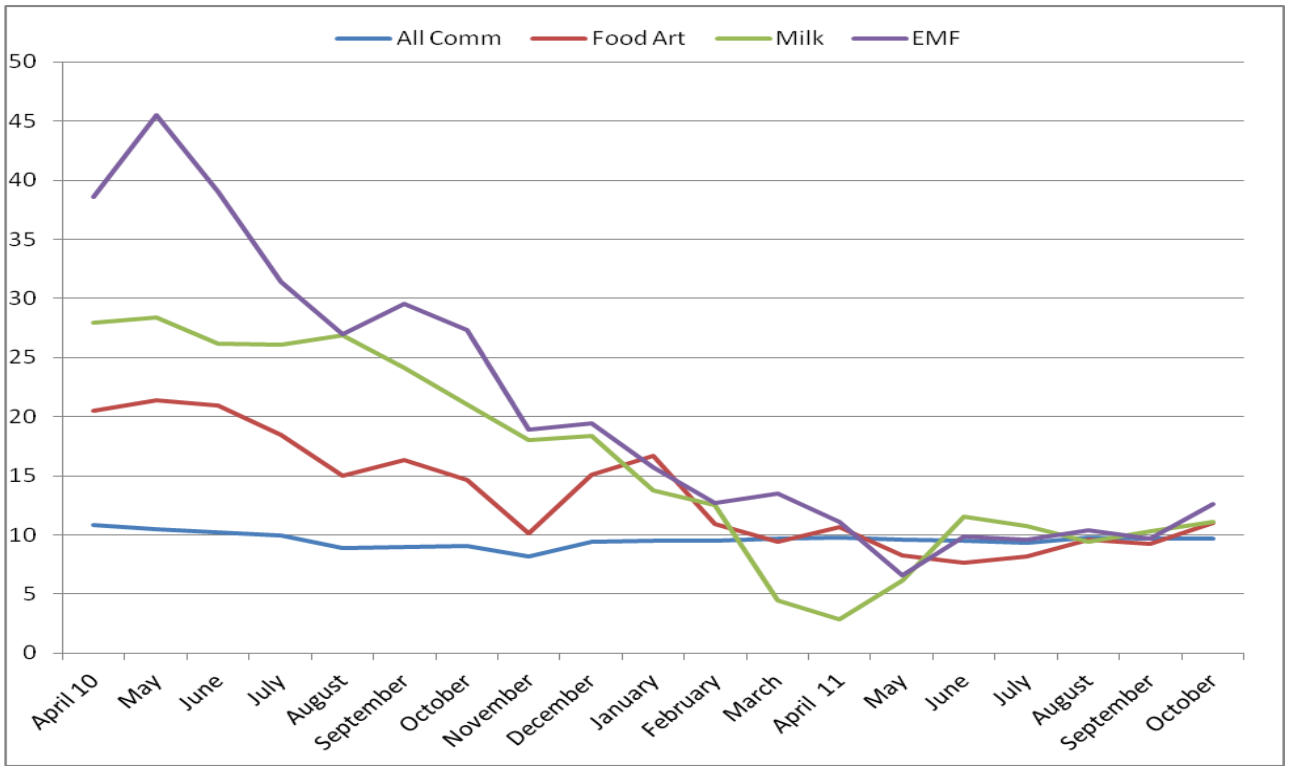
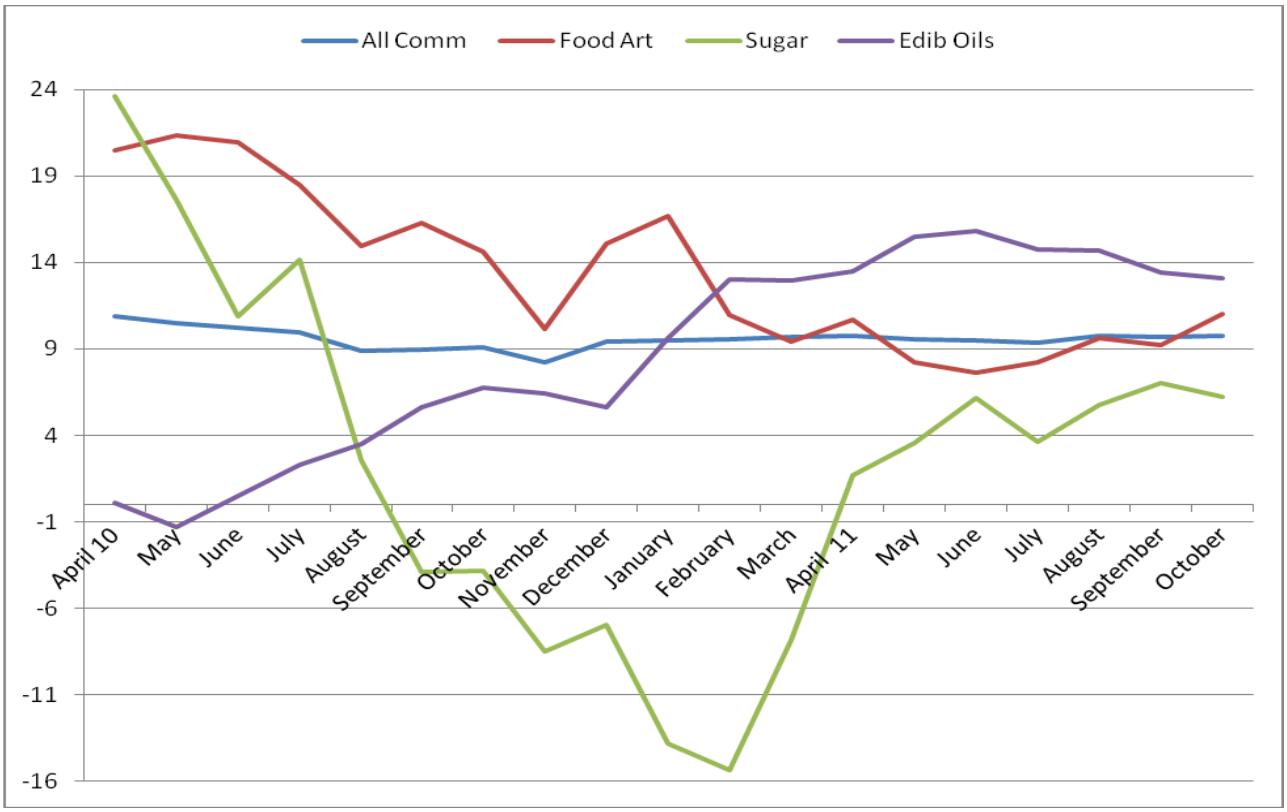


Fig 5.4: Trend in Inflation in All Commodities, Food Articles, Sugar and Edible Oils



5.5 Within food grains there were occasional spurts in the contribution of rice, coarse cereals and pulses during the period April 2010 to October 2011. Prices of fruits and vegetables have witnessed significant increases in the last one year but are now showing some stability.

5.6 The pattern suggests that livestock products, fruits and vegetables have been the main drivers of food inflation. Actually from January 2011, when the contribution of the selected major items in food basket of WPI peaked, there has been a rise in the contribution of other commodities such as spices and condiments, tea and coffee to food inflation. Thus, commodity-specific factors are also at play in influencing food inflation apart from more generic factors such a faster rise in demand.

5.7 Food prices in the international markets have also been on the rise at a faster pace since 2007. Such increases have an impact on domestic prices directly or indirectly. The volatility in domestic prices has been less than in the international prices. This has protected domestic producers and consumers from greater uncertainty over incomes and expenditures.

5.8 The rise in prices is not limited to food items alone. Petroleum product prices have also increased sharply in the last two years. As a result of higher costs and to some extent international prices, the minimum support prices have also increased to maintain incentives to the producers.

5.9 The rise in per capita GDP by an average of 6 percent in the last five years implies an increase in demand in excess of this given the income elasticity of more than unity for these items of consumption. In other words, production would have to catch up with demand growth to keep the price rise in check. Small decline in supplies can lead to sharp fluctuations in prices under these conditions.

5.10 Overall the retail prices of food items have shown a rising trend in 2010 and the first half of 2011 compared to 2009 in line with the movement of wholesale prices, with the exception of a few commodities. However, fluctuations in retail prices have been different in different markets depending on the local demand and supply conditions. There is considerable variation in average prices in major metros and sometimes even the direction of movement of prices varied across the metros.

Challenges

5.11 In comparison to wholesale prices, retail prices in different consumption centres display divergent trends in different markets. Due to regional differences in consumption patterns and supply conditions the prices and their movements vary across the major markets. Imperfect market conditions, restrictions on the movement of agricultural commodities due to infrastructural constraints, transport costs and local taxes, etc. influence the retail price trends across the major markets and consumption centres. Differences in tastes and in varieties consumed across the centres also pose problems for comparison of retail prices.

5.12 The principal factors behind the higher levels of inflation in the recent period are constraints in production and distribution especially in high value items such as pulses, fruits and vegetables, milk and dairy products, egg, meat and fish. Increase in prices can be

attributed to both supply and demand factors. The per capita availability of some of the items such as cereals and pulses have been declining resulting in some pressure on their prices. In the case of fruits and vegetables, milk, egg, meat and fish, prices have gone up despite an increase in per capita availability. This is due to a changing pattern in the demand of the households for high value items with increasing income levels. Supply constraints are important in influencing the recent price rise both globally and nationally. Supply constraints are long term and short term in nature. Long-term supply constraints include for example: inelastic supply of land; water; inadequate investments in key areas like irrigation; land development; and R&D.

5.13 Short-term constraints are weather fluctuations, lack of timely availability of inputs like fertilizers, quality seed, credit and policy environment, etc. Both long-term and short-term factors have influenced the production of agricultural output in the recent period. Market imperfections also add to these trends by restricting the price transmission. These include lack of infrastructure facilities like efficient transport facilities, storage, processing, marketing and credit facilities.

5.14 The Population of India increased from 1.03 to 1.21 billion during 2001-2011. Increasing population in the face of a relatively constrained supply of agricultural output has brought down the per capita net availability of food grains from 510 grams per day in 1991 to 444 grams per day in 2009. This is an indicator of constrained supply in the face of increasing demand exerting pressure on the prices of food commodities.

5.15 Substantial funds are being spent on various welfare and employment orieneted programmes and the same are likely to increase significantly in the near future with the introduction of the currently debated Food Security Bill. These programmes have infused substantial amounts of liquidity and purchasing power generating increased demand for food items.

5.16 When growth picks up at low income levels the demand for food items would increase as income elasticity of demand for food is higher at lower levels of income. Thus, lower per capita availability of food grains and structural shortage of key agricultural commodities like oilseeds and pulses combined with the rising demand have kept food price inflation high. This process has got further accentuated by spikes in global food prices through international transmission.

5.17 Rising international prices of oil also impacted the cost of production of agriculture through increase in input costs of fertilizers, transportation and a general rise in the cost of all other inputs and services. Increase in cost of production results in increasing the MSP of agricultural commodities which also influences market sentiments.

5.18 Supply responses to demand hikes are usually affected with a time lag. In the intervening period an injection of extra liquidity in the economy would lead to an upward pressure on prices. In India, expansionary monetary policies and fiscal deficits have been adopted in the recent years to maintain high growth rates in the face of global recession.

5.19 In the recent years, particularly since the commodity price hike of 2007-8, markets have become highly volatile. International stocks of key food items like cereals and animal feedstock are reduced due to shocks in major producing regions of Europe, Canada and Australia as also due to rising demand in developing countries putting upward pressure on prices. To some extent, speculative activities in the commodity markets also influence prices.

The Way Forward

5.20 The enduring solution to price inflation lies in increasing productivity, production and decreasing market imperfections.

Agricultural Price Policy and MSP

5.21 Minimum Support Prices have been a cornerstone of the agricultural policy since 1965. The objective is to ensure remunerative prices to the growers for their produce with a view to encourage higher investment and production and evolve a balanced and integrated price structure in the context of overall needs of the economy while safeguarding the interest of consumers by making available supplies at reasonable prices.

Box 5.1: Minimum Support Prices

The rationale behind determination of MSP include, (i) the need to provide incentive to the producer/farmer for adopting improved technology and for developing a production pattern broadly in the light of national requirements; (ii) the need to ensure rational utilization of land, water and other production resources; (iii) the likely effect on the price policy on the rest of the economy, particularly on cost of living, level of wages, etc., and (iv) the terms of trade between agricultural sector and non-agricultural sector.

The Commission for Agricultural Costs & Prices (CACP), while formulating the recommendations on Price Policy, considers a number of important factors which, *inter alia*, include cost of production, changes in input price, trends in market prices, demand and supply situation etc. Cost of cultivation data for principal crops are collected under a plan scheme to generate state wise and crop wise estimates of cost of cultivation/production and made available to the CACP for use in connection with their recommendations of MSPs. The cost of cultivation/production takes into account all paid out costs, such as, those incurred on account of hired human labour, bullock labor and machine labor (both hired and owned) and rent paid for leased-in land besides cash and kind expenses on use of material inputs like seeds, fertilizers, manures, irrigation charges including cost of diesel or electricity for operation of pump sets, etc. Besides, cost of production includes imputed values of wages of family labour and rent for owned land. The cost also covers depreciation for farm machinery, building, transportation and insurance charges. As such, the cost of production covers not only actual expenses in cash and kind but also imputed value of owned assets including land and family labor.

5.22 Implementation of MSP is undertaken through procurement by central and state level agencies. The procurement of wheat and rice is undertaken by the Food Corporation of India under the Department of Food & Public Distribution, primarily to meet the requirements of buffer stock; Targeted Public Distribution Scheme (TPDS) and other welfare schemes of the government. However, the designated agencies' intervention in the market for undertaking procurement operations assist market prices not to fall below the MSPs fixed by the government.

5.23 Details regarding MSPs for selected crops during 2010-11 and 2011-12 are given in Table 5.1. The MSP has been a major contributing factor among others for sustained increase in agricultural production. The impact has been more pronounced for some of the crops in recent years. The change in area and production has been remarkable in the case of *Arhar* (Tur), *Moong* and *Urad*. Between 2006 - 07 and 2010 -11, area under *Arhar* (Tur) increased by around 24 percent and its production by 25 percent. During this period, area under Gram increased by about 23 percent and its production by 30 percent. Increase in the area under Wheat, between 2006-07 and 2010-11, was about 5 percent which culminated in an increase in production by 13 percent. In case of Groundnut while the area increased by about 6 percent, the increase in production amounted to 55 percent indicating an improvement in yield per hectare also. Similarly, in case of Soyabean the increase in area by 15 percent resulted in a production increase by 43 percent. Between 2006-07 and 2010-11, the area under Cotton increased by about 22 percent and its production by about 48 percent.

Table 5.1 : Minimum Support Prices (According to Crop Year) ***Rs. per quintal***

Commodity	**2010-11**	**2011-12**
***Kharif* Crops**		
Paddy Common Grade 'A'	 1000 1030	 1080 1110
Bajra	880	980
Maize	880	980
Arhar (Tur)	3000*	3200*
Moong	3170*	3500*
Urad	2900*	3300*
Cotton Staple Length : 24.5- 25.5 mm Staple Length : 29.5-30.5 mm	 2500 3000	 2800 3300
Groundnut in shell	2300	2700
Sesamum	2900	3400
***Rabi* Crops**		
Wheat	1120#	1285
Gram	2100	2800
Rapeseed & Mustard	1850	2500
Other Crops		
Copra	4450	4525
Sugarcane@	139.12	145.00

Notes: *Additional incentive @ of Rs.500/- per quintal of *tur, urad* and *moong* sold to procurement agencies payable during the harvest/arrival period of two months.

An additional incentive bonus of Rs. 50/- per quintal is payable over the MSP.

@ Fair and Remunerative Price

Challenges

5.24 In a large number of markets in several states, such as Bihar, eastern UP, Orissa, Assam, M.P. and Chhatisgarh where surpluses are emerging, there is a need for effective procurement operations and for strengthening the market infrastructure.

The Way Forward

5.25 Measures to improve the efficacy of MSP in agricultural markets are namely:

- Extend the price support mechanism effectively across the country
- Invest in building market infrastructure in the states

Market Intervention and Price Support Schemes

5.26 The Department of Agriculture & Cooperation implements the Market Intervention Scheme (MIS) for procurement of horticultural commodities which are perishable in nature and are not covered under the Price Support Scheme. The objective of intervention is to protect the growers of these commodities from making distress sale in the event of a bumper crop during the peak arrival period when the prices tend to fall below economic levels and cost of production. The MIP is implemented when there is at least a 10 percent increase in production or a 10 percent decrease in the ruling market prices over the previous normal year. The Market Intervention Scheme (MIS) is implemented at the request of a state /UT government which is ready to bear 50 percent of the loss (25 percent in case of North-Eastern States), if any, incurred on its implementation. The extent of total amount of loss to be shared on a 50:50 basis between the central government and the state government is restricted to 25 percent of the total procurement value which includes cost of the commodity procured plus permitted overhead expenses. Under the Scheme, in accordance with MIS guidelines, a pre-determined quantity at a fixed Market Intervention Price (MIP) is procured by NAFED as the Central agency and the agencies designated by the state government for a fixed period or till the prices are stabilized above the MIP whichever is earlier. The area of operation is restricted to the concerned state only.

5.27 During the year 2010-11, the MIS has been implemented in five states covering potato (U.P. and W.B. with a total quantity of 10 lakh metric tonnes), oil palm (Andhra Pradesh : 47500 metric tonnes), apple (Himachal Pradesh 6100 metric tonnes) and areca nut (Karnataka 1200 metric tonnes).

Price Supports Scheme (PSS)

5.28 The Department of Agriculture & Cooperation implements the PSS for procurement of oil seeds, pulses and cotton, through NAFED which is the Central nodal agency, at the Minimum Support Price (MSP) declared by the government. NAFED undertakes procurement of oil seeds, pulses and cotton under the PSS as and when prices fall below the MSP. Procurement under PSS is continued till prices stabilize at or above the MSP. Losses, if any incurred by NAFED in undertaking MSP operations are reimbursed by the central covernment. Profit, if any, earned in undertaking MSP operations is credited to the central government.

5.29 Under the PSS during 2010-11, procurement was made Milling Copra in four states, Tamil Nadu (7,434 metric tonnes), Kerala (12,408 mertic tonnes), A&N Islands (53, 35 metric tonnes) and Karnataka (30,86 metric tonnes) for a total value of Rs 135 crore.

Agricultural Markets

5.30 The increasing trend of agricultural production has brought in its wake, new challenges in terms of finding markets for the increased marketed surplus in the country. Challenges and opportunities that the global markets offer in the liberalized trade regime are also to be addressed. For the farming community to benefit from the new global market access opportunities, the internal agricultural marketing system in the country needs to be integrated and strengthened. Agricultural marketing reforms and the creation of marketing infrastructure has therefore been a prime concern of the government.

5.31 The subject of agriculture and agricultural marketing is dealt with both by the state as well as the central government in the country. Starting from 1951, various Five-Year Plans laid stress on development of physical markets, on-farm and off-farm storage structures, facilities for standardization and grading, packaging, transportation, etc. Most agricultural commodity markets generally operate under the normal forces of demand and supply. The role of government is normally limited to protecting the interests of producers and consumers, only in respect of wage goods, mass consumption goods and essential goods; and to promote the organized marketing of agricultural commodities in the country through a network of regulated markets.

Regulation of Agricultural Produce Markets (APMCs)

5.32 To achieve an efficient system of buying and selling of agricultural commodities, most of the state governments and union territories have enacted several legislations to provide for regulation of the Agricultural Produce Markets. The basic objective in the setting up of setting up of a network of physical markets has been to ensure reasonable gains to the farmers by creating a market environment where there is fair play of supply and demand forces, to regulate market practices and to attain transparency in transactions. With growing agricultural production, the number of regulated markets has also been increasing in the country. While, there were 286 regulated markets in the country at the end of 1950, their number has increased to 7157 by 2010.

Marketing Reforms Initiatives

5.33 In response to the need for providing competitive choices of marketing to farmers and to encourage private investment for the development of market infrastructure and alternative marketing channels, a Model Act on agricultural marketing had been formulated and circulated to the states/UT by the Ministry of Agriculture in 2003 to guide them on the removal of barriers and monopoly in the functioning of agricultural markets. Seventeen states have already amended the APMC Act as per provision of the Model Act. Seven states have also notified APMC Rules under their Act. Details regarding the present status is indicated in Table 5.2:

Table 5.2: Progress of Reforms in Agricultural Markets (APMC Act) as on 31.10.2011

S.No.	Stage of Reforms	Name of States/ Union Territories
1.	States/ UTs where APMC Act reforms have been done for Direct Marketing; Contract Farming and Markets in Private/ Coop Sectors	Andhra Pradesh, Arunachal Pradesh, Assam, Goa, Gujarat, Himachal Pradesh, Jharkhand, Karnataka, Maharashtra, Mizoram, Nagaland, Orissa, Rajasthan, Sikkim, Uttrakhand and Tripura
2.	States/ UTs where APMC Act reforms have been done partially	a) **Direct Marketing:** NCT of Delhi, Madhya Pradesh and Chhattisgarh b) **Contract Farming:** Chhattisgarh, Madhya Pradesh, Haryana, Punjab and Chandigarh

Table 5.2: Progress of Reforms in Agricultural Markets (APMC Act) as on 31.10.2011 (Contd.)

S.No. Stage of Reforms	Name of States/ Union Territories
3. States/ UTs where there is no APMC Act and hence not requiring reforms	Bihar*, Kerala, Manipur, Andaman & Nicobar Islands, Dadra & Nagar Haveli, Daman & Diu, and Lakshadweep
4. States/ UTs where APMC Act already provides for the reforms	Tamil Nadu
5. States/ UTs where administrative action is initiated for the reforms	Meghalaya, Haryana, J&K, West Bengal, Puducherry, NCT of Delhi and Uttar Pradesh.

Note: * APMC Act is repealed w.e.f. 1.9.2006.

Status of APMC Rules

5.34 The status of APMC reforms in different states is given below:—

a) States where Rules have been framed completely :

Andhra Pradesh, Rajasthan, Maharashtra, Orissa, Himachal Pradesh, Karnataka, Rules have been framed completely.

b) States where Rules have been framed partially:

i) Mizoram only for single point levy of market fee;

ii) Madhya Pradesh for Contract Farming and special license for more than one market;

iii) Haryana for Contract Farming.

5.35 In order to expedite the pace of market reforms, the Ministry of Agriculture has set up a Committee of State Ministers In-charge Agricultural Marketing on 2 March, 2010, with members from the states of Maharashtra, Gujarat, Haryana, Uttarakhand, Bihar, Assam, Orissa, Andhra Pradesh, Karnataka and Madhya Pradesh. The Committee has submitted its "First Report" to the Government in September, 2011 which has been circulated to all States and UTs for implementation of its recommendations and to offer comments, if any.

5.36 The Government of India has also decided that assistance under National Horticulture Mission and Development and Strengthening of Agricultural Marketing Infrastructure, Grading and Standardization Schemes for development of market infrastructure projects to State Agencies/APMCs would be subjected to waiving of market fees for perishable horticultural commodities. It would permit direct marketing by farmers to consumers, processing units, bulk buyers of cold chain facilities, storage and contract farming. However, it has been decided that reasonable user charges can be levied for the use of market facilities and infrastructure.

Linking Farmers to Markets

5.37 Some of the initiatives taken for Linking Farmers to markets at the state and the national level through infrastructure development and technological innovations are presented below in Box 5.2. A typical Rythu Bazar scene is shown in Fig 5.5 while Fig 5.6 displays a Shetkari Bazar site in Maharashtra.

Fig 5.5. Rythu Bazar in Andhra Pradesh

Fig 5.6. Shetkari Bazar In Maharashtra

Box: 5.2. Types of Direct Marketing by Farmers

Rythu Bazar is an initiative to create infrastructure facilities to enable farmers to sell their products directly to consumers thereby ensuring that farmers realize better prices and consumers receive fresh vegetables, fruits, etc., at reasonable prices and thus, address constraints in the agricultural marketing infrastructure. Both producers and consumers are benefited from Rythu bazaars as producer's share in consumer's rupee is more by 15 to 40 percent as compared to other markets and consumers get fresh vegetables, fruits and food items at 25-30 percent less prices than the prevailing prices in nearby markets. Jain *et al.*

Typically, a Rythu Bazar covers 10 to 15 villages and at least 250 farmers including 10 groups (Self Help Groups) who are selected by a team consisting of Mandal Revenue Officers, Horticulture Officers and Agriculture Officers in the villages operate in the bazars. Adequate transport facilities are arranged for transport of goods to Rythu Bazars in consultation with State Road Transport Corporation. In addition, online information of prices and commodities movements is provided on the internet. More than 100 Rythu Bazars are in existence benefitting 4500 farmers and large number of consumers. Rythu Bazars can play a key role in addressing marketing problems and there is, thus, a clear need to facilitate similar marketing infrastructure throughout the country.

Shetkari Bazar is a concept of direct marketing by producer (farmer) to consumers. By circumventing the intermediaries, the produce reaches in good shape with minimum handling. This results in better price realization for the farmer-producer and good quality produce to the consumer at reasonably lower price. This is expected to help small farmers with small quantity of perishable fruit and vegetables to get a fair price and escape commercial exploitation in the market place. In 2002, the Government of Maharashtra decided to set up Shetkari Bazars in the State and the Maharashtra State Agriculture Marketing Board was appointed as nodal agency for implementing this scheme. The Shetkari Bazars are located in all district and key taluka places and are managed by the Agriculture Produce Market Committees (APMC) from the area. The produce brought by farmers is not levied cess. Local committees are set up to monitor the prices and take the commitment forward (Prakash V, Director, CFTRI, Mysore) . A term loan up to Rs. 10.00 lakh is advanced to the APMCs for establishment of Shetkari Bazar. An amount of Rs. 31.10 crore has been sanctioned to 33 APMCs. There are 12 Shetkari Bazaars operating in the state and 33 additional markets have been sanctioned.

Impact of Farmers' Markets/Direct Marketing

5.38 Producers use different market outlets (commission agents, local traders and farmers' markets) at different times of the year as a strategy to get the best price for their produce. Farmer's Markets are especially beneficial for small producers, who have difficulties in selling small volumes during the dry season in the conventional market system. Farmers' Markets have influenced producers' practices in two main ways namely: (i) diversification of production to include a wider variety of vegetables, and (ii) intensification to maximize the use of water and land resources throughout the year. Farmer's Markets have also stimulated producers' adoption of marketing strategies through a better understanding of consumers' needs and preferences based on incomes, dietary habits and local needs. Factors which affect producers' capacity to adapt to changes include access to credit and financial assets, and institutional support across the system. These are key factors in ensuring that farmers fully benefit from the Farmers' Market initiatives, and deserve to be better addressed. Direct Marketing enables farmers and processors and other bulk buyers to economize on transportation cost and to considerably improve price realization. This also provides incentive to large scale marketing companies to affect their purchases directly from producing areas.

Market Research Information Network (MRIN)

5.39 Market information is of vital importance to all in the marketing system whether farmers, traders, processors or consumers who require market information for different purposes. For provision of information of prices of agricultural commodities prevailing in Agricultural Produce Markets in the country, the Ministry of Agriculture has launched the ICT-based Central Sector Scheme of Marketing Research and Information Network in March, 2000. This provides electronic connectivity to important wholesale markets in the country for collection and dissemination of price and market-related information. The scheme was implemented in the year 2000-2001 and presently, more than 3000 markets from all over the country have been linked to a central portal (**http://agmarknet.nic.in**). These markets report the daily prices and arrivals for more than 300 commodities and 2000 varieties from more than 1900 markets covering nearly all the major agricultural and horticultural produce. The information on arrivals and prices are disseminated in 12 regional languages.

5.40 In addition to price, diverse other market-related information is provided on the portal, for example, the accepted standards of grade labeling; sanitary and phyto-sanitary requirement; physical infrastructure of storage and warehousing; marketing yards; fees payable; etc. Efforts are underway to prepare a national atlas of agricultural markets on a GIS Platform that would indicate the availability of the entire marketing infrastructure in the country including storage, cold storages, markets and related infrastructure. Similarly, commodity profiles indicating the post-harvest requirements of important commodities are being loaded on to the portal.

5.41 Major stakeholders of the project are farmers, buyers and commission agents of agricultural produce, media persons, government functionaries, academicians, market functionaries, agri-business consultants, etc. The information available on the Portal is in the public domain and can be instantly accessed from anywhere in the world. Farmers and stakeholders are accessing this information throughout the length and width of the country and many agencies are using the contents of the Portal to generate market intelligence and making the same available to various stakeholders to support them in appropriate decision making. The project provides ready contents for the proposed one lakh IT kiosks being installed in rural areas by the Department of Information Technology.

Construction of Rural Godown Scheme (Grameen Bhandaran Yojana)

5.42 Presently, there is limited warehousing capacity in the country as can be seen from Table 5.3. To create additional storage capacity the government launched on 1 April 2011, the Gramin Bhandaran Yojana aimed at the creation of scientific storage capacity with allied facilities in rural areas. This will meet the requirement of farmers in manifold ways such as, storing farm produce, processed farm produce,

Table 5.3: Agriculture Warehousing Capacity in the Country

PSU	Capacity (in MT)
FCI	32.05
CWC	10.07
SWCs	21.29
State Civil Supplies Corp./Deptt	11.30
Total Public Sector	**74.71**
Cooperative Sector	15.07
Private Sector	18.97
Total	108.75

Source: Report of Sub-Group on Warehousing and Bulk Handling for XII Plan, Department of Food and Public Distribution.

agricultural inputs, promotion of grading, standardization and quality control of agricultural produce to improve their marketability, prevention of distress sales immediately after harvest by providing the facility of pledge financing and marketing credit. It will strengthen the agricultural marketing infrastructure in the country by paving way for the introduction of a national system of warehouse receipts in respect of agricultural commodities stored in such godowns and will help to reverse the declining trend of investment in the agriculture sector by encouraging private and cooperative sector to invest in the creation of storage infrastructure in the country. The scheme was revised for XI Plan period 26 June 2008, with subsidy being provided at 25 percent of the project cost to all categories of farmers, agriculture graduates, cooperatives and CWC/ SWCs. All other categories of individuals companies and corporations are being given subsidy at 15 percent of the project cost. In case of NE states/hilly areas and SC/ST entrepreneurs and their cooperatives and Women Farmers, the subsidy shall be 33.33 percent. Since the inception of the scheme w.e.f. 1 April 2001 and up to 31 March 2011, 24,706 godowns having a capacity of 283.26 lakhs tonnes with a subsidy release of Rs.696.45 crores have been sanctioned by NABARD and NCDC all over the country. The government has, from 20 October 2011 revised the cost norms under the Scheme to encourage the creation of additional warehousing capacity, particularly in those areas where it is yet to fully pick up.

Fig 5.7: A Typical Rural Godown

Development/Strengthening of Agricultural Marketing Infrastructure, Grading and Standardization Scheme (AMIGS)

5.43 The AMIGS is a reform-linked investment Scheme to encourage rapid a development of infrastructure projects in agriculture and allied sectors including dairy, meat, fisheries and minor forest produce. It is applicable in only such states/ UTs which undertake reforms in the APMC Act to allow direct marketing and contract farming and permit agricultural

produce markets to exist in private and cooperative sectors. The Scheme was launched in October, 2004. The assistance is provided for development of market infrastructure, linkages and value addition by private entrepreneurs, cooperatives and state agencies for projects such as cleaning, sorting, grading, drying and auction platform, pack-house etc. The Scheme is credit linked and demand driven. The subsidy for the projects under the Scheme is released through NABARD, NCDC and the Directorate of Marketing & Inspection. The sanctioned projects include combined harvesters, milk chilling units, cotton ginning and processing units, paddy parboiling units, fruits packaging, grading and marketing units, fruit and vegetables market yards, etc., which benefit the farmers during post-harvest management/ marketing of agricultural produce. Under the Scheme 6214 projects with a subsidy release of 439.54 crores has been sanctioned so far.

Challenges

5.44 Inefficiency in the wholesale markets result in a long chain of intermediaries, multiple handling, loss of quality and increase in the gap between the producer and consumer prices. A large number of small retailers, each handling small quantities, create high overheads leading to a high marketing margin on the produce.

5.45 The purpose of regulation of agricultural markets was to protect farmers from the exploitation of intermediaries and traders and also to ensure better prices and timely payment for the produce. However, due to lack of development of an appropriate market infrastructure in tandem with changes in production, intermediation has tended to continue resulting in post-harvest losses at every stage thereby reducing the farmer's share in consumer's price. There is a strong need for providing an appropriate backward and forward integration to producers for ensuring primary value additions to the produce to enhance shelf-life while ensuring quality.

5.46 It is observed that only five states namely, Madhya Pradesh, Andhra Pradesh, Punjab, Maharashtra, and Haryana have more than 60 percent of the total capacity of godowns sanctioned in the country. Other states like Karnataka, Uttar Pradesh, West Bengal and Gujarat are picking up whereas there is little progress in the states like Goa, Jharkhand, Kerala, Uttarakhand, and Bihar and the North Eastern States. Long payback period and low levels of viability are attributed to be the main reasons for this imbalance. In the North Eastern Region, there has been a lack of response also due to the reluctance of financial institutions to provide credit facilities to such back-ended credit linked projects due to a community land holding pattern which does not facilitate land collateral in the name of individual borrowers.

5.47 There has been a lack of investment in the logistics of the retail chain, leading to a fragmented market chain. Across the States there is wide variation in the availability of marketing infrastructure such as auction platform, electronic weigh bridge, price dissemination terminals and display, storages and warehousing facilities, cleaning, grading and packaging facilities, processing and value addition, etc. However, it is observed that despite some reform initiatives by the states, there has been a lukewarm response from the private sector for taking up projects for the development of marketing infrastructure. It is felt that this is mainly due to viability issues given the long gestation period of projects

involving agricultural marketing infrastructure. It may not be possible to fund very large investment requirements of these projects fully from the limited budgetary resources of the government of India alone. In order to remove this shortcoming and to bring in private sector investment and techno-managerial efficiencies, the government is promoting Public Private Partnerships (PPP) in infrastructure development through a special facility envisaging support to PPP projects through 'viability gap funding'. Primarily, this facility is meant to reduce the capital cost of the projects by credit enhancement, and to make them viable and attractive for private investments through supplementary grant funding. In order to give a further boost to the creation of warehousing capacity in the country, the Ministry of Finance has allocated Rs.2,000.00 crore in the current financial year under the Rural Infrastructure Development Fund (RIDF).

The Way Forward

5.48 The farming community requires facilities for efficient marketing including scientific storage so that wastage and produce deterioration are avoided. Also by meeting the credit requirement of the farmers, he will not be compelled to sell the produce at a time when prices are low. The states need to implement market reforms in their entirety to provide effective marketing channels to the producers.

5.49 The markets and their related infrastructure need to be covered under Viability Gap Funding so that the private sector is encouraged to make investments in the sector. More awareness programmes need be organized to popularize the Schemes with a special focus on the North Eastern Region.

India in Global Agriculture

5.50 The Department of Agriculture and Cooperation is the nodal contact point in government of India for the Food & Agriculture Organization and World Food Programme. Bilaterally with countries of strategic interest, Memoranda of Understanding, Agreements, Protocols and Work Plans are signed and implemented for furthering cooperation in the field of agriculture and its allied sectors. The benefits that accrue to the sector from such agreements and MoUs are in the nature of capacity building, knowledge exchange through visits of scientists and technicians, exchange of genetic resources, etc. that aid in development of appropriate technologies and farm practices for enhancing agriculture productivity at farmers' field. Such cooperation also facilitates the creation of opportunities for trade in agricultural commodities. India's strategic interests are also served through partnerships with other countries.

5.51 India is a founder member of the FAO and has been taking part in all its activities. India has been availing services from the FAO from time to time in the form of training, consultancy services, equipment and material in the field of agriculture and allied sectors under its Technical Cooperation Programme. The World Food Programme (WFP) was set up in 1963 jointly by the United Nations and the Food & Agriculture Organization (UN/FAO). India is the founder member of WFP. WFP is mandated to provide emergency feeding in places facing acute food insecurity due to natural calamities as also man-made causes. Currently, the India Country Programme 2008-12 is under operation which focuses

on reducing hunger and malnutrition amongst women and children in vulnerable areas, development of appropriate products to deal with malnutrition at early ages of the children and creating livelihood opportunities for the poor. WFP has also made notable contributions through product innovations such as Indiamix and mapping of hunger in India through Food Atlases, etc. Presently, there are five agriculture sector-based projects which are being operated with the assistance of the World Bank. These projects mainly relate to Watershed Development, Soil and Water Conservation measures (Natural Resource Management), as well as overall agricultural development related issues. India also has cooperation programmes with other multilateral organizations such as the Japan International Cooperation Agency (JICA), German Technical Cooperation (GTZ), Asian Development Bank and International Fund for Agriculture Development (IFAD).

G-20 Initiatives

5.52 In the context of price volatility of agricultural commodities a Ministerial on Agriculture-related issues has been set up. At the meeting of G-20 Agriculture Minister's in Paris on 22-23 June, 2011, a Ministerial Declaration on Action Plan on Food Price Volatility and Agriculture has been issued. It has been decided to focus generally on the following areas: (i)Agricultural production and productivity; (ii) Market information and transparency; (iii) International policy coordination; (iv) Reducing the effects of price volatility for the most vulnerable; and (v) Financial regulation of agricultural financial markets. The concrete steps outlined to achieve these goals are as follows: (i)International Research Initiative for Wheat Improvement (IRIWI) (ii)Agricultural Market Information System (AMIS); (iii) The Global Agricultural Geo-Monitoring Initiative; (iv)Rapid Response Forum; (v)Agriculture and Food Security Risk Management Toolbox; and (vi)Emergency Humanitarian Food Reserves. Follow up action has commenced.

Box 5.3: Agricultural Market Information System (AMIS)

The last few years have been characterized by high and volatile food prices. Stronger demand for food crops, animal products and bio-energy in conjunction with slow growth in agricultural productivity in addition to low stocks will continue to put upward pressure on prices and generate more volatility, In addition, over the past two decades grain production has expanded most in those regions of the world that are more prone to unstable weather. This contributes to food price fluctuations becoming more extreme while also make the forecasting of food production difficult.

In June 2011, the G20 Ministers of Agriculture while recognizing the importance of timely, accurate and transparent information in addressing food price volatility launched the Agricultural Market Information System (AMIS), a collaborative food information initiative. AMIS builds on and complements existing systems and_improves global food market information. AMIS is a platform through which countries, international organizations and the private sector can work together to strengthen synergies and collaboration in order to improve data reliability, timeliness and frequency. AMIS will also build developing countries' capacity in market outlook analysis and promote policy dialogue.

Agricultural Outsourcing

5.53 It is the endeavor of the government to keep itself abreast of global trends and practices in agricultural production, trade and investments. It has taken note of the efforts being made by China, Japan, Malaysia, South Korea, Libya, Saudi Arabia, UAE and Egypt to acquire agricultural lands in third countries to augment domestic food and fuel requirements.

It is a fact that a large country like India cannot depend on food imports to a large extent, especially as the global prices are impacted significantly with India's entry. Therefore, with a view to explore the possibility of offshore agriculture investments for addressing food security and also leveraging the skills of India's vibrant agri- entrepreneurs, the Department has entrusted a study to the Indian Institute of Foreign Trade on 'Agricultural Outsourcing : Possible Opportunities for India'. The recommendations made in the report are given in the Box 5.4.

Box 5.4: Agricultural Outsourcing: Possible Opportunities for India

The study has recommended, *inter alia*, that India should enter into bilateral framework agreements with countries which are willing to facilitate Indian investments, formulate Responsible Investment Principles on the basis of international norms, in consultation with investors, co-ordinate interventions of the Government of India under the India- Africa Framework for Cooperation and private investments by Indian entities in Africa to maximize the impact, and have a special focus on Latin America, where our Missions and the host countries are eager that India should take the initiative in this regard. A supportive policy will encourage Indian entrepreneurs to obtain the desired results.

5.54 The Ministry of Agriculture will need to play a nodal role in the initiative, in coordination with relevant Ministries and Agencies like the MEA, Ministry of Finance, Ministry of Commerce and Industry, Reserve Bank of India, EXIM Bank, etc. The provisions contained in the MoUs and Agreements are operationalised through drawing biennial Work Plans. Some examples of success in bilateral cooperation with other countries are discussed below.

5.55 There are more than 50 countries with which India has signed MoUs and Agreements and Work Plans for agricultural cooperation. During 2010-11, the following MoUs, Agreements and Work Plans were signed by the Department of Agriculture and Cooperation: (i) MOU with South Africa; (ii) Work Plan and Protocol with Turkey; (iii) MOU with Argentina; (iv) MOU with Austria; (v) Agreement with Tajikistan; and (vi) MOU with Government of Islamic Republic of Afghanistan and National Institution Building Project. Broadly, the areas for cooperation identified in these MoUs and agreements include cooperation in research and development, capacity building, germ-plasm exchange, post-harvest management, value addition and food processing, plant protection, animal husbandry, dairy and fisheries, etc.

5.56 Projects for setting up Centres of Excellence for mango, citrus and pomegranate under the Indo-Israel Work Plan in the State of Maharashtra are underway. Similar projects for the creation of Centres of Excellence for fruits and vegetables at Sirsa and Karnal have been initiated in the State of Haryana. These are in the final stages of completion and activities are being taken up under the advice of Israeli experts. Israeli experts are also providing technical assistance to the Department of Horticulture, Rajasthan for development of a Centre of Excellence at village Bassi, Jaipur in Rajasthan. The main activities selected for implementation are use of brackish water in agriculture and demonstration of front line technology in kinnow cultivation. Similarly, assistance has been extended to Sri Lanka by way of exporting seeds as per the requirements of that country. As a sequel to the signing of the MoU between India and USA on Strategic

Cooperation in Agriculture and Food Security in 2010, three working groups namely: (i) Working Group-I:-Strategic Cooperation for Food Security (including trilateral cooperation with African countries); (ii) Working Group-II:-Food Processing, Farm to Market Linkages and Agricultural Extension; (iii) Working Group-III:- Crop and Weather and Climate Forecasting were constituted. Follow up action has commenced.

5.57 India is also part of the strategic groups such as India, Brazil, South Africa (IBSA), Brazil, Russia, India, China and South Africa (BRICS), Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation (BIMSTEC) and South Asian Association for Regional Cooperation (SAARC), etc. for further cooperation with other countries for advancing its strategic interests.

Indian Agriculture in World Trade

5.58 India is among the 15 leading exporters of agricultural products in the world. As per international trade statistics, 2010, published by WTO, India's agricultural exports amounted to US $ 17 billion with a share of 1.4 percent of word trade in agriculture in 2009. On the other hand, India's agricultural imports amounted to US 14 billion with a share of 1.2 percent of World Trade on agriculture in 2009.

5.59 Agricultural exports increased from Rs. 89341.50 crore in 2009-10 to Rs 120185.95 crore in financial year 2010-11 registering a growth of about 34.52 percent. Increase in value of agricultural exports during 2010-11 was primarily on account of higher exports of sugar, molasses, cotton, guar gum meal, spices, Niger seed, ground nut, maize, coffee, oil meal, castor oil, tea and jute compared to corresponding period of previous year. However, the share of agricultural exports in total exports decreased slightly from 10.57 percent in 2009-10 to 10.47 percent in 2010-11.

5.60 Agricultural imports recorded an overall decrease from Rs. 59528.33 crore in 2009-10 to Rs 56196.20 crore in 2010-11 registering a decline of -5.6 percent over the corresponding previous period. Decrease in the value of agricultural imports during this period was primarily due to lower imports of pulses, sugar and cotton. The share of agricultural imports in total imports also decreased from 4.37percent in 2009-10 to 3.50percent in 2010-11.

5.61 There has been generally a surplus in agricultural trade over the years. The trade surplus increased from Rs. 29813.17 crore in 2009-10 to Rs. 63989.75 crore in 2010-11 mainly due to the higher export of cotton, sugar and oil meals. India's major exports and imports in terms of value of total agricultural exports and imports in the recent period are given in Fig 5.8 and 5.9.

Fig 5.8: India's Major Agricultural Exports

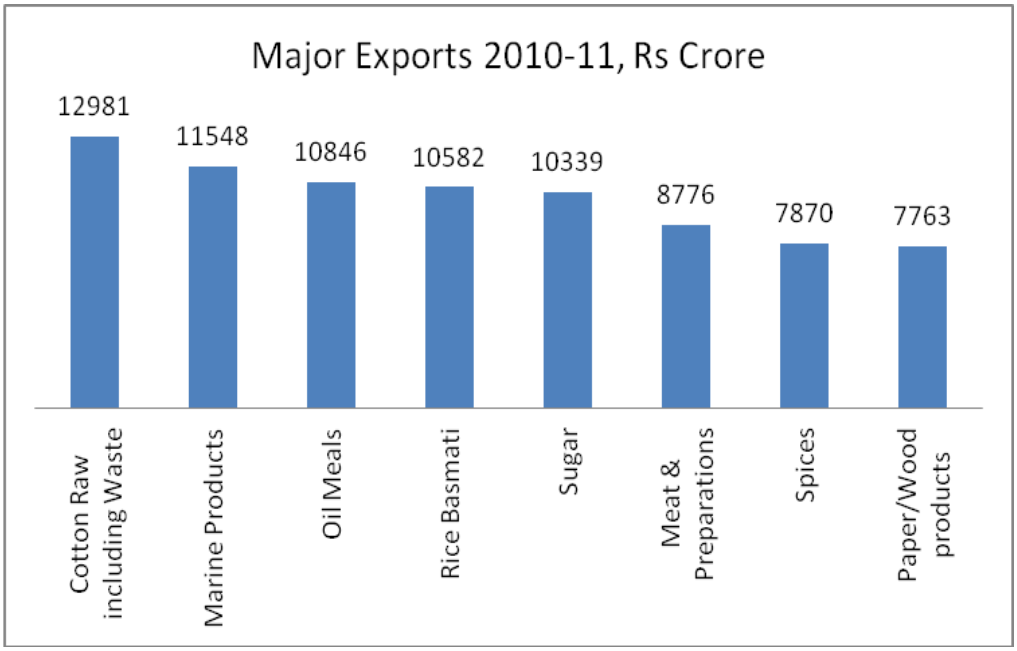
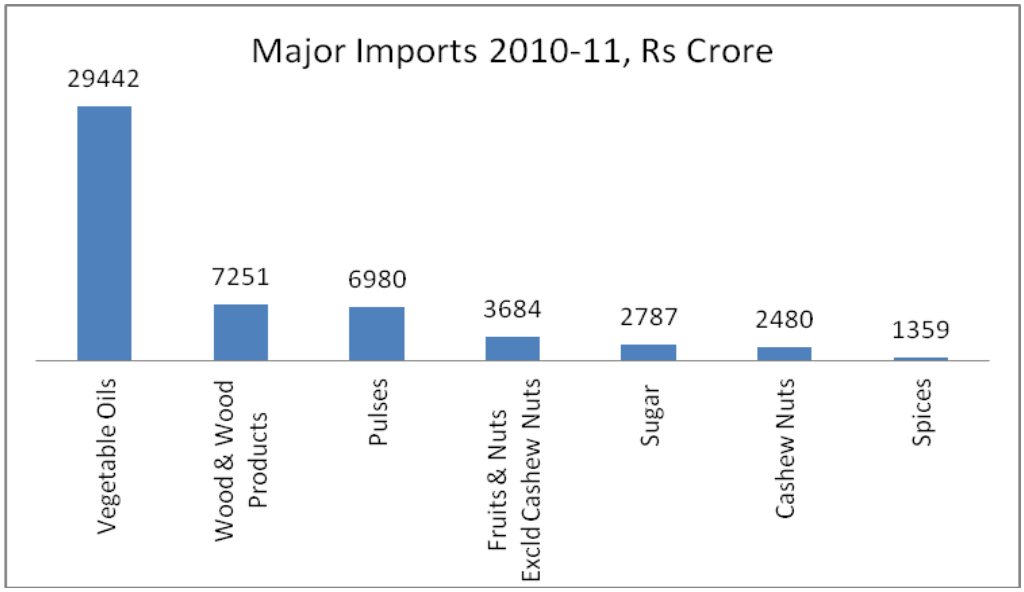


Fig 5.9: India's Major Agricultural Imports



Preferential / Free Trade Agreements (PTA/FTA)

5.62 Negotiations on PTAs/FTAs are at various stages of progress with the European Union, EFTA (Switzerland, Norway, Iceland and Liechtenstein), MERCOSUR (Brazil, Argentina, Paraguay, Uruguay), Chile, Israel, Indonesia, Australia, New Zealand and Thailand. ASEAN (Brunei, Indonesia, Malaysia, Philippines, Singapore, Thailand, Cambodia, Lao PDR, Myanmar and Vietnam) Trade in Goods Agreement was signed on 13 August 2009. This has become effective from 1 January 2010. India –South Korea Partnership Agreement Comprehensive Economic Partnership Agreement (CEPA) was concluded on 7 August 2009.

Trade in goods agreements under India- Japan CEPA and India-Malaysia Comprehensive Economic Cooperation Agreement (CECA) were concluded during 2010-11 and have become effective from 1 August 2011 and 1 July 2011, respectively.

5.63 The Doha round of trade negotiations in the World Trade Organizations (WTO), which were launched in November 2001, is essentially on hold currently. The last revised Draft Modalities on Agriculture was brought on 6 December, 2008. Ten issues are namely Blue box support for US, Cotton, Sensitive Products / Non Sensitive Products beyond 100 percent duties, Tariff Simplifications, Tropical Products & Diversification Products and Preservation of Long Standing Preferences have been in square brackets or otherwise annotated in the modalities since December 2008.

5.64 The focus shifted to possibility of selecting some issues for finalization as an 'Early Harvest' in time for the 8th Ministerial Conference of the WTO scheduled to be held in December 2011,. As part of the "Early Harvest', it was decided to take up LDC issues , which were enlarged to LDC+ issues as largely insisted upon by USA. Australia has been taking the lead in pushing the Early Harvest Package which would include several other issues apart from LDC issues. Core LDC issues are Duty Free Quota Free (DFQF) market access and cotton subsidies. USA has been insisting that all the major players including Brazil, China, and India should make significant contributions in the package to take shape.

5.65 India has said that though the early harvest of LDC issues was important, the remaining issues of the Doha development agenda should also be dealt with. USA is unwilling to commit in LDC core issues such as DFQF and cotton it has been seeking to shift the onus on Brazil, China and India.

Challenges

5.66 A Mini Ministerial was held in Geneva from 21 -29 July, 2008 to finalize the Modalities for Agriculture and NAMA. However, the Agricultural Negotiations broke down due to lack of consensus on the Special Safeguard Mechanism (SSM) apart from lack of consensus on other important areas of negotiation like sensitive products, tariff capping, tariff simplification etc. There were several other important developing country issues like cotton, preference erosion, tropical products, Duty Free Quota Free (DFQF) market access on which no agreement has been reached.

The Way Forward

5.67 It is reported that the July 2008 negotiations in Geneva had moved very close to consensus. This development has enough flexibility to enable India to protect its agriculture against imports from developed countries. Hence India has to try hard to hasten the conclusion of this round.

CHAPTER 6

Agricultural Research, Education and Extension

6.1 India, by adopting a path of science-led agriculture growth reaped dividends in the form of a reasonably strong, self-reliant and resilient food security situation. India's National Agricultural Research System spearheaded by the Indian Council of Agricultural Research (ICAR) has been responding to constantly evolving concerns and is poised to do so in the years ahead. However, the overarching concerns of nutritional and livelihood security, poverty alleviation, profitability, gender equity, ecology and environment, competitiveness in terms of cost and quality will continue to be major research issues for the National Agricultural Research System. Against this backdrop of diverse challenges, there is an increasing realisation that productivity growth in the agricultural sector is critical to address the twin issues of sustainable food security and poverty alleviation.

6.2 Greater agricultural research and development efforts and investments are essential to increase agricultural productivity. Extensive empirical evidence demonstrates that agricultural R&D greatly contributes to economic growth, agricultural development, and poverty reduction. Technology generation and dissemination through the public extension system has been the main driver of rapid agricultural transformation in India leading to not only attainment of self-sufficiency in food grains but also occasional exports. This transformation is not apparent only in the crop sector but also in allied sectors like horticulture, livestock, poultry and fishery. The Indian Council of Agricultural Research of the Ministry of Agriculture through its network of institutions spread across India and the State Agricultural Universities (SAUs) under the National Agricultural Research System (NARS) are the main public sector agricultural R&D organizations in India (Annex 6.1). The major contributions of the agricultural R&D system in the last ten years include Bt cotton, hybrid maize and Pusa basmati. The contribution of the public sector in this breakthrough has been significant in the Pusa basmati varieties (Pusa RH-10 and Pusa 1121), whereas it is mainly from the private sector in the other two cases suggesting a greater need for public-private sector partnerships. Technology would be the prime mover of agriculture growth in future and it is observed that the private sector particularly, the multinationals have invested heavily in R&D. Owing to the Intellectual Property Rights (IPR) issues, government will have to either substantially increase investment in agri R&D or join hands with the private investors **(Box 6.1)**. Therefore, the agricultural research system has to substantially raise the level of investment. Further, institutional reforms to organize research, giving incentives and rewards, IPR management and the whole issue of increasing accountability has to be addressed by the public sector R&D system. A faster, transparent approach has to be followed to effectively pursue safety and commercialization aspects **(Box 6.2)**. The frontline activities of ICAR and public extension activities carried out by the Department of Agriculture and Cooperation of the MOA and Agricultural Department of the State Governments signify the dissemination of agricultural technology and knowledge to all stakeholders.

Box 6.1: Agri Innovate India

The Agri Innovate India has been established as a company fully owned by Government of India in the Department of Agricultural Research and Education (DARE) with a share capital of Rs.100 crore and the initial paid up capital of Rs.50 crore. It would promote the spread of R&D outcomes through IPR protection, commercialisation and forging partnerships both in the country and outside the country. The farmers of the country would benefit from the formation of the company because of the following: (i) The company would provide a model for quality seed availability in the country; (ii) The company would enable manufacturing and marketing models of good quality vaccines and diagnostic kits, etc., (iii) It would establish ICAR's R&D presence in other countries and regions, such as in Africa and the Asia Pacific region; and (iv) Intellectual Property Rights in ICAR would be efficiently managed for their protection and consequent commercialization.

Box 6.2 : National Agricultural Innovation Project (NAIP)

NAIP is a World Bank and Govt. of India funded project being implemented by the ICAR. The overall objective of NAIP is to contribute to the sustainable transformation of Indian agricultural sector from an orientation of primary food self-sufficiency to one in which a market orientation is equally important for poverty alleviation and income generation. NAIP is playing a key role in bringing pluralism in the NARS by integrating non-traditional partners (38% of the implementing institutions are from ICAR-SAU system) in the NARS, particularly for complementing the research skills which are not available in the ICAR-SAU system. NAIP consists of four components, namely ICAR as a catalyzing agent for management of change in Indian NARS, Research on production to consumption, Research on sustainable rural livelihood security and strengthening basic and strategic research in frontier areas of agricultural sciences. This project with 188 sub-projects distributed in 364 centres spread across 32 states and union territories with a total budget outlay of Rs 1273.3 crores is the one of the largest externally-funded projects with wide application. A number of novel technological innovations are being developed under the project.

Natural Resource Management

6.3 In view of the pressure on natural resources for meeting the ever increasing demand of food, fibre, fodder, feed and fuel requirements of the ever increasing human and livestock population, judicious management of soil and water resources is extremely essential. The NARS is focussing on capacity building of all stakeholders, developing technologies and management strategies for sustaining agricultural production at higher levels from limited soil and water resources. The emphasis is on increasing use efficiency of all the resources including building up of data bases of various resources for efficient planning and developmental activities.

Achievements

6.4 The Natural Resource Management (NRM) Division has so far prepared soil maps of the country (1:1 million scale), states (1:250,000 scale) and several districts (1:50,000 scale). Twenty agro-ecological regions and sixty agro-ecological sub-regions of the country have been delineated and mapped on a 1:4.4 million scale. A soil degradation map of the country (1:4.4 million scale) and soil erosion maps for states (1:250,000 scale) have also been developed for effective resource conservation planning. The NRM Division has developed several location-specific soil and water conservation measures to tackle soil erosion which are being implemented through different integrated watershed management programmes run by various agencies to prevent a decline in agricultural productivity. Similarly, CAZRI, Jodhpur has developed sand dune stabilization and shelterbelt plantation technologies to check wind erosion. The Division has also developed cost effective amelioration technology *i.e.* liming at 2-4 qtls. per ha in furrow along with integrated nutrient management to raise the productivity of acid soils regions. Similarly, reclamation technology and resistant cultivars have been developed for rehabilitation of salt affected soils.

6.5 The Division has prepared digitized soil fertility maps (macro & micronutrients) for different states and developed ready reckoners for soil test-based fertilizer recommendations. Also documented are integrated nutrient management packages for major cropping systems of the country to promote balanced fertilization. The water productivity in India is still very low at the country level. It could be enhanced substantially through multiple uses of water, efficient on-farm water management practices, aerobic rice cultivation, micro-irrigation and resource conservation technologies. Several location-specific sustainable technologies (suiting soil and climate) like crop diversification, resource conservation technologies (zero tillage, bed planting, conservation furrow, laser levelling, System of Rice Intensification (SRI), raised & sunken bed, etc.), integrated farming system and agro-forestry models, etc. have been recommended for sustainable food grain production in the country. District level contingency plans are being prepared to provide an action plan to the states in event of extreme climatic events like drought and floods.

Challenges

6.6 The key challenges facing India are that of improving agricultural productivity in the face of climate change, enhancing inputs use, and ensuring efficiency of nutrients, water and land use.

6.7 Enhancing nutrient use efficiency would be possible by improving integrated nutrient management through conservation agriculture. Soil fertility maps need to be prepared at the district, *taluk* and block level using GIS and GPS tools for the development of a user-friendly decision support system (DSS) for soil-test based online fertilizer recommendations tailored to the farmers' resources availability. Through pyrolysis of agro-wastes and residue biomass for conversion into *terra preta* (*biochar*) are options that need to be explored for long-term carbon sequestration in soil to reduce the impact of climate change on soil health. Probing for applications of nanotechnology to enhance nutrient use efficiency and development of bio-sensors for soil quality assessment, characterization and deployment of soil functional communities (particularly N_2 fixers, mycorrhizae, P and S solubilizers and

lingo-cellulolytic organisms) for enhancing nutrients acquisition and availability are being explored. Enhancing water use efficiency by development of suitable technologies for water conservation and enhanced use efficiency mitigation and adaptation strategies on water management for suitable and evolving strategies under climate resilient agriculture, enhancing productivity of water logged areas through integrated water resource utilization are to be taken up for research. Other issues that require more research attention include the following:

(a) Diversification of land use through integration of trees – crops – livestock for risk reduction and optimal use of resources. (b) Prioritize research on land use efficiency in rainfed areas and integrated farming systems to provide sustainable livelihood to small and marginal farmers; (c) Crop simulation modelling for forecasting abiotic and biotic stresses and their impacts including drought characterization, mitigation and risk transfer measures; (d) Near- real time forecasting of pests incidence based on weather parameters and cost-effective corrective measures; (e) Phenotyping of rainfed crops for multiple abiotic stresses and identification of climate-ready varieties; (f) Optimization of resource inflow and input-output relationships in different integrated farming systems (IFS) models through decision support systems.

Box 6.3: National Initiative on Climate Resilient Agriculture (NICRA)

The Indian Council of Agricultural Research (ICAR) launched a new scheme, namely, National Initiative on Climate Resilient Agriculture (NICRA) to assess the impact of climate change on agriculture and its allied sectors in the country and to evolve cost effective adaptation and mitigation strategies. The components of the scheme include: (i) strategic research on natural resources, major food crops, livestock, marine and freshwater fisheries for adaptation and mitigation; (ii) demonstration of available climate resilient practices on farmer's field; (iii) strengthen research infrastructure and capacity building for climate change research; and (iv) sponsored research. The demonstration of climate resilient technologies to cope with drought, floods, heat at farmers' field in more than one hundred vulnerable districts of the country through the Krishi Vigyan Kendra (KVKs) and All India Coordinated Research Projects (AICRPs) on Dryland Agriculture and Agro-meteorology has been initiated from 2011 onwards.

The Way Forward

6.8 Certain initiatives proposed during Twelfth Five Year Plan include demonstration of integrated farming systems including Mission-mode programme and three research platforms on the National Initiative on Climate Resilient Agriculture, National Initiative on Conservation Agriculture and National Initiative on Solid Waste (agro-waste, municipal) Management.

Crop Science

6.9 The Crop Science Division of ICAR in collaboration with SAUs is engaged in the improvement of over 25 field crops, some of which form part of the food security mission of the country. Twenty five institutes and the twenty six All India Coordinated Research Projects

(AICRPs), as Plan fund schemes, strive to develop new high yielding crop varieties having specific traits that improve yield and nutritional quality along with tolerance and resistance to various biotic and abiotic stresses of target agro-ecologies. These crop varieties possess inherent tolerance to various key pests and diseases. The tolerance to drought, salinity and acidity and alkalinity of soils was also imparted in many of them. In addition, State Variety Release Committees have recommended 16 varieties and one hybrid for different situations in the six states. The research efforts attempted to provide suitable improved crop varieties (including hybrids, as the case may be) along with better crop husbandry technologies. Such high yielding crop varieties along with appropriate crop husbandry technologies could contribute to the country's harvesting success of a record foodgrains production of 250.42 million tonnes in 2011-12. Many of these technologies have futuristic features to address anticipated biotic and abiotic stresses.

Achievements

Cereals

6.10 Two hybrids in rice (Sahyadri 4 and GK 5003) and eight varieties in wheat (HS 490, PBW 590, Raj 4120, CBW 38, MP 1203, UAS 415(d), PBW 596 and MACS 2971) for different eco-systems and a new dual purpose barley variety (RD2715) were released for commercial cultivation. Fourteen maize hybrids (HM 11, NAH 2039, EH 434042, DHM 111, DHM 113, DHM 117, NK30, NK 6240, PAC 740, JKMH 502, SMH 3904, PINNACLE, 900 M GOLD) and two composites (VIVEK SANKUL 35 & VIVEK SANKUL 37) have been released for different agro-ecological conditions of the country.

Box 6.4: Challenges in Climate Change

Challenges in climate change could be addressed through identification of the gene tolerant to high temperature, flooding and drought, development of nutrient efficient cultivars and a production system for efficient use of nutrients and water. Strategies have to address the enhanced water efficiency, cultural practices that conserve water and promote crop. Development of climate resilient horticultural crops which are tolerant to high temperature, moisture stress, salinity and climate proofing through genomics and biotechnology would be essentially required. This would need highly prioritized research to address the impact of climate change. Concerted and integrated efforts with effectiveness and efficiency will be essential to meet the ever increasing demand. The regional Rapid Detection and Response Centres for plant diagnostics can assist in this effort as they begin to develop their programmes. On-campus and outreach educational programmes will be essential to expand the capacity of these few individuals. Outreach programmes, such as train-the-trainer programmes, are needed to provide an adequate number of individuals who can recognize changes from the normal appearance of plants and are in regular contact with production sites. These include farmers and plant pathologists, researchers, state and county extension specialists, crop consultants, pesticide applicators, and others.

For an effective biosecurity system in the country the following are very essential:

- Strengthening the infrastructure and building the capacity of the plant and animal biosecurity systems;

- Operationalising the National Centre for Agricultural Biosecurity;
- Establishing the National Agricultural Biosecurity Network; and
- Setting up the National Agricultural Biosecurity Council, trace back potential to site(s) of origin of pest/disease.

6.11 Two new sweet sorghum varieties [SPSSV 6 (CSV 24SS) and SPV 1746 (CSV 25)], six pearl millet hybrids [(HHB 216 (MH 1421), RHB 173 (MH 1446), PAC 909 (MH 1435), HHB 223 (MH 1468), KDBH 1151 (MH 1456)] and three open-pollinated varieties [(OPVs) (NMH 69 (MSH 199), CSBV 6 (MP 479) and ABPC (MP 484)] have been identified for release for various agro-ecologies. Barnyard millet variety [VL 207] is a high yielding, grain smut resistant cultivar and released for cultivation in all barnyard millet growing states except Tamil Nadu and Gujarat. Proso millet variety – TNAU 151 was developed and released for all proso millet growing states. It is an early maturing cultivar with profuse tillering ability, lodging resistant while the grains are bold and golden yellow in colour. Others such as the Napier bajra hybrid: RBN-13; in Oats Variety NDO-1and OS-346; in Tall Fescue: Variety EC 178182 were identified for release. Thus in all 50 varieties and hybrids of different food and fodder crops were released and notified for commercial cultivation.

Box 6.5: Success in Varieties

Successes of varieties in agricultural production are reflected through development of single cross hybrids (SCH) in maize over the open pollinated varieties and composites. Due to promotion of SCH in maize during the last 4-5 years, the production of maize has increased from 15.1 million tonnes in 2006-07 to 21.73 million tonnes during 2010-11. Development of high yielding varieties with rust resistance in wheat had enhanced its production from 69.4 million tonnes in 2005-06 to 88.31 million tonnes in 2011-12. In rice varieties like Improved *Pusa Basmati* 1 & Improved *Samba Mahsuri*, resistant to bacterial leaf blight have been developed to enhance productivity. The demand for breeder seed of Improved *Pusa Basmati* for the year 2012-13 has gone to 117 quintals against 47 quintals of *Pusa Basmati*. For submergence variety, *Swarna Sub-1* has been developed to withstand submergence for about two weeks. Variety '*Sahbhagidhan*' yields 3.8 to 4.5 t/ha in about 100 days and can withstand terminal drought for atleast two weeks. Considering all the food crops, the varietal improvement with respect to yield and resistance to biotic and abiotic stresses has led to enhanced food production from 208.60 million tonnes in 2005-06 to 250.42 million tonnes in 2011-12. The short duration, large seeded Yellow vein mosaic virus resistant *mung* bean varieties, IPM 2-03 and IPM 02-14 for spring / summer cultivation are promoted/ popularised through technology demonstrations of 2010 and 2011. Sizeable acreage under these varieties has increased pulse production. The early maturing Groundnut varieties, JL 501, *Vijetha*, *Greeshma* and *Girnar-3*; mustard variety, Pusa mustard 27, Pusa mustard 25 and NRC DR 601; Sunflower hybrid, KBSH 53, CO2 and DRSH1; Castor hybrids, DCH 591 and YRCH.1 have been successfully integrated into the seed chain for enhancement of area in the last three years.

Pulses

6.12 The estimate of pulse production for 2010-11 indicates that the total pulse production is 18.24 million tonnes from 26.40 million ha which is an all-time high. This could be achieved partly due to better access to quality seed of improved variety by farmers and partly due to increase in area. ICAR has made sincere efforts in enhancing breeder seed production of major pulse crops. Apart from the availability of quality seeds of high yielding varieties, strong technology back up from Indian Institute of Pulses Research (IIPR), Kanpur and its wide network of AICRPs across the country, increase in minimum support prices and effective government programmes like NFSM (pulses) 60,000 pulses and oilseed villages helped in increasing pulses production. Varietal development in pulses is focused upon utilization of diverse sources in the hybridization programme to accumulate desirable alleles for agronomic traits and resistance to diseases and pests. The wide hybridization programme in *Vigna* has been very useful in broadening the genetic base of *mungbean* and *urdbean*. In chickpea, large seeded (>50 g/100 seed weight) *Kabuli* varieties were developed for the central southern zone. Similarly, large seeded, short duration, rust resistant varieties of lentil were developed for late planting under rice fallows. IIPR, Kanpur in collaboration with identified KVKs in major pulse growing states have conducted 6000 demonstrations on pulses. The demonstrations are conducted on recently released varieties for the region along with a complete technology package such as fertilizer, management, IPM for insect control, *Rhizobium* culture, weed management, etc. The results of the technology demonstrations conducted during 2010 indicate a yield increase due to technology demonstrations benefiting farmer's practice to the tune of 30-60%.

Box 6.6: Pigeon pea genome

The Indian Council of Agricultural Research has been strong partner in the unravelling of the pigeon pea genome. The first draft of the whole genome sequence data of 511 million base pair has been completed by Indian scientists. A group of thirty-one Indian scientists have decoded the genome of '*Arhar*', the second most important pulse crop of India. This is the first plant genome sequenced entirely through a network of Indian institutions and it will provide a highly valuable resource for variety improvement of pigeon pea. The genome of the popular *Arhar* variety 'Asha' was assembled using long sequence reads of 454-FLX second generation sequencing technology resulting in 511 million base pairs of high quality genome sequence information. The scientists have identified 47,004 protein coding genes in the Arhar genome, of which 1,213 genes are for disease resistance and 152 genes for tolerance to drought, heat and salinity that make it a hardy crop. The research was undertaken in the biotechnology laboratories of National Research Centre on Plant Biotechnology (ICAR), New Delhi, Indian Agricultural Research Institute (ICAR), New Delhi; Indian Institute of Pulse Research (ICAR), Kanpur, UP; Banaras Hindu University, Varanasi, UP; Panjabrao Deshmukh Krishi Vidyapeeth, Akola, Maharashtra; University of Agricultural Sciences, Dharwad, Karnataka. Another draft of the pigeon pea genome sequence data has also been repeated by International Crop Research Institute for Semi-arid Tropics (ICRISAT), Hyderabad with international and Government of India support.

Oilseeds

6.13 India is the fifth largest vegetable oil economy in the world next only to USA, China, Brazil and Argentina contributing 7% of the world's oilseed production. India has the distinction of being the largest producer of sesame, safflower and castor from the largest acreage in the world. Globally, it ranks second, third, fourth and fifth in production of groundnut, rapeseed-mustard, linseed and soybean, respectively. Though the country has spent about Rs.29,500 crore through the import of edible oil, it has earned Rs.20,800 crore through the export of oilseeds and its derivatives during 2010-11. India is the largest exporter of castor oil, holding about 70% share of the global trade. The demand of edible oil has outstripped the supply and there is a steady rise of edible oil import to bridge the yawning gap. There is a sharp increase in edible oil consumption in India which is induced by an increase in per capita income. India is the world's largest consumer of edible oils, beating China to the top slot last year. The increase in population and per capita income has resulted in higher requirements of vegetable oils in India. The varietal development programme in oilseeds aims to develop short duration and disease resistant varieties and hybrids of sunflower, groundnut and sesame for *rabi or* spring season. Short duration and photo-thermo insensitive varieties of groundnut and sesame were developed for the spring season. Early maturing varieties of soybean and mustard were developed to increase the efficiency of soybean and mustard based cropping system and also to extend the crop in non-traditional areas. Development of the Cytoplasmic Male sterility System and release of mustard hybrids have been some of the significant achievements in recent years. Varieties of rapeseed-mustard with low erusic acid content have also been released.

6.14 The frontline demonstrations conducted under real farm situations in different agro-ecological conditions in nine oilseeds crops during 2007-2010 indicated that improved technologies can increase the overall mean yield of oilseed crops by 49% over the existing yield. There exists a tremendous potential for enhancing the yield of all the nine oilseed crops by adopting the package of recommended technologies. The gap between improved technology and farmers' existing practices ranged from 29% in Sunflower to 106% in Niger. It was estimated that by bridging this gap, the national oilseeds production level could be increased from 27.90 million tonnes (average of 2008-2011) to 39.7 million tonnes without bringing any additional area under these crops, if all the farmers adopt the improved technologies in the existing cropped area.

Cotton

6.15 The average productivity of cotton increased from 190 kg per ha in 2000-01 to 499 kg per ha in 2010-11, primarily due to the introduction of Bt cotton. The Central Institute for Cotton Research at Nagpur has cutting edge research programmes in improving the genetic diversity, development of more than 35 new varieties (both *Gossypium hirsutum* and *G. arboreum*) and hybrids besides identifying novel genes (new sources to combat biotic and abiotic stresses) and more acceptable refugia strategies for Bt hybrids. The standardized newer agro-techniques to maximize productivity and developed technologies to improve water and nutrient use efficiency in Bt hybrids had all helped to sustain the productivity of Bt cotton hybrids. Cost effective management strategies for the management of mealy bugs,

leaf reddening, etc. and development of Bt detection kits to empower stakeholders including farmers to check the spread of spurious seeds in the market are some of the landmark achievements that had brought about a revolution in cotton production in the country.

6.16 The bollworm resistance management strategies using the resistance detection kits were implemented in 26 to 32 cotton growing districts in the country over 10 years with financial support from the ICAR and the Ministry of Agriculture, Government of India. The research and technology innovation thus resulted in reducing the usage of insecticides by more than 60-80% without any reduction in yields. The project which has been funded by the Ministry of Agriculture has about 100,000 farmers as direct beneficiaries and was implemented in 1650 villages covering nearly 200,000 hectares in 30 districts of 10 cotton growing states since 2002. The direct benefits from the project implementation are estimated to be more than Rs. 160 crore on account of insecticide reduction and enhanced yields. Last year, the IRM strategies were disseminated in 330 villages of 11 districts in the North zone, 172 villages in 11 districts of the Central zone 150 villages of 10 districts in the South zone and 10 villages of South 24 Pargana, district of the East zone reaching out to 38,472 cotton farmers. The closer coordination between ICAR and DAC through the Technology Mission on Cotton has brought rich dividends to the country through dissemination of improved technologies and faster adoption by farmers on a large scale in a shorter possible time. This has enabled the country to be self-reliant in the cotton sector besides helping the country to emerge as a net exporter of cotton and cotton-related textiles. The impressive performance of the cotton sector during the Eleventh Plan could be attributed to several factors including:

- Successful implementation of the programmes under Technology Mission on Cotton-MM-I and MM-II;
- Increase in area under cotton due to improved productivity in the first half of the Eleventh Plan and more remunerative prices to cotton farmers in the second half;
- Steady increase in area under Bt cotton;
- Several technological breakthroughs in the last few years, including increased coverage under hybrid seeds, seed treatment with imidacloprid, thiomathoxam, spinosad, etc., successful management of mealy bugs, and CLCuV to control biotic and abiotic stresses in Bt cotton, IPM, INM, IWM technologies to sustain productivity of Bt hybrids;
- Frontline demonstrations (FLDs), Farm Field Schools and financial support for farm equipments, drip and pheromone traps through TMC MM-II and the undisputed success of IRM programmes on pesticide resistance monitoring and management, further helped to sustain cotton yields.

Sugarcane

6.17 In the area of sugarcane improvement, ICAR is actively involved in developing sugarcane varieties resistant to red rot. So far, about 32 varieties resistant to red rot have been released and notified for cultivation in different parts of the country. With concerted disease management efforts by the ICAR and stakeholders, red rot has been contained successfully and as a result sugarcane production in the country did not decline due to red

rot. The problem of red rot in sugarcane was adequately addressed at the field level through Moist Hot Air Therapy and the Three-tier Seed Programme. ICAR has also developed a technology for bio-management of red rot using *Trichoderma*, a fungal antagonist. It boosts the resistance of cane to diseases and promotes the growth of cane. Research work on drought tolerance and resistance to shoot borer is being carried out by ICAR. For drought tolerance, varieties like Co 99004, Co 2001-13, Co 2001-15, CoC 01061, Co 98014, CoPant 97222, CoH 119, CoLk 94184 etc., have recently been developed.

Jute

6.18 Although Jute acreage has stabilized around 8 lakh hectares in the country, jute productivity has more than doubled to 22.12 q/ha in 2010-11 since partition of the country from 11 qtl per ha and the total production of raw jute in the country is about 10.58 million bales of 180 kg each. This has happened due to development of short duration high yielding varieties as well as other production technologies by ICAR including fertilizer management, weed management, farm machineries and pest management. CRIJAF (ICAR) has developed around 15 high yielding varieties of jute and allied fibres. Production and distribution of certified seed of newly released varieties are the need of the hour for further improvement in productivity. ICAR has taken the initiatives for production of quality seed of newly released varieties of jute in its farms which may increase the yield by at least 20-30%. Five most important issues namely, improvement in productivity, quality improvement, retting of jute, farm machineries and quality seed production are addressed by the ICAR through various on-going projects, which have contributed to the present level of production with adequate support from the Jute Technology Mission and Directorate of Jute Development of the Ministry of Agriculture.

Crop Health Management

6.19 Research on crop health management led to the development of a number of crop varieties that have been notified with high tolerance to key pests (insects, mites, diseases, nematodes, etc.). While resistance sources for certain biotic stresses are under constant exploitation as in rice and wheat, integrated pest management through biological control, cultural practices has reduced over-dependence on pesticides which effectively suppress various pests. Intensification of breeding for Stem rust strain Ug99 is in progress. With development of new biotic stress problems such as three mealy bug species in various crops, *Spodoptera* damage in soybean and cotton, mites, thrips, root knot nematode in rice, research programmes are put in place to address such emerging issues so as to provide adequate mitigation to farmers.

6.20 Suitable research output has led to the development of integrated pest management (IPM) for various cropping systems in the country. The recent alignment of such IPM modules into the Bureau of Indian Standard (BIS) standardised Good Agricultural Practices (GAP) has brought credible alignment with WTO supported trading of agricultural commodities.

6.21 Suitable biotechnological tools such as marker assisted selection, transgenic crop variety development and many such novel tools and techniques have been deployed for faster and accurate identification of promising crop genotypes. Changes in climate, cropping patterns

due to economic compulsions have been considered while developing many crop varieties. Impedance of abiotic stresses, especially in large chunks of drylands has been focused clearly in research programmes of crops to yield tangible benefits of responsive varieties.

Seed research scenario

6.22 Seed technology research has provided adequate inputs for production, processing and storage of crop seeds in the country. ICAR is responsible for the production of breeders seed of important and popular crop varieties and hybrids. During the year 2009-10, the breeder seed production was 115,866.8 quintals against an indent of 91,409.8 quintals from the Government of India and various states. In all the cases, the breeder seed production met the requirement of indent. The breeder seed production data for the *kharif* crops for the year 2010-11 also showed that the indents of all crops are met. Under the Mega Seed Project, ICAR has produced more than six lakh quintals of quality seed of different classes. The economic impact of these to the country could be anticipated when all these form part of their respective seed chain and get accessed by farmers for large-scale cultivation. Enormous team work and co-ordinated approach of evaluation created such a spectrum of crop varieties for the benefit of Indian growers.

Bio-security through crop production

6.23 Indian agriculture, in recent times, has been threatened by various pests and diseases that have potential trans-boundary movement possibilities. Examples such as Ug99 race of black rust of wheat, Coconut leaf beetle, Downy mildew of soyabean, a number of weed seeds from various countries from where food grains are imported are typical threats. Recent invasives such as coconut eryiophid mite, which spread to India from Male, and devastated coconut in coastal areas of the country for over a decade, Papaya mealy bug that recently entered into southern India from Sri Lanka and reached up to Odisha and Tripura, in addition to the Peninsular states, were successfully controlled.

6.24 The Papaya mealy bug that invaded Tamil Nadu and other states and subsequently spread to the plateau region and even to Tripura in North Eastern India, threatened many horticultural and field crops including the mulberry plantations which in turn could have affected the silk industry in southern India. Timely intervention to import three species of natural enemy parasites from USDA laboratory at Puerto Rico and the utilization of one of these proved to be extremely successful in containing the spread and build-up of this pest. Saving of avoidable crop loss was at least Rs. 1600 crore in the last one year. Ground truth surveillance of crop pests as a pilot project in Maharashtra in soyabean and cotton crops did prove to be a novel approach in collaboration with the *Rashtriya Krishi Vikas Yojana* for effective and timely suppression of caterpillar pests. Similar efforts have been expanded to the rice crop of Odisha and many field crops such as pulses of Karnataka and Gujarat. Disease detection-diagnostic kits are being developed. A major success consists in the case of Pomegranate wilt in Maharashtra and other southern states. The identified kit is under field validation. The research network system identified suitable methods to suppress wilt pathogens infecting a host of crops and successfully developed various biological control options in addition to crop resistance in castor, pepper and tomato. The immense sap-sucking pest pressure

and wilting in genetically modified cotton crop has been mitigated by appropriate research and helped the farmers to contain emerging pests in the absence of bollworms in cotton crop.

Box 6.7: Yellow Rust Disease

The Ministry of Agriculture organised monitoring along the Indo-Pak border in Gurdaspur district and adjoining areas for timely detection of the **yellow rust disease,** which was brought on by late rains in February 2010. This alerted the wheat growing states to take pre-emptive steps viz. fungicide spray with Propiconozole (TILT) to standing crop to contain the build up of this rust inoculum to new areas and to avert further damage to the affected crop. Monitoring teams scouted the wheat growing districts and advised spraying of fungicide in Punjab, Haryana, Uttarakhand and western Uttar Pradesh. Quick and empowered decisions to execute field spraying in hot-spot areas adequately reduced the threat , arising out of aberrant weather patterns at the fag end of the wheat season, from this serious disease. Current wheat breeding programme to pyramid various resistant genes through modern breeding techniques would impart higher tolerance to yellow rust in all popularly cultivated wheat varieties.

6.25 Trans-boundary movement of pests (insects, mites, diseases, nematodes and weeds seeds) need careful planning and execution through meticulous implementation of existing laws and rules thereon by all states, supported by the federal system. A huge capacity development in human resources and infrastructure is require to monitor this.

Biotechnology in Crop Improvement

6.26 For several biotic, abiotic stresses and for agronomically important traits in rice, genes and Quantitative Trait Loci (QTL) have been identified with the help of PCR based DNA markers. Molecular marker-assisted selection (MAS) is now regularly deployed for targeted manipulation of various agronomically important traits and is widely accepted to have great potential to improve the efficiency and precision of rice breeding. This has been amply demonstrated through the development and release of a few MAS derived products in India (Improved *Samba Mahsuri* and Improved *Pusa Basmati* 1 possessing bacterial blight resistance trait) and *Swarna Sub-1* possessing submergence tolerance**.**

6.27 In maize, Vivek QPM 9 is the first MAS product of maize released in India. This Quality Protein Maize (QPM) hybrid was developed through transfer of *o2* gene and endosperm modifiers in the two parental lines (CM145 and CM212) of Vivek Hybrid 9. Using the same strategy, several other early maturing elite in-breds have been converted into their QPM versions.

6.28 The most compelling case for transgenic crops (Genetically modified (GM) crops), is their capability to contribute to the following: (i) increased crop productivity, and thus contribution to global food, feed and fibre security; (ii) lowering of production costs; (iii) conservation of biodiversity, as a land-saving technology capable of higher productivity; (iv) more efficient use of external inputs, for a more sustainable agriculture and environment; (v) increasing stability of production to lessen suffering during famines due to abiotic and biotic stresses; and (vi) to the improvement of economic and social benefits.

6.29 Subsequent to the introduction of Bt cotton in India in 2002 a spectacular revolution occurred in cotton production. The area under Bt cotton increased from 29,307 hectares in 2002 to an estimated 9.4 million hectares by 2010.Bt cotton covered an area of 92 per cent of total cotton area in 2010 with more than 5 million farmers growing genetically engineered cotton. India produced 33.43 million bales of cotton in 2010-11 and India currently occupies second position in global cotton production after China. Large-scale cultivation of Bt cotton has resulted in significant reduction of insecticide use to the tune of 40 to 60% less than the intensity on the corresponding non-transgenic varieties.

6.30 Fruit borer resistant Bt brinjal hybrids have been cleared by GEAC with respect to environmental safety and biosafety. Currently, fifty-four events developed by private and public research laboratories in more than a dozen crops expressing various traits are under testing. Some of the transgenics such as cotton, chickpea, sorghum, sugarcane, potato, castor and tomato are being field-tested.

6.31 An array of tools and techniques in the field of molecular biology have become available for supplementing the conventional genetic approaches for improving crop plants. One of the approaches, popularly known as 'Marker assisted Breeding' or 'Molecular Breeding' employs molecular markers for genome mapping, gene tagging and marker assisted selection (MAS). Four genes for bacterial blight (BB) resistance have been pyramided in a normal rice genotype in contrast to Improved Pusa Basmati 1 released for farmers. QTLs that impart tolerance to three abiotic stresses (moisture stress, submergence and salinity) are being introgressed in elite genotypes of rice by ICAR institutes and SAUs under a Network Programme 'QTL to Variety'. Tomato Genome Sequencing was accomplished as an international collaborative effort. India has become a partner in International Wheat Genome Consortium with the responsibility of sequencing Chromosome 2A. Deep transcriptome profiling was carried out in pigeonpea by 454/FLX sequencing. A combination of genic-SSR markers and single nucleotide polymorphism markers being mined from the Expressed Sequence Tags contiguous will be a powerful resource for molecular taxonomic studies and construction of a reference molecular map of the pigeonpea genome. An initiative to establish High throughput Phenomics Platform was undertaken. The facility will be useful to phenotype rice germplasm, breeding populations, mutants, recombinant inbred lines and transgenic events for various physiological traits under moisture stress.

Bio-diversity in Crop Sector

6.32 The management of plant genetic resources in the country including germplasm exploration and collection, germplasm introduction, plant quarantine inspection, germplasm characterization and evaluation, *ex situ* conservation of germplasm accession in the National Genebank, genomic resource management are taken up together with developing genomic resources and tools, discovering and validating the functions of genes of importance to agriculture and developing bioinformatics tools for utilization of genomic resources.

Challenges

6.33 The growth in agricultural productivity in terms of Total Factor Productivity (TFP) has been declining in recent years on account of falling investment, infrastructural development, institutional changes, slow spread of even the available promising technologies and not much improvement in technologies. High growth in demand and slow growth of some food commodities is widening the gap between supply and demand.

6.34 The significant challenge that the country faces in agriculture is due to climate change for which suitable technologies for adaptation to climate resilience, crop varieties including horticulture as well as in animal and fish breeds; natural resource management tactics; suitable farm machinery and implements, and farming strategies to accommodate the seasonal changes of monsoon, drought pattern; as well as emerging pest (weeds, insects, diseases, nematodes, mites, rodents, etc.) scenario due to such changes. In fact enhancement in the types and intensity of various pests and disease causing organisms and weeds in all agro-climatic regions of the country is anticipated. Other challenges include a limited spread of farm mechanisation in the context of challenge for human labour in agriculture; weak input use efficiency is also anticipated. High perishability of commodities due to inept post-harvest handling and securing through effective primary processing and storage of commodities are in the forefront of the research agenda of ICAR. Reducing regional disparities is another important issue that needs serious attention. Reducing dependence on agriculture for livelihood security should receive high priority in future developmental programmes. A sizeable population, especially of marginal and small holders, should be made economically viable by progressively employing them gainfully in non-agricultural sectors.

6.35 Tackling increased vulnerability due to increasing integration with the world food market is a necessary condition to protect the interest of small holders. Maintaining a natural resource base to ensure sustainable agricultural growth is a pre-requisite for higher agricultural growth. Deteriorating soil and water resources are posing serious problems and are adversely affecting agricultural production.

6.36 The country is presently short of pulses and oilseeds and edible oils and has been importing substantial quantities of these items over the years. The substantial increases in prices of pulses during the last year and fruits and vegetables, milk and dairy products during the current years are clear signals of demand and supply imbalances. Therefore, there is a need to give higher priority to production of pulses, oilseeds and horticultural crops.

The Way forward

6.37 Higher investment in agriculture, agricultural R&D, spreading available promising technologies, contributing to technological breakthroughs through application of frontier technologies, creating rural infrastructure and evolving appropriate institutions are efforts that should be pursued to accelerate agricultural growth.

Box 6.8: Borlaug Institute of South Asia

The Government of India has approved the proposal of International Maize and Wheat Improvement Centre (CIMMYT) to establish an international institute, namely, the **Borlaug Institute of South Asia** (BISA) in India with centres at Ludhiana in Punjab, Pusa in Bihar and Jabalpur in Madhya Pradesh. This will be an international institution expected to carry out cutting-edge research of global standards. The establishment of BISA in India will enable India to harness the best of international science in enhancing productivity in wheat and maize. India would be able to rapidly and effectively absorb the research output of BISA, thus benefiting farmers of the country. This major International R&D institution will make India even a bigger centre for agricultural research and this, in turn, would attract further research & development investment in the country.

GM crops

6.38 The increased thrust to develop genetically modified (GM) crops by imparting tolerance genes for both abiotic stresses and biotic stresses has been achieved in this decade of twenty first century. However, further research effort and investment to achieve faster results, especially in pulses, vegetables and food crops are required. The national policy on GM food crops needs to develop GM crop-based agriculture in cost-effective, high yielding crop varieties.

Photosynthesis through C3/C4 systems:

6.39 Exploration of the possibility to exploit current scientific advancement in converting C3 cereal producing crop plants into C4 types would bring in comfortable utilisation of the anticipated enhancement of carbon-di-oxide concentration.

Bioinformatics

6.40 Second generation genome sequencing work is in rapid progress. Earlier it required ten years to unravel information in the first draft genome sequence which can be done now in one year. Competitive work is in place, globally to undertake genome sequencing and for gene discovery. India needs to play a pivotal role in this field to sequence indigenous and exotic germplasm, land races and engage in association mapping, annotations, gene discovery and functional genomics. Based on syntenny, bioinformatics (Box 6.9) would allow the understanding of second generation of genetics, allele mining, molecular breeding and transgenics for the development of designer crops. Indian priority for this work is in pulses, rice, wheat, millets, rapeseed mustard, cotton, jute and other fibre yielding crops.

Box 6.9: National Agricultural Bioinformatics Grid (NABG)

NABG is planned to help in developing databases, data warehouse, software and tools, algorithms, genome browsers and high-end computational facilities through a systematic and integrated approach in the field of agricultural bioinformatics. Further, it will provide a platform for inter-disciplinary research in cross-species genomics. One of the main purposes of this project is to integrate institutions and organizations in order to provide a computational framework and support to carry out biotechnological research.

Horticultural Crops

6.41 Horticulture has emerged as a core sector in agriculture passing through the various phases with a coverage of nearly 22.25 million ha in 2011-12, encompassing a wide variety of crops, vegetables, root and tuber crops, mushroom, ornamentals , medicinal and aromatic plants, nuts, plantation crops including coconut and oil palm. Fruits and vegetables are also a rich source of vitamins, minerals, and carbohydrates and are referred to as protective foods and assume great importance in the nutritional security of the people. The cultivation of horticultural crops, especially fruits and vegetables, plays a vital role in the prosperity of the nation and is directly linked with the health and happiness of its people. The emphasis on horticulture is recognition of the need for attaining nutrition security and also for a

sustainable income. Fruits and vegetables provide 90% of vitamin C and 60% of vitamin A in the world.

Achievements

6.42 The main focus of the research programme in horticulture is to conserve, characterise and utilise the genetic resources, develop suitable cultivars, and to enhance the production and protection technologies. Outreach research programmes to combat the serious diseases caused by *Phytophthora*, *Fusarium, Ralstonia, Alternaria* and viruses have been initiated. Ten institutes for horticulture crops conduct area specific research, besides several international programmes, which address these issues. Two genomic network projects are being operated in various ICAR institutes on horticultural crops namely, International Solanaceae Genome Network programme and an International Network on Improvement of Banana and Plantain.

Crop improvement in horticultural crops

6.43 Regular bearing mango hybrid, export quality grapes, multiple disease resistant vegetable hybrids, high value spices and tuber crops of industrial use have been developed and have revolutionized the horticultural sector. High-yielding *Gauri Sankar* and *Sree Bhadra* sweet potatoes have a role to play in minimizing malnutrition and improving nutritional security. Similarly, breeding to develop grape cultivars suitable for wine making, black pepper cultivars rich in aroma compound 'Caryophyllene', development of processing tomatoes, etc. are some of the research programmes being carried out in various horticultural institutes. Varieties are being bred for processing qualities in potato for chips making, white onion with high soluble sugar, papaya varieties for table and papain production are some of the successful research programmes being carried out at various ICAR institutes.

Hybrid technology for high productivity and quality

6.44 The hybrid technology has revolutionized the production of vegetable crops and demand for hybrid seeds is continuously increasing. Hybrids of tomato, chilli, cucumber and muskmelon are being produced at several locations in the country. Besides this, imported seeds of mostly cole crops are available to the Indian farmers. The All India Co-ordinated Vegetable Improvement Project (AICVIP) has so far recommended the cultivation of more than 45 hybrids. Besides, many hybrids of vegetable crops, developed and marketed by the private sector are also available to the farmers. At present, the area under vegetable hybrids accounts for 10 % of the total area. Area under high yielding F_1 hybrids in important vegetable crops have been developed in tomato, cabbage and brinjal and the area under hybrid capsicum and chilli is on the increase. High production, earliness, superior quality, uniform produce and resistance to biotic and abiotic stresses are the main advantages of F_1 hybrids. Cytoplasmic Male Sterile lines have successfully been utilized to produce potential experimental crosses of onion and commercial hybrids of chilli. Genetic male sterile lines (GMS) of tomato, brinjal and chilli were developed and are being successfully utilized for developing a number of cost effective experimental crosses at various centres. Hybrid seeds of chilli (CH-1, CH-3, CCH-3), brinjal (*Kashi Sandesh*), tomato (TH-1) are now being produced by the farmers by honing their skill. The parental lines of a number of hybrids developed have been sold on a non-exclusive basis to the seed companies with an aim to promote these hybrids among the farmers.

Rootstocks for production and profitability

6.45 Appropriately selected rootstocks have potential to modify the architecture of plants for efficient utilization of resources. It can ameliorate the soil, enhance nutrient and water use. Therefore, rootstocks have become integrated in the production system of grapes, citrus, apple and many fruit crops for successful production. Citrus rootstock, *Rangpur lime* can adapt to water stress, calcareous soils and resist *Phytophthora*. The use of rootstock in grape cultivation has gained popularity, and almost all newer vineyards are being planted on stress tolerant rootstocks only. The popular rootstocks for grape are Dog ridge B-2/56 and 110R, which can sustain abiotic stresses like drought and soil salinity and provides vigour of vine needed for production. In sapota, *Khirni* (*Maninkara hexandra*) has proved drought tolerant and productive in marginal soil.

Quality planting material and seed technology

6.46 There have been technological changes in seed production, techniques for production of hybrid seeds, using of cytoplasmic male sterile lines (CMS), technologies for vegetative methods of propagation, now *in vitro* propagation technologies, a success story in banana, potato and citrus. Knowledge has also improved about the diseases being transmitted through the vegetative propagation chain, and now diagnostic technologies are available for early detection. Enabling policies have also facilitated the availability of the best materials to the farmers. However, seed chains addressing the production of nucleus, foundation and certified seeds are weak. Management of quality and health of plants needs upgradation, in order to ensure quality seeds and healthy planting material. Therefore, it is essential that the dynamics of technologies and policies are analysed in perspective to address the challenges of the future, because appropriate seeds and planting material hold the key to success in horticulture.

Diagnostics for health management

6.47 Various diagnostic methods for instance ELISA, Polymerase Chain Reaction (PCR), multiplex PCR, Real Time PCR are available for different viruses, bacteria and fungi. PCR-based diagnostic protocol has been developed for rapid detection of viruses and *Phytophthora* in citrus, banana, potato, coconut and tuber crops.

High density planting system

6.48 High density planting technology has been standardized for many crops and also adopted by many fruit growers in India. It has become a success story in banana, pineapple, guava, papaya, mango and cashew. High density orchards have not only provided a higher yield and net economic returns per unit area in the initial years, but also facilitated more efficient use of inputs. In high density planting, closer spacing has given two and half times more yield than normal spacing in mango, guava, papaya and pomegranate. Technologies for high density planting, canopy management and rejuvenation of old and senile orchards have been developed and successfully demonstrated at farmers' field. Technologies for meadow orcharding in guava are being adopted across the country for higher productivity. Coconut based high density multi-species cropping system helps to improve soil properties, realize higher and stable farm net income and generates additional employment.

Efficient input use and nutrient dynamics

6.49 Among various inputs, fertilizers alone account for a significant amount of the total cost of production. The nutritional requirement of various horticultural crops in different agro-climatic zones has been worked out and successfully adopted by farmers. However, streamlining is required in the use of biofertilizers, VAM fungi, biological N fixers and other beneficial microbial agents for effective nutrient use efficiency.

Water use technology for high efficiency

6.50 Good water management using well designed systems is critical for sustaining production and quality of produce, specially in the case of horticultural crops. If a water deficit is experienced at the active growth phase or fruit development stages it causes severe loss to production and quality. Therefore, it is imperative to manage the water by posing questions of when, where and how to use this resource to draw maximum efficiency and productivity. Therefore, a scheduling based on plant water balance in consonance with soil and climate is appropriate. Water has to be applied to the root zone to save the losses. Among various methods tried drip irrigation has proved successful in exhibiting high water productivity by saving irrigation water from 25 to 60% in various orchard crops and vegetables with a 10 to 60% increase in yield as compared to the conventional method of irrigation. It is one of the latest methods of irrigation which is becoming popular in areas with water scarcity and salt problems. Fertigation has become the state of art technique in orchard crops and vegetables because nutrients can be applied to plants in the correct dosages and at the time appropriate for the specific stage of plant growth. Fertigation requirement in fruits (mango, banana, grapes, papaya, and pomegranate, citrus and strawberry), vegetables (tomato, chillies, brinjal, okra, potato, muskmelon, cucumber) and ornamental crops (rose, carnation, gerbera) and plantation crops (coconut, arecanut and coffee) have been standardized to improve the nutrient and water use efficiency from 120 to 290%.

Organic horticulture

6.51 India is best known as an exporter of organic tea and also has a niche market for spices, fruits and vegetables. The protocol for organic production in many horticultural crops has been worked out which includes a use of resistant varieties, management of soil vermi-compost and biofertilizer, and management of disease and pests using biological control as well as bio-pesticides.

Horticulture-based cropping systems

6.52 A farming system and cropping system approach for sustainable use of farm resources and reduced risks has been successfully demonstrated in perennial horticulture. Various farming system models have been developed. Shade loving medicinal and aromatic crops like *patchouli*, rose geranium, long pepper, *sarpgandha, kacholam,* etc., are successfully grown under coconut and areca nut. The elephant foot yam is widely grown as intercrops in *litchi*, coconut, banana orchards. Spices like black pepper, ginger, turmeric, vanilla, nutmeg, clove and some medicinal plants are the ideal intercrops for coconut.

Hi-tech horticulture and precision farming

6.53 Precision farming calls for efficient management of resources through location-specific hi-tech interventions. Hi-tech horticulture encompasses a variety of interventions such as micro irrigation, fertigation, protected and greenhouse cultivation, soil and leaf nutrient based fertilizer management, mulching for *in situ* moisture conservation, micro propagation, biotechnology for germplasm, genetically modified crops, use of biofertilizers, vermiculture, high-density planting, hi-tech mechanization, green food, soil-less culture, biological control, etc. Precision farming application of fertilizers has proved to be profitable along with recommendations based on a package of practices. About 17 Precision Farming Development Centres (PFDC) have been established in different agro-climatic regions. Some crops for which the components of precision farming have been practiced are banana, grape, pomegranate, capsicum, tomato, chilli, cashew and selected flowers.

Plant health management system

6.54 There are several pests and diseases such as fruit fly, stem and fruit borer, bark eating, leaf gall midge, aphids, mites and moths and diseases like scab, powdery mildew, leaf spot, brown spot, gummosis, canker causing serious damage to various horticultural crops. Among different pests, termites, rodents also cause considerable damage particularly in low rainfall areas. The chemical control measures for various pests and diseases have been worked out at various centres, but there is need for eco-friendly practices. During the last two decades IPM has moved from a peripheral position to the central stage of horticultural production programmes. A variety of techniques have been developed and refined for controlling different insect pests.

6.55 Plant health management in horticultural crops involves not only pre-harvest but also post harvest-health management strategies such as production of pest and disease-free planting materials, use of bio-inoculants and other growth enhancing soil amendments, indexing for major pathogens and certification of planting materials, seed plot technique and mother garden technique and other such measures. Disease forecasting models that are developed proved to be useful in determining the role of climatic factors in disease appearance and progression and in devising a suitable management strategy.

Post-harvest technology

6.56 In order to make horticulture a viable enterprise, value addition is essential. Harvest indices, grading, packaging, storage techniques have been developed and standardized for major horticultural crops. Value addition through dehydration of fruits and vegetables including freeze drying, dried and processed fruits, vegetables and spices and fermented products have also been developed. Potato chips, spices flakes and fingers, French fries are becoming popular as fast food business. Development of new products like juices, chips, essential oils, fruit wines are gaining popularity. Packing materials like Corrugated Fibreboard boxes (CFBs), perforated punnettes, cling film wraps, sachets, etc. have been standardized for packaging of different fresh horticultural produce.

6.57 As food consumption patterns are changing towards more convenient foods, the demand for products like pre-packed salads, packed mushrooms and baby corn frozen vegetables, etc. has increased. In order to reduce the dependence on refrigerated storage, the low cost eco-friendly cool chamber for on farm storage of fruits and vegetables has been developed. Standardization of Modified Atmosphere Packaging and Storage systems with a greater emphasis on safety (pesticide free), nutrition and quality is being given a priority in research programmes.

Mechanization in horticulture

6.58 Most of the horticultural operations in India are done manually or with animal power. Several machines and tools have been developed to enhance the efficiency of farm operation. In fruit crops, the tractor operated pit-hole digger and bucket excavators (JCB) have been developed but uses at the farm level has yet to occur. In the fruit nurseries mechanisation using media siever, media mixer and plastic bag filler has been achieved.

Biosecurity in horticultural crops

6.59 Biosecurity is a strategic and integrated approach to analyze and manage risks associated with food safety, plant and animal health and environment. It includes biosafety, which describes policies and procedures adopted to ensure environmentally safe application of modern biotechnology including products derived from the use of recombinant DNA technology.

6.60 Survey and surveillance of plant pathogens in horticultural crops such as bacteria, fungi and viruses are under implementation. There is a programme on climate change and insurgence of diseases in horticultural crops specially aphid, thrips and whitefly borne viruses in horticultural crops. Monitoring of the vector population and forecasting systems for diseases are in operation in different horticultural crops such as fruits, vegetable and ornamental crops. Five accredited laboratories are available for monitoring of pathogens in tissue culture propagated horticultural crops. At present, the ICAR is involved in diagnosis of plant pathogens of fruits, vegetables and ornamental crops in seed, propagating material and tissue culture plants both for import with domestic distribution and for exports.

Biotechnology in Horticulture

6.61 Different themes of horticultural biotechnology have shown great promise in the case of both potential and working examples for instance, commercial micropropagation by tissue culture, *in vitro* conservation of germplasm, transgenics development, molecular markers, marker assisted breeding and various omics (genomics, transcriptomics, proteomics, metabolomics, phenomics, etc). Newer areas like bioinformatics, gene silencing, gene pyramiding, gene mining and targeted protein engineering have also shown promise in improved productivity, quality and increased shelf-life of horticultural crops. Genes that confer resistance to abiotic stresses (drought and salinity tolerance), herbicide tolerance, have also demonstrated their worth through transgenic validation and utilization.

6.62 A large number of transgenic horticultural crops with wide ranging novel traits are under various stages of advanced evaluation in India. In the coming years, a number of GM

horticultural crops with value added transgenic traits will be ready for commercialization at Indian Institute of Horticulture Research (IIHR), other institutes of ICAR and other research institutes working in the field of horticulture in India and abroad. Use of meristem culture and micro grafting, is successful in citrus for elimination of viruses. Anthers of capsicum variety *Arka Gaurav* and tomato hybrid *Avinash* 2 responded to culture with an embryogenic like response without an intervening callus phase. Androgenesis has been successfully used for brinjal, pepper, cabbage, cauliflower, potato, asparagus and carrot, whereas gynogenesis has been successful in onion. Embryo rescue has been successfully employed in the production of hybrids of banana *Musa accuminata*, *M. balbisiana, Carica papaya, C. cauliflora,* interspecific crosses in pineapple and seedless x seedless grape varieties.

6.63 Efforts are under way to fingerprint mango, banana, cashew nut, kiwifruit, walnut, grape, citrus, etc. by different research centres. Quantitative Trait Loci (QTL) mapping is in progress in many crops such as brinjal, tomato, capsicum while association mapping (linkage disequilibrium) is used in case of perennials such as black pepper, cardamom and coconut. Gene pyramiding for useful genes in one back ground variety of commerce is in progress in solanaceous vegetables.

6.64 A network project for development of transgenics is in operation which involves six horticultural crops (banana, brinjal, cassava, papaya, potato and tomato. A large number of transgenics with *Cry-l* AB gene have been produced with resistance to the most damaging insects, usually *Lepidoptera* followed by *Coleoptera* and *Diptera*. Nutritionally improved transgenic potatoes have been obtained by transferring the amaranth seed albumin gene (AmA1) from *Amaranthus hypochondriacus* in to potato and also succeeded in reversing the sweetening process in potato by using invertase inhibitor gene.

Bioactive components – enhancing nutritive value

6.65 A new approach to increase crop active components such as caroteinoids from tomatoes, glucosinolates from *Brassica* vegetables, phytoestrogenes from soybean and phenolics and antioxidants from various plants helps to protect and prevent numerous disease. Phytoestrogens from *Dioscorea* species such as wild yam (*Dioscorea villosa)* also possess numerous physiological benefits. Some sweet potato varieties have an anti-diabetic potential.

Biodiversity in Horticultural Crops

6.66 Mapping of India's horticultural biodiversity on a fine scale can predictably open up immense possibilities and enable a variety of end uses ranging from understanding processes to developing newer and novel products. The database can facilitate the search for a new distributional range of species and also enable the recovery of populations of species long thought to have been locally extinct. For example, *Semecarpus kathalakanensis* (family Anacardiaceae) is an extremely rare and endemic tree species of the Western Ghats with only four known populations. Application of GIS modelling tools along with the databases have recently led to the discovery of additional sites and populations of this species, clearly obviating, to some extent, the extreme threat of extinction the species was thought to have been facing. The spatial and non-spatial databases can contribute to efforts in chemical prospecting. Not only have the studies indicated a substantial geographical

variation with respect to the content of CPT, but have also led to the discovery of high yielding individuals and populations of the species. This could result in semi-domesticating the species for meeting the high demand for this alkaloid. It is hoped that in the near future, commodity specific databases developed, will lead to the discovery of novel processes and products from the rich horticultural bioresources of the country.

Challenges

6.67 Climate change has been perceived as threat and will have a significant impact on horticultural crops, due to increased temperature, erratic rainfall, and new forms of biotic and abiotic stresses. Crop productivity under the emerging threats due to biotic and abiotic stresses needs constant attention in research. Post-harvest primary processing to reduce perishability of horticulture commodities is of paramount importance.

The Way forward

6.68 Enhanced horticultural productivity and production associated support services such as marketing, processing, credit, post-harvest loss prevention, etc. through the application of modern technologies and diversified cropping patterns is a major objective. By means of this the nutritional status at the household level can be improved through creating an environment with sufficient access to fruits and vegetables at affordable prices throughout the year. Sustainable capability will need to be developed among low income communities in increasing productivity and year round production of horticultural crops (fruits, vegetables and spices) through the introduction of superior quality planting materials and seeds and the promotion of production skills. Post-harvest losses would have to be minimised while primary producers' income maximised through the promotion of on-farm and community-based produce handling. Demand for high value produce is growing both in the domestic and overseas market at the same time, but competition is also increasing. New changes in retailing participation by the corporate sector means that retailing will depend upon strategic alliance and supply chain management. Research on impact assessment of climate change on horticultural crops using controlled environmental facilities and simulation models, analysis of past weather data and integration with productivity changes (including extreme events) need to be strengthened. Intensification of studies on pest, disease and weather relationships will be beneficial. Therefore to some of sustainability will depend upon improving competitiveness, reducing the impact on environment, quality assurance and food safety and capability of communities engaged in this sector to manage change.

Animal Science

6.69 Animal production forms the backbone of the agriculture sector in terms of income and employment generation, equity, sustainability and foreign exchange earnings in India. Post green revolution era of the eighties, growth in agricultural production during the first four years of the Eleventh five year plan has been marginally lower than the 4 per cent target. By contrast, the growth in animal production and productivity has kept an encouraging pace. In addition, non-food benefits of livestock include fibre (wool, mohair, hairs, etc.), skin or leather, dung and draft energy. The sector also provides considerable energy through diverse draft animal breeds. The livestock sector accounts for about 29% of the value of output of the agricultural sector. In the present scenario, livestock can play a crucial role for developing a sustainable agricultural system, especially in Indian conditions

where land holdings are shrinking due to rapid increase in population and increased urbanization. Moreover, the crop farming systems are frequently threatened by natural calamities. Its strength may be seen in terms of the economic and social security to 60 per cent of India's population engaged in the animal-farm sector. Presently, the country occupies the first position in global milk production due to a significant increase in the number of buffaloes and cross bred cows.

Achievements

Impact of improved germplasm on milk productivity

6.70 To overcome the low per animal productivity in Indian dairy, massive programmes have been taken up for cross-breeding of local non-descript cattle mainly utilizing semen of two exotic breeds, namely Holstein Friesian (for irrigated areas and for farmers with adequate fodder resources) and Jersey (for dry/hilly areas and farmers having low fodder resources).

6.71 In the case of buffaloes, the programme for upgrading of local buffaloes using semen of better dairy breeds like Murrah and Mehasana shows that the overall field results of crossbreeding with artificial insemination (A.I.) are still not very satisfactory. During the last one decade, the percentage of buffaloes covered through AI has increased approximately from 10% to 20% and conception rate has increased from 20 to 30% due to research efforts. Only about 10% of the breedable buffaloes were covered by A.I., the rest being covered by natural insemination service from locally available bulls for which the correct pedigree history is not available. Graded Murrah buffaloes have been developed through research efforts, producing 2,200 kg. milk per lactation. ICAR has established elite herds of Niliravi, Jafrabadi, Pandarpuri, Surti, Bhadavari and swamp buffaloes. As a result of these efforts, per animal productivity has increased in average daily milk yield of non-descript cows by 440g (26.5%), Crossbreds by 850g (15%) and buffaloes by 830g (23.2%) since 1993-94. The conventional breeding programmes have no doubt made a significant contribution in terms of genetic gain for milk production. The Frieswal Project envisages evolving a national milch breed 'Frieswal', a Holstein-Sahiwal cross, yielding 4000 kg. of milk with 4% butter fat in a mature lactation of 300 days. The total population of Frieswal females at 43 Military Farms (MF) at the end of year 2005 was 19,045. The overall average milk yield, total milk yield, peak yield and lactation length were 3248.3 kg., 3303.7 kg., 14.89 kg. and 323.6 days, respectively. Top ten bull semen is available having their breeding value between 2835 and 2965 kg.

Box 6.10: Buffalo cloning at NDRI, Karnal

NDRI is involved in buffalo cloning for the multiplication of elite individuals. The first cloned calf "Garima" was produced from skin fibroblast using the Hand Guided cloning technique. Later on "Garima 2" and "Shreshta" (the first cloned male buffalo) were also produced through cloning using fetal fibroblast and embryonic stem cells of buffaloes. The Institute is in the process of improving the technique as the efficiency of production of cloned embryos and animals are still low. Further effort for producing the clones from elite buffaloes is under progress. This technology could go a long way in enhanced multiplication of superior milch buffaloes in India. The World's largest population of buffaloes is in India and they contribute about 55% of total milk produced in the country, but the percentage of elite animals is very low and there is an urgent need to conserve the germplasm of this population. Hence this technology is of importance for the future.

Poultry and Egg production

6.72 Poultry industry which provides a cheap source of animal protein has taken a quantum leap in the last three decades evolving from a near backyard practice to a venture of industrial promotion. Poultry is one of the fastest growing segments of the agricultural sector in India today. India is on the world map as one of the top five egg producing countries with 63.02 billion eggs produced during 2010-11. The poultry sector in India has undergone a paradigm shift in structure and operation. This transformation has involved sizeable investments in breeding, hatching, rearing and processing. The traditional farmers in India have moved from rearing non-descript birds to rearing hybrids. Improved poultry germplasm has also benefitted the weaker sections of society due its low investment requirement and short gestation period at backyard and on a small scale level. High quality chicks, equipment, vaccines and medicines are available. The improved management practices reduced disease and mortality incidences to a great extent.

Poultry Strains

6.73 The ICAR has already developed many poultry strains with better adaptability and production traits especially suited to backyard poultry farming through a mega seed programme initiated to optimize rural poultry production. *Vanaraja* is a multi-coloured dual-purpose chicken variety developed for free range and rural backyard rearing. The plumage colour and disease resistance of *Vanaraja* is similar to native chicken but it grows faster and produces more eggs than the native chicken. Commercial poultry layers meant for eggs and broilers meant for meat are usually white, more prone to diseases, sensitive to environmental changes and not suitable for free-range or rural backyard rearing.

6.74 *Gramapriya,* a multi-coloured egg purpose chicken variety lays a larger number of eggs than native chickens and eggs are tinted brown in colour and are heavier than native chicken eggs. This bird has better adaptability to adverse conditions and better immune-competence. In poultry CARI-Nirbheek, CARI-Shyama, Hitcari, Upcari among improved native crosses, in broilers CARIBRO-Vishal, CARIBRO-Dhanraja, CARIBRO-Mrityunjai, CARI-Rainbro, and CARIBRO-Tropicana and in Layers CARI-Priya, CARI-Sonali are some of the popular strains of poultry.

Other alternate species of poultry germplasm developed by ICAR

6.75 Japanese quail (*Coturnix japonica)* have created a big impact in recent years and many quail farms have been established for egg and meat production. This is due to increasing consumer awareness and demand for production of better quality broiler quail meat. It is of great importance to select stocks, which have an inherent capacity to yield better quality meat and egg. Workable packages of management production and alternate plumage colour varieties of quails have been developed to support scientific, commercial quail production. Japanese quail, *Coturnix japonica,* commonly known as *Bater* was utilised for developing specialized egg and meat lines of quail. The important Quail varieties are CARI-Pearl, CARI-Sweta, CARI-Ujjwal, CARI-Uttam. In Turkeys CARI-Virat in Guinea Fowls, Chitambari, Kadambari, Swetambari in Ducks White Pekin, Khaki Campbell, Moti, *desi* Dual Purpose CARI-Debendra.

Small Ruminants

6.76 New strains of sheep *Avikalin* and *Bharat Merino* have been evolved among small ruminants. The production traits of native sheep *Malpura*, *Mawrari* and *Chokla* have been sizably improved by scientific breeding, feeding and management. The evolution of a prolific sheep from *Malpura* using *Garole* germplasm is in progress. Some of the important technologies generated are maximization of fodder production through multi-tier agro forestry system, intensive lamb production for mutton, complete feed block for feeding during scarcity, artificial insemination of sheep through liquid chilled semen, embryo transfer technology, cost effective worm control programme for sheep, disease data information system for organized sheep and goat farms and wool and hair blended products. The research interventions in improved germplasm for sheep breed improvement has been provided to farmers in different areas through Network Projects and KVKs. The goat breeds found in the north and north-western region are primarily used for meat and milk purposes. To enhance and then sustain goat productivity for meat, milk and fibre, various research programmes have been undertaken.

Other livestock species

6.77 Camels are used for transportation and agricultural operations. There are a total of nine breeds. The National Research Centre (NRC) on Camel at Bikaner has done research work on camel breeding, genetics, physiology and reproduction, AI and embryo transfer and utilization of camel milk and other products. There are six important breeds of Indian horses well known for their pace and speed, and these also possess good endurance power. The Manipuri breed is used for polo, racing and military transport. Various types of donkeys have been evaluated and characterized. The National Research Centre on Equines (NRCE**)** is conducting research on equine health and production considering the importance of equines in India. Performance appraisal and genetic cataloguing of indigenous pigs, development of improved pig variety together with production, health, product processing and pig-based integrated farming system technologies are provided to the pig rearers of the country achieving household food, nutritional and economic security. The modern Pig slaughter house provisioned for in the Eleventh plan is a landmark establishment for hygienic pork production. Considerable work on the unique yak species has been done, besides monitoring of drug residues and environmental pollutants in milk products of yaks. The Rumen Microbes which are unique in Yak, have been identified and characterized. Mithun is primarily reared as a meat animal and is highly preferred among the tribal people of North Eastern region of India. Mithun is also used as a ceremonial animal and plays an important role in the economical, social and cultural life of the tribal people of North East. It is now established that superior quality milk and hide can be obtained from Mithun. Considerable work in genetic characterization and conservation of Mithuns has been done.

Animal Health

6.78 India has made significant inroads in combating heavy mortality and morbidity losses due to disease outbreaks in livestock thereby making India free from Rinderpest. But, other diseases, such as Foot and mouth (FMD), demands control and the ultimate target is its eradication. Several vaccines, drugs and diagnostic kits have been developed and

commercialized from time-to-time to meet the challenges of existing and emerging diseases and pathogens of livestock and poultry. There is, however, a need to enhance the production of pharmaceuticals and biologicals for different infectious and non-infectious diseases, and also diseases of unknown etiologies, including those that are trans-boundary diseases. Controlling the incidence and propagation of infectious diseases such as avian influenza and FMD is important for agriculture, industry and public health officials because of the devastating economic consequences and the possibility of transmission to human-beings. The institutes are provided with state of the art facilities like bio-safety and bio-containment laboratories, nuclear laboratories, semen evaluation and quality control, residue analysis, feed analysis, quality control, embryo transfer, molecular genetics, rumen biotechnology, milk and milk product processing unit, meat and meat processing unit, wool analysis, blending, dying and processing unit, model dairy plant, vaccine production unit, germplasm conservation unit, sera, semen, dairy rumen microbes and veterinary pathogen repositories and banks.

Challenges

6.79 Animal science has great potential to enhance growth objectives. However, strategies have to be devised to answer some of the challenges, for example:

- Availability of quality nutrients through feed and fodder resources has to be ensured.
- The large size of cattle population is hampering the vertical genetic improvement in cattle production.
- The small sized herds both in governmental and institutional farms and with private farmers is an important issue especially when the developed countries are making use of genomic tools for vertical genetic improvement in their livestock genetic resources.
- Disease diagnosis, health and hygiene maintenance of livestock is affecting the production potential.
- Emerging and remerging animal disease that may affect the health across the species is causing concern, especially, the zoonotic diseases.
- Safer food, packaging and maintenance of quality milk and other animal products would positively affect the livestock products in the country as well as for exports.
- Amelioration of ill effects arising out of climate changes especially the mitigation strategies for methane production by livestock.
- Faced with increasing resource constraints, large population size, low productivity and small livestock unit holding are the main constraints.

The Way forward

6.80 Rapid growth in the demand for high value agriculture in which livestock products constitute a major share, and a fast changing livestock production system necessitates the provision of an efficient flow of information and knowledge, services and support to the

livestock farmers for better decision-making. Expansion in India is being driven by rising incomes and a shift in industry structure toward integrated ownership and coordination of the input, production, and marketing operations involved in livestock production (vertical integration). These factors, in addition to government policies affecting feed supply levels, will help shape the future growth in animal production in India, as well as in emerging trade and investment opportunities.

6.81 Potentials and ways in which this could be achieved is by sustaining higher growth in the livestock sector, in which availability and supply of nutritious feed and fodder is critical. Further, a strong HRD programme in emerging areas of biotechnologies to solve research issues, that arise a networking approach to take up research on the problems affecting the livestock, particularly relating to breed improvement, use of best production and management practices and developing an adequate and dependable health cover should receive priority attention. The development of value chains, market infrastructure and quality and safety mechanisms is also very necessary to make livestock rearing profitable. International collaborations and transboundary issues related to animal production and disease controls are also issues to be attended to.

Fisheries

6.82 In the last five decades the fishing industry has witnessed significant developments with the improvement and modernization of boats, fishing gears and other equipment, which have enhanced the fishing capacity, improved the working conditions and reduced the drudgery of fishermen. Improvements in fish harvest technology have been in the areas of craft technology and mechanization of propulsion, introduction of synthetic gear material; acoustic fish detection and satellite-based remote sensing techniques, advances in electronic navigation and provisions for on-board fish processing and preservation.

Achievements

6.83 The present enhanced fish production in the marine sector has been largely possible due to the introduction of mechanized fishing vessels and synthetic gear materials, and the development of infrastructure for preservation, processing and storage. Expansion of trawl fleet and increase in the number and efficiency of craft and gear, introduction of purse-seining and ring seines, diversification of fishing, acoustic fish detection and satellite-based remote sensing techniques for identification of fishing areas and advances in electronic navigation have substantially contributed to the increased fish production in the marine sector. The gear interventions such as like large mesh purse-seine, long lining, and large mesh gill netting have oriented the industry towards selective fishing and to venture to deeper waters easing the pressure on the over exploited coastal resources. Of late, the focus has been on by-catch reduction devices, like juvenile fish excluder, square mesh cod ends, turtle excluder devices etc. for resource conservation.

6.84 Given the wide spectrum of cultivable species and technologies available, the long coastline and the favourable climate, mariculture is likely to generate considerable interest amongst the coastal population. Mussels, oysters and seaweeds have been the main components of mariculture, with possibilities of crab and lobster fattening. Breeding and

culture technologies for species like seabass, cobia and pompano have been standardised. The successful commercial culture of edible oyster (*Crassostrea madrasensis)*, green mussel (*Perna viridis)*, brown mussel (*P. indica),* clams (*Meritrix meritrix* and *Anadara granosa)* in captivity needs to be highlighted in the context of enhanced nutrition and employment opportunities. Technology for the culture of marine pearls and farming of the pearl oyster *Pinctada fucata* in open sea as well as shore-based systems has been developed. Fifteen marine ornamentals such as *Amphiprion percula* and *A. ocellaris* were successfully bred and possibilities of cultivation of sea cucumber, *Holothuria scabra* are being explored, with its achieved success in breeding. Agar-yielding seaweed, *Gracilaria edulis* with commercially viable productivity in a short span of three months by vegetative fragment culture (net and rope culture) is now a successful enterprise.

6.85 Commercial farming so far confined to a single commodity i.e., shrimp, *Penaeus monodon* owing to its high export potential is now being expanded by the introduction of the white legged shrimp *Litopenaeus vannamei*. Semi-intensive culture practices mainly with black tiger shrimp have the production potential of over 2.5 t per ha each year in two crops, ensuring profits of over Rs.1.5 lakh per ha each year and the culture of *L. vannamei* with an average production of 12 t per ha each year realizing a profit of Rs 3 lakh/ha/year is now made possible. Technology for breeding and culture of sea bass, banana shrimp and mud crab which has high potential is now available in the country.

6.86 Carps, catfishes, prawns and ornamental fishes form important components of freshwater culture practices in the country. Technologies are available for breeding and culture of air-breathing (*Clarias batrachus, Heteropneustes fossilis*) and non-air-breathing catfishes (*Wallago attu, Mystus seenghala, M. aor, Pangasius pangasius*). The success in farming technologies of freshwater prawns, (*Macrobrachium rosenbergii* and *M. Malcolmsonii)* has already attracted the attention of farmers. Molluscan culture has become important with the production of cultured freshwater pearls, through nuclei implantation in the bivalves, (*Lamellidens marginalis, L corrianus* and *Parreysia corrugate)*. While two important technologies- *induced fish breeding* and *composite carp culture-* triggered the growth of carp culture in the country, two more developments that took place in recent years have opened up new possibilities in freshwater aquaculture. Thus, improved rohu (*Jayanti* - CIFA IR 1) with a 17% higher growth realization per generation through a selection programme and a multiple and off-season breeding of carps has enabled seed availability at different times of the year. With an adoption of the technology of composite carp culture and the design of portable hatcheries, the mean production level across the country has gone up to over 2.4 t/ha/year, while several farmers are able to achieve much higher production levels of 8-10 t/ha/year. Further genetic improvement programmes have been undertaken for species such as *Catla catla* and *Macrobrachium rosenbergii. T*he three Indian major carps *viz.,* catla (*Catla catla)*, rohu (*Labeo rohita)* and mrigal (*Cirrhinus mrigala)* constitute 87% of freshwater aquaculture production. Culture systems with different combinations of carps have been standardized to suit varied ecosystems and input levels, as also integrated with other farming practices, with net profit levels of Rs.50,000-90,000 per ha annually. Several variants of carp culture technologies such as wastewater-recycled culture and short-term culture are also available.

6.87 Opportunities for enhancing yield and production exist in some of the open waters such as reservoirs and floodplain wetlands with the technologies developed for cage and pen culture. Similarly, enhanced capture fisheries through species and stock enhancement is expected to increase the yield from medium and small reservoirs to 100-250 kg./ha/year from the present 10-12 kg./ha/year. Research efforts for enhancement of yields in upland lakes and polyculture in ponds in hills have developed a specific package of practices with carps and Pengba (*Osteobrama belangeri*) and other species. Mixed carp farming technology involving different Chinese carps that was demonstrated in the mid-hills between altitudes of 900-1740 msl is giving a yield of 1.2 - 3.6 t/ha/year. The poly line culture system developed for upland terrain has also proved to be a success in providing livelihood to the small land holding farmers.

6.88 Fresh iced fish is being transported and consumed in the domestic market in the country. Processing and value addition technologies have made available products such as filleted fish products, canned fish and shellfish, ready to serve fish curry in retortable pouches with long shelf-life, cured fish, rack dried fish, IQF fish products, dehydrated jelly fish, *beche-de-meer* (sea cucumber), *masmin/masmin* flakes from tuna, fish wafers, soup powder, battered and breaded value added products and pickles. A number of technologies for fishery by-products have now emerged with applications in medicine, surgery, industry and food processing such as chitin and chitosan, surgical sutures from freshwater carp guts, collagen-chitin film as artificial skin, shark cartilage, squalene from shark liver oil, shark fin rays, isinglass for liquor industry, concentrated PUFA from fish oil with Omega 3 fatty acids, agar-agar and agarose from sea weeds, insulin, fish albumin, glucosamine hydrochloride, bile extracts, drugs and chemicals from sea weeds, and steroids and fish gelatin. Packaging plays a key role in the commercialization of food products and modified atmosphere packaging that has been developed has become a trend in the seafood industry. Compliance of hygienic standards such as Hazard Analysis and Critical Control Points (HACCP) has been considered mandatory for which the necessary protocol has been developed.

Challenges

6.89 In the coastal waters there is no specific share of water for fisheries. In order to achieve the goal of increased aquaculture production and provide greater choice to the consumer, research has to be oriented to discover ways to bring regionally important fin fishes and shellfishes (species diversification) into aquaculture practices. A package of practices for several more commercially important species has to be developed. Availability of quality seed is still a problem and establishment of certified brood banks and seed villages for commercially important fish and shellfish species in addition to a mechanism for seed certification and hatchery accreditation are essential for growth. Research on protocols for best management practices (BMPs) and diagnostic kits for viral diseases in shrimp have to be developed. Efforts are needed to produce and SPF certified seed and distribute to the farmers.

6.90 Commercial aqua-farming in India largely involves the use of formulated pellet feed, constituting a significant share of the input expenditure. Quality fish feed production from locally available non - conventional agro-byproducts and fishery waste has to be developed.

6.91 In view of the intensification of aquaculture practices, healthcare specifically in shrimp & carp farming is important. For trade, issues such as traceability and anti-dumping are expected to have a significant influence on increase in export of aquaculture produce and subsequently, on growth of the aquaculture sector. Substantial gaps exist between the potential and actual fish yields from culture-based fisheries resources such as reservoirs and wetlands. Fish transportation to distant regions is still not properly undertaken for want of a cold chain from the fish landing centres and aquaculture farms. While there has been a decennial census of marine fisheries, similar studies in the inland fisheries are lacking. Lack of a reliable database on open water fisheries, both physical as well as biological, remains an impediment in formulating appropriate management norms. Remote sensing and GIS technologies have to be developed for the creation of appropriate data bases. Research concerning aspects of minimum and environmental flows for the riverine systems is also important for the sustenance of fisheries and conservation of biodiversity. Seed production of mahseers and snow-trouts, mid-altitude exotic carp farming, integrated farming and development of sport fishery in streams and high altitude lakes are other areas where research has to be undertaken. Commensurate with the changes in the life style and the food consumption patterns, a new approach to fish processing and value addition is a priority.

The Way Forward

6.92 Concerted efforts are needed to put aquaculture on to a higher growth trajectory while at the same time ensuring conformity with the norms of sustainability and equity. Major highlights of the future strategy would include for example: value chain approach for fishing high value species, with suitable consortia of private-public partnerships, where island ecosystems will be in focus. Capacity enhancement for deep sea fishing and maximizing the benefits from the Indian EEZ to open up new areas for harvesting the resource. Potential sites for mariculture, both open and within enclosure, to be identified with due backward linkages in terms of quality seed of finfish and shellfish to harness the vast potential along the Indian coast. Diversification of species in coastal aquaculture while a consortia approach for production of inputs such as quality seed and feed has to be ensured. In paying attention to open water fisheries management due recognition also is needed of the potentials of inland aquatic resources, habitat restoration and fish conservation in marine and inland ecosystems, water management including pollution management, bioremediation and multiple use of waters. Fish yield enhancement initiatives in small and medium reservoirs and wetlands, preferably through co-management with the stakeholders; large-scale cage and pen culture in reservoirs for raising proper stocking material and wider coverage of reservoirs for stocking advanced fingerlings are to be encouraged.

6.93 Fish genomics and breed improvement for enhanced aquaculture productivity can go a long way in developing new disease resistant breed in the aquaculture industry. Assured provision of quality inputs such as seed, feed, fertilizers, drugs and aquaculture medicines has to be developed by orienting research towards the specific areas. Fish and shellfish seed certification and hatchery accreditation are being proposed for ensuring quality seed availability. More specialized fish feed plants are to be established and the animal and poultry feed plants are to be encouraged to produce aqua feeds as well, along with due regulations.

6.94 Integrated farming and aquaculture as a tool for treatment of domestic sewage and aquaculture in degraded systems like inland saline waters are proposed. Ornamental fish breeding and fisheries, allied aspects like pearl culture, sport fisheries are to be developed. Mechanization of farming practices, developing effective cold chains and market models suitable for different practices in inland fisheries and aquaculture, customized fish product development to suit varied consumer preferences in the country; and promotion of fish as health food can also receive a greater emphasis.

Agricultural Engineering

6.95 Engineering and technological inputs in agriculture have made significant contributions in increasing production and productivity through timely farm operations, accurate metering and better placement of seed and fertilizer, conserving soil and water resources, increasing irrigation potential and efficiencies, reducing losses of produce by providing improved storage structures and technologies, and value addition. In future, Indian agriculture will face challenges to increase its production substantially from almost the same cultivated land to feed its growing population, reduce the cost of production, reduce losses, add value to the farm produce and raise the quality of raw and processed products to a high standard to compete with foreign goods, both for the domestic and export markets. The biggest challenge is to make agriculture profitable. This will be possible only by reducing the cost of cultivation through mechanization and by higher returns to the farmers through value addition in production catchments and adopting loss prevention measures.

6.96 The small land holding pattern offers a complex set of challenges for mechanization. With the number of operational holdings increasing, alternative sources of income will be needed to sustain farm distress. Research, development and management options need to be evolved to the meet requirement of small landholders. Unlike other advanced countries, which have greatly reduced the human intervention in agriculture through mechanization, India would continue to depend on human labour. Small farm mechanization, precision farming and post-harvest technology will have to play a major role in future to increase production and productivity, to lower the cost of production and in generating more income and employment opportunities in rural areas. The need is to transform rural India from a producer of agricultural goods to producer-cum-primary processor.

Achievements

6.97 R&D efforts and approaches in agricultural engineering have been directed towards finding cost-effective solutions to location-specific problems of agriculture in farms and for post-harvest primary and secondary processing of agricultural commodities. The major areas of research and development encompass a vast spectrum, for example: the development of farm machinery specific to regional requirements; a feasibility testing of machine prototypes for adoption across the regions; evolving custom hiring models through selection and development of machinery packages; development of renewable energy based gadgets and protocols for application in the agricultural sector; processing and value addition to agricultural produce for reducing losses and enhancing profitability of farmers; development of entrepreneurship-based Agro-Processing Centres in production catchments for ergonomic evaluation and refinement of agricultural tools and machinery; and application of Plasticulture technology for efficient use of inputs and productivity enhancement.

6.98 Sustained efforts of R&D institutions and support from the government have resulted in development of several successful engineering technologies related to agricultural production and processing. Significant achievements during the past year are as follows:

Farm mechanization

- Precision seeder
- Manure spreader
- Root crop harvester
- Garlic planter
- Vegetable seedling transplanter
- Hydraulic platform for fruit harvesting
- Straw combine with integrated trailer
- Punch planter for plastic mulch
- Tractor mounted forage harvester

Energy

- Biomass based gas stove and improved cook-stoves
- Technology for alcohol (ethanol) production from crop residues
- Production of bio-diesel from non-edible oils
- Development of biomass based decentralized power generation system.

Post harvest technology and value addition

- Extruded products from millets
- Extractors for chillis, tomato, tamarind seeds and pomegranate arils
- Pilot plant for cleaning, grading, waxing and packaging of fruits
- Value added processed products such as dried powders from beetroot, carrot, green chilli, *sarson saag*, ginger, garlic, onion
- Protocols for minimal processing and MAP of important vegetables
- Low cost green house
- FRP hatchery for carp.

Challenges

6.99 The challenges confronting agricultural mechanization, processing, value addition, food quality and safety and energy management include the following:

- Enhancing productivity and profitability through higher efficiency of input use
- Development of equipment for conservation agriculture with special reference to rainfed agriculture

- Small farm mechanization through appropriate technologies and custom hiring models
- Mechanization of cotton and sugarcane crops
- Use of surplus biomass for decentralized energy production
- Reduction in post-harvest losses and enhancing profitability
- Improvements in food quality and safety

The Way Forward

6.100 Research on agricultural engineering will continue to focus on developing innovative technologies for ensuring higher returns to stakeholders with sustainable agricultural development. During the Twelfth Plan priority will have to be given to the following areas: (i) R&D in precision farming, conservation agriculture, mechanization of hill agriculture, and mechanization of horticultural and other cash crops; (ii) enhancement of energy-use efficiency of mechanized operations through the use of farm machinery matching with the power source; (iii) development of techno-preneurship in custom hiring of farm machinery; (iv) establishment of 'Farm Equipment Promotion Centres' in different parts of the country to adopt need-based farm equipment, serve as incubation centre for promoting local manufacturing of equipment and carry out HRD for entrepreneurship; (v) harnessing and efficient utilization of renewable energy sources along with innovative utilization of by-products and residues in agricultural production catchments; (vi) decentralized power generation using bio-methanation and gasification of agricultural residues; (vii) reduction in post-harvest losses and enhancing profitability through processing and value addition in production catchments; (viii) exploit the untapped potential of the vast number of products which can be obtained from main commodities and by-products of agricultural and horticultural crops, livestock and fishery sectors using high end effective technologies, e.g., chitosan, pectin, vitamins, nutraceuticals, etc. Other initiatives include development of health foods based on conventional agricultural produce, setting up of value-chain based agro-processing centres in the production catchments, and setting up of facilities and referral laboratories for quality testing of processed foods.

Higher Agricultural Education

6.101 India achieved spectacular agricultural growth since 1966. Apart from government policies and a high receptivity of the farming community, the seed of success was planted by establishing institutions of higher agricultural education (Annexure 6.2). These institutions developed skilled human resources which developed new technologies and disseminated these in the country's farming community. Today, we have a network of 53 State Agricultural Universities (SAUs), one Central Agricultural University (CAU), five Institutes having Deemed-to-be-Universities (DUs) status (four of them are ICAR Institutes: IARI, New Delhi; IVRI, Izatnagar; NDRI, Karnal and CIFE, Mumbai and, the fifth, Allahabad Agricultural Institute, Allahabad) and four Central Universities (CUs) with Agriculture faculty (BHU Varanasi, AMU Aligarh, Vishwa Bharti, Shantiniketan and Nagaland University, Medziphema). These institutes have embraced education, research and extension education

as integral to their functioning and have contributed a great deal in propelling agricultural growth in the country. With about 265 constituent colleges with a 35,000 student-intake capacity, the AUs impart education in 11 major disciplines at the undergraduate and in about 95 subjects at post-graduate level. In higher agricultural education, about 55% students are from a rural back ground and, on an average, 36% are the girl students. Besides, IIT, Kharagpur imparts education in the field of Agricultural Engineering, and about 150 privately owned colleges, a majority of these being affiliated to general universities while, others particularly, in the states of Maharashtra and Chhattisgarh, are affiliated to SAUs and impart higher agricultural education.

6.102 The State Agricultural Universities are established through the Legislative Act of the respective state and with major financial support from the respective state governments which also administer the functional and policy controls. The central Government through the Indian Council of Agricultural Research provides professional and partial financial support for enhancing the quality and relevance of higher agricultural education in the country. The ICAR facilitates, namely, (i) quality assurance in higher agricultural education in the country through policy support, accreditation, academic regulation, personnel policies, review of course curricula and delivery systems, development support for creating and strengthening infrastructure and facilities, improvement of faculty competence and admission of students through All India competitions; (ii) enhancement of performance and visibility of AUs by augmenting their strategic strength in a specific niche area of research and education, experiential learning towards imparting an appropriate blend of knowledge, skill and attitude to the students, and fostering need-based partnership and linkages; and (iii) promoting excellence and expertise in education and research at the national level by creating chairs and positions through the National Professor, National Fellow and Emeritus Scientist schemes, and by providing incentives and rewards through scholarships and fellowships to students and best teacher awards, etc.

Achievements

6.103 The main achievements of agricultural education programmes under ICAR include the following:

- Established **Accreditation Board** and accredited 34 agricultural universities for quality assurance in agricultural education.
- Revised the **Model Act for Agricultural Universities in India** in 2009 for enhancing the uniformity of structure, governance and efficiency in these.
- 30 **Niche Areas of Excellence** established to augment the strategic strength of AUs in specific areas including those in new and emerging cutting-edge technologies.
- 264 units for **Experiential Learning** established in all the universities for providing skill oriented hands-on training to the students at the undergraduate level.
- Regular **financial and professional support** provided to SAUs, CUs and DUs for modernization and strengthening of academic facilities, infrastructure and faculty improvement.

- Revised **Course Curricula and Syllabi** for undergraduate education with an emphasis on hands-on training, experiential learning for skill development, and for the first time, for all PG programmes.
- **Rural Awareness Work Experience** at the undergraduation level, encouraged through providing financial support.
- Financial support extended to SAUs for construction of **girls' hostels** to promote gender mainstreaming. One to two girls hostel in each AU have been provided; total 124 during Tenth & Eleventh Plan supported.
- Supported construction of 47 **International Hostels** during Tenth & Eleventh Plan for facilitating education of foreign students in the SAUs.
- Conducted regularly the **examination for admission** of students to the tune of 15% of total seats in UG programmes and 25% seats in PG programmes for quality up-gradation and reduction of inbreeding in education. Every year about 1750 meritorious candidates are admitted in UG programmes and 2450 in PG programmes.
- About 1000 **National Talent Scholarships** for undergraduate studies, 475 **Junior Research Fellowships** for post-graduate studies and 200 **Senior Research Fellowships** for Ph.D provided every year towards the Human Resource Development, national integration and reducing inbreeding.
- With the dual objectives of namely, (i) facilitating education of Indian nationals in one of the best Universities abroad, and (ii) facilitating admission of foreign students in Indian agricultural universities to help demonstrate the strengths of the Indian agricultural system, initiated the **ICAR International Fellowships** programme in 2009-10 with a provision of 15 fellowships every year.
- Started **India-Africa Fellowship and India-Afghanistan Fellowship Programmes**, both in 2010-11, with a provision of 75 and 115 fellowships, respectively, for agricultural Human Resource Development in Africa and Afghanistan through formal education.
- Forty three Indian scientists and faculty members received training in the USA under the **Indo-US Norman Borlaug Fellowships Programme** in the four identified priority areas of cooperation for instance (i) Human Resources and Institutional Capacity Building, (ii) Agri-Processing and Marketing, (iii) Emerging Technologies, and (iv) Natural Resource Management**.**
- Faculty competence improvement undertaken through 31 **Centres of Advanced Studies**.
- About 2400 scientists trained in emerging areas through about 90 **Summer/Winter Schools** organized in cutting edge areas every year.
- Promoted Indian higher agricultural education among developing countries by providing opportunities to overseas students, with about 250 **foreign students admitted** every year.

- Promoted excellence at the national level through **ICAR National Professor and National Fellow Schemes.**
- A chair of National Professor named "**Norman Borlaug Chair in Biotechnology for Crop Improvement**" has been established with the objective of developing a centre of excellence in this field.
- 100 outstanding superannuated scientists awarded **ICAR Emeritus Scientist Award** for research in the specific areas.
- Recognition of outstanding teachers at the University level through institution of **Best Teacher Awards**.
- Supported **e-Learning in AUs** giving an opportunity to students to learn almost anytime and anywhere; digitalization of the Ph.D. theses of all AUs through a project **Krishi Prabha**; strengthening of digital library and management through a project **e-Granth**; availability of electronic version of national and foreign journals to 124 centres under a project **Consortium for e-Resources in Agriculture (CeRA)**, and development of **e-courses** for B.Sc. (Agriculture), B.V.Sc. & A.H., B.F.Sc., B.Sc. (Horticulture), B.Sc. (Home Science) and B.Tech. (Dairy Technology) in consortium mode.

Box 6.11: National Academy of Agricultural Research Management (NAARM)

The National Academy of Agricultural Research Management (NAARM) was established by the Indian Council of Agricultural Research (ICAR) at Hyderabad in the year 1976, as the Central Staff College of Agriculture. Initially its primary role was to impart Foundation Training to the new entrants of the Agricultural Research Service of ICAR. In 1979, it acquired its present name, and over the years, it has grown as a full-fledged Academy with a wider mandate to enhance the capacities of the institutions under NARS at all levels in agricultural research and education management, and carry out research to provide policy support in critical areas of organizational reform. In the Eleventh Plan period, the Academy added a new dimension of Post Graduate education in Agricultural Management and Technology Management to develop a new generation of leaders for meeting the challenges of agricultural development in the 21st century.

Challenges

6.104 Various initiatives taken in the recent past have led to a reversal in the decline of quality in agricultural education and in some cases substantial improvement was effected but the situation presently is much below the expectations of the stakeholders. The pace and quality of technology generation and human capacity building in most of the SAUs have slackened owing mainly to inadequate state funding, depleted faculty strength, inadequate faculty development programmes, specific lack of competence of existing faculty in new and emerging areas, extensive inbreeding in faculty, lack of modern infra-structure for education and research. Establishment of new and sectoral state agricultural universities and new colleges without matching resources has compounded the problem. There is need for integrating agricultural education with job creation, revision of course curricula for producing human resource that are professional service providers and address the demand

of client groups. The new challenges faced by Indian agriculture are formidable and these call for development of a new breed of human resource that is equipped with new skills and knowledge to propel agricultural growth.

Box 6.12: Open Access Policy for Research Journals

The Council has adopted an open access policy for research journals and ICAR Journals have reached to 173 countries disseminating the agriculture knowledge of India on a global platform. Electronic and print modes are being continuously used for reaching the un-reached for knowledge empowerment of the farming community. Showcasing of agricultural technologies educational prospects on international platform have also being undertaken as new initiatives. Special efforts are being made to share and disseminate agricultural knowledge with ASEAN and SAARC countries.

The Way Forward

6.105 Several improvements can be beneficial as for example:

- Enhancement of management capacity and improvements in administrative processes in AUs.
- Ensuring compliance with ICAR's quality assurance policies, criteria and procedures, and strengthening accreditation and quality monitoring capacity.
- Strengthening Priority Setting, Monitoring and Evaluation (PME) capacity at different levels.
- Expansion of Higher Agricultural Education through increasing the capacity for student intake in the AUs, increasing the number of constituent colleges, attracting and retaining bright brains in agricultural education and research including starting schemes like ASPIRE, encouraging greater participation by rural students, and facilitating graduating students to benefit farming and related enterprises.
- Opening of new universities and colleges to be linked with assured funding, manpower and physical resources as per norms and manpower need.
- Strengthening infrastructure and facilities for teaching and learning in AUs.
- Restructuring and modernizing undergraduate and postgraduate programmes including curricula revision in various specializations.
- Development of entrepreneurship skills in students through Experiential Learning and in-plant and industrial training at the undergraduate level.
- Promotion of academic excellence in critical and emerging areas at the postgraduate and doctoral levels: Faculty recruitment and development, project based funding to young and bright teachers, starting a post-doctoral fellowship scheme, faculty exchange, strengthening adjunct and visiting professors and Emeritus Scientist schemes.

- Building excellence in specific strategic areas in education and research through Niche Areas of Excellence and Centres of Excellence in AUs.
- Starting non-formal education.
- Increasing scope and effectiveness of networking and partnership with educational institutions and research organizations within India and abroad for sandwich programmes, curriculum development and delivery, faculty and students exchange and training, as well as joint research.
- Increasing public-private partnership in agricultural education through an increased role of the private sector in curriculum design, faculty and students development, research and development, institution's governance, and providing a window for direct project support for other specific initiatives.
- Setting up of Agricultural Technology Parks for empowering farm graduates to link production and post-harvest technologies in a mutually reinforcing manner.
- Development of Vision for Agricultural Education for next 20 years and 40 years which should also include the measurable goals as well as strategies to achieve these.
- Development of a National Agricultural Education Project for reforming and reorienting the higher agricultural education.

Box 6.13: National Fund for Basic Strategic and Frontier Application Research in Agriculture

Based on the recommendations of a Committee constituted by the Planning Commission and chaired by Dr. M. S. Swaminathan, the Indian Council of Agricultural Research, Ministry of Agriculture established a National Fund for supporting basic and strategic research in 2006 (Tenth Plan period). The main objective was to build capacity for basic, strategic and cutting-edge application research for generating knowledge needed for solving existing, emerging or future agricultural problems and to make India a global leader in frontier research for agriculture. This implied a broadening and strengthening the national agricultural research system (NARS) by mobilizing the best available scientific expertise in all research institutions (both agricultural and non-agricultural) in the public and private sectors and maximizing the complementarities among different institutions and scientific disciplines. The budget of the Fund for the Eleventh Plan period being Rs.100 crore.

The Fund is governed by an Empowered Committee (EC) constituted by the Hon'ble Minister of Agriculture, Government of India, with a nationally eminent scientist as the Chairman and four to five distinguished scientists from outside the ICAR from diverse disciplines of science relevant to agriculture as the Expert Members. The Director General, ICAR is an *Ex-officio* member. A National Coordinator executes the activities of the Fund.

The funding covers areas of agricultural research of strategic importance identified through a wide dialogue. Projects of three to five-year durations on basic, strategic and frontier cutting edge applied research addressing a multidimensional problem of research are supported. Now 40 projects are in operation. A number of institutions from outside the NARS are participating. A strong monitoring system is a part of project system.

Highlights of the results emanating from the projects are given below:

Box 6.13: National Fund for Basic Strategic and Frontier Application Research in Agriculture (Contd.)

In the process of developing biomass based production of hydrogen as a source of energy a catalyst has been developed for conversion of wood gas into hydrogen based on metal in substituted ceria and titania by a novel solution combustion. A method to load these catalysts on ceramic honeycombs has been developed. The catalyst converts both CO and methane from wood gas into hydrogen at about 350 ^{0}C to 400 ^{0}C.

A rule based prediction model for predicting onset of downey mildew disease, the most important disease of cucurbits, has been developed and validated combining average daily temperature and night leaf wetness duration has been developed. The model has been validated on three cucurbit crops at the experimental station in 2010 and 2011 with a 75% success rate. The model is now being tested in farmers' fields.

Laboratory based molecular diagnosis techniques of important fungal diseases (caused by *Phytophthora palmivora,* and *Sclerotium*rolfsii) of the major tuber crops, cassava, taro, elephant's foot and yam, species specific primers and nucleic acid probes were developed.

A native non-gall forming isolate of the bacterium Agrobacterium radiobacter, isolate UHFBA-218 (Cherry 2E-2-2) showed control of crown gall of peach by 92.14 per cent as compared to 74.19 per cent by strain K-84 of the bacterium that is used world over as seed treatment on peach. The disease incidence in untreated plants was 84.92 per cent.

A positive marker vaccine for the important foot-and-mouth virus of cattle has been prepared and tested in crossbred female calves. A novel foot and mouth disease virus Asia 1(Indian Vaccine strain) replicon based viral vector for vaccine research and development has also been developed.

The available plant transformation methods have a score of challenges such as random integration, multiple transgene copies and unpredictable transgene into a predetermined locus in the plant genome. A technique has been developed for gene integration into the desired sites on chromosomes in a plant system. The efficacy of the method has been tested in rice and the success rate has been as high as 17%. This technique has been for the first time applied in transgenic research studies in plants.

Extension Research

6.106 The endeavours of extension or transfer of technology has been a mix of field extension carried out by line departments of the states, backstopped by frontline extension systems of ICAR Institutes and SAUs, Commodity Boards, non-government organisation (NGOs) and voluntary organizations. Recently Farmers' consortia under different nomenclature have also emerged with this mandate. But most of them are yet striving to reach out to the broad spectrum of farmer clientele, who look for problem solving technologies and advice. Public extension services are stated to be very weak in India, particularly, to address the emerging technological and knowledge needs. However, efforts are made to strengthen the system with some new and innovative schemes, such as establishing and operating *Krishi Vigyan Kendras* (Farm Science Centres). The Scheme is currently in operation in 603 districts of 28 States & 3 Union Territories. The scheme, essentially, focuses on institutionalizing key agricultural technological intervention to enable breakthrough in agriculture production and profitability in rural communities.

Achievements

Krishi Vigyan Kendra (Farm Science Centre)

6.107 The ICAR through *Krishi Vigyan Kendra* assesses, refines and demonstrates new technology and products. Research conducted under controlled conditions often needs fine tuning before its adoption in farmer's fields. With the objective of developing location specific technology modules, the entire process is carried out in participatory mode involving the farmers. The process of Technology Assessment and Refinement (TAR) uses a tool know as On Farm Trial (OFT) which consists of namely, (i) problem identification, (ii) problem prioritization, (iii) finding various technology options through discussions, (iv) designing OFTs, (v) implementation of OFTs, and (vi) follow up and getting feed-back from clients. Once a particular technology option is found to be technically feasible, socially acceptable, economically viable and environmentally safe in a particular location specific environment, then the same can be popularized among the farming community through Frontline Demonstrations. If not, the best performing technology option may be modified a little for suiting the local conditions through technology refinement and then popularized through FLDs. The major thematic areas under which On-Farm Trials were carried out in crop husbandry include for example Varietal Evaluation, Integrated Nutrient Management, Integrated Crop Management, Integrated Disease Management, Integrated Pest Management, Resource Conservation Technologies, Weed Management, Integrated Farming Systems, Post-Harvest Technology and Value Addition, Improved Tools and Farm Machinery, Seed and Planting Material Production, and Improved Storage Techniques; in the case of livestock Production and Management, Disease Management, Breed Evaluation, and Nutrition Management and in case of other enterprises sericulture, mushroom production, vinegar production, vermicomposting and market led extension culture.

6.108 Frontline demonstration (FLD) is another major mandated activity of KVKs, which aims at proving the potential productivity in any crop or enterprises mainly through technological integration. Separate emphasis was given regarding FLDs on oilseeds, pulses and cotton. In the case of oilseeds, the increase in yield was primarily due to popularization of suitable high yielding varieties in various agro-climatic zones and better adoption of Integrated Disease Management practices against major diseases like groundnut leaf spot, sesame phyllody, powdery mildew and alternaria blight of sun flower, etc. In addition, oilseed farmers were encouraged to adopt better Integrated Crop Management covering all the major technological aspects of crop husbandry. The increase in productivity in paddy, wheat and sorghum was mainly due to dissemination of high yielding varieties and hybrids and popularization of latest technologies in farm mechanization, balanced nutrient management. In the case of pulses, popularization of many high yielding varieties of Bengal gram, red gram, green gram and black gram through Integrated Crop Management Practices was the major technological intervention responsible for realizing higher productivity. In case of fodder crops, use of high yielding varieties was the major technology that resulted in higher productivity. For horticultural crops, a wide range of technologies including high yielding varieties and hybrids in major vegetables and fruit crops, high density planting in banana, Integrated Pest and Disease Management especially in vegetables like brinjal, okra and chillies, nutrient management in mango and jasmine are responsible for higher productivity.

6.109 Demonstrations on hybrids were conducted on oilseeds (groundnut, castor, linseed, mustard, sesame, soybean, sunflower and *toria*), pulses (blackgram, greengram, lentil and *rajmah*), cereals (rice, wheat, maize, sorghum), millets (pearl millet), commercial crops (cotton, ginger, turmeric), vegetables (bottlegourd, brinjal, cabbage, capsicum, chilli, cluster bean, cucumber, okra, onion, pea, potato, tomato, watermelon, pumpkin) and fruits (aonla, apple and banana). Technologies were popularized among the farmers in various parts of the country through frontline demonstrations, field days, exhibitions, *kisan mela*, *kisan ghosthi* and film shows. Other extension programmes include scientists visits to farmers fields, group meetings and discussions, workshops, lectures, etc. In addition, KVKs are also disseminating technologies through mass media.

6.110 Kisan Mobile Advisory is a new initiative in using Information and Communication Technology for dissemination of need-based and timely information to the farmers. Mobile advisory services through 300 KVKs were launched. Regular mobile advisory services with regard to information on weather, market and farm operations are provided to farmers in 300 districts located in eight zones of the country.

6.111 The Kisan Mobile Advisory has made access to the information easier and cost effective to the farmers. During 2010-11, about 64,108 registered farmers have received 20,307 messages on various aspects of agriculture, horticulture and animal husbandry, besides weather forecast, and pest and disease control. The other major contributions made by the KVKs, are as follows: production and supply of technological products; innovative technology delivery mechanisms; following an institutional approach for technology adoption through FIGs, Farmer Clubs, etc.; technology spread through FLDs; special emphasis on women empowerment; production of inputs at site like seed and planting materials; effective use of information and communication technology; emphasis on rural entrepreneurial development like piggery rearing, low cost mushroom production, bee keeping, etc.; promotion of eco-friendly technologies like IPM, Zero tillage, etc.; and promotion of resource conservation technologies like laser levelling, agro-forestry mode, etc. In addition to these, there are several success stories of KVKs covering paddy task force- a solution to farm-labour shortage, quality protein maize, innovative approach in sericulture, sweet potato-based feeding system for pig, and protected cultivation of vegetables in net-house. Further, some special programmes have been introduced, for instance, the soil water and plant analysis, rainwater harvesting with micro-irrigation system, interventions in mitigating drought during 2009–10. ICAR has also created unique facilities for the promotion and dissemination of knowledge products nationaly and globally such as the establishment of the National Academy of Agricultural Sciences (Box 6.14) and National Agricultural Science Centre (Box 6.15).

Box 6.14: National Academy of Agricultural Sciences (NAAS)

The National Academy of Agricultural Sciences (NAAS), established in 1990, is among the youngest of the Science Academies of India. It owes its origin to the vision of the late Dr. B. P. Pal, FRS. The Academy focuses on the broad field of agricultural sciences including crop husbandry, animal husbandry, fisheries, agro-forestry and interface between agriculture and agro-industry. The Academy's role is to provide a forum to Agricultural Scientists to deliberate on important issues of agricultural research, education and extension and present views of the scientific community as policy inputs to planners, decision and opinion makers at various

Box 6.14: National Academy of Agricultural Sciences (NAAS) (Contd.)

levels. To achieve this, the Academy organizes and supports national and international congresses, conferences, seminars, symposia, workshops and brainstorming sessions on critical issues in the field of agricultural sciences. The Academy accords recognition to scientists at various levels, and encourages cutting edge research in different fields of agricultural sciences. The Academy has emerged as a vibrant national level body devoted to agricultural sciences. It has organized several programmes of national and international importance in critical areas. The Fellows of the Academy, recognized for their contributions to science, include distinguished personalities in the field of Agriculture and Allied Sciences, both from India and abroad.

Box 6.15: National Agriculture Science Centre

National Agriculture Science Centre is a prestigious Complex built by the Indian Council of Agricultural Research spread over an area of around 22 acres with multi-dimensional state of the art facilities like a National Agricultural Museum, Symposia Complex, large underground parking, offices of the international and national organizations of agricultural research, National Academy of Agricultural Sciences (NAAS), Association of Agricultural Universities of India, Podium. It has lush green large landscapes and an International Guest House fully centrally air conditioned comprising of 76 single/double rooms and 22 suites each fitted with modern facilities, telephone, Internet, TVs, etc.

The complex being a national focal point and an interactive platform for the international, national institute, socialites, agencies including State Agricultural Universities, Central Agricultural University and all other public sector organizations engaged in the promotion of agricultural research coordination and its extension. The prestigious NASC complex is located on the main Dev Prakash Shastri Marg at a strategic location in the New Delhi area of PUSA campus.

Challenges

6.112 The main challenges of KVKs under ICAR include the following:

- KVKs are finding it difficult to meet the expanding mandate in respect of new expert areas like NRM, agribusiness and marketing, agricultural engineering, etc.
- E-connectivity and bandwidth problems are hindrances in the use of ICTs by KVKs and other outreach programmes.

- Adequacy and continuity of staff in KVKs is emerging as a bottleneck to make progress.

The Way forward

6.113 The important measures that will strengthen KVKs to perform will include:

- KVKs should be involved in the Block action plan preparation and adequate staff and funding support to KVKs are necessary
- Strengthening communication and knowledge sharing through establishment and maintenance of technology museums, mobile field services, village adoption programmes, farmer field schools, Tele-Advisory services, online agri video channel, SMS based agri-advisory service, information kiosks, disaster management interventions, organising exhibitions, filed days, exposure visits, etc.
- Strengthen media and e-resources through publications such as newsletters, books, manuals, leaflets, brochures, technology hand outs, etc., media coverage of extension programmes, development of cyber extension platforms and extension portal, content development cyber extension, production of AV and interactive aids, etc.
- Strengthening market intelligence, EDP and consultation through EDP packages, project report preparations and consultancies, industry and enterprise relations and partnership, establishing local market network on prices, establishing value chain demonstration units, etc.
- Strengthening continuing education programmes through open and distance learning for farmers and entrepreneurs with online courses, conducting certificate courses for farmers, entrepreneurs, input dealers, extension agencies, etc.

Extension Services

6.114 The extension or transfer of technology endeavors in India has been a mix of field extension carried out by line departments, anchored by frontline extension systems of the ICAR Institutes and SAUs, Commodity Boards, NGOs and voluntary organizations. Recently, Farmers' Consortiums under different nomenclature have also emerged with this mandate. But most of them have not been able to reach out to the broad spectrum of clientele, who need problem solving, relevant technologie and ground level adviseries. All These efforts have proved to be inadequate in the context of food security concerns. Robust provision of services are require by new factors such as: an overwhelming role of ICTs; growing emphasis on people's participation and democratic decentralization; increasing role of NGOs; growing thrust on entrepreneurship development; growing challenges of globalization and multiplicity of facilitating and consultancy services required by different stakeholders. Public extension services are stated to be very weak in India, particularly, in addressing the emerging technological and knowledge needs. However, efforts are made to strengthen the system with some new and innovative schemes.

Support to State Extension Programmes for Extension Reforms

6.115 The Scheme is currently in operation in 603 districts of 28 states & 3 UTs. The scheme essentially focuses on institutionalizing key reforms. The extension support to farmers under the scheme is provided through a 'basket of activities' called the ATMA Cafeteria, which covers activities that are to be implemented at both State and District levels. State level activities include preparation of State Extension Work Plan (SEWP), support for up-grading state level training institutions, such as, State Agricultural Management & Extension Training Institutes (SAMETI), human resource development of extension functionaries, organization of various agriculture related activities including monitoring and evaluation. District level activities are further categorized into four groups; namely: (i) Farmer Oriented Activities; (ii) Farm Information Dissemination Activities; (iii) Research-Extension-Farmer Activities, and (iv) Innovative Activities. Based on SREP, and the Block Action Plans jointly firmed up by the Block Technology Team (BTT) and BFAC, the District Agriculture Action Plans (DAAPs) are prepared annually. At the State Headquarter, district plans are collated and a State Extension Work Plan (SEWP) is approved by Inter-Departmental Working Group (IDWG) headed by the Agriculture Production Commissioner/ Secretary (Agriculture) of the State. The State Extension Work Plan (SEWP) approved by IDWG is further put up to State Level Sanctioning Committee for approval and Government of India for release of funds.

6.116 The status of implementation of Extension Reforms Scheme is as under: —

- Over 157 lakh farmers have been benefited so far since inception of the scheme through various extension activities viz.:
  - Over 10.97 lakh farmers benefited through Exposure Visits;
  - Over 39.55 lakh farmers through various training programmes at different levels;
  - Over 16.97 lakh farmers through Demonstrations; and
  - Over 89.85 lakh farmers through *Kissan Melas*/Field days and *Kissan Goshties*.
  - Over 75,000 Farmers Interest Groups have been mobilized.
  - Over 25,400 Farm Schools have been set up on the field of Progressive/Awardee farmers.

6.117 The evaluation and impact assessment of the scheme has been conducted during 2009-10 through an independent agency namely, Agricultural Finance Corporation (AFC). While the assessment has found a large increase in trainings, exposure visits and demonstrations after the introduction of the Scheme , it stressed the need for further increase in exposure visits and demonstrations.More than 52% of the respondent farmers agreed that they have gained knowledge of new practices and technologies and a substantial section of them disseminated the newly acquired knowledge among fellow farmers (Farmer to Farmer Extension). About 25% of the farmers reported increase in agricultural production and income. The Study recommended that CIGs/SHGs are to be promoted in order to fill gaps in extension services at the village level. They also recommended that the time-lag between technology generation and dissemination needs to be minimized.

Establishment of Agri-Clinics and Agri-Business Centres

6.118 Launched in 2002, the Scheme on Establishment of Agri-Clinics and Agri-Business Centres (ACABC) was aimed to strengthen the extension services and to tap the potential of unemployed agriculture graduates in order to provide them self employment opportunities. Under the scheme, free training and handholding support is provided to unemployed agriculture graduates so as to enable them with required knowledge, skill and orientation towards agri-preneurship. Needed support is also extended to the trained graduates for developing a bankable agri-business project and for availing loans from a commercial bank at concessional rates. A provision of back ended capital subsidy and interest subsidy to them on the loans availed of for Agri- venture establishment was also made in the year 2006. The Scheme is being implemented by Government of India through National Institute of Agricultural Extension Management (MANAGE) and the National Bank for Agriculture and Rural Development (NABARD). MANAGE coordinates and implements the training and handholding support through a network of Nodal Training Institutes (NTIs) identified through a well designed process of screening and assessment. NABARD looks after the credit part of the scheme by refinancing the agri-business loans granted by commercial banks to the trained graduates and release of subsidy thereon.

6.119 Ever since its launch in the year 2002, a total of 24,229 candidates have been trained under the scheme out of which 8604 have established their ventures. This shows that the scheme has invoked tremendous interest in the unemployed agriculture graduates towards entrepreneurship in the rural areas. UP, Maharashtra and Bihar have exhibited remarkable achievement in the numbers of candidates that enrolled for ACABC training. States like Rajasthan, Karnataka, Tamil Nadu, Andhra Pradesh, and J&K have also exhibited a modest progress. Overall progress in the establishment of agri ventures by trained graduates was 35.5% since its inception. Though the success has been maintained during the preceding year, at least 50% success rate during coming years is further anticipated.

6.120 Many factors contribute to the development of agripreneurs through ACABC Scheme including level of agricultural development in the State, awareness in prospective candidates about the ACABC scheme and infrastructure facilities available. Thus, the need for efficient support organizations to monitor the activities of small enterprises was felt. Moreover, prediction of the future demand, introduction of modern technologies, cost control and business expansion are the important areas, where entrepreneurs need regular support. Major revisions were made in the Scheme during 2010-11 to accommodate these concerns. The revised training cost per trainee is now limited to Rs.35,000 by proportionately raising the limits under different components and adding the new area of hands on industry training. In order to incentivize most successful agripreneurs under that scheme an element of refresher training has been introduced in the revised Scheme format. This training of about 3-5 days duration would be conducted in specialized Institutions like SAUs/ICAR Institutes /IIMs/ IITs/CSIR Institutes /DST Institutes/Private Institutions. Similarly, NABARD has been given support to organize sensitization training and workshops to motivate the bankers across the country to provide credit to agripreneurs for establishing ventures. The initial Interest and Capital Subsidy pattern of the Scheme has been replaced with a Composite Subsidy (36% for general and 44% for women, SC/ST & NE) in place of earlier Interest + Capital

Subsidy to make the assessment simpler. The benefit of Subsidy shall be limited for the project cost up to Rs. 20 lakh (plus 5 lakh for extremely successful individuals) for individual projects and project cost up to Rs.100 lakh for a group project (established by a group comprising of minimum of five individuals) of trained candidates under the Scheme. In order to ensure that the provisions made under the revised Scheme are gainfully utilized and Scheme achieves the desired success rates, sufficient checks and balances, and an effective monitoring mechanism has been put in place with the active involvement of all the stakeholders including MANAGE, NABARD, Banks, State Functionaries, SAUs and ICAR Institutes.

Kisan Call Centres (KCC)

6.121 To harness the potential of ICT in agriculture, the Ministry of Agriculture has launched an innovative scheme, called 'Kisan Call Centers.(KCCs).' KCCs have been functioning since 21 January, 2004 and working in 25 different locations covering almost all the states. At present 144 Call Center Agents have been engaged in KCCs who are answering farmer's queries in 22 local dialects. All KCC locations are accessible by dialing single toll free number 1800-18-1551 from 6.00 AM to 10.00 PM on all 7 days a week nationwide. This number is accessible through all mobile numbers of all telecom net works even of private service providers and land lines as well. At each KCC location there are Kisan Call Centre Agents. Twenty five Nodal Officers of Government of India are keeping liaison with them for providing technical support for running the Kisan Call Centres. Till September, 2011, 62.5 lakh calls from the farmers have been received in the Kisan Call Centres since inception. The number of calls have trebled since November, 2010. In order to monitor the activities of Kisan Call Centers a State Level Monitoring Committee has been constituted comprising of the Secretary (Agri.)/Director Agriculture allied Depts, representatives of local BSNL office, and concerned nodal officer. Call escalation matix has been revised to offer different tiers of support and to ensure greater and direct involvement of farmers.

Capacity Building

6.122 The Extension Education Institutes were established at four locations in phases namely: (i)Nilokheri (Haryana) in 1958: (ii) Anand (Gujarat) in 1962; (iii) Rajendranagar, Hyderabad (A.P) in 1962; and (iv) Jorhat (Assam) in 1987. The primary objective of establishing four Extension Education Institutes is to prepare high quality professional leaders in the field of extension education and communication to serve as trainers of various training programmes for the growth and development of agriculture. Initially these institutes were required to organize a three month duration course for the Subject Matter specialist. Besides, the institutes were providing long term in-service training to instructional staff of Gram Sevak Training Centres. EEIs are also engaged in adaptive research in extension teaching methods and communication. Looking into the weakness in the institutional framework of the Extension Education institutes, a study on restructuring of the EEIs was commissioned during December 2004 through the agency Centre for Organizational Research & Development in Management (CORD-M), Hyderabad. It was observed that the EEIs had become, over a period of time, another department of the respective university. All these resulted in exclusion of EEIs from the mainstream of extension system. The concerned states and vice

chancellors of all four SAUs (Hyderabad, Anand, Nilokheri & Jorhat) involved with EEIs were consulted and based on the intimation a roadmap for restructuring the EEIs has been drawn.

Model Training Courses (MTCs)

6.123 The 'Model Training Courses (MTCs)' scheme has been implementing since 1996 which emphasizes a demand-driven capacity building of extension managers, marketing managers and extension functionaries of the State development departments. ICAR Institutes and State Agricultural Universities are engaged in the technology dissemination and these technologies need to percolate to the farmers' field. MTCs are of national character and offer training courses in specialized areas through ICAR and SAUs in agriculture, horticulture, veterinary, sericulture and extension. MTCs are very cost effective as the training infrastructure and specialists of the host institutes are used for imparting training. The Model Training Course of 8 days duration offers an interface between host institutes and extension field functionaries.

Use of Media in Reaching up to the Farmers

6.124 The Central Sector Scheme 'Mass Media Support to Agriculture Extension' has been launched during the Tenth Plan Period to enable a revamping of the extension services in the country by using electronic media i.e the wide network of Doordarshan and All India Radio for transfer of technology and information to the farmers. The primary objective of the Scheme is to use Television and Radio with their massive penetration as a vehicle that could be exploited for the purpose of extension. They have the advantage of reaching a wide audience at a very low cost. Under this Scheme, the existing infrastructure of Doordarshan (DD) and All India Radio (AIR) is being utilized to make the farmers aware of modern technologies and researches related to agriculture and allied areas. A 30 minute programme is being telecast five to six days a week through National, 18 Regional Kendras and 180 High Power/Low Power Transmitters of Doordarshan. Similarly, 96 Rural FM Radio Stations of All India Radio are being utilized to broadcast 30 minutes of programme for farmers 6 days a week. For telecasting success stories, innovations and for popularization of change-setting technology and farming practices through the Saturday slot of Doordarshan's National Channel, DAC is producing films, which would consciously project inter-alia positive aspects of agriculture in India. A three-tier system has been set up, Apex Committee at the Centre, the State Level committees (SLC) and the District Level committees (DLC) to provide guidance and monitor the programmes telecast/ broadcast through DD and AIR. A hundred percent achievement in respect of the physical target during the Eleventh Five year is expected under the Scheme.

Focused Advertisement Campaign

6.125 The Department of Agriculture & Cooperation, Ministry of Agriculture has launched a 'Focused Advertisement Campaign'; which would cut across all the Divisions of the Ministry to create awareness of assistances available under various schemes. The Campaign was launched on 5 July, 2010. At the national level this is being implemented by way of short advertisements Audio & Video Spots of 30 – 60 seconds duration. The spots are broadcast/telecast through AIR, DD and private channels operating at the national and

regional level during news, serials, and entertainment programmes having maximum viewership.

On an average, one spot in every month is dubbed in different languages. Till date the following spots are produced under the campaign.

- Farm School (Munim)
- Farm School (Sass Bahoo)
- Kisan Credit Card
- National Horticulture Mission
- Accelerated Pulse Production Programme (A3P)
- Jagrook Kisan – Drought Advisories for Bihar, Jharkhand and West Bengal.
- Judicious use of Fertilizers
- Poorvi Bharat Haritkranti.

6.126 The spots were telecast through DD National and 25 Regional Kendras of DD as well as 21 private channels operating at National & Regional level. To monitor the campaign, a soft ware has been developed with the help of NIC. All the Channels are uploading the pre-logs (time band of 20 min) and post logs. IP TVs have also been installed to monitor the campaign. A 'Focused Publicity Campaign Committee' has been formed in DAC and regular meetings of the committee are being held to monitor the programme. A proposal has already been initiated to get the feedback of the campaign through Audience Research Unit (ARU) of Doordarshan.

Challenges

6.127 The main challenges of the public extension services include the following:

- Many progressive states such as Gujarat, Haryana, HP, Madhya Pradesh and West Bengal have not been able to show a level of progress matching with their agricultural development initiatives. Except for Assam, Nagaland and Manipur, many of the NE States have exhibited very poor progress under the Scheme on Establishment of Agri-Clinics and Agri-Business Centres
- There was hardly any institutionalized relationship between EEIs & MANAGE and EEIs & SAMETIs. There is not much consultancy and research work done by the faculty of EEIs and there is no interaction with private organizations.
- SLC & DLC have been constituted in all the States but the meetings of the committees are not being held regularly.
- Monitoring the scheme in respect of the quality and content of the programmes telecast/broadcast needs attention.
- Monitoring of Focused Advertisement Campaign; Feedback of the Farmers on the campaign and the programmes in which the spots could be placed will be productive.

The Way forward

6.128 Some of the important measures which can strengthen the public extension services include the following:

- All the institutions involved in extension activities should better target their beneficiaries; characterize the requirements of each beneficiary group; and customize their extension services, so that they become total solution providers to target groups.
- Extension activities to emphasize sustainable natural resource management including indigenous knowledge systems.
- Documentation, rationalization and institutionalization and popularization of contemporary farmer innovations
- Promote CIGs/SHGs in order to fill gaps in extension services at the village level.
- The time-lag between technology generation and dissemination needs to be minimized by devising suitable mechanism.
- Strengthening communication and knowledge sharing through establishment and maintenance of technology museums, mobile field services, village adoption programmes, farmer field schools, tele-advisory services, online agri video channel, SMS-based agri advisory service, information kiosks, disaster management interventions, organizing exhibitions, field days, exposure visits, etc.
- Strengthen media and e-resources through publications such as newsletters, books, manuals, leaflets, brochures, technology hand outs, etc.; media coverage of extension programmes; development of cyber extension platforms and extension portal; content development cyber extension, production of AV and interactive aids, etc.
- Strengthening market intelligence, EDP and consultation through EDP packages, project report preparations and consultancies, industry and enterprise relations and partnership, establishing local market network on prices, establishing value chain demonstration units, etc.
- Strengthening continuing education programmes through open and distance learning for farmers and entrepreneurs with online courses, conducting certificate courses for farmers, entrepreneurs input dealers, extension agencies, etc.

CHAPTER 7

Animal Husbandry, Dairying & Fisheries

7.1 The animal production system in India is predominantly part of a mixed crop-livestock farming system vital for the security and survival of large numbers of poor people. In such systems, livestock generate income, provide employment, draught power and manure. This production system assumes special significance in the present context of sustained economic growth, rising income, increasing urbanization, changes in taste and preference that have lead to dietary changes reflecting the importance of milk, meat, egg and fish. The estimated growth rates of production are about 4.6% in milk, 5.69% in meat and 4.56% in eggs. The trends in the production of milk, meat, wool, egg and fish are given below:

Dairy and Livestock Production

Milk

7.2 India continues to be the largest producer of milk in the world. Production is estimated to be around 121.8 million tonnes during 2010-11 as compared to 53.9 million tonnes in 1990-91. Per capita availability of milk at national level has increased from 176 grams per day in 1990-91 to 281 grams per day in 2010-11.

Meat

7.3 Total meat production from cattle, buffalo, sheep, goat, pig and poultry at the all India level increased from 1.5 million tonnes in 2000-01 to an estimated 4.83 million tonnes in 2010-11. Poultry meat production from commercial poultry farms were included from 2007-08 onwards.

Wool

7.4 The anticipated estimate of wool production at the national level has marginally increased to 43.13 million kg. in 2010-11 in comparison to 41.2 million kg. in 1990-91.

Egg

7.5 The total egg production for the year 2010-11 was an estimated around 61.45 billion as compared to 21.1 billion during 1990-91. As per FAOSTAT latest production data for the year 2010, India ranks 3rd in egg production in the world.

Fish

7.6 India is the second largest producer of fish in the world, contributing 5.54 percent of global production. The total fish production during 2010-11 is estimated at 8.29 million tonnes with a contribution of 5.07 million tonnes from the inland sector and 3.22 million tonnes from the marine sector. The value of output from the fisheries sector at current prices during 2009-10 was Rs. 67,913 crore which is 4.9 per cent of the total output of agriculture & allied sectors. India's marine product exports have for the first time crossed USD 2 billion. During 2010-11, the volume of fish and fish products exported was 8,13,091 tonnes worth Rs. 12,901 crore registering the highest growth rate of 10% in volume of fish exports in recent years.

7.7 Growth in fishery sub-sector is next only to poultry. The policy for fishery development emphasizes inland fisheries, particularly aquaculture in recent years, which has been instrumental in increasing production, enhancing exports and reducing the poverty of fishermen. The four components of production, nutrition, health and management in these sub-sectors are examined later.

Table 7.1: Compound Annual Growth Rates (CAGRs) in Production of Milk, Egg, Wool and Fish at All-India Level (%)

	1980-81 to 1989-90	1990-91 to 1999-00	2000-01 to 2009-10	1980-81 to 2009-10
Milk	5.6	4.2	4.2	4.6
Eggs	8.06	4.2	5.7	6.04
Wool	3	1.7	-1.3	1.00
Meat	-	-	3.34*	-
Fish	4.4	4.2	3.3	4.4

Note: *CAGR for meat production is for the year 2000-01 to 2006-07. Meat production data from 2007-08 is not comparable with the previous years data as pultry meat production from commercial poultry farms was included from 2007-08 onwards.

Source: DAHD&F

7.8 India has the world's largest livestock population, accounting for about half the population of buffaloes and 1/6th of the goat population. Such a large population presents a challenge wherein existing productivity levels are sustained by application of modern science and technology, incentives and policies.

Plan Schemes

7.9 Dairying is an important source of income for millions of rural families and has assumed as an important role in providing employment and income generating opportunities. The Government of India and state governments are making strong efforts to increase the productivity of milch animals and increase the per capita availability of milk. The Department of Animal Husbandry, Dairying and Fisheries has attempted the building up cooperative infrastructure, revitalization of sick dairy cooperative federations and extended support for creation of infrastructure for production of quality milk and milk products. Two important schemes being implemented are the Intensive Dairy Development Programme for increasing milk production and procurement and the National Project for Cattle and Buffalo Breeding for genetic upgradation of bovines. This section highlights the efforts made by the GOI through its schemes formulated to increase the production and productivity of milk, poultry, meat and fish.

Strengthening Infrastructure for Quality & Clean Milk Production

7.10 The scheme, introduced during October, 2003 has its objective the improvement of the quality of raw milk produce at the village level by creating awareness among farmers and members. Under the scheme, there is a provision for training of farmers on good milking practices and the setting up of Bulk Milk Cooler (BMC) at Dairy Cooperative Society level.

Assistance to Cooperatives

7.11 The central sector scheme started in 1999-2000, aims at revitalizing the sick dairy cooperative unions at the district level and cooperative federations at the State level. The rehabilitation plan is prepared by the National Dairy Development Board (NDDB) in consultation with the concerned State Dairy Federation and District Milk Union.

7.12 The achievements under assistance to cooperatives scheme reveal that the rehabilitation period of seven years is over with respect to 17 Milk Unions out of 37. Of these, four Unions have achieved positive net worth and six Unions are earning profits but have not yet achieved a positive net worth. The remaining seven Unions are incurring losses and their net worth is negative. Regarding the remaining 20 unions, three unions have achieved a positive net worth even before the completion of the seven-year rehabilitation period. Further one new rehabilitation project of Sangrur Milk union has been approved recently.

Dairy Venture Capital Fund (DVCF)/Dairy Entrepreneurship Development Scheme (DEDS)

7.13 The Dairy/Poultry Venture Capital Fund scheme was started in December, 2004. It has been modified and renamed as the Dairy Entrepreneurship Development Scheme (DEDS) and is being implemented from September, 2010.

Cattle and Buffalo Breeding: Livestock Production

7.14 At present 28 States and one Union Territory (UT) are participating in National Project for Cattle and Buffalo Breeding. The objective of this scheme is to promote genetic upgradation of bovines. Semen production in the country has increased from 22 million straws (1999-2000) to 54 million straws (2010-2011) and number of Artificial Insemination (AI) from 21.8 to 52 million per annum. Conception rate increased from 20% to 35%. The numbers of animals in milk has increased from 62 million during 2000 to 77 million during 2007. Crossbred cattle population has increased from 20 million (1997) to 34 million (2007). 21,700 breeding bulls with high genetic merit have been inducted for natural service in the areas out of the coverage of AI services. 36,000 Government stationary AI centres have been assisted and equipped to function as mobile AI centres and 21,000 private AI centres have been established for delivery of breeding services. In order to improve the quality of semen production a Minimum Standard Protocol (MSP) for semen production has been enforced at all semen stations; 49 frozen semen bull station have been strengthened as per this MSP. A central Monitoring Unit (CMU) has been constituted for evaluation of one semen stations in two years. Thirty four semen stations in the country have acquired ISO certification against 3 during 2004. MSP for progeny testing and standard operating procedures for AI technicians has also been formulated.

Challenges

7.15 The challenges facing the dairy sector are given below:

- Small herd size and poor productivity
- Inadequate budgetary allocation over the years

- Lack of equity with crop production
- Inadequate availability of credit
- Poor access to organized markets deprive farmers of proper milk price
- Poor AI service net-work
- Shortage of manpower and funds
- Limited availability of quality breeding bulls
- Low acceptability of AI in buffaloes
- Disease outbreaks: mortality & morbidity
- Deficiency of vaccines and vaccination set-up
- Induction of crossbred animals in areas poor in feed resources
- Majority of grazing lands are either degraded or encroached
- Diversion of feed & fodder ingredients for industrial use

The Way Forward

7.16 Continuous support to the States is essential for further genetic upgradation programmes to meet the fast increasing demand for milk in the country. There is further need to consolidate and improve the breeding infrastructure created under NPCBB, scientific programmes like Embryo Transfer Technology (ETT), Multi Ovulation Embryo Transfer Technology (MOET), Markers Assisted Selection (MAS) and development of semen sexing technology and use of sexed semen for faster propagation of elite germplasm and for increasing bovine productivity. The following policy initiatives are required to attract investment and for further development of dairy and livestock sector:

- Incentivize investment in this sector
- Increase public investment.

Meat and Poultry Sector

7.17 India possesses around 141 million goats and 71.6 million sheep. In terms of population, India ranks second in the world in goats and third in sheep. Unlike the dairy sub-sector, growth in poultry production is mainly attributed to the efforts of the organized private sector, which controls over 80% of the total production in the country.

7.18 In poultry development, the following three components are funded by the Department:

(i) Assistance to State Poultry Farms
One time assistance is provided to strengthen farms in terms of hatchery, brooding and rearing houses, laying houses for birds with provision for feed mill and their quality monitoring and in-house disease diagnostic facilities and feed analysis laboratory. Till date, 228 farms have been assisted under the scheme since the inception.

(ii) Rural Backyard Poultry Development
This component envisages supply of backyard poultry to beneficiaries from Below Poverty Line (BPL) families to enable them to gain supplementary income and nutritional support.

(iii) Poultry Estates
Entrepreneurship skills are to be improved through an exploratory pilot project, 'Poultry Estates' in two States. It is meant primarily for educated, unemployed youth and small farmers with some margin money, for making a profitable venture out of various poultry related activities in a scientific and bio-secure cluster approach.

Poultry Venture Capital Fund

7.19 The scheme provides finance through NABARD for components like establishment of poultry breeding farm with low input technology birds, establishment of feed go-down, feed mill, feed analytical laboratory, marketing of poultry products, egg grading, packing and storage for export capacity, retail poultry dressing unit, egg and broiler carts for sale of poultry products and central grower unit, etc.

Central Poultry Development Organizations & Central Poultry Performance Testing Centre

7.20 The four centres of the Central Poultry Development Organizations are located at Chandigarh (Northern Region), Bhubaneswar (Eastern Region), Mumbai (Western Region) and Bangalore (Southern Region) while one Central Poultry Performance Testing Centre is at Gurgaon, Haryana. These centres are promoting the development of poultry through the following measures:

- Availability of quality chicks of identified low-input technology poultry stocks is ensured.
- Diversification into rearing of Duck and Turkey (Southern Region), Japanese Quail (Northern and Western region) and Guinea fowl (Eastern region).
- Training of trainers, farmers, women beneficiaries, various public and private sector poultry organizations, NGOs, Banks, Cooperatives and foreign trainees etc.
- Regular testing of various stocks available in the country to assess their performance.

Challenges

7.21 The challenges facing the meat and poultry sector include:

- Maize availability and cost: maize is the single most important ingredient of poultry feed, its' availability at a reasonable cost is the major problem of poultry sector.
- Diseases: Pathogenic and emerging diseases namelyAI often cause heavy losses both in domestic market and international trade.
- Lack of Marketing Intelligence: There is a dire need for realistic national marketing intelligence to bridge the gap between supply and demand of poultry & poultry products.

- Human Resource Development: To meet the growing demand of sustainable and safe production there is a huge demand for trained and skilled manpower in poultry sector.
- Large size of target population to be improved in terms of productivity with application of science and technology pose a formidable challenge.
- Low level of processing and value addition in animal products.

The Way Forward

7.22 The following measure are suggested to strengthen the meat and poultry sector for accelerated and sustainable growth:

- Long-term sustainable production measures have to be looked into to increase the production & quality of maize.
- Active surveillance, monitoring and control in case of any outbreaks in rapid manner.
- Network for a realistic national and global poultry database and marketing intelligence may be developed.
- Sufficient trained manpower should be developed in the existing institutions.
- With growing urbanization and increasing quality consciousness, the market for scientifically produced meat products is expected to grow rapidly. The market is growing for ready-to-eat and semi-processed meat products because of a changing socio-economic scenario and an increase in exports to neighboring countries, especially the Middle East.
- The mechanized slaughter houses produce huge quantities of offal and digesta from the slaughtered animals which could be profitably utilized for production of value added products, like Meat-cum-Bone Meal (MBM), Tallow, Bone Chips, Pet Foods and methane as a source of energy for value addition in most of the modern plants.
- There is a need to support pig rearing in order to improve sow productivity, growth rate of piglets and feed conversion efficiency.
- It is important to encourage proper utilization of by-products of livestock slaughter for higher income of livestock owners. The environmental pollution and spread of livestock diseases has to be prevented.

Nutrition: Fodder and Feed

7.23 With only 2.29% of the land area of the world, India is maintaining about 10.71% of the worlds livestock. The nutritive value of feed and fodder has a significant bearing on productivity of livestock. The gap between the demand and supply of fodder is fast increasing. In order to bridge this gap, and ensure production of quality fodder, the DADF is implementing a Central Fodder Development Organization (CFDO) Scheme. This has 7 Regional Stations for Forage Production and Demonstration (RSFP&D), one Central Fodder

Seed Production Farm (CFSPF) at Hessarghatta (Karnataka) and Central Minikit Testing Programme (CMTP) for fodder crops. A modified 'Centrally Sponsored Fodder & Feed Development Scheme' is being implemented from April, 2010 for assisting the states in their efforts to augment the quantity and quality of feed and fodder.

Challenges

7.24 The main challenges in providing adequate and quality fodder and feed include:

- While numbers of livestock are growing, but the grazing lands are gradually diminishing. The area under fodder cultivation is also limited.
- A majority of the grazing lands have either been degraded or encroached upon restricting their availability for livestock grazing.
- Due to increasing pressure on land for growing food grains, oil seeds, and pulses, adequate attention has not been given to the production of fodder crops.
- Diversified use of agriculture residues like paper industry, packaging, etc. widening the gap between the supply and demand for fodder.
- There is lack of authentic data on availability of fodder, crop residues, agro industrial by- products and feed grains (coarse cereal grains). This is required to build an actual database, on feed and fodder, to be used for more effective and realistic planning of livestock sector development.
- Current production of improved fodder seed in the country is about 40,000 metric tonnes as against the requirement of 5.4 lakh metric tonnes to be cultivated on 10.8 million ha area.
- A substantial amount of crop residues is burnt by the farmers after harvesting of main crop like wheat and paddy.
- In most of the states there are inadequate staffs to address the problems related to fodder.

The Way Forward

7.25 The measures which can contribute to improved fodder and feed situation include the following:

- A reliable data-base is required for assisting in realistic planning.
- Supply of quality fodder and feed should be encouraged on a priority basis.
- The forest department can play a major role in augmenting fodder production in the country. The degraded forest areas, mostly under the Joint Forest Management Committees (JFMCs), can be used for assisting growth of indigenous fodder varieties of grasses, legumes, and trees under area-specific Silvi-pastoral systems.
- There is a need for undertaking an effective Extension campaign in major states for efficient utilization of crop residues, growing fodder crops, Azolla production, etc.

- Production of seeds of high yielding fodder varieties needs to be increased in the organized/cooperative sector.
- High yielding fodder varieties need to be introduced throughout the country, instead of dual purpose varieties.
- Production of condensed fodder blocks needs to be encouraged by creating an assured market, coupled with providing a transport subsidy for supply to distant areas.

Livestock Health

Infectious Diseases

7.26 High prevalence of various animal diseases like Foot & Mouth Disease (FMD), Peste des Petits Ruminants (PPR), Brucellosis, Classical Swine Fever and Avian Influenza is a serious impediment to growth in the livestock sector. Foot and Mouth Disease (FMD) alone leads to economic losses of more than Rs. 20,000 crore per annum (NCAP, Preliminary Report 2010). Most of these losses can be prevented through timely immunization. The Department of Animal Husbandry, Dairying & Fisheries (DADF) has initiated National Programmes for prevention and control of FMD, PPR and Brucellosis. The FMD control programme initially started in only 54 districts in 2003 has been expanded to 221 districts and will be expanded to cover the entire country in a phased manner. Similar programmes have been initiated to control PPR and Brucellosis. Shortages of vaccines and lack of proper cold chain facility are among the major hindrances to a faster implementation of these programmes.

Veterinary Support Services

7.27 India has a total of 8,732 veterinary hospitals and polyclinics and 18,830 veterinary dispensaries (against the requirement of about 67,000 institutions). Most of these have poor infrastructure and equipment. Further, the technical manpower is too inadequate (only about 25,000 veterinarians in government sector against the requirement of 67,000) to support health programmes for the massive livestock population. The DADF has now initiated a programme for the "Establishment and Strengthening of existing Veterinary Hospitals and Dispensaries (ESVHD)". There is a dire need to strengthen veterinary hospital facilities for timely diagnosis and treatment of animal diseases. Emphasis also needs to be given to strengthen art mobile veterinary services to ensure door-step veterinary support.

Disease Reporting

7.28 The present system of disease reporting is slow. A computerized National Animal Disease Reporting System (NADRS) linking Taluka, Block, District and State Headquarters to a Central Disease Reporting and Monitoring Unit at the DADF in New Delhi has been initiated in 2010-11. A faster and reliable disease reporting and processing of data will help in the development of appropriate policies and intervention for disease prevention and containment.

Challenges

7.29 the main challenges confronting the animal health sector include:

- Veterinary hospitals, dispensaries and technical manpower are inadequate.
- The disease reporting is neither timely nor complete which delays proper interventions.
- Inadequate availability of vaccines and lack of cold storage.

The Way Forward

7.30 The following measures will strengthen the animal health sector:

- Adequate veterinary disease diagnosis, epidemiology, hospital infrastructure and manpower need to be developed.
- A strong programme for supply of sufficient veterinary vaccines is necessary.

Fisheries Sector

7.31 Allocations made for the development of fisheries sector through the Centrally Sponsored Schemes and Central Sector Schemes are utilized for implementation of both development and welfare oriented schemes through the respective states and UTs. In addition to the allocations made through CSS and CS, assistance is provided through other flagship programmes like Rashtriya Krishi Vikas Yojana (RKVY) and the recently launched National Mission for Protein Supplements (NMPS)

Marine Fisheries Development Scheme

7.32 During the eleventh Five Year Plan, the Marine Fisheries Development Scheme made provision for development of 12 fishing harbors and 4 fish landing centres. These were taken up for implementation while repairs to 4 Fishing Harbors (FH) were attended to, 29 units of post harvest infrastructure like ice plants, retail outlets were created; 5184 traditional crafts motorized; 3921 safety appliances provided; 40,993 KL of HSD provided to fishers with rebate; 3 deep sea resource-specific fishing vessels were promoted; introduction of 88 intermediate craft were taken up and one new private fishing harbor was funded under a Build-Transfer (BOT) package.

Inland Fishery Development Scheme

7.33 Under the scheme, 7,91,628 ha area of fresh water and 39,750 ha area of brackish water were covered for aquaculture and 13,19,522 fish farmers were benefitted for freshwater aquaculture and 28,171 fish farmers for brackish water aquaculture.

Fishermen Welfare Scheme

7.34 Under the scheme, funds were released for coverage of 37 lakh fishers for insurance, construction of 28,359 houses, benefit of 4 lakh fishers under Saving-cum-relief scheme and training of 28,248 fishers in various fish farming and post harvest activities.

Database Scheme

7.35 Under the scheme, inland water bodies are surveyed in most of states, mapping of smaller water bodies have been completed in the State of West Bengal on a pilot basis. The Marine Fisheries Census was completed in all maritime states and islands, registration of fishing vessels of all the coastal States and UTs was initiated and development of database is under progress.

Challenges

7.36 The main challenges facing the fisheries sector include:

- Shortage of quality and healthy fish seeds and other critical inputs.
- Lack of resource-specific fishing vessels and reliable resource and updated data.
- Inadequate awareness about nutritional and economic benefits of fish.
- Inadequate extension staff for fisheries and training for fishers and fisheries personnel.
- Absence of standardization and branding of fish products.

The Way Forward

7.37 The following measures will help to further strengthen the fisheries sector:

- Schemes of integrated approach for enhancing inland fish production and productivity with forward and backward linkages right from production chain and input requirements like quality fish seeds and fish feeds and creation of required infrastructure for harvesting, hygienic handling, value addition and marketing of fish.
- Existing Fish Farmers Development Authority (FFDAs) would be revamped and cooperative sectors, SHGs and youths would be actively involved in intensive aquaculture activities.
- Large scale adoption of culture-based capture fisheries and cage culture in reservoirs and larger water bodies are to be taken up.
- Sustainable exploitation of marine fishery resources especially deep sea resources and enhancement of marine fish production through sea farming, mariculture, resource replenishment programme like setting up of artificial reefs.

CHAPTER 8

Post Harvest Management and Value Addition

8.1 While increased productivity is an essential component of a vibrant agricultural sector, improved post-harvest handling and processing is essential to ensure high-quality products reach the markets. Too often, even when the yields are high, producers lose income due to poor post-harvest practices.

Food Processing Sector

8.2 Food processing aims to make food more digestible, nutritious and extend the shelf life. Due to the seasonal variations high levels of wastage or shortages can arise if adequate measures are not taken to preserve and store the foods.

8.3 Food processing covers all the processes that food items go through from the farm to the time it arrives on the consumer's plate. It includes basic cleaning, grading and packaging as in case of fruits and vegetables and also alteration of the raw material to a stage just before the final preparation. Value addition processes to make ready-to eat food like bakery products, instant foods, flavored and health drinks, etc. is also included in this definition.

8.4 Processed food can be customized to suit the nutritional requirements of groups such as the elderly, pregnant women, infants, young children and athletes. Such foods are characterized by a balanced composition of energy suppliers in the form of fats, carbohydrates and proteins, and by a combination of vitamins and minerals composed according to the current state of scientific knowledge.

8.5 Food processing offers an opportunity for the creation of sustainable livelihoods and economic development for rural communities. Food processing has come a long way in the last few decades. The ever changing lifestyles, food habits and tastes of customers' globally have altered the dynamics of the industry. The world food production and consumption patterns are evolving with a change in the needs of the customer. Increasing demand for ethnic and different foods from customers across the world has redefined the market canvas for food processors across the world. With these changes, producers, processors, retailers and suppliers of food, world over, are reorienting their business plans to meet the new demands of the customers.

8.6 Food processing benefits all the sections of the society. It helps the:

Farmers - get higher yield, better revenues and lower the risks drastically, **Consumers -** have access to a greater variety, better prices and new products, **Economy -** gets benefitted with new business opportunities for the entrepreneurs and the work force gets employment.

8.7 With a huge production base, India can easily become one of the leading food suppliers to the world while at the same time serving the vast growing domestic market of over a billion people. India's large market size with growing incomes and changing life styles also creates incredible market opportunities for food producers, food processors, machinery makers, food technologists and service providers in this sector.

8.8 Growth in food processing sector is also expected to open up a lot of opportunities for players having strong linkages in the agri value chain. Significant investment opportunities are yet to be tapped in the areas of supply chain management, cold storages, financing, retailing and exports. Historically, agriculture and FPI have been plagued by factors such as low public investment, poor infrastructure, inadequate credit availability and high levels of fragmentation. However, in the last few years there have been significant improvements on almost all the fronts. The regulatory environment is now changing for the better.

8.9 The Indian food processing sector's higher rate of growth as compared to the agriculture growth rate is indicative of its low base, the increased availability of surpluses, changing life styles, tastes and higher disposable income with consumers.

8.10 Food processing sector which has been identified as a thrust area for development needs huge investments in logistics for supporting the value chain from farm to plate. It should promote clustering of the farmers to undertake cleaning, grading, primary processing activities in the village itself and linking this with processing and marketing. The processers and retailers should be allowed and encouraged to get actively involved in linking farming to the value chain. It is largely a private sector activity but government should provide needed incentives for faster investments.

8.11 The enabling rules of the game and policy regime will determine the performance of the sector. Most food processing enterprises have been exempted from industrial licensing under the Industries (Development and Regulation) Act, 1951 with the exception of beer and alcoholic drinks and items reserved for the small scale sector. For foreign investment, automatic approval is given even up to 100 percent equity for a majority of processed foods. The policy initiatives of the government also include for example, automatic approvals for foreign technology agreements; sale of 50 percent in the domestic tariff area of agro-based 100 percent EOUs, zero duty EPCG Scheme extended to the food processing sector with a reduced threshold limit of Rs. one crore in the EXIM policy; declaration of the industry as a candidate for priority lending by banks; the formulation of Plan Schemes envisaging grant of loans at a very low rate of 4 percent interest and grant-in-aid to select co-operatives and NGOs assistance for upgrading standards to the international level; assistance for R&D activities; development of agri export zones and opening up of mega food parks. Apart from the various schemes from the central government, various state governments are implementing their own food processing promotion policies and schemes.

8.12 Effective post-harvest management allows not only the minimization of losses but also increases the value of the marketed agricultural products by transforming the agricultural raw materials (fruit juice, jam, cheese; salting, drying, smoking). Good processing enables preservation of product quality at every stage of the marketing process. Attractive packaging makes the product more appealing to consumers who are therefore willing to pay more if the product offered is of good quality and easy to use.Growth in the

food processing sector in the recent years has been significant as may be gauged from the Table below:

Table 8.1: Growth of Food Processing Sector

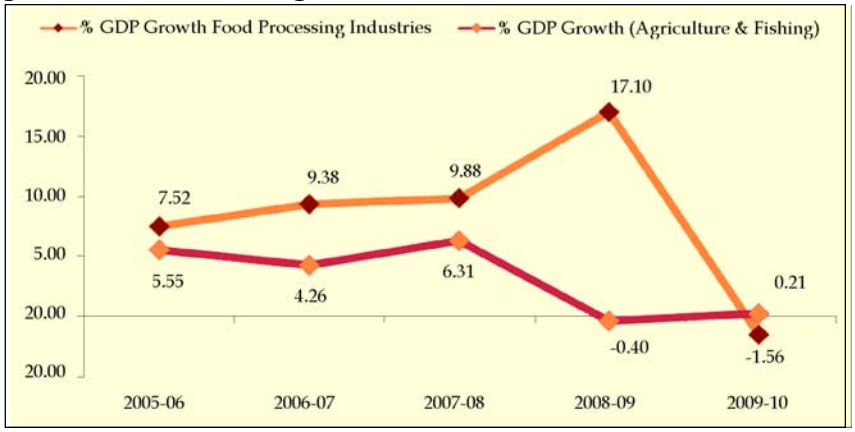
(Rs crore)

Activity	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	CAGRs (percent)
Manufacturing (Registered & Unregistered) under Food Processing Sector							
Meat, Fish, Fruits, Vegetables and Oils	9,236	8,682	9,548	10,349	12,043	12,224	7.29
Dairy Products	3,509	4,342	4,319	4,608	5,419	4,762	6.66
Grain Mill Products	13,467	12,347	11,903	12,846	15,947	17,741	6.55
Other Food Products	14,722	17,794	20,895	22,522	25,775	23,664	10.71
Beverages	3,421	4,525	5,499	6,995	7,938	7,687	18.61
TOTAL	44,355	47,690	52,164	57,320	67,122	66,078	9.30
percent GDP Growth (FP Industries)	-	7.52	9.38	9.88	17.1	-1.56	
GDP Agriculture	4,76,634	5,02,996	5,23,745	5,56,956	5,53,454	5,53,010	3.17
Fishing	27,152	28,749	30,650	32,427	33,561	35,215	5.34
GDP (Agriculture+Fishing)	5,03,786	5,31,745	5,54,395	5,89,383	5,87,015	5,88,225	3.29
percent GDP Growth (Agriculture+Fishing)	-	5.55	4.26	6.31	-0.40	0.21	

Source: National Accounts Statistics, 2011.

8.13 It may be seen from the above table that meat, fish, fruits and vegetables, oils, dairy products, grain mill products, beverages and other food products are the main items being processed. Beverages and other food products have exhibited the highest growth rates followed by meat, fish, fruits, vegetables and oils during 2004-05 to 2009-10.

Fig 8.1: Gross Domestic Product (2004-05 prices) percent Growth in Agriculture (including Fishing) & Food Processing Sector



8.14 From the above figure it can be seen that growth in food processing sector is higher as compared to growth in GDP from Agriculture. This is a positive development. It may also be seen that the growth in the number of registered processing units have been significant in grain mill products and beverages (Table 8.2). The employment generated under registered food processing industries has been increasing since 2003-04 (Fig 8.2). Further, it may be seen from Table 8.3 that the FDI in food processing during 2000-11 was 1.78 percent of the total FDI and the major sectors which attracted FDI were food processing and fermentation industries. It may be seen from the above that the three forms of investment (invested, fixed and working capital) are steadily increasing over the years (Fig 8.3).

Table 8.2: Sector-wise Number of Registered Processing Units

Year	Processing of Meat, Fish, Fruits & Vegetables and Oils	Dairy Products	Grain Mill Products	Other Food Products	Beverages	Total
1998-1999	4241	737	12164	5682	1029	23853
1999-2000	3819	795	12405	5810	1113	23942
2000-2001	3740	735	12446	5985	1082	23988
2001-2002	3454	865	12429	5688	1049	23485
2002-2003	3284	769	12856	5899	1008	23816
2003-2004	3352	912	12741	5757	1078	23840
2004-2005	3484	927	13639	6093	1219	25362
2005-2006	3549	1049	13893	6009	1225	25725
2006-2007	3459	1015	13880	6245	1160	25759
2007-2008	3667	1096	13805	6300	1351	26219

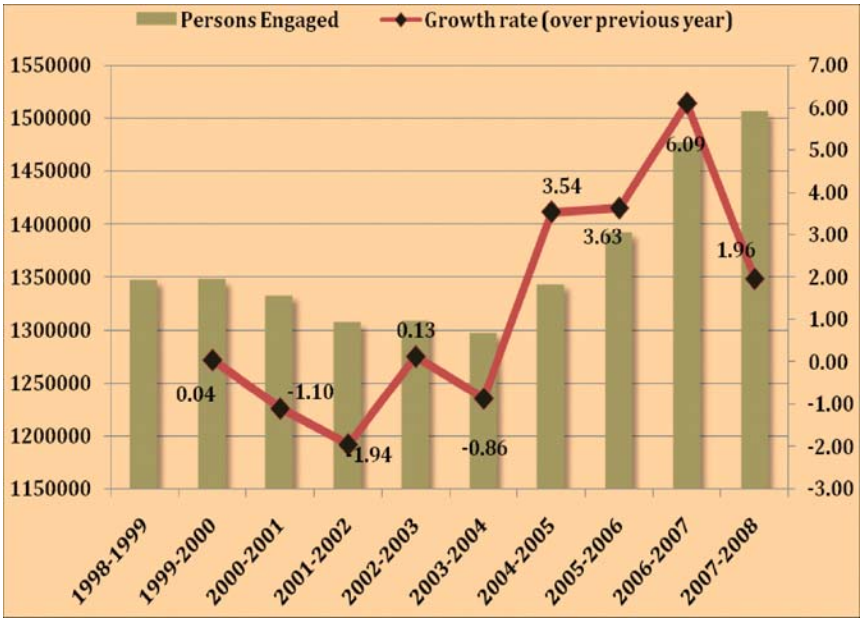
Source: Annual Survey of Industries, MOSPI

Table 8.3: Foreign Direct Investment in Food Processing Sector from April 2000 to August 2011

Sl. No.	Sector	Amount of FDI Inflows		Percentage share of Total FDI
		(In Rs Crore)	(In US$ million)	
1	Food Processing Industries	5872.16	1,286.53	0.89
2	Fermentation Industries	4269.92	979.74	0.65
3	Vegetable Oils And Vanaspati	1103.22	238.72	0.17
4	Tea And Coffee	446.61	99.38	
	Total Food Processing Sector	11691.91	2604.37	1.78
TOTAL FDI		658586.43	147088.13	100

Source: Department of Industrial Policy and Promotion

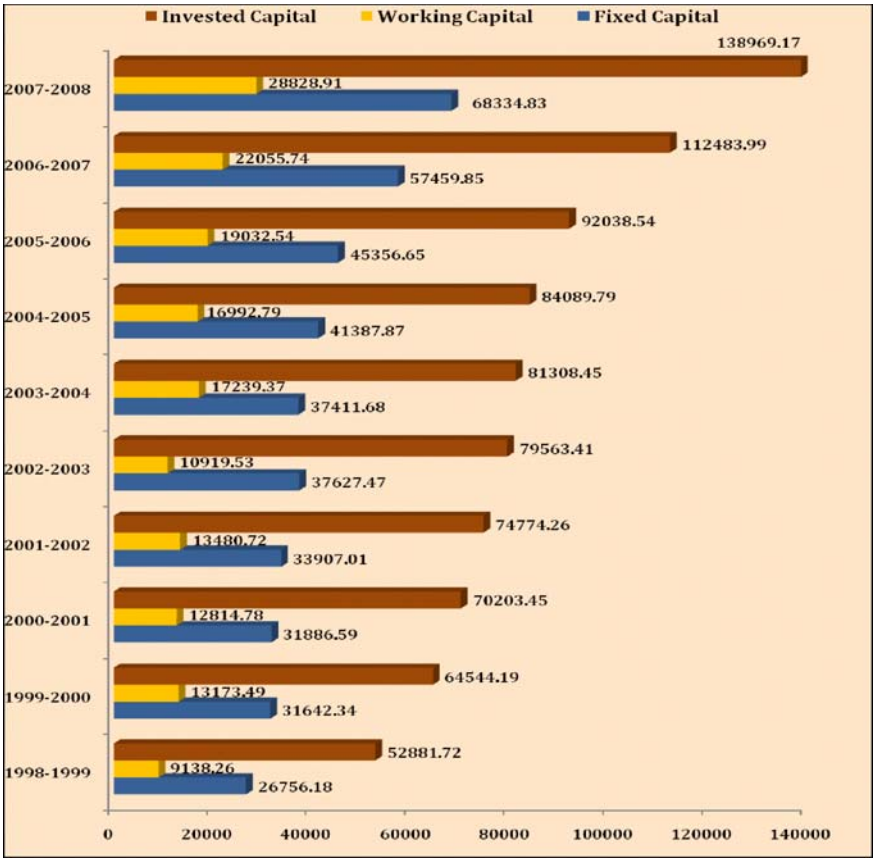
Fig 8.2: Employment under Registered Food Processing Industries



Source: Annual Survey of Industries, MOSPI.

Fig 8.3: Capital Investment in Registered Food Processing Industries

(Rs. in crore)



Source: Annual Survey of Industries, MOSPI

Plan Schemes

Scheme for Infrastructure Development

8.15 The creation of integrated and holistic infrastructure is extremely important for the food processing sector. Towards achieving this end the Ministry of Food Processing Industries (MOFPI) had launched new schemes in eleventh FYP for the creation of modern enabling infrastructure that can facilitate the growth of food processing and an integrated cold chain mechanism for handling perishable produce. The MOFPI initiatives include a launch of the following schemes for strengthening infrastructure in agro and food processing sector, it had launched the Mega Food Parks Scheme; the Scheme for Cold Chain; Value Addition and Preservation Infrastructure and the Scheme for Construction and Modernization of Abattoirs.

Mega Food Parks Scheme (MFPS)

8.16 The Mega Food Parks Scheme is the flagship programme of the Ministry of Food Processing Industries (MFPI) during the eleventh Five Year Plan. The Scheme aims to accelerate the growth of the food processing industry in the country by facilitating establishment of strong food processing infrastructure backed by an efficient supply chain. The Mega Food Parks Scheme provides for a capital grant of 50 percent of the project cost in difficult and ITDP notified areas (with a ceiling of Rs 50 crore). The grant shall be utilized towards creation of common infrastructure in Central Processing Centre (CPC) and Primary processing Centres (PPCs) in the park. Such facilities are expected to complement the processing activities of the units proposed to be set up at the CPC in the Park. Each Mega Food Park may take about 30-36 months to be completed.

8.17 Out of 30 Mega Food Parks proposed during the eleventh five year plan, the Ministry has taken up 15 projects under the Scheme so far. Among these, final approval has been accorded to 15 Mega Food Parks in the states of Andhra Pradesh, Punjab, Jharkhand, Assam, West Bengal, Uttarakhand, Tamil Nadu, Maharashtra, Gujarat, Uttar Pradesh, Madhya Pradesh, Tripura, Orissa, Bihar and Karnataka. The total assistance from the government to these projects is estimated at Rs.750 crore. In addition to these, 15 new Mega Food Parks have been recently approved by the government.

Scheme for Cold Chain, Value Addition and Preservation Infrastructure

8.18 The Task Force on Cold Chain set up by the Ministry of Agriculture has identified a huge gap of 9 to 10 million tonnes of cold storage capacity in the country. The Ministry of Food Processing Industries through its Scheme for Cold Chain, Value Addition, and Preservation Infrastructure has been successfully addressing the above issue. The Scheme was approved in 2008 with an objective to provide integrated and complete cold chain, value addition and preservation infrastructure facilities without any break, for perishables from the farm gate to the consumer. The assistance under the Scheme includes financial assistance (grant-in-aid) of 50 percent of the total cost of plant and machinery and technical civil works in General areas and 75 percent for the NE region and difficult areas subject to a maximum of Rs 10 crore. In the first phase, the Ministry has approved 10 integrated cold

chain projects in 2008-09, which are already being implemented in different parts of the country. Out of the 10 projects, 8 have started commercial operation. Substantive value addition, reduction in wastage and enhancement in farmers' income is evident from concurrent evaluation of the projects. In the second phase, 39 projects have been approved. The approved projects envisage creating a cold chain capacity of about 1.60 lakh metric tonnes. Taking note of the high demand and the gap in the requirement of cold storage, processing, preservation and cold logistics facilities in India, the Ministry is planning to upscale the Scheme and the Planning Commission has already accorded an 'In-principle' approval for the same.

Modernization of abattoirs

8.19 The Ministry has approved 10 projects in first phase which are at various stages of progress. Two projects have been completed. A proposal for up-scaling the scheme is under consideration.

Scheme for Technology Upgradation, Establishment, Modernization of Food Processing Industries

8.20 Under the Scheme for Technology Upgradation, Establishment, Modernization of Food Processing Industries, financial assistance is provided in the form of grants-in-aid for the setting up of new food processing units as well as Technological Upgradation and Expansion of existing units in the country. The Ministry extends financial assistance in the form of grant-in-aid to entrepreneurs at 25 percent of the cost of Plant & Machinery and Technical Civil Works subject to a maximum of Rs. 50 lakhs in general areas or 33.33 percent subject to a maximum of Rs. 75 lakhs in difficult terrains. The implementation process of the Scheme has been made more transparent and decentralized from 2007 onwards. Earlier all the applications for such grants were received by the Ministry through the State Nodal Agencies. These applications were then centrally processed and grants disbursed directly by the Ministry. From 2007-08, the receipt of applications, their appraisal, calculation of grant eligibility as well as disbursement of funds has been completely decentralized. Under the new procedure, an entrepreneur or applicant can file an application with the neighborhood Bank branch or Financial Intuition (FI). The Bank or FIs would then appraise the application and calculate the eligible grant amount as per the detailed guideline given to them by the Ministry. The Banks and FIs appraise the project and its recommendation for the release of grant is transmitted to the Ministry through an e-portal established for this purpose. After the recommendation and requisite documents are received from the Bank or FIs, the Ministry sanctions the grant and transfers the funds through the e-portal itself. This has resulted in a faster sanction procedure and enlarged the outreach of the Scheme. In the eleventh Five Year Plan, a total allocation of Rs. 600 crore was provided. Out of the total allocation, an amount of Rs 488.51 crore has been received so far including Rs.98 crore Budget Estimate (BE) of 2011-12. The Ministry has utilized almost the entire budget allocated under this scheme (except NER) and has assisted 2532 Food Processing Units so far.

8.21 Initiatives have been taken by the Ministry to create awareness in the industry and entrepreneurs by advertisements, organization of investors' meets and special meetings in NER. In so far as general areas are concerned, the Ministry has been continuously reviewing

the status and organizing meetings with the focal point banks on a quarterly basis. The Ministry has also engaged an agency (CMI) to maintain the data and to monitor the scheme closely. Under this arrangement, the details of all the pending applications along with their present status has been put in the public domain on the website of the Ministry. Any applicant can find out the current status of his application by clicking on to http://www.mofpi@nic.in for the e-portal-status of applications or http://cmi/mofpi/status. This scheme has added a huge capacity to the food processing industry which in turn has resulted in significant reduction of wastages.

Quality Assurance, Codex Standards and Research & Development and Promotional Activities

8.22 In the global market today, quality and food safety gives a competitive edge which is an important factor for the enterprises producing processed foods and providing services. Apart from domestic standards for food products, processes and management practices, Codex prescribes international standards for safety and quality of food as well as codes of good manufacturing practices, which are accepted worldwide. Further, equal emphasis is required to be accorded to R&D activities for the development of innovative products, cost effective processes and efficient technologies for the food processing sectors. The scheme for food safety, codex and R&D has been successful in making a dent in this area in the country. (**Box 8.1**.)

Box 8.1: Components of Food Safety Schemes

(i) Setting up/Up gradation of Food Testing Laboratories (maximum grant Rs. 2.50 crore per project). (22 projects assisted in XI Plan so far).

(ii) Implementation of HACCP / ISO / GMP / GHP / Safety Management System in food processing units (maximum grant Rs. 15.00 lakh / Rs. 20.00 lakh per project in general area / difficult area, respectively) . (18 Projects assisted in XI Plan so far).

(iii) Research & Development in food processing sector. (40 projects assisted in XI Plan so far).

(iv) Promotional activities including advertisement & publicity. (Rs. 46.78 crore spent in XI Plan so far).

Human Resource Development:

8.23 The human resource development is very critical for sustained growth in the sector. Extensive training and entrepreneurship development is given top priority. (Box 8.2)

Box 8.2: Human Resource Development in Food Processing Sector

(i) Creation of infrastructural facilities for running degree/ diploma courses in food processing (maximum grant Rs. 75.00 lakh per project). (33 projects approved in XI Plan so far).

(ii) Entrepreneurship Development Programmes (EDP) (maximum grant Rs. 2.00 lakh per programme) (846 EDPs assisted during 11th Plan so far).

(iii) Setting up of Food Processing Training Centres (FPTC) (maximum grant Rs. 6.00 lakh / Rs. 15.00 lakh per project for single line/multi line products). (140 Centres assisted in XI Plan so far).

(iv) Training at recognized national / state-level institutes, etc. sponsored by MFPI or other training programme.

8.24 During eleventh Five Year Plan, the Ministry is expected to provide assistance for the setting up of about 270 FPTCs, organize 750 EDPs and facilitate need-based professional development training programmes. In addition about 55 Universities/Colleges/ Institutions would be assisted for creating infrastructure facilities for degree/diploma courses in food processing.

Strengthening of Institutions

Indian Institute of Crop Processing Technology (IICPT)- A National Institute with International Repute

8.25 The Indian Institute of Crop Processing Technology is a world class R&D and Educational Institute located as under the Ministry of Food Processing Industries, Government of India. The mandatory activities of IICPT are teaching, research and outreach activities in post harvest processing, preservation and value addition of agricultural and horticultural produces. IICPT and its scientists are experts in their own fields of research. IICPT has created in its main campus at Thanjavur world class research laboratories for conducting research in different areas of food processing technologies.

8.26 Considering the importance of the food processing sector and food processing industries and the future demands for trained manpower in the areas of food processing, the Institute began offering formal degree courses at the bachelors, masters and doctoral levels in food process engineering from academic year, 2009 – 10.

Box 8.3: Achievements of IICPT

(i) Filed 11 patents and got 4 patents approved.

(ii) Developed Mobile Processing Unit for Tomatoes.

(iii) Conducting approx 320 one-day outreach programme for farmers all over the country.

(iv) Developed 10 new products along with their commercial testing.

(v) Established a Food Testing Lab of International Standards at Thanjavur.

National Meat and Poultry Processing Board (NMPPB)

8.27 The Government of India established the National Meat and Poultry Processing Board on 19 Feb 2009. The Board is an autonomous body and would initially be funded by the Government of India for 3 years and would be managed by the industry itself. The Board has 19 Members including a CEO of the Board. The Chairman is from the industry. This industry-driven institution has been launched to work as a National hub for addressing all key issues related to the Meat and Poultry processing sector for its systematic and proper development. The Board serves as a single window service provider for producers, manufacturers and exporters of meat and meat products, for promoting the meat industry as a whole.

Box 8.4 : Achievements of the NMPPB

(i) Establishing a world class Meat Products testing lab.

(ii) Conducting nearly 40 one day training progammes each year for meat workers (Butchers) all over the country.

(iii) Development of model for a modern meat shop.

(iv) Arrangement of two National Conferences and five experts meet.

Indian Grape Processing Board

8.28 The Union Government in 2009 gave its approval for the establishment of the Indian Grape Processing Board (IGPB) at Pune, Maharashtra which is close to the principal grape growing and processing areas in the country. The 15 Member Board that is led by an eminent professional from the Industry has been registered under the Societies Registration Act, 1860 at Pune.

Box 8.5: Functions and Objectives of the IGPB

- To focus on Research & Development, Extension, and Quality upgradation, market research and information, domestic and international promotion of Indian wine.
- To foster sustainable development of Indian Wine Industry
- To formulate a vision and action plan for the growth of Indian Wine Sector including research and development for quality upgradation in new technologies/processes.

8.29 During two years of its existence, the Board has focused on the promotion of "Wines of India" in the domestic as well as international market by participating in important and relevant exhibitions, fairs, consumer awareness & training programmes, undertaking advocacy work with the various state governments/central ministries on various issues related to taxes/levies and promotion aspects.

National Institute of Food Technology, Entrepreneurship & Management (NIFTEM)

8.30 The government in 2006 approved the setting up of NIFTEM at an estimated cost of Rs. 244.60 crore including a foreign exchange component of US $ 8.1 million. Further, the government approved a revision of the estimated cost for the setting up of NIFTEM from Rs. 244.60 crore to Rs. 479.94 crore in April, 2011 Since the legal status of NIFTEM as a Company was creating hurdles in obtaining statutory recognition as a Deemed University from University Grants Commision (UGC) for running its Academic courses, the government has approved the following activities:

- Registering NIFTEM as a Society.
- Transferring of all assets & liabilities from the Company to the Society
- Winding up of NIFTEM Company.

8.31 In pursuance of above decision, NIFTEM Society has been incorporated on 19 May 2010. Its Assets & Liabilities have been transferred from the Company to the Society since 11 November 2010. The winding up process of the Company has been initiated. NIFTEM

would work as a Sector Promotion Organization/ Business Promotion Organization of the food processing sector. The NIFTEM website is registered under the domain name niftem.ac.in with the URL address www.niftem.ac.in for public access. NIFTEM started its activities by conducting the short-term training programmes on Skill Development from 20 -22 July 2011 and 19 - 21 September, 2011. NIFTEM has also been conducting nearly 20 outreach progammes each year all over the country with the help of its knowledge partners.

Challenges

8.32 The most important challenges among others in the sector include avoidance of the significant wastage at every level and in value addition.

Wastage :

8.33 A study undertaken by the Central Institute of Post Harvest Engineering and Technology (CIPHET) has calculated the wastage in various produce. This is summarized in Table 8.4 below:

Table 8.4: Wastage in the Various Crops

Crop	Cumulative Wastage (percent)
Cereals	3.9-6
Pulses	4.3-6.1
Oil Seeds	6.0
Fruits & Vegetables	5.8-18
Milk	0.8
Fisheries	2.9
Meat	2.3
Poultry	3.7

Source: CIPHET, Ludhiana

8.34 One of the most critical aspects in the value chain, wastage happens at all levels in the value chain. The factors responsible for wastage vary at different levels and are shown in the Table below:

Table 8.5: Wastage in Agricultural Commodities

Wastage	Farmer/ VLA Level	Crop Damage Improper Harvesting Techniques Poor Packaging Poor Transportation
	Wholesaler/ Semi wholesaler Level	Moisture Loss Poor Handling Poor Transportation Multiple handling Storage Grading sorting by retailers
	Retailer Level	Poor handling Poor Transportation Handling by customers Moisture Loss

Source: CIPHET, Ludhiana

The Way Forward

8.35 The measures to strengthen the food processing include the following:

- Agriculture must diversify in favor of high-value enterprises. The emphasis should be on production of high value commodities for example, fruits, vegetables and fish with enhanced quality and specific nutritional and processing characteristics, rather than increasing production *per se* as in the past. Pricing policies also need to be changed, as linking these with the quality of the produce or a product is the basis for fixing per unit price, just as fat content in milk; higher protein quality/ quantity in wheat; better aroma or cooking quality in rice and shelf life of fruits and vegetables.
- Since marketing of products is more remunerative than sale of raw commodities, farmer - processor linkages are needed to add value as per demands of the consumers.
- There is great scope of developing some of our traditional food items from cereals, fruits, milk, poultry and fish. Appropriate and cost-effective packaging technology for these items is needed to ensure safety and prolonged shelf life.
- Agriculture is fast becoming demand driven from the earlier supply driven situation. Farmers will have to grow specific varieties needed for processing or add value to their produce. Policy and legislation should be reformed to allow processors to purchase their produce requirement directly from the farmers.
- Intermediaries in the food chain lock value and add to the cost of the raw materials sometimes by even 80 to 100 per cent. Effective linkages need to be built between

farmers and processors on a mutually beneficial contractual agreement, particularly when a large number of small farmers are to be involved in contract farming.

- Self-help or common interest groups, producer companies on the model of cooperatives should be encouraged to enhance the bargaining power of the farmers and negotiate effectively with the industry, just as is being done in Kerala and Punjab.
- The Town and Village Enterprises (TVEs) model of China is an excellent example for involving surplus rural labor in industrial activity by providing them alternative work at their doorstep. This can be considered for adoption with suitable modifications, for primary processing of the agricultural produce and effectively linked to urban units for secondary processing, product development and marketing.
- Location of food-processing units should be strategically placed depending upon the raw material availability, labor, product utilization and domestic and/or export marketing. It should be nurtured to evolve on a natural course after the initial nucleation, as has been done for the IT industry.
- Often indigenous technologies are better suited for application than the imported ones. A scientific database of these technologies should be created to form a basis for the ones that are offered to us by other countries. There are nearly 200 major indigenous technologies for food processing which have been listed by CFTRI. NABARD or other financial institutions need to finance this activity.
- The creation of commodity-based management systems would be beneficial. These could advise the government and R&D institutions to take steps proactively, based on continuous tracking of the demand, supply, consumer needs and prices both in the domestic and international markets. The intelligent information collecting system should be networked with all user agencies and farmers in the country, using the latest IT technologies and infrastructure.
- The processing of agricultural raw material generates a sizable amount of utilizable byproducts, commonly termed as 'waste'. Experimental protocols for converting these into usable secondary or co-products are available. These need to be developed into commercially viable technologies.

CHAPTER 9

Information Technology and Agricultural Statistics

9.1 The National Policy for Farmers emphasizes the use of Information and Communication Technology (ICT) at village level for reaching out to the farmers with the correct advisories and requisite information. ICT Tools and Space Science Applications are also being used for ensuring greater reliability of crop yield and production estimates which will help in improving the process of planning and policy making. In this connection, sustained efforts have been made to improve and harness the latest Information Technology techniques to capture and collate data, add value to it and disseminate the same to all the stakeholders.

Applications of Geospatial Techniques in Agriculture

Pre-harvest Production Forecasting of Major Crops

9.2 Procedures have been developed for acreage estimation and production forecast of major crops at (national, state, district) levels, using satellite remote sensing data, weather data and crop growth simulation models. The technique is also useful in assessing the change in cropping pattern, the areas affected by flood (extent and duration) and change in crop vigour. This exercise has been undertaken under the Forecasting Agricultural output using Space, Agro-meteorology and Land based Observations (FASAL) Scheme which envisages multiple crop area and production forecasts of following 11 major crops at National-State-District-level depending on the status of technology available:

- Rice (*Kharif* & *Rabi*)
- Jowar (*Kharif* & *Rabi*)
- Maize
- Bajra
- Jute
- Ragi
- Cotton
- Sugarcane
- Groundnut (*Kharif* & *Rabi*)
- Rapeseed & Mustard
- Wheat.

9.3 Currently, multiple operational forecasts of 5 crops namely, wheat, *kharif* & *rabi* rice, winter potato, mustard and jute at the National-State-level are being made in each season for 7 to 13 major States. Besides this, single forecasts of crops at the district-level are made in respect of cotton, mustard, *rabi* groundnut, *rabi* rice, *rabi* sorgum, sugarcane and wheat crops.

9.4 Recently, this exercise of crop yield and acreage assessment has been extended to the onion crop at the block level for Gujarat and Maharashtra under a National Horticulture Board initiative. With effect from 2011, this initiative has been extended to major onion growing states by the National Horticulture Research & Development Foundation (NHRDF), Nasik under a DAC-sponsored project

Weekly Assessment of Kharif Crops Based on Soil Moisture

9.5 Geospatial soil moisture modelling using satellite derived rainfall [KALPANA Satellite and Climate Protection Centre of the National Oceanic and Atmospheric Administration, USA CPC-NOAA] has been developed and used to assess on a weekly basis, the crop prospects namely sowing, field moisture status and flooding probability for the major *kharif* crops like rice and coarse cereals. This will be linked to the crop insurance service gradually.

Short-range Weather Forecast

9.6 Short-range weather forecast for 72 hr with a horizontal resolution of 45 km for the All-India grid points is used for the farmer's advisory on field preparation, crop sowing, etc.

Cropping System Analysis

9.7 Mapping of crop rotations and cropping pattern and geospatial modelling to assess the performance has been done at block-district-state-level for the Indo-Gangetic plains region. The output of this activity is linked with crop diversification and intensification planning under the National Food Security programme.

Site Suitability for Horticulture Development

9.8 Geospatial modelling has been done to identify suitable areas for cluster approach based expansion of horticulture crops under the "Horticulture Mission for North Eastern and Himalayan States (HMNEH)".Culturable fallow lands forming a cluster over adjacent villages near the existing orchards of same crop had been mapped for instance apple in Arunachal Pradesh, passion fruit in Mizoram, cashew in Meghalaya, pineapple in Manipur and Tripura and mandarin oranges in Sikkim. A similar exercise was done to characterize the existing apple orchards in Himachal Pradesh and the mapping of suitable areas for further expansion.

Methanogenic Stratification of Rice Lands

9.9 The rice lands of India were categorized as per their methane emission potential following the Intergovernmental Panel on Climate Change (IPCC) guidelines. The map output will help in planning the extension work for alternate rice crop growing strategy to reduce methane emission. This stratification was also used for *in situ* measurement of methane emission from rice lands in India with a proper sampling frame and generating strata emission co-efficient. This has a linkage with the updating of emission statistics under India's national communication to Climate Change. The stratified rice land map will help in planning the mitigation strategy (alternate planting method).

Wetland Inventory and Assessment: Input for Inland Fishery Development

9.10 Mapping of all the wetlands in India was done on a 1:50,000 scale, where all the water bodies >2.25 hectare have been mapped and characterized in terms of change in water spread, water turbidity and aquatic vegetation during the pre and post monsoon season. A small pond of around one hectare has also been identified. All are numbered in a systematic data base approach. Some of these inputs are used in the inland, coastal fishery (lake/pond/ lagoon etc.) development plan.

Development of Portals

9.11 DAC has developed 80 portals, applications and websites (primarily in collaboration with the National Informatics Centre) covering both the headquarters and its field offices/ directorates. The important portals include SEEDNET, DACNET, AGMARKNET (prices and arrivals in mandis), RKVY (Rashtriya Krishi Vikas Yojana), ATMA, NHM (National Horticulture Mission), INTRADAC, NFSM (National Food Security Mission) and APY (Acreage, Productivity and Yield). DAC is getting the online data entry done right from the district level, so as to expedite the generation of requisite queries and reports in an efficient manner.

Farmers' Portal

9.12 This portal aims to serve as a One Stop Shop for all the farmers for accessing information on agricultural activities. Besides giving links to appropriate pages of the 80 portals already developed so far, the Farmers' Portal links the location of the farmer (from his Block) with NARP (National Agricultural Research Project) Zone that he belongs to. Thereafter, all information related to the crops grown in that area (coupled with agro-climatic conditions in that region) is then provided to the farmer using a graphical interface. Farmers can get information about a package of practices; crop and seed varieties; common pests; dealer network for seeds, fertilizers & pesticides; machinery and tools; agro-met advisories, etc. Data for most states has been entered in one language, but the portal will be launched after the data is entered both in English and in the vernacular language of the state.

AGRISNET

9.13 Under this Scheme, funds are provided to state and UTs for computerization down to Block level. Funds to 26 states have been released under AGRISNET for the objective of providing computers up to the block level. State-specific software packages have been developed to disseminate information to the farmers**.** Availability of requisite hardware and locally suitable software packages has resulted in quick retrieval of data, dissemination of information to farmers and provision of farmer centric services to farmers. The states and UT's which have availed assistance under the Scheme are Andhra Pradesh, Madhya Pradesh, Tamil Nadu, West Bengal, Uttar Pradesh, Gujarat, Karnataka, Assam, Uttarakhand, Himachal Pradesh, Meghalaya, Nagaland, Sikkim, Maharashtra, Punjab, Orissa, Mizoram, Kerala, Haryana, Rajasthan, Chhattisgarh, Puducherry , Arunachal Pradesh, Goa, Bihar, and Manipur.

State Initiatives Under Agrisnet

9.14 One of the successful ICT initiatives is MAHAAGRI SMS of Maharashtra Government. MAHAAGRI SMS, an e-Governance project under AGRISNET, has been initiated with the objective of helping farmers and villagers through farm specific, need based, demand driven and just-in-time advice and knowledge. A minimum of five progressive and active farmers from each village are selected as "Krishi Mitra". Forty three major crops have been identified for sending crop specific advisory. The registered farmers on receiving the SMS pass on the message to the other farmers in the village. This application enables delivery of location-specific, need-based advisory and information to the farmers (for which a farmer gets registered). The content is delivered in Marathi as well as in English. The handsets compatible for Indian languages receive contents in Marathi.

9.15 Yet another successful initiative is the Agrisnet portal of Tamil Nadu Government. The Portal focuses on Soil Health Card, Village level Fertility index, etc. The farmers can take a printout of the soil test result from their place of domicile instead of coming to Block Agricultural Extension Centre. The Village level Fertility Index is made available on the basis of the composite samples tested for this purpose along with recommendations. The stock positions of all crop seeds, procurement and distribution of seeds have been automated and the farmer at any point of time can access the database for his requirement. Further, the availability of fertilizers is being gathered from the retail points and displayed in this portal. Other items that add value to this portal are the information on market trends in commodity prices, rainfall forecast, etc. E-Krishi Kiran of Gujarat inter alia suggests alternative crops based on moisture indices, soil nutrients and weather parameters. A.P. Agrisnet is an excellent and comprehensive portal in vernacular with audio output and visual prompts for persons who cannot read.

National E-Governance Plan in Agriculture

9.16 The Mission Mode Project has been introduced during the last phase of the eleventh plan to achieve rapid development of agriculture in India through the use of ICT for ensuring timely access to agriculture related information for the farmers of the country. There are a number of current IT initiatives and schemes undertaken or implemented by DAC which are aimed at providing information to the farmers on various activities in the agriculture value chain. These initiatives will be integrated so that farmers would be able to make proper and timely use of the available information. Such information is intended to be provided to farmers through multiple channels including Common Service Centers, Internet Kiosks and SMSs. 12 clusters of services have been identified and the project has been sanctioned for implementation in 7 States i.e. Assam, Himachal Pradesh, Karnataka, Jharkhand, Kerala, Madhya Pradesh and Maharashtra. The services include for instance information on pesticides, fertilizers & seeds, soil health; information on crops, farm machinery, training and Good Agricultural Practices (GAPs); weather advisories; information on prices, arrivals, procurement points, and provision of interaction platform; electronic certification for exports & import; information on marketing infrastructure; monitoring implementation and evaluation of schemes and programme; information on fishery inputs; information on irrigation infrastructure; drought relief and management; livestock management. The first phase of the Project is being implemented at a cost of Rs. 227 crore.

Box 9.1: Computerized Online Pesticide Registration System

A computerized online pesticide registration system was introduced in July 2008 in the Secretariat of Central Insecticides Board & Registration Committee (CIB&RC), Faridabad. The system enables pesticide companies to apply for registration of pesticide products and receive queries about deficiencies online. The status of application is also available to the applicant online. The system is designed to increase efficiency and reduce transaction cost with greater transparency.

Challenges

9.17 An important activity is the generation of intelligence, knowledge and wisdom from information and data. Effective use of current satellites' (with higher resolution and swathe) data is needed. Similarly, more efforts are needed to develop knowledge bases and knowledge delivery mechanisms in different sectors of agriculture such as water management, soil management, and plant protection/livestock health cover.

The Way forward

9.18 The available satellite data relating to weather news, long-term and short-term weather forecast, production information, market prices policy developments pertaining to agriculture, apart from the number of advisory services in public or private domain that disseminate information should be utilized adeqately .

9.19 New initiatives are required to develop data bases and knowledge bases and knowledge delivery mechanisms in different sectors of agriculture such as water management, soil management, plant protection, animal and fish health cover, protected cultivation in high value agriculture, genome analysis for genetic transformation in plants and animals, etc.

Agricultural Statistics

9.20 Timely availability of reliable information on agricultural output and other related aspects is of great significance for planning and policy formulation particularly in the context of food security, price stability, international trade, etc. To meet these requirements, the Directorate of Economics and Statistics (DES), Department of Agriculture & Cooperation releases estimates of area, production and yield in respect of principal crops of food grains, oilseeds, sugarcane, fibre crops. Estimates of crop production are obtained by multiplication of area estimates by corresponding yield estimates. Generally, four advance estimates and one final estimate of area, production and yield are released during each agricultural crop year (July to June). A brief description of methodology adopted for collection of area statistics and crop yield is given below:

Area Statistics

9.21 For collection of area statistics, the states are divided into three broad categories, namely:

(i) States and UTs which have been cadastral surveyed and where land records are maintained by the revenue agencies generally referred to as "Land Record States" or temporarily settled states). Seventeen states, namely Andhra Pradesh, Assam

(excluding hilly districts), Bihar, Chhattisgarh, Gujarat, Haryana, Himachal Pradesh, Jammu & Kashmir, Jharkhand, Karnataka, Madhya Pradesh, Maharashtra, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh and Uttarakhand and four UTs of Chandigarh, Delhi, Dadra & Nagar Haveli and Pondicherry accounting for about 86 percent of the reporting area fall within this category. These are covered under Timely Reporting Scheme (TRS) under which 20 percent villages are selected on a random basis for complete area remuneration.

(ii) States where area statistics are collected on the basis of sample surveys under a scheme for Establishment of an Agency for Reporting of Agricultural Statistics (EARAS), in the states of Kerala, Orissa and West Bengal, Arunachal Pradesh, Nagaland, Sikkim and Tripura. These states account for about 9% of reporting area. The estimation of area is made through sample surveys in a sufficiently large sample of 20 percent villages and investigator zones.

(iii) The hilly districts of Assam, rest of the states in North-Eastern Region (other than Arunachal Pradesh, Nagaland, Tripura and Sikkim), Goa, UTs of Andman & Nicobar Islands, Daman & Diu and Lakshwadeep where no reporting agency had been functioning, the work of collection of Agricultural Statistics is entrusted with the village headmen. The area statistics in these states are based on impressionistic approach. These areas and states account for 5 percent of the reporting area.

Yield Estimates

9.22 The yield estimates of crops are obtained through Crop Cutting Experiments (CCE). At present over 95 percent of the production of foodgrains is estimated on the basis of yield rates obtained from the CCEs. Field Operations Division (FOD) of the National Sample Survey Office (NSSO) provides technical guidance to the states and Union territories for organizing and conducting Crop Estimation Surveys.

9.23 Final estimates of production based on complete enumeration of area and yield through crop cutting experiments become available long after the crops are actually harvested. However, for policy formulation four advance estimates of production are released during the course of the year. The first estimate of area and production of *kharif* crops is prepared in September, when South-West monsoon season is about to be over and *kharif* crops are at an advanced stage of maturity. The second advance estimate comprising of both *kharif* and *Rabi* crops is released in January. The third advance estimates are released towards the end of March/ beginning of April every year based on the deliberations in Crop Weather Watch Groups (CWWG), information made available by State Agricultural Statistical Authorities (SASAs) and remote sensing data by Space Application Centre, Ahmedabad. The fourth advance estimates are released in the month of June/July, after most of the *rabi* crops get harvested by the end of May and SASAs are in a position to supply the estimates of both *kharif* and *rabi* seasons as well as the likely assessment of summer crops. These are validated with information available from other sources.

9.24 Under the existing system of crop estimation, the fourth advance estimate is followed by final estimates in December/January of the following agricultural year. The main factors contributing to the relatively large number of crop estimates are the large variations in crop seasons across the country and the resulting delay in the compilation of yield estimates based on crop-cutting experiments.

New Initiatives to Improve Agricultural Statistics

9.25 The existing system of agricultural statistics, in spite of established procedures and wide coverage, has inherent limitations in providing an accurate assessment of crops production at the pre-harvesting stages with desired spatial details.

9.26 With a view to enhance the capabilities of the existing system of crop forecasts and crop estimation, the Department visualized adopting emerging methodologies such as Remote Sensing (RS), Geographic Information System (GIS), etc. as early as 1988 when the Crop Area and Production Estimates (CAPE) Project was initiated in collaboration with Indian Space Research Organization (ISRO) to develop the RS methodology for crop production forecast. Other inputs such as weather data, land- based observations and economic parameters influencing farmers' decisions, etc Forecasting at the sowing stage is attempted through econometric models using the previous years' crop acreage and production data, market prices, current season weather data, etc. followed by agromet and remote sensing forecasts during the mid season and pre-harvest crop stage. By integrating inputs from these diverse sources to make accurate and timely forecasts, a Central Sector Plan Scheme titled "**F**orecasting **A**gricultural output using **S**pace, **A**gro-meteorology and **L**and based observations" (FASAL) was formulated and is in operation since August 2006. The results in terms of national-state-district-level forecasts have started flowing in based on remote sensing methodology and econometric models developed for certain crops. In order to further fine tune and revamp the forecasting technologies, the setting up of a new Centre National Centre for Crop Forecasting (FASAL-NCCF) is in progress. The new Centre located in IARI, Pusa Campus, New Delhi, will operationalize methodologies already developed by ISRO for in-season and multiple crop forecasting and for drought assessment. The Centre would also be responsible for integrating the forecasts based on Remote Sensing Methodology, econometric models, agromet models and inputs from the State Agricultural Statistics Authorities (SASAs).

Expert Committee on Agricultural Statistics

9.27 The system of collection of agricultural statistics has been reviewed at various levels from time to time. The National Statistical Commission (NSC) expressed its concern on the system of collection of area statistics and yield estimates and recommended that TRS and EARAS should be regarded as programmes of national importance and that the state governments be prevailed upon to give due priority to these, deploy adequate resources for the purpose and ensure proper conduct of field operations in time. As a follow-up to the meeting with the Chairman, NSC on the subject, an Expert Committee was set up by the Department on 26 February 2009 under the chairmanship of Professor A. Vaidyanathan, eminent agricultural economist. The Committee was constituted for improving agricultural statistics and to examine the use of remote sensing applications in agricultural statistics.

9.28 After detailed review and analysis of the existing system of area and yield statistics, the Committee has recommended exploring the ways for making the primary data collection (needed for getting reliable area and yield estimates) more manageable and less prone to human error. The strategy of restructuring recommended by the Committee is to distinguish between for example (a) the need for reliable and timely flow of data on area and production on a regular basis for every crop season, year after year; and (b) requirements for various special purposes such as crop insurance. According to the Committee, the function of the restructured system should be strictly limited to the former.

9.29 The Committee is of the view that reliable estimates within acceptable margins of error (sampling and non sampling) can be achieved with improved sampling techniques, including stratification. For national and state level estimates the required number of villages is much smaller than the number covered by TRS/EARAS. A smaller sample will be far more manageable in terms of organization, requirements of trained personnel and proper supervision at a reasonable, affordable cost. The Committee also recommended creation of the National Crop Statistics Centre (NCSC) as an autonomous professionally run organization fully funded by the Government to design, organize and supervise the generation of area and yield estimates at the state and national levels. The Committee also recommended the expansion of the present Remote Sensing programme and to provide reliable and validated in-season forecasts and end-season estimates of area for a wider range of crops at the state and national levels; as well as comprehensive and detailed plot-level data of land use and crops at the village level.

Agriculture Census

9.30 The Agriculture Census forms part of broader system of collection of agricultural statistics, which is a large-scale statistical operation for collecting and deriving quantitative information about important facets of agriculture in the country. The Agriculture Census in India is conducted at an interval of five years under which operational holding has been taken as statistical unit at the micro-level for data collection. Periodic Agriculture Censuses are main sources of information on the basic characteristics of operational holdings such as land use, cropping patterns, irrigation status, tenancy, terms of leasing and dispersal of holdings. This information is tabulated by different farm-sizes and social groups to serve as an input for development planning, socio-economic policy formulation and the establishment of national priorities. The Census also provides a basis for development of a comprehensive integrated national system of agricultural statistics. Eight Agriculture Censuses since 1970-71 have been completed in the country.

9.31 As a follow-up to the Agriculture Census, an Input Survey is also carried out. The Reference Year of Input Survey is the year following the Reference Year of Agriculture Census. Input survey provides valuable information on multiple cropping, use of chemical fertilizers, organic manures and pesticides (separately for irrigated and un-irrigated areas under various crops), livestock, use of agricultural implements/machinery, agricultural credit, types of seeds used, IPM, besides information on size of household, literacy and age of head of farm household, etc. So far, seven Input Surveys since 1976-77 have been completed in the country.

9.32 The Agriculture Census in India is conducted following the broad guidelines of decennial World Census of Agriculture evolved by Food and Agriculture Organization (FAO) of United Nations. The Agriculture Census is implemented in 3 distinct phases which are statistically linked together, but focus on different aspects of agricultural statistics.

9.33 In Phase I, a list of holdings with area, gender, type of holdings and social group of holders is prepared. In Phase II, detailed data on agricultural characteristics of the holdings is collected from selected villages and estimates are generated at various administrative levels. In Phase III, data on input use patterns are collected from selected holdings of selected villages and values of different parameters are estimated at district and state levels.

Results of Agriculture Census 2005-06

9.34 Results of the latest Agriculture Census 2005-06, including the Input Survey 2006-07 have been finalized and report on number and area of operational holdings in India has been published. Detailed tables of the Agriculture Census 2005-06 are available on the Department's website at http://agcensus.nic.in

Main findings of Agriculture Census 2005-06 are briefly given below:

- Total number of operational holdings in the country has been estimated at 129.22 million in 2005-06 as against 119.93 million in 2000-01, indicating an increase by 7.8 per cent.
- Total operated area in 2005-06 was 158.32 million ha as against 159.44 million hectares in 2000-01, showing a marginal decline of 0.7 per cent.
- Average size of operational holding has steadily declined. Average size of a holding which was 2.28 ha in 1970-71, came down to 2.00 hectare in 1976-77, 1.84 hectare in 1980-81, 1.69 ha in 1985-86, 1.55 hectare in 1990-01, 1.41 ha in 1995-96, 1.33 ha in 2000-01 and 1.23 ha in 2005-06.
- Among different size groups of holdings, the highest number of holdings (about 65 percent) are marginal holdings (below 1 ha) followed by about 18 percent small holdings (1-2 ha), about 11 percent semi- medium holdings (2-4 ha.), about 5 percent medium holdings (4-10 ha) and less than 1 percent large holdings (10 ha and above).
- About 96 percent of holdings (constituting 94 percent of total operated area) have entire operated area in Village of their residence of holding operator.
- The cropping intensity is calculated to be 132 percent.

Table 9.1: Distribution of Operational Holdings in India by Tenancy Status and Size Classes

(Number in '000)

Sl. No.	Major size classes	Total number of holdings	Wholly owned & self-operated	Wholly leased in	Wholly otherwise operated	Partly owned, Partly leased in & Partly otherwise operated
1	Marginal	64,437 (100.00)	62,463 (96.94)	245 (0.38)	188 (0.29)	1,541 (2.39)
2	Small	18,801 (100.00)	18,201 (96.81)	53 (0.28)	29 (0.15)	519 (2.76)
3	Semi-medium	11,238 (100.00)	11,011 (97.98)	14 (0.12)	13 (0.12)	200 (1.78)
4	Medium	53,52 (100.00)	5,284 (98.73)	4 (0.07)	3 (0.05)	61 (1.15)
5	Large	1,022 (100.00)	1,004 (98.28)	1 (0.13)	Neg#	16 (1.55)
	All Size Classes	1,00,849 (100.00)	97,963 (97.14)	317 (0.31)	232 (0.23)	2,337 (2.32)

Note: (1) Figures in brackets indicate percentages to total number of holdings.
(2) Total may not tally due to rounding off.* excluding Bihar, Jharkhand and Maharashtra.
#Neg.=Negligible (less than 500 holdings.)

Source: Agriculture Census 2005-06

Fig 9.1: Number of Operational Holdings as per different Agriculture Census

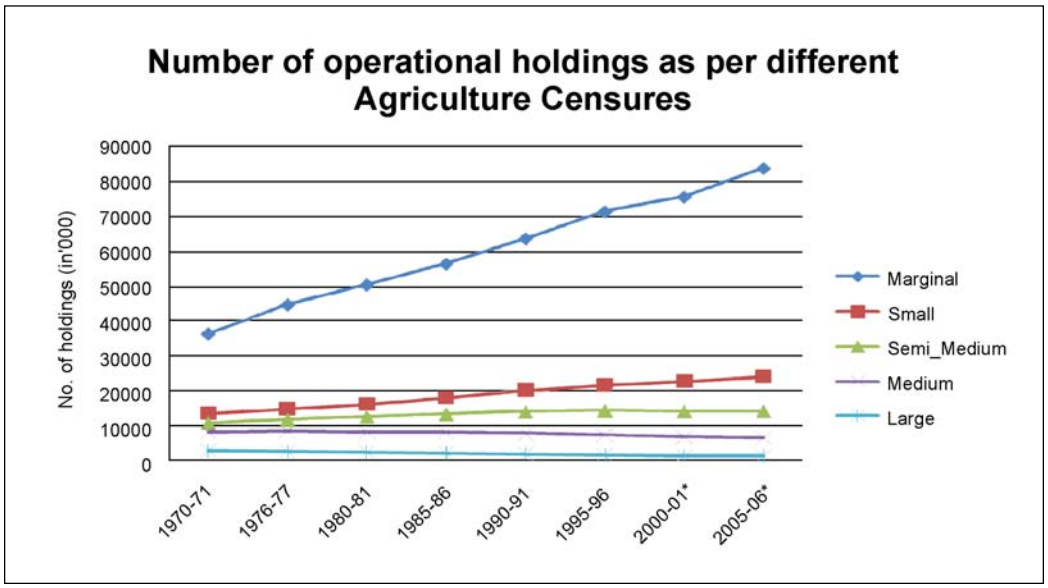
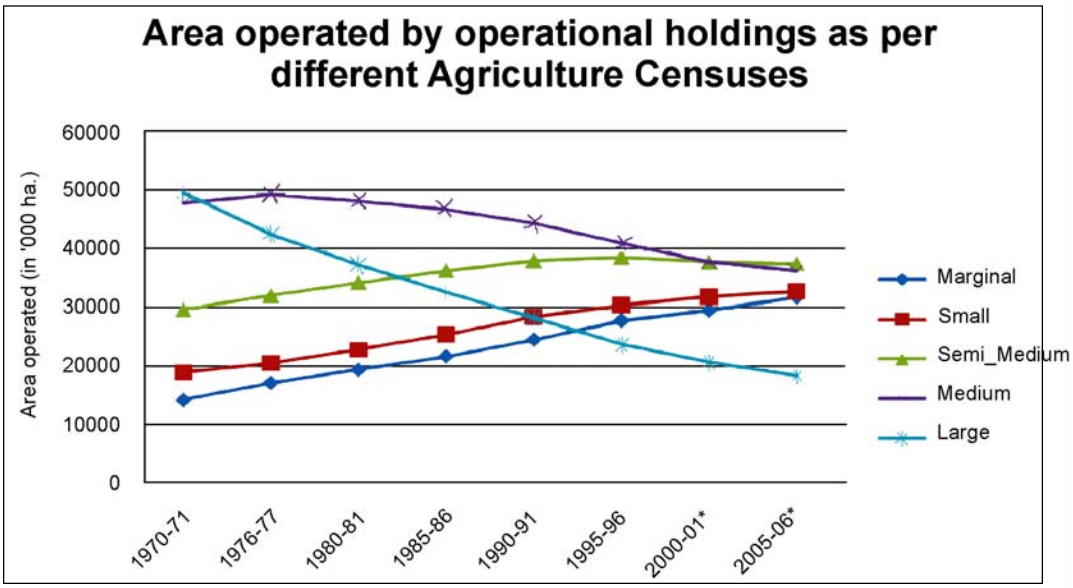


Fig 9.2: Area Operated by Operational Holdings as per different Agriculture Censuses



Agriculture Census, 2010-11

9.35 The Ninth Agriculture Census with reference year 2010-11 has been launched on 4 January, 2011. Schedules and Manuals of instructions for data collection of Agriculture Census, 2010-11 have been circulated to states and UTs and time schedule for completion of various activities has been prepared in consultation with state and UT governments.

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Annexure. 1.1: Plan-wise Growth Rates (%) by Economic Activity

(2004-05 prices)

Year	Five Year Plan	Total Economy	Agriculture, forestry & fishing	Agriculture, incl. live stock	Forestry & logging	Fishing
1	2	3	4	5	6	7
1950-51		..	..	..	..	..
1951-52		2.3	1.5	1.6	-0.2	6.2
1952-53	**First Plan (1951-56)**	2.8	3.2	4.2	-5.4	5.5
1953-54		6.1	7.7	9.0	-3.2	2.1
1954-55		4.2	2.9	2.8	3.8	7.5
1955-56		2.6	-0.9	-1.5	4.0	8.1
	Average	**3.6**	**2.9**	**3.2**	**-0.2**	**5.9**
1956-57		5.7	5.4	6.0	-0.7	11.1
1957-58	**Second Plan**	-1.2	-4.5	-5.1	0.4	2.3
1958-59	**(1956-61)**	7.6	10.1	11.2	-0.2	4.3
1959-60		2.2	-1	-1.5	3.5	0.9
1960-61		7.1	6.7	7.3	1.1	6.9
	Average	**4.3**	**3.3**	**3.6**	**0.8**	**5.1**
1961-62		3.1	0.1	-0.3	4.0	2.8
1962-63		2.1	-2.0	-2.1	0.2	-5.1
1963-64	**Third Plan (1961-66)**	5.1	2.3	1.9	5.8	9.3
1964-65		7.6	9.2	10.3	-1.7	10.0
1965-66		-3.7	-11	-13.5	13.4	0.0
	Average	**2.8**	**-0.3**	**-0.7**	**4.3**	**3.4**
1966-67	**Annual Plan (1966-67)**	1.0	-1.4	-2.3	4.9	3.6
1967-68	**Annual Plan (1967-68)**	8.1	14.9	17.1	-0.4	4.3
1968-69	**Annual Plan (1968-69)**	2.6	-0.2	-0.3	0.4	6.0
	Average	**3.9**	**4.4**	**4.8**	**1.6**	**4.7**
1969-70		6.5	6.4	7.2	-0.3	2.4
1970-71		5.0	7.1	7.4	4.9	2.6
1971-72	**Fourth Plan (1969-74)**	1.0	-1.9	-2.7	4.4	6.4
1972-73		-0.3	-5.0	-5.6	-0.9	2.7
1973-74		4.6	7.2	8.4	-2.8	2.9
	Average	**3.4**	**2.8**	**3**	**1.1**	**3.4**
1974-75		1.2	-1.5	-2.8	8.7	7.6
1975-76		9.0	12.9	14.2	2.8	6.1
1976-77	**Fifth Plan (1974-79)**	1.2	-5.8	-6.1	-3.3	-3.3
1977-78		7.5	10.0	12.5	-11.5	0.0
1978-79		5.5	2.3	2.0	5.4	4.8
	Average	**4.9**	**3.6**	**4**	**0.4**	**3.1**

1	2	3	4	5	6	7
1979-80	**Annual Plan (1979-80)**	-5.2	-12.8	-13.4	-8.9	-0.7
1980-81		7.2	12.9	14.4	-1.5	1.8
1981-82		5.6	4.6	4.8	2.8	0.9
1982-83	**Sixth Plan (1980-85)**	2.9	-0.3	-0.1	-1.9	-1.1
1983-84		7.9	10.1	10.8	-3.2	19.6
1984-85		4.0	1.6	1.5	0.4	6.8
	Average	**5.5**	**5.8**	**6.3**	**-0.7**	**5.6**
1985-86		4.2	0.3	0.2	0.6	3.3
1986-87		4.3	-0.4	-0.4	-1.2	0.5
1987-88	**Seventh Plan (1985-90)**	3.5	-1.6	-1.7	-1.8	2.7
1988-89		10.2	15.6	16.8	-0.6	9.1
1989-90		6.1	1.2	0.4	9.9	11.4
	Average	**5.7**	**3**	**3.1**	**1.4**	**5.4**
1990-91	**Annual Plan (1990-91)**	5.3	4.0	4.3	-1.3	4.8
1991-92	**Annual Plan (1991-92)**	1.4	-2.0	-2.3	0.8	3.6
	Average	**3.4**	**1**.0	**1**.0	**-0.3**	**4.2**
1992-93		5.4	6.7	7.1	-2.3	8.5
1993-94		5.7	3.3	3.2	-0.5	11.2
1994-95	**Eighth Plan (1992-97)**	6.4	4.7	4.7	2.7	6.3
1995-96		7.3	-0.7	-1.0	-0.4	5.2
1996-97		8	9.9	10.4	1.5	8.1
	Average	**6.5**	**4.8**	**4.9**	**0.2**	**7.9**
1997-98		4.3	-2.6	-3	2.5	1.7
1998-99		6.7	6.3	7.1	1.2	-5.0
1999-00	**Ninth Plan (1997-2002)**	7.6	2.7	2.4	4.4	7.0
2000-01		4.3	0.0	-0.6	2.7	4.7
2001-02		5.5	6.0	6.5	3.1	5.0
	Average	**5.7**	**2.5**	**2.5**	**2.8**	**2.7**
2002-03		4.0	-6.6	-8.1	0.7	4.1
2003-04		8.1	9.0	10.8	-1.1	3.6
2004-05	**Tenth Plan (2002-07)**	7.0	0.2	0.1	2.1	-2.0
2005-06		9.5	5.1	5.5	1.8	5.9
2006-07		9.6	4.2	4.1	3.3	6.6
	Average	**7.6**	**2.4**	**2.5**	**1.3**	**3.6**
2007-08		9.3	5.8	6.3	1.4	5.8
2008-09	**Eleventh Plan (2007-12)**	6.7	0.1	-0.3	1.9	2.7
2009-10		8.4	1.0	0.7	2.8	3.0
2010-11		8.4	7.0	7.8	2.9	3.0
	Average (1st four years)	**8.2**	**3.5**	**3.6**	**2.2**	**3.6**

Annexure. 1.2: Plan Wise Share (%) to Total Economy by Economic Activity

(2004-05 prices)

Year	Five Year Plan	Agriculture, forestry & fishing	Agriculture, incl. livestock	Forestry & lodging	Fishing
1	2	3	4	5	6
1950-51		51.9	41.8	14.3	1.0
1951-52		51.4	41.5	14.0	1.0
1952-53	**First Plan (1951-56)**	51.6	42.1	12.9	1.0
1953-54		52.4	43.2	11.7	1.0
1954-55		51.7	42.6	11.7	1.0
1955-56		50.0	41	11.9	1.1
	Average	**51.4**	**42.1**	**12.4**	**1**
1956-57		49.9	41.1	11.1	1.1
1957-58		48.2	39.5	11.3	1.2
1958-59	**Second Plan (1956-61)**	49.3	40.8	10.5	1.1
1959-60		47.8	39.3	10.6	1.1
1960-61		47.6	39.4	10.0	1.1
	Average	**48.6**	**40**	**10.7**	**1.1**
1961-62		46.3	38.1	10.1	1.1
1962-63		44.4	36.5	9.9	1.0
1963-64	**Third Plan (1961-66)**	43.2	35.4	10.0	1.1
1964-65		43.9	36.3	9.1	1.1
1965-66		40.5	32.6	10.8	1.2
	Average	**43.7**	**35.8**	**10**	**1.1**
1966-67	**Annual Plan (1966-67)**	39.6	31.5	11.2	1.2
1967-68	**Annual Plan (1967-68)**	42	34.2	10.3	1.1
1968-69	**Annual Plan (1968-69)**	40.9	33.2	10.1	1.2
	Average	**40.8**	**33**.0	**10.5**	**1.2**
1969-70		40.9	33.4	9.4	1.1
1970-71		41.7	34.2	9.4	1.1
1971-72	**Fourth Plan (1969-74)**	40.5	32.9	9.7	1.2
1972-73		38.6	31.2	9.7	1.2
1973-74		39.5	32.3	9.0	1.2
	Average	**40.2**	**32.8**	**9.4**	**1.2**
1974-75		38.5	31.1	9.7	1.3
1975-76		39.9	32.5	9.1	1.2
1976-77	**Fifth Plan (1974-79)**	37.1	30.2	8.7	1.2
1977-78		38.0	31.6	7.2	1.1
1978-79		36.8	30.6	7.2	1.1
	Average	**38.1**	**31.2**	**8.4**	**1.2**

1	2	3	4	5	6
1979-80	**Annual Plan (1979-80)**	33.9	27.9	6.9	1.1
1980-81		35.7	29.8	6.3	1.1
1981-82		35.3	29.6	6.2	1.0
1982-83	**Sixth Plan (1980-85)**	34.2	28.7	5.9	1.0
1983-84		35.0	29.5	5.3	1.1
1984-85		34.2	28.8	5.1	1.1
	Average	**34.9**	**29.3**	**5.7**	**1.1**
1985-86	**Seventh Plan (1985-90)**	32.9	27.7	4.9	1.1
1986-87		31.4	26.4	4.6	1.1
1987-88		29.9	25.1	4.4	1.1
1988-89		31.3	26.6	4.0	1.1
1989-90		29.9	25.2	4.1	1.1
	Average	**31.1**	**26.2**	**4.4**	**1.1**
1990-91	**Annual Plan (1990-91)**	29.5	24.9	3.9	1.1
1991-92	**Annual Plan (1991-92)**	28.5	24.0	3.8	1.1
	Average	**29**	**24.5**	**3.8**	**1.1**
1992-93		28.9	24.4	3.6	1.2
1993-94		28.2	23.8	3.3	1.2
1994-95	**Eighth Plan (1992-97)**	27.8	23.5	3.2	1.2
1995-96		25.7	21.7	3.0	1.2
1996-97		26.2	22.1	2.8	1.2
	Average	**27.4**	**23.1**	**3.2**	**1.2**
1997-98		24.5	20.6	2.8	1.2
1998-99		24.4	20.7	2.6	1.0
1999-00	**Ninth Plan (1997-2002)**	23.3	19.7	2.6	1.0
2000-01		22.3	18.8	2.5	1.0
2001-02		22.4	18.9	2.5	1.0
	Average	**23.4**	**19.7**	**2.6**	**1.1**
2002-03		20.1	16.7	2.4	1.0
2003-04		20.3	17.1	2.2	1.0
2004-05	**Tenth Plan (2002-07)**	19.0	16.0	2.1	0.9
2005-06		18.3	15.5	1.9	0.9
2006-07		17.4	14.7	1.8	0.9
	Average	**19**	**16**	**2.1**	**0.9**
2007-08		16.8	14.3	1.7	0.8
2008-09	**Eleventh Plan (2007-12)**	15.8	13.4	1.6	0.8
2009-10		14.7	12.4	1.5	0.8
2010-11		14.5	12.3	1.4	0.7
	Average	**15.5**	**13.1**	**1.6**	**0.8**

Annexure. 1.3: Plan Wise Year Wise Share (%) of Public & Private Sector in Gross Capital Formation (GCF)

(2004-05 prices)

Plan Period	Year	(%) Share of Public & Private GCF in GCF of Agriculture & Allied Sectors		(%) Share of Public & Private GCF in GCF of Agriculture Sector incl. livestock		(%) Share of Public & Private GCF in GCF of Forestry & logging Sector		(%) Share of Public & Private GCF in GCF of Fishing	
		Public	Private	Public	Private	Public	Private	Public	Private
	1950-60	NOT AVAILABLE							
	1960-61	**44.6**	**55.4**	**44.0**	**56.0**	**97.7**	**2.3**	**0.0**	**100**.0
Third Plan	1961-62	39.7	60.3	39.1	60.9	105.2	-5.2	0.0	100.0
(1961-66)	1962-63	44.0	56.0	42.9	57.1	103.2	-3.2	0.0	100.0
	1963-64	42.1	57.9	41.3	58.7	98.5	1.5	0.0	100.0
	1964-65	38.9	61.1	38.2	61.8	96.1	3.9	0.0	100.0
	1965-66	41.3	58.7	40.7	59.3	96.4	3.6	0.0	100.0
Average		**41.2**	**58.8**	**40.4**	**59.6**	**99.9**	**0.1**	**0.0**	**100.0**
Annual Plan (1966-67)	1966-67	32.7	67.3	32.0	68.0	98.2	1.8	0.0	100.0
Annual Plan (1967-68)	1967-68	27.9	72.1	27.0	73.0	95.1	4.9	0.0	100.0
Annual Plan (1968-69)	1968-69	29.0	71.0	28.5	71.5	96.7	3.3	0.0	100.0
Average		**29.9**	**70.1**	**29.1**	**70.9**	**96.7**	**3.3**	**0.0**	**100.0**
Fourth Plan	1969-70	28.4	71.6	27.8	72.2	105.2	-5.2	0.0	100.0
(1969-74)	1970-71	32.4	67.6	31.7	68.3	98.3	1.7	0.0	100.0
	1971-72	32.6	67.4	31.9	68.1	98.2	1.8	0.0	100.0
	1972-73	39.8	60.2	39.5	60.5	98.1	1.9	0.0	100.0
	1973-74	35.9	64.1	35.6	64.4	98	2.0	0.2	99.8
Average		**33.8**	**66.2**	**33.3**	**66.7**	**99.6**	**0.4**	**0**	**100**
Fifth Plan	1974-75	32.7	67.3	32.4	67.6	98.4	1.6	0.4	99.6
(1974-79)	1975-76	35.3	64.7	34.9	65.1	98.7	1.3	0.7	99.3
	1976-77	40.2	59.8	39.7	60.3	98.7	1.3	0.7	99.3
	1977-78	41.9	58.1	41.5	58.5	100.8	-0.8	0.6	99.4
	1978-79	38.8	61.2	38.2	61.8	98.6	1.4	0.6	99.4
Average		**37.8**	**62.2**	**37.4**	**62.6**	**99.1**	**0.9**	**0.6**	**99.4**
Annual Plan (1979-80)	1979-80	40.4	59.6	39.8	60.2	98.6	1.4	0.6	99.4
Sixth Plan	1980-81	49.2	50.8	48.5	51.5	99	1.0	1.3	98.7
(1980-85)	1981-82	54.7	45.3	54	46	99.2	0.8	1.5	98.5
	1982-83	51.2	48.8	50.3	49.7	99.1	0.9	1.6	98.4
	1983-84	48.1	51.9	46.7	53.3	98.9	1.1	2.6	97.4
	1984-85	49.5	50.5	48.3	51.7	98.9	1.1	3.8	96.2
Average		**50.5**	**49.5**	**49.6**	**50.4**	**99**	**1.0**	**2.2**	**97.8**
Seventh Plan	1985-86	46.6	53.4	45.6	54.4	99.7	0.3	2.4	97.6
(1985-90)	1986-87	43.8	56.2	42.6	57.4	98.7	1.3	3.4	96.6
	1987-88	35.8	64.2	35.0	65.0	98.0	2.0	1.8	98.2
	1988-89	35.8	64.2	34.7	65.3	98.2	1.8	0.9	99.1
	1989-90	31.0	69.0	29.5	70.5	98.3	1.7	0.9	99.1
Average		**38.6**	**61.4**	**37.5**	**62.5**	**98.6**	**1.4**	**1.9**	**98.1**

		Public	Private	Public	Private	Public	Private	Public	Private
Annual Plan (1990-91)	1990-91	20.6	79.4	19.1	80.9	98.2	1.8	0.7	99.3
Annual Plan (1991-92)	1991-92	26	74	24.4	75.6	98.4	1.6	0.6	99.4
Average		**23.3**	**76.7**	**21.8**	**78.2**	**98.3**	**1.7**	**0.6**	**99.4**
Eighth Plan (1992-97)	1992-93	22.0	78.0	20.8	79.2	98.2	1.8	0.1	99.9
	1993-94	27.0	73.0	26.1	73.9	98.0	2.0	0.4	99.6
	1994-95	31.2	68.8	30.6	69.4	98.1	1.9	0.2	99.8
	1995-96	31.5	68.5	31.0	69.0	98	2.0	0.2	99.8
	1996-97	27.9	72.1	27.3	72.7	97.9	2.1	0.1	99.9
Average		**27.9**	**72.1**	**27.2**	**72.8**	**98**	**2.0**	**0.2**	**99.8**
Ninth Plan (1997-2002)	1997-98	22.1	77.9	21.2	78.8	97.4	2.6	0.1	99.9
	1998-99	20.7	79.3	19.8	80.2	97.0	3.0	0.3	99.7
	1999-00	15.0	85.0	14.6	85.4	95.2	4.8	-0.1	100.1
	2000-01	15.2	84.8	14.8	85.2	95.5	4.5	0.0	100.0
	2001-02	14.4	85.6	14.3	85.7	94.3	5.7	0.0	100.0
Average		**17.5**	**82.5**	**16.9**	**83.1**	**95.9**	**4.1**	**0.1**	**99.9**
Tenth Plan (2002-07)	2002-03	14.0	86.0	14.2	85.8	94.6	5.4	0.0	100.0
	2003-04	18.1	81.9	17.6	82.4	95.9	4.1	0.0	100.0
	2004-05	21.3	78.7	22.1	77.9	95.9	4.1	0.0	100.0
	2005-06	23.0	77.0	23.8	76.2	94.6	5.4	0.0	100.0
	2006-07	25.3	74.7	26.3	73.7	96.6	3.4	0.0	100.0
Average		**20.4**	**79.6**	**20.8**	**79.2**	**95.5**	**4.5**	**0.0**	**100.0**
Eleventh Plan (2007-12)	2007-08	22.1	77.9	23.1	76.9	97.1	2.9	0.0	100.0
	2008-09	17.6	82.4	18.2	81.8	93.7	6.3	0.0	100.0
	2009-10	17.7	82.3	18.5	81.5	95.3	4.7	0.0	100.0
Average (first three years)		**19.2**	**80.8**	**19.9**	**80.1**	**95.4**	**4.6**	**0.0**	**100.0**

Annexure. 1.4: Plan-wise and Year-wise (%) Share of GCF/Investment

(2004-05 prices)

Plan Period	Year	(%) Share of GCF in Agriculture & Allied Sectors to Total GCF *			(%) Share of Agri. Allied GCF to GDP in Agriculture & Allied Sectors			(%) Share of GCF to total Economy GDP in total Economy		
		Public	Private	Total	Public	Private	Total	Public	Private	Total
First Plan	1950-51		..	23.5		..	7.3		..	16.1
(1951-56)	1951-52	..	..	25.2	..	..	7.5	..	..	15.3
	1952-53	..	..	26.6	..	..	6.7	..	..	13.0
	1953-54	..	..	28.8	..	..	6.4	..	..	11.6
	1954-55	..	..	24.3	..	..	6.5	..	..	13.7
	1955-56	..	..	23.6	..	..	7.4	..	..	15.7
Average				**25.7**			**6.9**			**13.9**
Second Plan	1956-57	..	..	21.0	..	..	7.9	..	..	18.9
(1956-61)	1957-58	..	..	19.8	..	..	7.6	..	..	18.6
	1958-59	..	..	21.6	..	..	6.6	..	..	15.0
	1959-60	..	..	15.1	..	..	5.4	..	..	17.2
	1960-61	14.5	18.7	16.6	2.8	3.4	6.2	9.1	8.7	17.8
Average				**18.8**			**6.8**			**17.5**
Third Plan	1961-62	13.7	19.8	16.8	2.7	4.1	6.7	9.0	9.5	18.5
(1961-66)	1962-63	13.1	19.4	16.0	3.1	4.0	7.1	10.5	9.1	19.6
	1963-64	12.0	21.0	15.9	3.2	4.4	7.7	11.6	9.2	20.8
	1964-65	11.7	20.4	15.8	3.0	4.7	7.7	11.3	10.2	21.5
	1965-66	12.0	19.6	15.6	3.6	5.1	8.7	12.1	10.5	22.6
Average		**12.5**	**20.0**	**16.0**	**3.1**	**4.5**	**7.6**	**10.9**	**9.7**	**20.6**
Annual Plan	1966-67	11.5	21.2	16.7	3.2	6.5	9.6	10.8	12.1	22.9
(1966-67)										
Annual Plan	1967-68	12.9	24.2	19.5	2.8	7.3	10.2	9.2	12.7	22.0
(1967-68)										
Annual Plan	1968-69	14.5	26.7	21.5	3.3	8.0	11.2	9.2	12.2	21.4
(1968-69)										
Average		**13.0**	**24.0**	**19.2**	**3.1**	**7.3**	**10.4**	**9.7**	**12.4**	**22.1**
Fourth Plan	1969-70	14.3	24.1	20.2	3.0	7.5	10.5	8.5	12.7	21.2
(1969-74)	1970-71	14.6	20.7	18.2	2.8	5.8	8.6	8.0	11.7	19.7
	1971-72	14.1	19.6	17.4	3.1	6.3	9.4	8.8	13.1	21.9
	1972-73	15.2	21.8	18.6	4.1	6.3	10.4	10.5	11.1	21.6
	1973-74	14.3	19.9	17.4	3.4	6.1	9.6	9.5	12.2	21.7
Average		**14.5**	**21.2**	**18.4**	**3.3**	**6.4**	**9.7**	**9.1**	**12.2**	**21.2**
Fifth Plan	1974-75	14.6	18.0	16.7	3.3	6.7	9.9	8.6	14.3	22.9
(1974-79)	1975-76	14.1	22.9	18.8	3.2	5.8	9.0	9.0	10.2	19.1
	1976-77	16.1	23.6	19.9	4.6	6.9	11.5	10.7	10.9	21.5
	1977-78	16.9	19.6	18.4	4.6	6.4	11.0	10.4	12.4	22.8
	1978-79	17.1	21.2	19.4	4.9	7.7	12.6	10.5	13.4	23.9
Average		**15.8**	**21.0**	**18.6**	**4.1**	**6.7**	**10.8**	**9.8**	**12.2**	**22.0**
Annual Plan	1979-80	17.0	23.0	20.2	5.8	8.6	14.4	11.6	12.6	24.2
(1979-80)										
Sixth Plan	1980-81	17.0	20.0	18.4	5.7	5.9	11.6	12.0	10.5	22.5
(1980-85)	1981-82	13.3	13.4	13.3	5.1	4.2	9.3	13.6	11.2	24.8
	1982-83	11.9	15.9	13.6	5.0	4.8	9.8	14.4	10.3	24.8
	1983-84	12.3	18.2	14.8	4.7	5.1	9.8	13.4	9.8	23.2
	1984-85	11.0	15.0	12.7	4.4	4.5	9.0	13.8	10.3	24.1
Average		**13.1**	**16.5**	**14.6**	**5.0**	**4.9**	**9.9**	**13.4**	**10.4**	**23.9**

		Public	Private	Total	Public	Private	Total	Public	Private	Total
Seventh Plan (1985-90)	1985-86	9.5	12.9	11.1	4.0	4.5	8.5	13.7	11.6	25.3
	1986-87	8.5	14.4	11.1	4.0	5.1	9.1	14.7	11.1	25.7
	1987-88	9.4	17.7	13.5	4.0	7.2	11.2	12.7	12.2	24.8
	1988-89	8.1	13.6	11.0	3.2	5.8	9.0	12.3	13.2	25.6
	1989-90	7.0	13.8	10.6	2.8	6.2	8.9	11.8	13.4	25.2
Average		**8.5**	**14.5**	**11.4**	**3.6**	**5.7**	**9.3**	**13.0**	**12.3**	**25.3**
Annual Plan (1990-91)	1990-91	6.6	19.9	14.1	2.6	10.2	12.8	11.8	15.1	26.9
Annual Plan (1991-92)	1991-92	6.0	15.2	10.9	2.4	6.8	9.1	11.3	12.6	23.9
Average		**6.3**	**17.6**	**12.5**	**2.5**	**8.5**	**11.0**	**11.5**	**13.9**	**25.4**
Eighth Plan (1992-97)	1992-93	6.5	16.1	12.2	2.4	8.6	11.0	10.7	15.4	26.1
	1993-94	6.7	14.9	11.2	2.5	6.7	9.1	10.4	12.6	23.1
	1994-95	6.3	10.9	8.9	2.5	5.6	8.1	11.1	14.2	25.3
	1995-96	6.7	7.8	7.4	2.5	5.5	8.1	9.7	18.2	28.0
	1996-97	6.8	9.9	8.8	2.2	5.7	7.9	8.5	15.1	23.6
Average		**6.6**	**11.9**	**9.7**	**2.4**	**6.4**	**8.8**	**10.1**	**15.1**	**25.2**
Ninth Plan (1997-2002)	1997-98	5.8	8.8	7.9	1.9	6.7	8.6	8.1	18.7	26.8
	1998-99	5.7	9.8	8.5	1.9	7.3	9.2	8.1	18.2	26.4
	1999-00	5.4	12.6	10.5	2.0	11.2	13.1	8.5	20.6	29.1
	2000-01	5.1	12.4	10.2	1.8	10.1	11.9	7.9	18.1	26.0
	2001-02	6.0	14.3	11.9	2.1	12.5	14.6	7.9	19.6	27.5
Average		**5.6**	**11.6**	**9.8**	**1.9**	**9.5**	**11.5**	**8.1**	**19.0**	**27.1**
Tenth Plan (2002-07)	2002-03	5.7	12.2	10.5	2.0	12.2	14.2	7.1	20.1	27.2
	2003-04	6.3	10.0	9.0	2.2	10.1	12.4	7.2	20.6	27.8
	2004-05	6.7	7.8	7.5	2.9	10.6	13.5	8.1	25.9	34.0
	2005-06	7.1	7.4	7.3	3.4	11.2	14.6	8.7	27.7	36.4
	2006-07	7.1	6.5	6.6	3.7	10.9	14.6	9.1	29.2	38.3
Average		**6.6**	**8.8**	**8.2**	**2.8**	**11.0**	**13.9**	**8.0**	**24.7**	**32.7**
Eleventh Plan (2007-12)	2007-08	6.1	6.7	6.5	3.6	12.5	16.0	9.8	31.4	41.2
	2008-09	5.3	9.5	8.3	3.5	16.2	19.7	10.3	26.8	37.1
	2009-10	5.2	8.6	7.7	3.6	16.7	20.3	10.1	28.4	38.5
Average (first three years)		**5.5**	**8.3**	**7.5**	**3.5**	**15.1**	**18.7**	**10.1**	**28.9**	**38.9**

*Total GCF for economy as a whole

Annexure. 1.5: All India Average Annual Growth Rates of Area, Production and Yield of Principal Crops

Crop	1990-91 to 1999-2000			2000-01 to 2010-11		
	A	P	Y	A	P	Y
Rice	0.70	2.09	1.36	-0.39	1.32	1.47
Wheat	1.62	4.52	2.87	0.57	1.39	0.73
Jowar	-3.45	-0.92	1.88	-3.28	-2.00	1.56
Bajra	-1.83	5.43	5.58	1.41	14.61	9.27
Maize	0.85	2.24	1.37	2.68	7.12	4.13
Ragi	-3.42	-1.19	2.09	-1.20	4.00	3.51
Small Millets	-6.23	-6.78	-0.71	-6.59	-3.39	3.57
Barley	-2.74	0.61	3.15	0.14	1.76	1.46
Coarse Cereals	-2.42	-0.08	2.03	-0.13	5.00	4.64
Total Cereals	**-0.12**	**2.29**	**2.38**	**-0.09**	**1.82**	**1.69**
Gram	0.88	3.86	2.97	4.31	6.39	1.19
Tur	-0.45	1.89	2.03	2.58	1.89	-0.65
Other Pulses	-1.40	0.07	1.50	1.13	4.19	2.36
Total Pulses	**-0.91**	**1.06**	**1.82**	**2.30**	**4.02**	**1.21**
Total Foodgrains	**-0.27**	**2.19**	**2.43**	**0.34**	**1.95**	**1.37**
Sugarcane	**2.25**	**3.16**	**0.91**	**1.95**	**2.12**	**0.03**
Groundnut	-2.25	-2.40	-0.30	-1.08	13.13	12.76
Sesamum	-3.71	-3.39	1.26	2.99	9.87	5.80
R & M	2.28	4.82	2.96	2.76	6.26	2.72
Sunflower	3.06	3.20	0.76	-1.04	1.15	3.55
Soyabean	11.01	16.37	4.67	4.15	8.31	4.17
Total Nine Oilseeds	**0.75**	**2.53**	**1.76**	**1.27**	**7.00**	**5.18**
Cotton	**1.42**	**0.93**	**-0.54**	**2.66**	**12.12**	**9.15**
Jute	2.82	3.67	0.72	-0.80	0.86	1.57
Mesta	-1.68	-0.29	1.35	-5.84	-5.13	0.54
Jute & Mesta	1.80	3.12	1.16	-1.59	0.29	1.85

Note: A: Area, P: Production, Y: Yield

Source: Directorate of Economics & Statistics, Ministry of Agriculture

Annexure. 1.6: Disaggregated Public Sector Outlays / Expenditure under Agriculture and Allied Activities

(Rs. Crore at current prices)

Sector	2002-03		2003-04		2004-05		2005-06		2006-07		Tenth Plan Total	
	BE	AE	BE	AE	BE	AE	BE	AE	BE	AE	BE	AE
DAC	5379	3644	5202	4514	5828	6023	7372	7065	8432	4195	32213	25441
a) Crop Husbandry	3361	2597	3726	3329	4240	3938	5624	5225	6196	4012	23147	19101
b) Horticulture	0	59	0	82	118	185	189	196	335	na	642	522
c) Soil & Water Conservation	1315	544	893	650	976	884	941	839	1072	21	5197	2938
d) Cooperation	703	443	583	453	494	1016	618	805	829	162	3227	2879
DAHD&F	907	745	935	771	1152	1103	1536	1393	1918	682	6448	4694
a) Animal Husbandry	506	371	545	457	661	643	909	821	1071	440	3692	2732
b) Dairy Development	87	105	93	73	116	110	154	155	187	67	637	510
c) Fisheries	314	269	297	241	375	350	473	417	660	175	2119	1452
Agriculture, Research & Edn. **(DARE)**	1026	939	1020	1018	1257	1163	1434	1374	1768	1287	6505	5781

Sector	2007-08		2008-09		2009-10		2010-11		2011-12	Eleventh Plan Total	
	BE	AE	BE	AE	BE	AE	BE	AE	RE	BE	RE
DAC	4802	5085	6050	5990	6316	6672	7183	9283	8128	32479	27030
a) Crop Husbandry	4657	4922	5902	5840	6165	6545	7084	9159	7891	31699	26466
b) Horticulture	na	na	na	na	na	na	na	na	na	na	na
c) Soil & Water Conservation	21	21	11	13	14	14	16	15	15	77	63
d) Cooperation	124	142	137	137	137	113	83	109	222	703	501
DAHD&F	904	739	1000	898	1127	934	1174	1136	1443	5648	3707
a) Animal Husbandry	540	467	620	601	627	507	855	787	950	3592	2362
b) Dairy Development	80	101	89	89	89	86	77	77	223	558	353
c) Fisheries	284	171	291	209	411	341	242	272	270	1498	993
Agriculture, Research & Edn. **(DARE)**	1458	1291	1584	1584	1584	1707	2070	2070	2492	9188	6652

Source: Statement 13, Expenditure Budget Vol. 1 State Plan Division, Planning Commission.

Annexure. 2.1: Land Use Classification

(Area in thousand ha.)

Year	Geographical Area	Agri. Land/ Cultivalbe land/ Culturable Land/Arable Land	Forests	Not available for cultivation		Other uncultivated land excluding floolw land			Follow Lands		Total cropped area
				Area under non-agricultural uses	Barren and unculturable land	Permanent pastures & other grazing lands	Land under Misc. tree crops & groves (not incl. in net area sown)	culturable waste land	follow lands other than current follows	Current follows	
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	
1950-51	**328726**	**189641**	40482	9357	38160	6675	19828	22943	17445	10679	**131893**
1960-61		**179689**	54052	14840	35911	13966	4459	19212	11180	11639	**152772**
1970-71		**182056**	63830	16478	28128	13261	4367	17500	8728	10598	**165791**
1980-81		**185156**	67460	19596	19958	11989	3578	16744	9720	14826	**172630**
1981-82		**185170**	67365	19630	20092	12025	3603	16424	9658	13365	**176750**
1982-83		**184864**	67330	19865	20104	11930	3545	16332	9357	14817	**172748**
1983-84		**184983**	66599	20237	20337	12034	3628	15565	9271	13308	**179560**
1984-85		**185222**	66391	20458	20239	12000	3569	15882	9512	15358	**176330**
1985-86		**185127**	67067	20631	20090	11783	3563	15718	10051	14894	**178464**
1986-87		**185253**	66875	20879	20164	11838	3632	15548	10255	16240	**176405**
1987-88		**184898**	66936	21168	20112	11723	3509	15530	10862	20912	**170738**
1988-89		**185142**	66944	21299	19916	11525	3514	15167	10247	14323	**182277**
1989-90		**185211**	67406	21258	19699	11304	3803	15102	10273	13694	**182269**
1990-91		**185177**	67805	21087	19389	11404	3818	14995	9662	13703	**185742**
1991-92		**185000**	67866	21465	19270	11299	3761	14994	9941	14672	**182242**
1992-93		**184875**	67981	21771	19122	11096	3781	14589	9672	14188	**185618**
1993-94		**184734**	68277	22210	18694	10966	3696	14409	9834	14376	**186595**
1994-95		**184173**	68603	22556	18463	11034	3732	14262	9969	13250	**188053**
1995-96		**183623**	68817	22362	19009	11064	3481	14098	10016	13831	**187471**
1996-97		**184121**	69103	22554	17964	10880	3655	14021	10192	13323	**189502**
1997-98		**183972**	69245	23138	17461	10845	3730	13943	10078	14275	**189988**
1998-99		**184024**	69215	23348	17524	10896	3679	13899	10106	13587	**191649**
1999-00		**183873**	69164	23598	17536	10845	3725	13742	10289	15053	**188396**
2000-01		**183506**	69529	23889	17590	10666	3441	13630	10293	14778	**185340**
2001-02		**183607**	69406	24049	17524	10532	3450	13520	10560	15345	**188286**
2002-03		**183172**	69572	24263	17802	10535	3358	13607	11885	21857	**175580**
2003-04		**183186**	69654	24651	17576	10488	3379	13240	11338	14471	**190077**
2004-05*		**183007**	69646	24890	17578	10456	3400	13271	10687	14481	**191546**
2005-06*		**182742**	69680	25122	17441	10448	3389	13224	10603	14065	**193316**
2006-07*		**182565**	69688	25568	17397	10418	3362	13270	10510	15425	**192491**
2007-08*		**182505**	69625	26017	17175	10363	3423	13066	10353	14759	**195156**
2008-09*		**182385**	69635	26308	17017	10343	3402	12762	10316	14541	**195104**

*: Provisional

#: In 2002-03 there is significant decline in Total Cropped Area and Net Area Sown due to decline in net area sown in the States of Andhra Pradesh, Karnataka, Kerala, Madhya Pradesh Maharashtra, Orissa, Rajasthan, Tamil Nadu, West Bengal and Haryana. This was mainly due to deficient rainfall.

Annexure. 2.2: Agricultural Land by use in India

(Million Hectares)

S. No.	Classification	1970-71	1990-91	2003-04	2008-09
I.	Geographical Area	328.73	328.73	328.73	328.73
II.	Reporting Area	303.75	304.86	305.56	305.69
	1. Forest	63.83	67.81	69.65	69.63
	percentage to the Reported Area.	21.01	22.24	22.80	22.78
	2. Not Available for Cultivation (A+B)	44.61	40.48	42.23	43.32
	(A) Area Under Non-agricultural Uses	16.48	21.09	24.65	26.31
	percentage to the Reported Area.	5.42	6.92	8.07	8.61
	(B) Barren & Un-culturable Land	28.13	19.39	17.58	17.02
	percentage to the Reported Area.	9.26	6.36	5.75	5.57
	3. Other Uncultivated land excluding Fallow Land (A+B+C)	35.13	30.22	27.11	26.51
	(A) Permanent Pasture & other Grazing Land	13.26	11.40	10.49	10.34
	percentage to the Reported Area.	4.37	3.74	3.43	3.38
	(B) Under Miscellaneous Tree Crops & Groves not included in Net Area Sown	4.37	3.82	3.38	3.40
	percentage to the Reported Area.	1.44	1.25	1.11	1.11
	(C) Culturable Waste Land	17.50	15.00	13.24	12.76
	percentage to the Reported Area.	5.76	4.92	4.33	4.17
	4. Fallow Lands (A+B)	19.33	23.37	25.81	24.86
	(A) Fallow Lands other than Current Fallows	8.73	9.66	11.34	10.32
	percentage to the Reported Area.	2.87	3.17	3.71	3.37
	(B) Current Fallows	10.60	13.70	14.47	14.54
	percentage to the Reported Area.	3.49	4.49	4.74	4.76
	5. Net Area Sown (6-7)	140.86	143.00	140.76	141.36
	percentage to the Reported Area.	46.37	46.91	46.07	46.24
	6. Total Cropped Area (Gross Cropped Area)	165.79	185.74	190.08	195.10
	7. Area Sown more than once	24.93	42.74	49.32	53.74
	8. Cropping Intensity *	117.70	129.89	135.04	138.01
III.	Net Irrigated Area	31.10	48.02	56.96	63.20
IV.	Gross Irrigated Area	38.20	63.20	78.15	88.42
P	Provisional				
*	Cropping Intensity is percentage of the gross cropped area to the net area sown.				

Source: Directorate of Economics & Statistics, Ministry of Agriculture.

Annexure. 3.1: All-India Consumption of Fertilisers in Terms of Nutrients (N, P & K)

(Thousand Tonnes)

Year	N	P	K	Total
1	2	3	4	5
1950-51	58.7	6.9	-	65.6
1955-56	107.5	13.0	10.3	130.8
1960-61	210.0	53.1	29.0	292.1
1965-66	574.8	132.5	77.3	784.6
1970-71	1487.0	462.0	228.0	2177.0
1975-76	2148.6	466.8	278.3	2893.7
1980-81	3678.1	1213.6	623.9	5515.6
1985-86	5660.8	2005.2	808.1	8474.1
1986-87	5716.0	2078.9	850.0	8644.9
1987-88	5716.8	2187.0	880.5	8784.3
1988-89	7251.0	2720.7	1068.3	11040.0
1989-90	7386.0	3014.2	1168.0	11568.2
1990-91	7997.2	3221.0	1328.0	12546.2
1991-92	8046.3	3321.2	1360.5	12728.0
1992-93	8426.8	2843.8	883.9	12154.5
1993-94	8788.3	2669.3	908.4	12366.0
1994-95	9507.1	2931.7	1124.7	13563.5
1995-96	9822.8	2897.5	1155.8	13876.1
1996-97	10301.8	2976.8	1029.6	14308.1
1997-98	10901.8	3913.6	1372.5	16187.9
1998-99	11353.8	4112.2	1331.5	16797.5
1999-00	11592.7	4798.3	1678.7	18069.7
2000-01	10920.2	4214.6	1567.5	16702.3
2001-02	11310.2	4382.4	1667.1	17359.7
2002.03	10474.1	4018.8	1601.2	16094.1
2003-04	11077.0	4124.3	1597.9	16799.1
2004-05	11713.9	4623.8	2060.6	18398.3
2005-06	12723.3	5203.7	2413.3	20340.3
2006-07	13772.9	5543.3	2334.8	21651.0
2007-08	14419.1	5514.7	2636.3	22570.1
2008-09	15090.5	6506.2	3312.6	24909.3
2009-10	15580.0	7274.0	3632.40	26486.4

Note : Figures upto 1982-83 relate to Feb-.Jan. and onwards to April-March.

Source: Department of Agriculture & Cooperation

Annexure. 3.2: Fertiliser Consumption per Hectare in Agricultural Land in Selected Countries

(Kg./Hectare)

Country	2007				2008			
	N	P2 O5	K2 O	Total	N	P2 O5	K2 O	Total
1	2	3	4	5	6	7	8	9
Africa								
Egypt	316.6	47.9	14.7	379.1	321.6	50.9	15.5	388.1
Morocco	7.7	4.9	1.8	14.4	8.7	5.9	-	14.5
South Africa	4.4	1.9	1.4	7.7	4.3	1.9	1.2	7.3
North & Central America								
Canada	28	9.9	5.4	43.2	26.9	8.5	2.6	38
Mexico	10.9	3.5	2.8	17.2	10.7	2.8	2.4	15.9
USA	27.9	9.3	10.3	47.5	26.5	7.5	6.2	40.1
South America								
Brazil	10.4	13.8	15.8	40	9.5	12.1	13.9	35.5
Chile	17	9.7	7.1	33.7	16.3	6.8	6.4	29.4
Asia								
Bangladesh	142.9	25.3	18.3	186.4	126.2	8.6	5.4	140.2
China, Main	63.4	22.1	12.4	97.9	63.6	20.1	9	92.7
India	80.2	30.7	14.7	125.6	84	36.2	18.4	138.6
Indonesia	54.1	11.3	19.4	84.8	56.6	11	17.7	85.3
Japan	95.5	95.6	74.6	265.7	90.8	75.6	54	220.4
Korea Rep.	176.9	70.2	93.6	340.7	167.1	49.9	55.4	272.4
Malaysia	72.1	32.5	134	238.7	67.6	22.5	114.8	204.8
Nepal	1.2	1.2	0.5	2.9	1.9	1.9	0.2	4
Pakistan	108.8	23.4	1	133.3	115.8	24	1	140.8
Sri Lanka	57.7	21.3	30.5	109.6	62.7	18.9	26.5	108.1
Thailand	52.8	16.9	17.4	87.1	47.5	15.1	18.6	81.1
Turkey	34.3	13.1	2.8	50.2	29	8.4	2.3	39.6
Vietnam	111.9	63.3	43	218.2	96.9	60.9	37.6	195.5
Europe								
Balarus	50.1	21.4	63.6	135.2	58.8	20.3	67.8	146.9
Denmark	83.5	11.3	27	121.8	71.2	5.2	13.9	90.3
France	81.7	21.5	27	130.1	71.8	10.1	13.4	95.2
Germany	106.6	18.7	30.2	155.4	91.6	10.3	10.6	112.5
Netherlands	140	23.5	23	186.5	128	17.1	18.7	163.8
Poland	70.6	28.6	33.2	132.3	65	25.4	25.4	115.8
Russian Fedn.	5.4	2.2	1.4	8.9	6.6	2.4	1.5	10.5
Spain	34.9	18.8	15.4	69.1	26.2	5.7	6.7	38.6
UK	58.7	12.2	18.4	89.3	51.9	7.5	11.7	71.1
Ukraine	14.5	3.4	3.6	21.5	19.4	3.6	3.8	26.8
Oceania								
Australia	2	2.3	0.5	4.8	2	2	0.5	4.5
New Zealand	28.6	33.4	10.7	72.7	24.6	20.5	8.6	53.7
World	**20.6**	**7.9**	**5.9**	**34.5**	**20.2**	**7**	**4.7**	**31.9**

Annexure. 3.7: Consumption of Electricity for Agricultural Purposes

Year	Consumption for Agricultural Purposes (GWh)	Total Consumption (GWh)	% Share of Agriculture Consumption to Total Consumption
1	2	3	4
1982-83	17817	95589	18.64
1983-84	18234	102344	17.82
1984-85	20960	114068	18.38
1985-86	23422	122999	19.04
1986-87	29444	135952	21.66
1987-88	35267	145613	24.22
1988-89	38878	160196	24.27
1989-90	44056	175419	25.11
1990-91	50321	190357	26.44
1991-92	58557	207645	28.20
1992-93	63328	220674	28.70
1993-94	70699	238569	29.63
1994-95	79301	259630	30.54
1995-96	85732	277029	30.95
1996-97	84019	280206	29.98
1997-98	91242	296749	30.75
1998-99	97195	309734	31.38
1999-00	90934	312841	29.07
2000-01	84729	316600	26.76
2001-02	81673	322459	25.33
2002-03	84486	339598	24.88
2003-04	87089	360937	24.13
2004-05	88555	386134	22.93
2005-06	90292	411887	21.92
2006-07	99023	455748	21.73
2007-08	104182	501977	20.75
2008-09	107776	527564	20.43

Gwh: Giga watt hour
Source: Central Electricity Authority, New Delhi.

Annexure. 3.8: State-wise Consumption of Electricity for Agriculture purpose in 2008-09

Region	State/UTs	Consumption for Agriculture Purpose (GWh)	Total Consum-ption (GWh)	% Share of Consumption for Agricultural Purpose
1	2	3	4	5
NORTHERN	Haryana	7365.4	19291.41	38.18
	Himachal Pradesh	28.74	5460.51	0.53
	Jammu & Kashmir	271.42	4030.85	6.73
	Punjab	9325.42	29224.63	31.91
	Rajasthan	9790.86	26641.57	36.75
	Uttar Pradesh	6860.36	39636.82	17.31
	Uttrakhand	300.2	4736.11	6.34
	Chandigarh	1.35	1143.31	0.12
	Delhi	52.77	17465.43	0.3
	Sub-Total	**33996.52**	**147630.64**	**23.03**
WESTERN	Gujarat	11729.71	45967.89	25.52
	Madhya Pradesh	6217.5	21678.05	28.68
	Chhattisgarh	2049.93	12021.45	17.05
	Maharashtra	13066.12	72804.42	17.95
	Goa	40.18	2616.98	1.54
	Daman & Diu	2.47	1325.35	0.19
	D. & N. Haveli	9.2	3070	0.3
	Sub-Total	**33115.11**	**159484.14**	**20.76**
SOUTHERN	Andhra Pradesh	16604.57	54241.14	30.61
	Karnataka	11314.43	36039.59	31.39
	Kerala	234.98	12188.89	1.93
	Tamil Nadu	10529	53553.49	19.66
	Lakshadweep	73.48	1864.98	3.94
	Pondicherry	0	23.5	0
	Sub-Total	**38756.46**	**157911.59**	**24.54**
EASTERN	Bihar	798	4984.06	16.01
	Jharkhand	69.62	12582.93	0.55
	Orissa	141.49	11732.52	1.21
	West Bengal	843.28	27779.3	3.04
	A.& N. Islands	0.7	160.48	0.44
	Sikkim	0	277.31	0
	Sub-Total	**1853.09**	**57516.6**	**3.22**
NORTH EASTERN	Assam	20.86	2797.6	0.75
	Manipur	0.12	197.12	0.06
	Meghalaya	0.5	945.5	0.05
	Nagaland	0.04	192.97	0.02
	Tripura	33.39	450.84	7.41
	Arunachal Pradesh	0	271.47	0
	Mizoram	0	165.5	0
	Sub-Total	54.91	5021	1.09
	Total (All India)	**107776.09**	**527563.97**	**20.43**

Gwh: Giga watt hour
Source : Central Electricity Authority, New Delhi.

Annexure. 3.9: State-wise Number of Kisan Credit Cards issued and Amount Sanctioned since inception up to 30th October 2011

Sr.No.	Name of State/Uts	Cooperative Banks		Regional Rural Banks		Commercial Banks		Total	
		Cards Issued (No)	Amount Sanctioned (Rs. crore)	Cards Issued (No)	Amount Sanctioned (Rs. crore)	Cards Issued (No)	Amount Sanctioned (Rs. crore)	Cards Issued (No)	Amount Sanctioned (Rs. crore)
1	Andhra Pradesh	4169364	6750.97	2443981	3144.37	11170501	18949.80	17783846	28845.14
2	Assam	18271	11.66	235406	270.67	490906	337.21	744583	619.54
3	Arunachal Pradesh	980	1.47	3354	2.11	22169	20.25	26503	23.83
4	Bihar	854683	798.54	1511378	1805.98	2209023	2605.22	4575084	5209.74
5	Gujarat	1362270	17608.59	276689	2258.95	1770160	4557.26	3409119	24424.80
6	Goa	5221	16.92			13824	106.97	19045	123.89
7	Haryana	1284995	7629.58	437912	2907.46	967430	5398.58	2690337	15935.62
8	Himachal Pradesh	209824	234.36	77997	121.83	292752	602.82	580573	959.01
9	Jammu & Kashmir	54001	66.67	37313	107.20	22953	29.31	114267	203.18
10	Karnataka	2060453	6809.11	1478165	5144.12	2995531	9617.31	6534149	21570.54
11	Kerala	1660308	3181.33	513231	1320.83	1718194	3202.01	3891733	7704.17
12	MadhyaPradesh	4014022	13293.52	703456	2154.48	2109955	7350.11	6827433	22798.11
13	Maharashtra	5699510	30249.44	380052	1068.67	3678961	7478.38	9758523	38796.49
14	Meghalaya	11661	10.91	22201	28.30	61554	44.39	95416	83.60
15	Mizoram	2134	1.28	9603	39.37	18910	16.23	30647	56.88
16	Manipur	13532	33.64	2082	2.66	30796	30.16	46410	66.46
17	Nagaland	3470	0.67	1841	2.41	27438	24.98	32749	28.06
18	Orissa	4143054	8110.49	821836	1064.30	1461764	1352.88	6426654	10527.67
19	Punjab	949657	5595.41	174157	1079.33	1551468	8970.66	2675282	15645.40
20	Rajasthan	3498318	8373.43	630062	2746.30	2166355	6913.99	6294735	18033.72
21	Sikkim	3466	5.65			9304	10.00	12770	15.65
22	Tamil Nadu	1889966	5228.89	360268	485.91	4984771	7560.83	7235005	13275.63
23	Tripura	14236	5.03	76282	39.66	79127	59.72	169645	104.41
24	Uttar Pradesh	6880106	5910.01	4565538	11024.46	7849706	18143.36	19295350	35077.83
25	West Bangal	1657268	5054.74	565307	1307.30	1759538	1994.20	3982113	8356.24
26	A & N island	3727	7.42			3352	3.58	7079	11.00
27	Chandigarh					7382	2.01	7382	2.01
28	Daman & Diu					1781	3.02	1781	3.02
29	New Delhi	2279	8.77			25521	79.63	27800	88.40
30	D & N Haveli					3323	5.44	3323	5.44
31	Lakshdweep					775	1.81	775	1.81
32	Pondicherry	7691	34.15	133		70930	94.01	78754	128.16
33	Jharkhand	278892	544.33	474051	279.27	621549	503.01	1374492	1326.61
34	Chhattisgarh	1344371	2008.11	391708	495.77	367985	734.73	2104064	3238.61
35	Uttaranchal	359689	600.11	58607	152.86	371927	1039.12	790223	1792.09
36	Other States					47	0.12	47	0.12
	Breakup not available for CBs (1998-99)					188005	266.04	188005	266.04
	TOTAL	42457419	128185.20	16252610	39054.57	49125667	108109.15	107835696	275348.92

Source : Department of Agriculture and Cooperation, Credit Division.

Annexure. 3.3: Production and Consumption of Seed, Fertilizer and Pesticides in India

Programme		Unit	1991-92	1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99
1		2	3	4	5	6	7	8	9	10
1. Seeds										
(i)	Production of Breeder Seeds	Thousand Qtls.	34.90	36.00	37.00	40.11	43.36	46.03	46.13	38.99
(ii)	Production of Foundation Seeds	Lakh Qtls.	3.75	3.93	4.06	4.73	4.76	5.76	6.84	6.75
(iii)	Distribution of Certified/Quality Seeds	Lakh Qtls.	57.50	60.33	62.20	65.86	69.90	73.27	78.79	84.97
2.	**Consumption of Chemical**									
	Fertilisers									
	Nitrogenous (N)	Lakh Tonnes	80.46	84.26	87.88	95.07	98.23	103.02	109.02	113.54
	Phosphatic(P)	Lakh Tonnes	33.21	28.43	26.69	29.32	28.98	29.77	39.14	41.12
	Potassic(K)	Lakh Tonnes	13.61	8.84	9.09	11.25	11.56	10.29	13.72	13.32
	Total (N+P+K)	Lakh Tonnes	127.28	121.53	123.66	135.64	138.77	143.08	161.88	167.68
	Per Hectare **	Kg.	69.84	65.48	66.27	72.13	74.02	75.47	84.94	87.02
3.	**Consumption of Pesticides** (Technical Grade Material)	Thousand Tonnes	72.13	70.79	63.65	61.36	61.26	56.11	52.24	49.16
4.	**Area Covered Under Soil Conservation** (Cumulative)	Lakh Hactares	-	-	-	-	-	-	-	-

	Programme	Unit	1999-2000	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11
	1	2	11	12	13	14	15	16	17	18	19	20	21	22
1.	**Seeds**													
(i)	Production of Breeder Seeds	Thousand Qtls.	51.13	42.69	45.54	48.42	61.82	66.46	68.64	73.83	91.96	94.41	105.00	119.21
(ii)	Production of Foundation Seeds	Lakh Qtls.	4.66	5.91	5.44	6.14	6.50	6.90	7.40	7.96	8.22	9.69	10.50	17.53
(iii)	Distribution of Certified/Quality Seeds	Lakh Qtls.	87.98	86.27	91.80	98.03	108.59	120.26	126.75	155.01	179.05	215.81	257.11	277.34
2.	**Consumption of Chemical Fertilisers**													
	Nitrogenous (N)	Lakh Tonnes	115.92	109.20	113.10	104.74	110.77	117.13	127.23	137.73	144.19	150.91	155.8	165.58
	Phosphatic(P)	Lakh Tonnes	47.99	42.15	43.82	40.19	41.24	46.24	52.04	55.43	55.15	65.06	72.74	80.5
	Potassic(K)	Lakh Tonnes	16.78	15.67	16.67	16.01	15.98	20.61	24.13	23.35	26.36	33.12	36.32	35.14
	Total (N+P+K)	Lakh Tonnes	180.69	167.02	173.60	160.94	167.99	183.98	203.40	216.51	225.70	249.09	264.86	281.22
	Per Hectare **	Kg.	94.94	89.63	91.13	91.45	88.05	94.52	105.50	111.76	115.27	127.21	135.27	144.14
3.	**Consumption of Pesticides** (Technical Grade Material)	Thousand Tonnes	46.20	43.58	47.02	48.30	41.00	40.67	39.77	41.51	43.63	43.86	41.82	55.54
4.	**Area Covered Under Soil Conservation** (Cumulative)	Lakh Hactares	-	4.36	4.70	4.30	5.55	7.37	8.67	11.41	7.34	6.82	5.28	7.49

E- Estimated

Sources:- 1) Department of Agriculture & Cooperation, New Delhi.
2) States/Uts Zonal Conference, Kharif & Rabi.

Annexure. 3.4: State-wise Consumption of Fertilizers

in lakh tonnes

Sl. No.	State/Zone	2007-08				2008-09				2009-10			
		N	P	K	Total	N	P	K	Total	N	P	K	Total
1	2	3	4	5	6	7	8	9	10	11	12	13	14
South Zone													
1	Andhra Pradesh	1560.37	695.02	412.19	2667.58	1720.84	852.20	497.84	3070.88	1707.12	875.87	478.38	3061.37
2	Karnataka	790.28	386.78	330.32	1507.38	864.10	558.83	408.90	1831.83	962.90	629.85	465.73	2058.48
3	Kerala	93.26	42.73	72.31	208.30	111.74	55.02	94.15	260.91	112.75	58.18	93.96	264.89
4	Tamil Nadu	543.34	228.12	304.19	1075.65	646.68	254.99	363.55	1265.22	608.54	263.70	324.61	1196.85
5	Pondicherry	20.04	8.57	8.56	37.17	16.06	5.67	6.21	27.94	19.37	5.04	6.35	30.76
6	A&N Islands	0.39	0.36	0.12	0.87	0.28	0.18	0.14	0.60	0.31	0.27	0.13	0.71
7	Lakshadweep	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sub-Total (South Zone)		**3007.68**	**1361.58**	**1127.69**	**5496.95**	**3359.70**	**1726.89**	**1370.79**	**6457.38**	**3410.99**	**1832.91**	**1369.16**	**6613.06**
West Zone													
8	Gujarat	1052.63	424.52	146.11	1623.26	1068.82	465.17	182.99	1716.98	1101.60	491.66	206.46	1799.72
9	Madhya Pradesh	795.69	430.26	75.75	1301.70	803.41	530.03	89.96	1423.40	941.82	605.63	113.72	1661.17
10	Chhattisgarh	272.26	116.96	52.65	441.87	267.61	134.26	60.95	462.82	315.83	162.32	58.99	537.14
11	Maharashtra	1263.50	641.51	420.84	2325.85	1340.90	747.46	477.75	2566.11	1478.60	1016.51	570.35	3065.46
12	Rajasthan	705.33	260.46	20.91	986.70	709.53	319.02	23.47	1052.02	721.96	316.50	34.75	1073.21
13	Goa	3.47	1.84	1.82	7.13	3.03	2.92	2.18	8.13	3.25	3.14	2.71	9.10
14	Daman & Diu	0.38	0.06	0.03	0.47	0.29	0.08	0.02	0.39	0.31	0.13	0.02	0.46
15	D&N Haveli	0.57	0.40	0.05	1.02	0.61	0.44	0.05	1.10	0.72	0.45	0.04	1.21
Sub-Total (West Zone)		**4093.83**	**1876.01**	**718.16**	**6688.00**	**4194.20**	**2199.38**	**837.37**	**7230.95**	**4564.09**	**2596.34**	**987.04**	**8147.47**
North Zone													
16	Haryana	939.50	257.27	23.59	1220.36	946.28	313.52	29.37	1289.17	961.88	333.16	60.65	1355.69
17	Punjab	1315.47	343.91	38.38	1697.76	1331.77	379.28	56.51	1767.56	1358.19	433.60	73.83	1865.62
18	Uttar Pradesh	2751.94	821.85	182.13	3755.92	2882.24	900.35	250.17	4032.76	2898.83	1039.17	323.50	4261.50

in lakh tonnes

Sl. No.	State/Zone	2007-08				2008-09				2009-10			
		N	P	K	Total	N	P	K	Total	N	P	K	Total
1	2	3	4	5	6	7	8	9	10	11	12	13	14
19	Uttaranchal	115.44	24.75	10.29	150.48	110.52	29.78	12.53	152.83	115.40	29.65	10.26	155.31
20	Himachal Pradesh	32.34	8.91	8.71	49.96	35.46	10.71	11.20	57.37	31.32	10.90	11.02	53.24
21	Jammu & Kashmir	56.33	17.16	4.75	78.24	68.78	27.87	8.45	105.10	74.50	24.18	12.99	111.67
22	Delhi	0.30	0.08	0.01	0.39	0.64	0.00	0.00	0.64	1.86	0.36	0.13	2.35
23	Chandigarh	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sub-Total (North Zone)		**5211.32**	**1473.93**	**267.86**	**6953.11**	**5375.69**	**1661.51**	**368.23**	**7405.43**	**5441.98**	**1871.02**	**492.38**	**7805.38**
East Zone													
24	Bihar	929.63	191.59	84.42	1205.64	938.46	253.01	165.55	1357.02	894.43	247.44	167.99	1309.86
25	Jharkhand	89.41	45.83	9.76	145.00	88.59	45.95	12.73	147.27	94.03	53.84	19.48	167.35
26	Orissa	272.10	116.76	63.03	451.89	297.77	147.93	89.17	534.87	292.29	148.59	78.46	519.34
27	West Bengal	684.54	385.76	304.44	1374.74	698.24	415.42	405.65	1519.31	730.69	467.34	446.53	1644.56
Sub-Total (East Zone)		**1975.68**	**739.94**	**461.65**	**3177.27**	**2023.06**	**862.31**	**673.10**	**3558.47**	**2011.44**	**917.21**	**712.46**	**3641.11**
North East Zone													
28	Assam	103.35	54.61	55.98	213.94	115.21	48.24	57.16	220.61	127.25	48.75	66.27	242.27
29	Tripura	7.54	2.60	2.19	12.33	7.54	3.55	2.78	13.87	8.10	3.03	3.07	14.20
30	Manipur	14.35	3.36	1.30	19.01	9.44	1.95	1.48	12.87	10.67	1.01	0.36	12.04
31	Meghalaya	2.54	1.21	0.33	4.08	2.60	0.69	0.40	3.69	2.50	0.83	0.35	3.68
32	Nagaland	0.47	0.25	0.12	0.84	0.47	0.32	0.12	0.91	0.47	0.31	0.16	0.94
33	Arunachal Pradesh	0.45	0.19	0.09	0.73	0.51	0.21	0.09	0.81	0.51	0.22	0.09	0.82
34	Mizoram	1.91	1.06	0.90	3.87	2.11	1.19	1.05	4.35	2.00	2.41	1.06	5.47
35	Sikkim	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sub-Total(North East Zone)		**130.61**	**63.28**	**60.91**	**254.80**	**137.88**	**56.15**	**63.08**	**257.11**	**151.50**	**56.56**	**71.36**	**279.42**
All India		**14419.12**	**5514.74**	**2636.27**	**22570.13**	**15090.53**	**6506.24**	**3312.57**	**24909.34**	**15580.00**	**7274.04**	**3632.40**	**26486.44**

Source: Department of Agriculture and Coopration,INM Division.

Annexure. 3.5: State-wise Estimated Consumption of Fertiliser

(Kg/Per ha)

Sl. No.	State/ Zone	2007-08				2008-09				2009-10			
		N	P	K	Total	N	P	K	Total	N	P	K	Total
1	2	3	4	5	6	7	8	9	10	11	12	13	14
South Zone													
1	Andhra Pradesh	115.01	51.23	30.38	196.62	126.84	62.81	36.69	226.35	125.83	64.56	35.26	225.65
2	Karnataka	61.3	30	25.62	116.92	67.02	43.34	31.71	142.08	74.58	48.85	36.12	159.55
3	Kerala	33.78	15.48	28.19	75.44	40.47	19.93	34.1	94.5	40.84	21.07	34.03	95.94
4	Tamil Nadu	93.44	39.23	52.31	184.98	111.21	43.85	62.52	217.58	104.65	45.35	55.82	205.82
5	Pondicherry	572.57	244.86	244.57	1062	458.86	162	177.43	798.29	553.43	144	181.43	878.86
6	A&N Islands	27.86	25.71	8.57	62.14	20	12.86	10	42.86	22.14	19.29	9.29	50.71
7	Lakshadweep	0	0	0	0	0	0	0	0	0	0	0	0
Average (South Zone)		**85.72**	**38.8**	**32.14**	**156.66**	**95.75**	**49.22**	**39.07**	**184.03**	**97.21**	**52.24**	**39.02**	**188.47**
West Zone													
8	Gujarat	86.11	34.73	11.95	132.79	87.44	38.05	14.97	140.46	90.12	40.22	16.89	147.23
9	Madhya Pradesh	38.97	21.07	3.71	63.76	39.35	25.96	4.41	69.72	46.13	29.66	5.57	81.37
10	Chhattisgarh	47.37	20.35	9.16	76.87	46.56	23.36	10.6	80.52	54.95	28.24	10.26	93.45
11	Maharashtra	55.77	28.32	18.58	102.66	59.19	32.99	21.09	113.27	65.27	44.87	25.18	135.32
12	Rajasthan	31.76	11.73	0.94	44.43	31.95	14.37	1.06	47.38	32.51	14.25	1.56	48.33
13	Goa	20.41	10.82	10.71	41.94	17.82	17.18	12.82	47.82	19.12	18.47	15.94	53.53
14	Daman & Diu	190	30	15	235	145	40	10	195	155	65	10	230
15	D&N Haveli	21.11	14.81	1.85	37.78	22.59	16.3	1.85	40.74	26.67	16.67	1.48	44.82
Average (West Zone)		**49.06**	**22.48**	**8.61**	**80.14**	**50.26**	**26.36**	**10.03**	**86.65**	**54.69**	**31.11**	**11.83**	**97.63**
North Zone													
16	Haryana	145.48	39.84	3.65	188.97	146.53	48.55	4.55	199.63	148.94	51.59	9.39	209.92
17	Punjab	167.15	43.7	4.88	215.73	169.22	48.19	7.18	224.59	172.58	55.1	9.38	237.05
18	Uttar Pradesh	110.4	32.97	7.31	150.68	115.63	36.12	10.04	161.78	116.29	41.69	12.98	170.96
19	Uttaranchal	91.55	19.63	8.16	119.33	87.64	23.62	9.94	121.2	91.51	23.51	8.14	123.16
20	Himachal Pradesh	33.31	9.18	8.97	51.45	36.52	11.03	11.53	59.08	32.26	11.23	11.35	54.83
21	Jammu & Kashmir	49.67	15.13	4.19	68.99	60.65	24.58	7.45	92.68	65.7	21.32	11.46	98.48
22	Delhi	6.82	1.82	0.23	8.86	14.55	0	0	14.55	42.27	8.18	2.95	53.41
23	Chandigarh	0	0	0	0	0	0	0	0	0	0	0	0
Average (North Zone)		**122.14**	**34.54**	**6.28**	**162.96**	**125.99**	**38.94**	**8.63**	**173.56**	**127.55**	**43.85**	**11.54**	**182.94**
East Zone													
24	Bihar	117.53	24.22	10.67	152.42	118.64	31.99	20.93	171.56	113.08	31.28	21.24	165.6
25	Jharkhand	37.39	19.17	4.08	60.64	37.05	19.22	5.32	61.59	39.33	22.52	8.15	69.99
26	Orissa	30.18	12.95	6.99	50.12	33.03	16.41	9.89	59.33	32.42	16.48	8.7	57.6
27	West Bengal	70.19	39.56	31.22	140.97	71.6	42.6	41.6	155.79	74.93	47.92	45.79	168.64
Average (East Zone)		**67.97**	**25.45**	**15.88**	**109.3**	**69.6**	**29.66**	**23.16**	**122.41**	**69.2**	**31.55**	**24.51**	**125.26**
North East Zone													
28	Assam	26.92	14.23	14.58	55.73	30.01	12.57	14.89	57.47	33.15	12.7	17.26	63.11
29	Tripura	25.82	8.9	7.5	42.23	25.82	12.16	9.52	47.5	27.74	10.38	10.51	48.63
30	Manipur	61.06	14.3	5.53	80.89	40.17	8.3	6.3	54.77	45.4	4.3	1.53	51.23
31	Meghalaya	8.98	4.28	1.17	14.42	9.19	2.44	1.41	13.04	8.83	2.93	1.24	13
32	Nagaland	1.18	0.63	0.3	2.1	1.18	0.8	0.3	2.28	1.18	0.78	0.4	2.35
33	Arunachal Pradesh	1.65	0.7	0.33	2.68	1.88	0.77	0.33	2.98	1.88	0.81	0.33	3.01
34	Mizoram	19.9	11.04	9.38	40.31	21.98	12.4	10.94	45.31	20.83	25.1	11.04	56.98
35	Sikkim	0	0	0	0	0	0	0	0	0	0	0	0
Average (North East Zone)		**23.6**	**11.43**	**11**	**46.03**	**24.91**	**10.14**	**11.4**	**46.45**	**27.37**	**10.22**	**12.89**	**50.48**
All India (Average)		**73.64**	**28.16**	**13.46**	**115.27**	**77.07**	**33.23**	**16.92**	**127.21**	**79.57**	**37.15**	**18.55**	**135.27**

Source: Department of Agriculture and Cooperation, INM Division

Annexure. 3.6: Crop-wise Distribution of Certified/ Quality Seeds

(Lakh Quintals)

Crops	1983-84	1984-85	1985-86	1986-87	1987-88	1991-92	1992-93	1993-94	1994-95	1995-96	1996-97
1	2	3	4	5	6	7	8	9	10	11	12
Cereals											
Wheat	10.94	12.09	14.60	13.24	18.96	14.04	15.15	18.23	20.21	22.41	23.22
Paddy	8.86	8.49	10.41	15.12	10.85	14.47	14.28	13.58	14.63	15.37	16.57
Maize	1.44	1.51	1.75	1.88	1.04	1.50	1.50	1.35	1.35	1.55	1.88
Jowar	2.59	2.21	2.83	3.14	3.28	3.46	3.91	3.69	3.25	2.73	2.73
Bajra	1.65	1.59	1.58	1.58	1.09	1.68	1.69	1.68	1.61	1.66	1.71
Ragi	0.12	0.18	0.11	0.26	0.18	0.15	0.14	0.15	0.24	0.23	0.19
Barley	0.07	0.04	0.09	0.05	0.04	0.05	0.05	0.06	0.06	0.08	0.13
Sub-Total (Cereals)	**25.67**	**26.11**	**31.37**	**35.27**	**35.44**	**35.35**	**36.72**	**38.74**	**41.35**	**44.03**	**46.43**
Pulses											
Gram	0.85	0.66	0.87	1.49	1.40	1.03	1.02	1.11	1.14	1.22	1.44
Lentil	0.06	0.18	0.23	0.21	0.09	0.08	0.07	0.08	0.05	0.05	0.08
Peas	0.19	0.23	0.28	0.27	0.28	0.31	0.27	0.23	0.27	0.27	0.25
Urad	0.38	0.32	0.35	0.48	0.57	0.65	0.79	0.79	0.75	0.69	1.07
Moong	0.39	0.35	0.32	0.49	0.71	0.62	0.63	0.77	0.68	0.63	0.65
Arhar	0.14	0.26	0.19	0.27	0.29	0.49	0.48	0.49	0.56	0.57	0.58
Cowpea	0.08	0.09	0.06	0.10	-	0.08	0.09	-	0.15	0.15	0.12
Others	-	-	0.02	0.08	0.13	0.03	0.05	0.15	-	-	-
Sub-Total (Pulses)	**2.09**	**2.09**	**2.32**	**3.39**	**3.46**	**3.29**	**3.40**	**3.62**	**3.60**	**3.58**	**4.19**
Oilseeds											
Groundnut	5.16	4.67	3.37	4.55	4.72	6.72	7.00	6.73	7.01	6.85	7.27
Rapeseed & Mustard	0.29	0.49	0.48	0.45	0.45	0.77	0.75	0.79	0.75	0.86	1.02
Til	0.03	0.03	0.04	0.03	0.03	0.08	0.09	0.14	0.12	0.11	0.10
Sunflower	0.25	0.28	0.28	0.25	0.27	0.55	0.63	0.73	0.68	0.82	0.58
Soyabean	0.60	0.09	0.81	0.78	0.74	1.23	1.91	2.57	2.98	3.57	3.08
Linseed	0.01	0.01	0.06	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.02
Castorseed	0.10	0.09	0.18	0.15	0.07	0.21	0.22	0.22	0.22	0.26	0.30
Safflower	0.05	0.06	0.06	0.06	0.24	0.08	0.13	0.19	0.23	0.15	0.16
Others	0.01	0.01	-	0.01	0.01	-					
Sub-Total (Oilseeds)	**6.49**	**6.53**	**6.29**	**6.29**	**6.54**	**9.66**	**10.75**	**11.38**	**12.01**	**12.64**	**12.53**
Fibres											
Cotton	1.78	1.19	2.08	1.50	1.34	1.77	1.87	1.81	1.96	2.34	2.93
Jute	0.12	0.22	0.27	0.22	0.20	0.26	0.22	0.20	0.24	0.24	0.25
Mesta/Others	0.01	-	-	-	-						
Sub-Total (Fibers)	1.91	1.41	2.35	1.72	1.54	2.03	2.09	2.01	2.20	2.58	3.18
Other Miscellaneous											
Potato	8.74*	12.25*	13.22*	9.06*	9.16*	6.90	7.10	6.17	6.62	6.85	6.69
Others	0.07	0.07	0.07	0.16	0.16	0.27	0.27	0.28	0.08	0.24	0.25
Sub-Total (Other Miscs.)	**8.81**	**12.32**	**13.29**	**9.22**	**9.32**	**7.17**	**7.37**	**6.45**	**6.70**	**7.09**	**6.94**
Grand Total	**44.97**	**48.46**	**55.01**	**55.83**	**56.30**	**57.50**	**60.33**	**62.20**	**65.86**	**69.92**	**73.27**

1997-98	1998-99	1999-2000	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11
13	14	15	16	17	18	19	20	21	22	23	24	25	26
24.42	26.14	29.52	27.04	32.59	33.00	35.97	41.31	44.21	54.55	63.25	74.83	90.66	97.83
20.22	24.05	23.71	24.41	25.58	25.79	26.51	30.98	32.41	43.51	48.93	58.18	60.95	69.34
2.36	2.26	2.72	3.11	2.75	3.42	3.38	4.13	4.64	5.74	5.80	7.94	7.74	8.94
2.83	2.57	2.67	2.39	2.20	2.15	2.37	2.31	2.28	2.32	2.38	2.41	2.24	2.16
1.63	1.87	2.00	1.94	1.80	1.79	1.76	1.76	2.17	2.16	1.90	2.20	1.74	2.31
0.19	0.19	0.20	0.19	0.14	0.24	0.21	0.25	0.22	0.21	0.27	0.25	0.05	0.26
0.13	0.19	0.32	0.39	0.50	0.58	0.62	0.67	0.80	1.08	1.27	1.62	1.77	1.79
51.78	**57.27**	**61.14**	**59.47**	**65.56**	**66.97**	**70.82**	**81.41**	**86.73**	**109.87**	**123.80**	**147.43**	**165.15**	**182.62**
1.06	1.10	1.19	1.09	1.53	2.64	3.90	3.62	3.45	5.08	6.73	8.6	12.32	12.50
0.11	0.13	0.07	0.13	0.29	0.26	0.35	0.52	0.45	0.54	0.56	0.59	0.55	0.74
0.30	0.25	0.29	0.26	0.31	0.37	0.60	0.61	0.82	0.93	1.10	1.29	2.07	1.47
0.96	1.02	0.86	0.88	0.97	1.43	1.32	1.01	0.92	0.8	1.40	1.37	1.61	1.96
0.69	0.86	0.80	0.78	0.83	0.81	1.21	0.76	0.77	0.23	1.34	1.23	1.29	1.76
0.59	0.64	0.56	0.58	0.64	0.64	0.64	0.72	0.77	0.85	1.18	1.09	1.37	1.52
-	-	0.06	0.06	0.05	0.33	0.05	0.08	0.11	0.09	0.10	0.16	0.20	0.33
0.18	0.06	0.04	0.07	0.07	0.12	0.10	0.08	0.08	0.11	0.16	0.15	0.28	0.56
3.89	**4.06**	**3.87**	**3.85**	**4.69**	**6.60**	**8.17**	**7.40**	**7.37**	**9.63**	**12.57**	**14.48**	**19.69**	**20.83**
6.81	6.20	6.46	5.40	5.25	5.42	7.00	7.18	6.96	9.89	14.43	15.90	18.86	21.79
1.05	1.13	0.94	0.69	0.86	0.82	0.91	1.31	1.24	1.36	1.71	1.63	2.09	2.07
0.15	0.12	0.19	0.10	0.16	0.13	0.14	0.12	0.14	0.16	0.22	0.18	0.18	0.20
0.75	0.62	0.51	0.42	0.48	0.61	0.56	0.80	0.90	0.89	0.92	0.80	0.76	0.55
3.68	5.41	4.45	5.46	4.99	6.88	10.20	13.36	14.29	14.05	16.52	20.89	28.44	25.55
0.01	0.01	0.02	0.01	0.02	0.01	0.01	0.01	0.01	0.02	0.02	0.01	0.01	0.04
0.25	0.29	0.30	0.39	0.26	0.37	0.39	0.41	0.50	0.36	0.42	0.42	0.29	0.31
0.16	0.05	0.09	0.06	0.07	0.07	0.04	0.08	0.08	0.07	0.08	0.09	0.07	0.08
0.01	-	0.02	0.01	0.01	0.04	0.14	0.15	0.23	0.20	0.01		0.01	0.01
12.87	**13.83**	**12.98**	**12.54**	**12.10**	**13.36**	**19.39**	**23.42**	**24.35**	**27.00**	**34.33**	**39.92**	**50.71**	**50.61**
2.87	2.61	2.66	2.61	2.62	2.31	2.45	2.56	2.69	2.45	1.89	2.27	2.36	2.33
0.34	0.31	0.26	0.27	0.21	0.19	0.20	0.19	0.19	0.26	0.24	0.28	0.27	0.27
		0.01	0.03	0.06	0.24	0.13	0.01	0.01	0.34	0.50	0.03	0.02	0.04
3.21	2.92	2.93	2.91	2.89	2.74	2.78	2.76	2.89	3.05	2.63	2.58	2.65	2.64
6.83	6.86	6.89	7.23	6.33	7.16	7.01	5.05	5.08	5.12	5.35	10.55	18.68	20.08
0.21	0.03	0.17	0.27	0.23	0.21	0.23	0.22	0.33	0.34	0.37	0.85	0.23	0.55
7.04	**6.89**	**7.06**	**7.50**	**6.56**	**7.37**	**7.24**	**5.27**	**5.41**	**5.46**	**5.72**	**11.40**	**18.91**	**20.63**
78.79	**84.97**	**87.98**	**86.27**	**91.80**	**97.04**	**108.40**	**120.26**	**126.75**	**155.01**	**179.05**	**215.81**	**257.11**	**277.34**

Note: Data from 1988-89 to 1990-91 is not available. * Estimated

Source: Department of Agriculture and Coopration, Seeds Division.

Annexure. 3.10: Flow of Institutional Credit to Agriculture Sector

(Rs crore)

Particulars/Agency	1998-99	1999-2000	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12*
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
I. Production (ST) Credit														
Cooperative Banks	12514	14771	16528	18787	19668	22640	27157	34930	38622	40515	40230	56946	64527	47497
RRBs	1710	2423	3245	3777	4775	6088	10010	12712	16631	20715	22413	29802	37808	24976
Commercial Banks	9622	11697	13486	17904	21104	26192	36793	57640	83202	122289	147818	189908	216773	109049
Other Agencies	59	74	55	41	39	57	104	68	0	0	0	0	0	0
Sub Total (A)	23905	28965	33314	40509	45586	54977	74064	105350	138455	183519	210461	276656	319108	181522
II. MT/LT Total														
Cooperative Banks	3356	3489	4190	4737	3968	4235	4074	4474	3858	3169	5962	6551	5578	2335
RRBs	750	749	974	1077	1295	1493	2394	2511	3804	4099	4352	5415	6160	2484
Commercial Banks	8821	13036	14321	15683	18670	26249	44688	67837	83283	58798	81133	95892	115933	37039
Other Agencies	30	29	28	39	41	27	89	314	0	0	0	0	0	0
Sub Total (B)	12957	17303	19513	21536	23974	32004	51245	75136	90945	66066	91447	107858	127671	41858
ST+MT/LT Credit														
Cooperative Banks	15870	18260	20718	23524	23636	26875	31231	39403	42480	48258	46192	63497	70105	49832
RRBs	2460	3172	4219	4854	6070	7581	12404	15223	20435	25312	26765	35217	43968	27460
Commercial Banks	18443	24733	27807	33587	39774	52441	81481	125477	166485	181088	228951	285800	332706	146088
Other Agencies	87	103	83	80	80	84	193	382	0	0	0	0	0	0
Grand Total (A+B)	36860	46268	52827	62045	69560	86981	125309	180485	229400	254658	301908	384514	446779	223380

* Upto September, 2011

Source: Department of Agriculture and Cooperation, Credit Division.

Annexure. 3.11: National Agricultural Insurance Scheme (NAIS)

(As on 19.01.12)

S.No.	Season	No. of Farmers Covered	Area (ha)	Rs in Lakhs						No. of Farmers Benefitted
				Sum Insured	Premium	Subsidy	Claims Reported	Claims Settled	Claims Payble	
1	2	3	4	5	6	7	8	9	10	11
1	Rabi 1999-00	579940	780569.36	35640.71	542.48	165.70	769.26	769.26	0.00	55288
2	Kharif 2000	8409374	13219828.68	690338.38	20673.55	4739.92	122248.15	122248.15	0.00	3635252
3	Rabi 2000-01	2091733	3111423.25	160268.46	2778.76	823.53	5948.63	5948.63	0.00	526697
	Total 2000-01	**10501107**	**16331251.93**	**850606.84**	**23452.31**	**5563.45**	**128196.78**	**128196.78**	**0.00**	**4161949**
4	Kharif 2001	8696587	12887710.38	750246.11	26161.82	4762.14	49353.55	49353.55	0.00	1741873
5	Rabi 2001-02	1955431	3145872.65	149751.11	3014.79	777.79	6465.80	6465.80	0.00	453325
	Total 2001-02	**10652018**	**16033583.03**	**899997.22**	**29176.61**	**5539.93**	**55819.35**	**55819.35**	**0.00**	**2195198**
6	Kharif 2002	9768711	15532348.53	943169.37	32546.68	4486.39	182431.26	182431.26	0.00	4297155
7	Rabi 2002-03	2326811	4037824.35	183754.52	3850.43	672.81	18854.84	18854.84	0.00	926408
	Total 2002-03	**12095522**	**19570172.88**	**1126923.89**	**36397.11**	**5159.20**	**201286.10**	**201286.10**	**0.00**	**5223563**
8	Kharif 2003	7970830	12355513.83	811412.55	28333.19	2444.58	65267.94	65267.94	0.00	1712269
9	Rabi 2003-04	4421287	6468662.75	304949.21	6405.87	624.17	49705.64	49705.64	0.00	2098125
	Total 2003-04	**12392117**	**18824176.58**	**1116361.76**	**34739.06**	**3068.75**	**114973.57**	**114973.57**	**0.00**	**3810394**
10	Kharif 2004	12687104	24273393.97	1317061.59	45894.28	2009.22	103816.53	103816.53	0.00	2674743
11	Rabi 2004-05	3531045	5343243.62	377420.53	7585.28	412.36	16058.60	16058.60	0.00	772779
	Total 2004-05	**16218149**	**29616637.59**	**1694482.12**	**53479.55**	**2421.58**	**119875.13**	**119875.13**	**0.00**	**3447522**
12	Kharif 2005	12673833	20531037.95	1351909.81	44994.94	2043.54	105994.42	105994.42	0.00	2666221
13	Rabi 2005-06	4048524	7218417.22	507166.12	10482.40	523.12	33830.20	33830.20	0.00	980748
	Total 2005-06	**16722357**	**27749455.17**	**1859075.94**	**55477.34**	**2566.66**	**139824.62**	**139824.62**	**0.00**	**3646969**
14	Kharif 2006	12934117	19672993.68	1475946.18	46729.39	2654.85	177491.00	177491.00	0.00	3131511
15	Rabi 2006-07	4977980	7632881.68	654221.41	14287.60	1137.75	51596.27	51596.27	0.00	1390430
	Total 2006-07	**17912097**	**27305875.36**	**2130167.59**	**61016.99**	**3792.60**	**229087.27**	**229087.27**	**0.00**	**4521941**
16	Kharif 2007	13398822	20754746.67	1700796.37	52432.28	2666.05	91522.14	91433.01	89.13	1591287
17	Rabi 2007-08	5044016	7387156.02	746664.33	15871.00	1799.57	81004.66	81004.53	0.13	1578608
	Total 2007-08	**18442838**	**28141902.69**	**2447460.70**	**68303.28**	**4465.62**	**172526.81**	**172437.54**	**89.26**	**3169895**
18	Kharif 2008	12990975	17635162.07	1566540.81	51192.10	3371.91	237671.96	237671.96	0.00	4216435
19	Rabi 2008-09	6210620	8857495.28	1114859.28	29571.85	6494.63	150883.67	150234.24	649.43	1977328
	Total 2008-09	**19201595**	**26492657.35**	**2681400.09**	**80763.95**	**9866.53**	**388555.62**	**387906.20**	**649.42**	**6193763**
20	Kharif 2009	18253072	25769817.34	2761670.64	86284.89	5712.57	456682.93	443759.05	12923.88	7963775
21	Rabi 2009-10	5646964	7866817.55	1087561.21	28735.24	7278.00	57139.56	38945.84	18193.73	1039204
	Total 2009-10	**23900036**	**33636634.89**	**3849231.85**	**115020.13**	**12990.57**	**513822.49**	**482704.88**	**31117.61**	**9002979**
22	Kharif 2010	12684117	17193817.04	2370509.47	72164.94	4540.05	154200.60	135249.45	18951.15	2182988
23	Rabi 2010-11	4896166	6853311.90	1068889.15	28798.20	8895.06	57738.40	45413.97	12324.43	1065476
	Total 2010-11	**17580283**	**24047128.94**	**3439398.61**	**100963.14**	**13435.11**	**211939.00**	**180663.42**	**31275.58**	**3248464**
	Kharif Seasons Total	130467542	199826370.14	15739601.28	507408.07	39431.22	1746680.48	1714716.31	31964.16	35813509
	Rabi Seasons Total	45730517	68703675.63	6391146.03	151923.90	29604.49	529995.53	498827.81	31167.72	12864416
	GRAND TOTAL	**176198059**	**268530045.77**	**22130747.31**	**659331.96**	**69035.71**	**2276676.01**	**2213544.12**	**63131.88**	**48677925**

Source : Department of Agriculture and Cooperation, Credit Division.

Annexure. 4.1: All India Estimates of Area of Foodgrains

Area (million Hectares)

	Season	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12*
Rice	Autumn	3.04	2.78	2.70	2.63	2.56	2.30	2.22	2.23	2.08		
	Winter	15.32	14.73	14.84	14.54	14.99	13.50	13.61	13.95	13.56		
	Kharif	22.26	20.52	21.70	21.19	21.79	23.80	23.62	24.61	21.96		
	Total Kharif	40.62	38.04	39.23	38.36	39.34	39.60	39.45	40.79	37.60	38.03	40.51
	Rabi/Summer	4.28	3.14	3.36	3.54	4.32	4.21	4.46	4.74	4.32	4.83	3.90
	Total	44.90	41.18	42.59	41.91	43.66	43.81	43.91	45.54	41.92	42.86	44.41
Wheat	Rabi	26.34	25.20	26.59	26.38	26.48	27.99	28.04	27.75	28.46	29.07	28.89
Jowar	Kharif	4.47	4.24	4.46	4.10	3.76	3.74	3.50	2.89	3.24	3.07	2.54
	Rabi	5.32	5.56	4.87	4.99	4.90	4.73	4.26	4.64	4.55	4.31	3.69
	Total	9.80	9.30	9.33	9.09	8.67	8.47	7.76	7.53	7.79	7.38	6.23
Bajra	Kharif	9.53	7.74	10.61	9.23	9.58	9.51	9.57	8.75	8.90	9.61	9.05
Maize	Kharif	5.93	5.98	6.59	6.59	6.76	6.96	7.12	6.89	7.06	7.28	7.41
	Rabi/Summer	0.65	0.66	0.75	0.84	0.83	0.93	1.00	1.28	1.20	1.27	1.26
	Total	6.58	6.64	7.34	7.43	7.59	7.89	8.12	8.17	8.26	8.55	8.67
Ragi	Kharif	1.65	1.42	1.67	1.55	1.53	1.18	1.39	1.38	1.27	1.29	1.31
Small Millets	Kharif	1.31	1.20	1.19	1.10	1.06	1.01	1.04	0.91	0.83	0.89	0.82
Barley	Rabi	0.66	0.70	0.66	0.62	0.63	0.65	0.60	0.71	0.62	0.71	0.69
Coarse Cereals	Kharif	22.89	20.57	24.52	22.58	22.70	22.39	22.62	20.83	21.31	22.15	21.12
	Rabi	6.63	6.42	6.28	6.45	6.36	6.31	5.87	6.62	6.37	6.29	5.64
	Total	29.52	26.99	30.80	29.03	29.06	28.71	28.48	27.45	27.68	28.43	26.76
Cereals	Kharif	63.51	58.61	63.75	60.94	62.04	62.00	62.07	61.62	58.91	60.18	61.63
	Rabi	37.26	34.75	36.24	36.37	37.17	38.52	38.36	39.12	39.14	40.18	38.43
	Total	100.77	93.36	99.99	97.32	99.21	100.52	100.43	100.74	98.05	100.36	100.06
Tur (Arhar)	Kharif	3.33	3.36	3.52	3.52	3.58	3.56	3.73	3.38	3.47	4.37	3.99
Pulses Other Than Tur	Kharif	7.39	6.59	8.17	7.80	7.10	7.11	7.76	6.43	7.12	7.95	7.46
Gram	Rabi	6.42	5.91	7.05	6.71	6.93	7.49	7.54	7.89	8.17	9.19	8.96
Pulses Other Than Gram	Rabi	4.87	4.64	4.73	4.73	4.79	5.02	4.60	4.39	4.53	4.90	5.02
Pulses	Kharif	10.72	9.95	11.68	11.32	10.68	10.68	11.49	9.81	10.58	12.32	11.45
	Rabi	11.29	10.55	11.78	11.45	11.71	12.52	12.14	12.29	12.70	14.08	13.98
	Total	22.01	20.50	23.46	22.76	22.39	23.19	23.63	22.09	23.28	26.40	25.43
Foodgrains	Kharif	74.23	68.56	75.44	72.26	72.72	72.67	73.56	71.43	69.49	72.50	73.08
	Rabi	48.55	45.30	48.01	47.82	48.88	51.04	50.51	51.40	51.84	54.27	52.41
	Total	122.78	113.86	123.45	120.08	121.60	123.71	124.07	122.83	121.33	126.76	125.49

*As per Second Advance Estimates released on 03.02.2012.

Annexure. 4.2: All India Estimates of Production of Foodgrains

Production (million Tonnes)

	Season	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12*
Rice	Autumn	4.66	3.35	3.73	3.49	3.45	3.51	3.10	3.53	3.04		
	Winter	29.69	23.50	27.71	25.54	26.90	27.00	25.73	27.44	26.28		
	Kharif	46.17	36.24	47.18	43.20	47.92	49.66	53.82	53.94	46.60		
	Total Kharif	80.52	63.08	78.62	72.23	78.27	80.17	82.66	84.91	75.92	80.65	90.18
	Rabi/Summer	12.82	8.74	9.91	10.90	13.52	13.18	14.03	14.27	13.18	15.33	12.57
	Total	93.34	71.82	88.53	83.13	91.79	93.36	96.69	99.18	89.09	95.98	102.74
Wheat	Rabi	72.77	65.76	72.16	68.64	69.35	75.81	78.57	80.68	80.80	86.87	88.31
Jowar	Kharif	4.23	4.22	4.84	4.04	4.07	3.71	4.11	3.05	2.76	3.44	3.03
	Rabi	3.33	2.79	1.84	3.20	3.56	3.44	3.81	4.19	3.93	3.56	3.06
	Total	7.56	7.01	6.68	7.24	7.63	7.15	7.93	7.25	6.70	7.00	6.08
Bajra	Kharif	8.28	4.72	12.11	7.93	7.68	8.42	9.97	8.89	6.51	10.37	9.73
Maize	Kharif	11.25	9.27	12.73	11.48	12.16	11.56	15.11	14.12	12.29	16.64	16.10
	Rabi/Summer	1.91	1.88	2.25	2.70	2.55	3.54	3.85	5.61	4.43	5.09	5.50
	Total	13.16	11.15	14.98	14.17	14.71	15.10	18.96	19.73	16.72	21.73	21.60
Ragi	Kharif	2.37	1.32	1.97	2.43	2.35	1.44	2.15	2.04	1.89	2.19	2.26
Small Millets	Kharif	0.58	0.46	0.56	0.48	0.47	0.48	0.55	0.44	0.38	0.73	0.72
Barley	Rabi	1.42	1.41	1.30	1.21	1.22	1.33	1.20	1.69	1.35	1.66	1.68
Coarse Cereals	Kharif	26.71	19.99	32.22	26.36	26.74	25.61	31.89	28.54	23.83	33.37	31.84
	Rabi	6.66	6.08	5.39	7.10	7.33	8.31	8.86	11.49	9.72	10.32	10.24
	Total	33.38	26.07	37.60	33.46	34.07	33.92	40.75	40.04	33.55	43.68	42.08
Cereals	Kharif	107.23	83.07	110.84	98.59	105.01	105.78	114.55	113.45	99.75	114.02	122.02
	Rabi	92.25	80.57	87.45	86.64	90.21	97.30	101.46	106.45	103.70	112.52	111.13
	Total	199.48	163.65	198.28	185.23	195.22	203.08	216.01	219.90	203.45	226.54	233.14
Tur (Arhar)	Kharif	2.26	2.19	2.36	2.35	2.74	2.31	3.08	2.27	2.46	2.86	2.72
Pulses Other Than Tur	Kharif	2.58	1.97	3.81	2.37	2.13	2.48	3.33	2.42	1.74	4.26	3.67
Gram	Rabi	5.47	4.24	5.72	5.47	5.60	6.33	5.75	7.06	7.48	8.22	7.66
Pulses Other Than Gram	Rabi	3.06	2.74	3.02	2.94	2.92	3.07	2.61	2.82	2.98	2.90	3.22
Pulses	Kharif	4.84	4.15	6.16	4.72	4.86	4.80	6.40	4.69	4.20	7.12	6.40
	Rabi	8.53	6.97	8.74	8.41	8.52	9.40	8.36	9.88	10.46	11.12	10.88
	Total	13.37	11.13	14.91	13.13	13.38	14.20	14.76	14.57	14.66	18.24	17.28
Foodgrains	Kharif	112.07	87.22	117.00	103.31	109.87	110.58	120.96	118.14	103.95	121.14	128.41
	Rabi	100.78	87.55	96.19	95.05	98.73	106.71	109.82	116.33	114.15	123.64	122.01
	Total	212.85	174.77	213.19	198.36	208.60	217.28	230.78	234.47	218.11	244.78	250.42

*As per Second Advance Estimates released on 03.02.2012.

Annexure. 4.3: All India Estimates of Yields of Foodgrains

Yield (kg/Hectares)

	Season	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12*
Rice	Autumn	1532	1202	1385	1327	1349	1526	1396	1582	1458		
	Winter	1938	1595	1868	1756	1795	2000	1891	1967	1938		
	Kharif	2074	1766	2174	2039	2199	2086	2278	2192	2122		
	Total Kharif	1982	1658	2004	1883	1990	2024	2095	2081	2019	2121	2226
	Rabi/Summer	2992	2783	2947	3077	3127	3130	3147	3009	3053	3174	3223
	Total	2079	1744	2078	1984	2102	2131	2202	2178	2125	2239	2314
Wheat	Rabi	2762	2610	2713	2602	2619	2708	2802	2907	2839	2989	3057
Jowar	Kharif	945	995	1085	987	1082	992	1176	1055	853	1119	1189
	Rabi	625	552	377	641	726	727	894	904	865	827	829
	Total	771	754	716	797	880	844	1021	962	860	949	976
Bajra	Kharif	869	610	1141	859	802	886	1042	1015	731	1079	1075
Maize	Kharif	1896	1552	1932	1740	1799	1660	2122	2048	1740	2285	2174
	Rabi/Summer	2952	2851	2987	3224	3076	3793	3854	4387	3694	4003	4364
	Total	2000	1681	2041	1907	1938	1912	2335	2414	2024	2540	2492
Ragi	Kharif	1442	930	1180	1567	1534	1226	1552	1477	1489	1705	1730
Small Millets	Kharif	440	383	473	434	443	475	530	491	460	817	884
Barley	Rabi	2160	2006	1975	1958	1938	2055	1985	2394	2172	2357	2441
Coarse Cereals	Kharif	1167	972	1314	1168	1178	1144	1410	1371	1119	1507	1507
	Rabi	1005	947	858	1102	1152	1316	1510	1735	1525	1641	1817
	Total	1131	966	2121	1153	1172	1182	1431	1459	1212	1536	1572
Cereals	Kharif	1688	1417	1739	1618	1693	1706	1846	1841	1693	1895	1980
	Rabi	2476	2319	2413	2382	2427	2526	2645	2721	2649	2800	2892
	Total	1980	1753	1983	1903	1968	2020	2151	2183	2075	2257	2330
Tur (Arhar)	Kharif	679	651	670	667	765	650	826	671	711	655	683
Pulses Other Than Tur	Kharif	349	298	466	304	300	349	429	377	244	536	492
Gram	Rabi	853	717	811	815	808	845	762	895	915	895	856
Pulses Other Than Gram	Rabi	628	590	640	622	610	611	567	642	658	592	640
Pulses	Kharif	451	417	528	417	456	449	557	478	397	578	559
	Rabi	756	661	742	735	727	751	688	804	823	790	778
	Total	607	543	635	577	598	612	625	659	630	691	679
Foodgrains	Kharif	1510	1272	1551	1430	1511	1522	1644	1654	1496	1671	1757
	Rabi	2076	1933	2004	1988	2020	2091	2174	2263	2202	2278	2328
	Total	1734	1535	1727	1652	1715	1756	1860	1909	1798	1931	1996

*As per Second Advance Estimates released on 03.02.2012.

Annexure. 4.4: Area under Commercial Crops

(Million Hectares)

	Season											
		2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12*
Groundnut	Kharif	5.46	5.27	5.20	5.79	5.74	4.78	5.31	5.29	4.62	4.98	4.28
	Rabi	0.78	0.66	0.79	0.85	1.00	0.83	0.98	0.88	0.86	0.88	0.91
	Total	6.24	5.94	5.99	6.64	6.74	5.62	6.29	6.16	5.48	5.86	5.19
Castorseed	Kharif	0.72	0.58	0.72	0.74	0.86	0.63	0.79	0.87	0.73	0.88	1.45
Nigerseed	Kharif	0.48	0.41	0.43	0.43	0.41	0.47	0.41	0.39	0.38	0.37	0.33
Sesamum	Kharif	1.67	1.44	1.70	1.84	1.72	1.70	1.80	1.81	1.94	2.08	1.83
Rapeseed & Mustard	Rabi	5.07	4.54	5.43	7.32	7.28	6.79	5.83	6.30	5.59	6.90	6.70
Linseed	Rabi	0.54	0.45	0.48	0.45	0.44	0.44	0.47	0.41	0.34	0.36	0.36
Safflower	Rabi	0.40	0.37	0.36	0.37	0.36	0.38	0.32	0.29	0.29	0.24	0.18
Sunflower	Kharif	0.31	0.53	0.61	0.87	0.92	0.86	0.76	0.66	0.57	0.32	0.28
	Rabi	0.87	1.11	1.39	1.29	1.42	1.30	1.15	1.15	0.91	0.61	0.48
	Total	1.18	1.64	2.00	2.16	2.34	2.16	1.91	1.81	1.48	0.93	0.76
Soyabean	Kharif	6.34	6.11	6.55	7.57	7.71	8.33	8.88	9.51	9.73	9.60	10.19
Edible Oilseeds	Kharif	14.26	13.77	14.49	16.50	16.50	16.14	17.16	17.66	17.24	17.35	16.92
	Rabi	7.12	6.69	7.98	9.83	10.06	9.31	8.28	8.62	7.65	8.64	8.26
	Total	21.38	20.46	22.47	26.33	26.56	25.45	25.44	26.28	24.88	25.98	25.18
Non Edible Oilseeds	Kharif	0.72	0.58	0.72	0.74	0.86	0.63	0.79	0.87	0.73	0.88	1.45
	Rabi	0.54	0.45	0.48	0.45	0.44	0.44	0.47	0.41	0.34	0.36	0.36
	Total	1.25	1.03	1.19	1.19	1.30	1.06	1.25	1.27	1.08	1.24	1.81
Total Nine Oilseeds	Kharif	14.98	14.35	15.21	17.25	17.37	16.77	17.95	18.53	17.97	18.23	18.37
	Rabi	7.66	7.14	8.45	10.28	10.49	9.74	8.74	9.03	7.99	9.00	8.62
	Total	22.64	21.49	23.66	27.52	27.86	26.51	26.69	27.56	25.96	27.22	27.00
Cotton	Total	9.13	7.67	7.60	8.79	8.68	9.14	9.41	9.41	10.13	11.24	12.18
Jute	Total	0.87	0.86	0.85	0.77	0.76	0.79	0.81	0.79	0.81	0.77	0.81
Mesta	Total	0.17	0.17	0.15	0.14	0.14	0.14	0.15	0.12	0.09	0.10	0.10
Sugarcane	Total	4.41	4.52	3.94	3.66	4.20	5.15	5.06	4.42	4.17	4.88	5.08

*2nd Advance Estimates released on 03.02.2012.

Annexure. 4.5: Production of Commercial Crops

(Million Tonnes/bales)

	Season	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12*
Groundnut	Kharif	5.62	3.09	6.86	5.26	6.30	3.29	7.36	5.62	3.85	6.64	5.35
	Rabi	1.41	1.03	1.27	1.51	1.70	1.57	1.82	1.55	1.58	1.62	1.59
	Total	7.03	4.12	8.13	6.77	7.99	4.86	9.18	7.17	5.43	8.26	6.94
Castorseed	Kharif	0.65	0.43	0.80	0.79	0.99	0.76	1.05	1.17	1.01	1.35	2.34
Nigerseed	Kharif	0.13	0.09	0.11	0.11	0.11	0.12	0.11	0.12	0.10	0.11	0.09
Sesamum	Kharif	0.70	0.44	0.78	0.67	0.64	0.62	0.76	0.64	0.59	0.89	0.77
Rapeseed & Mustard	Rabi	5.08	3.88	6.29	7.59	8.13	7.44	5.83	7.20	6.61	8.18	7.50
Linseed	Rabi	0.21	0.18	0.20	0.17	0.17	0.17	0.16	0.17	0.15	0.15	0.15
Safflower	Rabi	0.22	0.18	0.13	0.17	0.23	0.24	0.22	0.19	0.18	0.15	0.10
Sunflower	Kharif	0.16	0.27	0.31	0.43	0.46	0.37	0.46	0.36	0.21	0.19	0.17
	Rabi	0.52	0.60	0.62	0.76	0.98	0.86	1.00	0.80	0.64	0.46	0.39
	Total	0.68	0.87	0.93	1.19	1.44	1.23	1.46	1.16	0.85	0.65	0.56
Soyabean	Kharif	5.96	4.65	7.82	6.88	8.27	8.85	10.97	9.91	9.96	12.74	12.08
Edible Oilseeds	Kharif	12.57	8.55	15.88	13.36	15.78	13.25	19.66	16.64	14.72	20.57	18.46
	Rabi	7.23	5.69	8.32	10.03	11.04	10.11	8.88	9.74	9.00	10.41	9.58
	Total	19.80	14.23	24.19	23.39	26.81	23.36	28.54	26.38	23.72	30.98	28.04
Non Edible Oilseeds	Kharif	0.65	0.43	0.80	0.79	0.99	0.76	1.05	1.17	1.01	1.35	2.34
	Rabi	0.21	0.18	0.20	0.17	0.17	0.17	0.16	0.17	0.15	0.15	0.15
	Total	0.86	0.60	0.99	0.96	1.16	0.93	1.22	1.34	1.16	1.50	2.49
Total Nine Oilseeds	Kharif	13.22	8.98	16.67	14.15	16.77	14.01	20.71	17.81	15.73	21.92	20.80
	Rabi	7.44	5.86	8.51	10.20	11.21	10.28	9.04	9.91	9.15	10.56	9.73
	Total	20.66	14.84	25.19	24.35	27.98	24.29	29.76	27.72	24.88	32.48	30.53
Cotton@	Total	10.00	8.62	13.73	16.43	18.50	22.63	25.88	22.28	24.02	33.00	34.09
Jute$	Total	10.58	10.27	10.25	9.40	9.97	10.32	10.22	9.63	11.23	10.01	10.95
Mesta$	Total	1.09	1.00	0.92	0.87	0.87	0.96	0.99	0.73	0.59	0.61	0.67
Sugarcane	Total	297.21	287.38	233.86	237.09	281.17	355.52	348.19	285.03	292.30	342.38	347.86

*2nd Advance Estimates released on 03.02.2012.

@ Thousand bales of 170 kgs each.

$ Thousand bales of 180 kgs each.

Annexure. 4.6: Yield of Commercial Crops

(Kg/Ha)

	Season											
		2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12*
Groundnut	Kharif	1030	587	1320	909	1097	689	1386	1063	835	1335	1251
	Rabi	1808	1548	1602	1771	1702	1880	1857	1764	1830	1846	1737
	Total	1127	694	1357	1020	1187	866	1459	1163	991	1411	1337
Castorseed	Kharif	911	733	1111	1068	1146	1213	1339	1352	1373	1534	1609
Nigerseed	Kharif	272	208	252	261	261	258	269	297	266	290	275
Sesamum	Kharif	418	306	460	366	372	363	421	354	303	429	419
Rapeseed & Mustard	Rabi	1002	854	1159	1038	1117	1095	1001	1143	1183	1185	1120
Linseed	Rabi	390	393	412	378	395	385	349	415	449	408	419
Safflower	Rabi	546	483	371	470	627	637	701	642	621	617	554
Sunflower	Kharif	501	510	501	494	496	425	607	540	378	608	605
	Rabi	604	541	448	587	692	661	870	696	700	748	828
	Total	577	531	464	549	615	567	765	639	576	701	746
Soyabean	Kharif	940	762	1193	908	1073	1063	1235	1041	1024	1327	1185
Edible Oilseeds	Kharif	881	621	1095	809	956	821	1146	942	854	1186	1091
	Rabi	1016	850	1043	1021	1098	1086	1073	1130	1177	1205	1159
	Total	926	696	1077	888	1010	918	1122	1004	953	1192	1113
Non Edible Oilseeds	Kharif	911	733	1111	1068	1146	1213	1339	1352	1373	1534	1609
	Rabi	390	393	412	378	395	385	349	415	449	408	419
	Total	688	585	832	808	894	874	970	1052	1080	1208	1373
Total Nine Oilseeds	Kharif	883	625	1096	820	965	836	1154	961	875	1203	1132
	Rabi	972	821	1007	993	1068	1055	1034	1097	1146	1174	1128
	Total	913	691	1064	885	1004	916	1115	1006	958	1193	1131
Cotton	Total	186	191	307	318	362	421	467	403	403	499	476
Jute	Total	2182	2139	2173	2186	2362	2342	2260	2207	2492	2329	2447
Mesta	Total	1131	1056	1087	1108	1136	1210	1219	1141	1121	1115	1209
Sugarcane	Total	67370	63576	59380	64752	66919	69022	68877	64553	70020	70091	68463

Annexure. 4.7 Area , Production & Productivity of Horticulture Crops

AREA : M.Ha.
PRODUCTION: Million tones.
Pdty / Yield: Tonne/Ha.

Crops	2006-07			2007-08			2008-09			2009-10			2010-11			2011-12 P		
	Area	Prod.	Pdty.	Area	Prod.	Pdty.	Area	Prod.	Pdty.	Area	Prod.	Pdty.	Area	Prod.	Pdty.	Area	Prod.	Pdty.
Fruits	5.55	59.56	10.72	5.86	65.59	11.20	6.10	68.47	11.22	6.33	71.52	11.30	6.38	74.88	11.74	6.58	77.52	11.78
Vegetables	7.58	114.99	15.17	7.85	128.45	16.37	7.98	129.08	16.17	8.01	134.10	16.74	8.49	146.55	17.26	8.59	149.61	17.42
Flowers Loose*	0.14	0.88	6.12	0.17	0.87	5.23	0.17	0.99	5.95	0.18	1.02	5.60	0.19	1.03	5.42	0.19	1.03	5.42
Plantation Crops	3.21	12.01	3.75	3.19	11.30	3.54	3.22	11.34	3.52	3.27	11.95	3.65	3.31	12.01	3.63	3.35	12.99	3.88
Spices	2.45	3.95	1.62	2.62	4.36	1.67	2.63	4.14	1.58	2.46	4.02	1.63	2.94	5.35	1.82	3.03	5.73	1.89
Total	19.39	191.81	9.89	20.20	211.24	10.46	20.53	214.44	10.45	20.77	223.18	10.75	21.82	240.43	11.02	22.25	247.54	11.13

*Cut flower not included. P : Provisional

Source: Deptt. Of Agriculture & Cooperation, Horticulture Division.

Annexure. 4.8 : Per Capita Net Availability of Foodgrains (Per day) in India

(As on 16.03.2011)
(Grams Per Day)

Year	Rice	Wheat	Other Cereals	Cereals	Gram	Pulses	Food Grains
1	2	3	4	5	6	7	8
1951	158.9	65.7	109.6	334.2	22.5	60.7	394.9
1956	187.7	61.5	111.2	360.4	29.0	70.3	430.7
1961	201.1	79.1	119.5	399.7	30.2	69.0	468.7
1966	161.9	95.4	102.6	359.9	18.3	48.2	408.1
1971	192.6	103.6	121.4	417.6	20.0	51.2	468.8
1976	187.2	79.5	107.4	373.8	20.2	50.5	424.3
1981	197.8	129.6	89.9	417.3	13.4	37.5	454.8
1985	188.8	138.6	87.9	415.3	12.9	38.1	453.4
1990	212.1	132.6	86.8	431.5	10.7	41.1	472.6
1991	221.7	166.8	80.0	468.5	13.4	41.6	510.1
1992	217.0	158.6	58.9	434.5	10.1	34.3	468.8
1993	201.1	140.2	86.6	427.9	10.7	36.2	464.1
1994	207.4	159.5	67.1	434.0	11.8	37.2	471.2
1995	220.0	172.7	64.9	457.6	14.9	37.8	495.5
1996	204.4	176.0	62.0	442.5	11.3	32.7	475.2
1997	214.0	179.1	72.9	466.0	12.4	37.1	503.1
1998	200.3	151.5	62.4	414.2	13.4	32.8	447.0
1999	203.4	162.3	63.4	429.2	14.6	36.5	465.7
2000	203.7	160.0	59.0	422.7	10.8	31.8	454.4
2001	190.5	135.8	56.2	386.2	8.0	30.0	416.2
2002	228.7	166.6	63.4	458.7	10.7	35.4	494.1
2003	181.4	180.4	46.7	408.5	8.5	29.1	437.6
2004	195.4	162.2	69.3	426.9	11.2	35.8	462.7
2005	177.3	154.3	59.4	390.9	10.6	31.5	422.4
2006	198.0	154.3	60.5	412.8	10.7	32.5	445.3
2007	194.0	157.8	55.5	407.4	11.9	35.5	442.8
2008	175.4	145.1	54.1	394.2	10.6	41.8	436.0
2009	188.4	154.7	63.9	407.0	12.9	37.0	444.0
2010(P)	184.8	167.9	54.3	407.0	13.5	31.6	438.6

Note:

The net availability of foodgrains is estimated to be Gross Production (-) seed, feed & wastage, (-) exports (+) imports, (+/-) change in stocks. The net availability of foodgrains divided by the population estimates for a particular year indicate per capita availability of foodgrains in terms of kg/year. Net availability, thus worked out further divided by the number of days in a year I.e., 365 days gives us net availability of foodgrains in terms of grams / day. Figures in respect of per capita net availability given above are not strictly representative of actual level of consumption in the country especially as they do not take in to account any change in stocks in possession of traders, producers and consumers. For calculation of per capita net availability the figures of net imports from 1981 to 1994 are based on imports and exports on Government of India account only. Net imports from 1995 ownwards are the total exports and imports (on Government as well as private accounts) Cereals includes rice,wheat and other cereals Pulses includes all kharif and rabi pulses Foodgrains includes rice, wheat,other cereals and all pulses Source: Directorate of Economics and Statistics, Department of Agriculture and Cooperation.

Annexure. 4.9: Per capita Consumption of Conventional Food Items

Commodities	Year	Quantity in Kg	
		Qty. consumed per Annum	
		Rural	Urban
Rice	1993-94	82.61	62.42
	2004-05	77.62	57.31
	2009-10	74.70	56.64
Wheat	1993-94	52.56	54.02
	2004-05	50.98	53.05
	2009-10	53.03	52.82
Coarse cereals	1993-94	27.86	12.53
	2004-05	18.86	10.59
	2009-10	10.34	4.60
All cereals	1993-94	163.03	128.97
	2004-05	147.46	120.94
	2009-10	138.08	114.05
All pulses & Pulse	1993-94	9.25	10.46
Products	2004-05	8.64	9.98
	2009-10	7.92	9.60
All edible oil	1993-94	4.50	6.81
	2004-05	5.84	8.03
	2009-10	7.74	9.95

Source: Based on NSSO Household Consumption Expenditure Surveys, various rounds

Annexure 4.10: Per capita Consumption of Emerging Food Items

Commodities	Year	Quantity in Kg/Litre/No. Qty. consumed per Annum	
		Rural	Urban
Fruits and Vegetables	1993-94	32.97	35.41
	2004-05	35.53	38.57
	2009-10	49.14	50.11
Milk (Litre)	1993-94	47.94	59.50
	2004-05	47.09	62.17
	2009-10	50.09	65.19
Eggs (No.)	1993-94	7.79	18.01
	2004-05	12.29	20.93
	2009-10	21.08	32.53
Fish (kg)	1993-94	2.19	2.43
	2004-05	2.45	2.51
	2009-10	3.27	2.90
Goat meat/Mutton	1993-94	0.73	1.34
(Kg)	2004-05	0.57	0.85
	2009-10	0.57	1.11
Chicken (kg)	1993-94	0.24	0.37
	2004-05	0.61	1.03
	2009-10	1.50	2.19

Source: Based on NSSO Household Consumption Expenditure Surveys, various rounds

Annexure. 4.11: Percentage Composition of Consumer Expenditure

	Rural					Urban				
Item group	Share in total consumer expenditure					Share in total consumer expenditure				
	1987-88	1993-94	1999-00*	2004-05	2009-10	1987-88	1993-94	1999-20*	2004-05	2009-10
1	2	3	4	5	6	7	8	9	10	11
Cereal	26.3	24.2	22.2	18.0	15.6	15.0	14.0	12.4	10.1	9.1
Gram	0.2	0.2	0.1	0.1	0.2	0.2	0.2	0.1	0.1	0.1
Cereal substitutes	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0
Pulses & products	4.0	3.8	3.8	3.1	3.7	3.4	3.0	2.8	2.1	2.7
Milk & products	8.6	9.5	8.8	8.5	8.6	9.5	9.8	8.7	7.9	7.8
Edible oil	5.0	4.4	3.7	4.6	3.7	5.3	4.4	3.1	3.5	2.6
Egg fish & meat	3.3	3.3	3.3	3.3	3.5	3.6	3.4	3.1	2.7	2.7
Vegetables	5.2	6.0	6.2	6.1	6.2	5.3	5.5	5.1	4.5	4.3
Fruits & nuts	1.6	1.7	1.7	1.9	1.6	2.5	2.7	2.4	2.2	2.1
Suger	2.9	3.1	2.4	2.4	2.4	2.4	2.4	1.6	1.5	1.5
Salt & spices	2.9	2.7	3.0	2.5	2.4	2.3	2.0	2.2	1.7	1.5
Beverages, ect.	3.9	4.2	4.2	4.5	5.6	6.8	7.2	6.4	6.2	6.3
Food tatal	**64.0**	**63.2**	**59.4**	**55.0**	**53.6**	**56.4**	**54.7**	**48.1**	**42.5**	**40.7**
Pan, tobacco, intox.	3.2	3.2	2.9	2.7	2.2	2.6	2.3	1.9	1.6	1.2
Fuel & light	7.5	7.4	7.5	10.2	9.5	6.8	6.6	7.8	9.9	8.0
Clothing & bedding	6.7	5.4	6.9	4.5	4.9	5.9	4.7	6.1	4.0	4.7
Footwear	1.0	0.9	1.1	0.8	1.0	1.1	0.9	1.2	0.7	0.9
Misc. & services	14.5	17.3	19.6	23.4	24.0	23.2	27.5	31.3	37.2	37.8
Durable goods	3.1	2.7	2.6	3.4	4.8	4.1	3.3	3.6	4.1	6.7
Non-food total	**36.0**	**36.8**	**40.6**	**45.0**	**46.4**	**43.6**	**45.3**	**51.9**	**57.5**	**59.3**
Total expenditure	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

* URP estimates shown except for 1999-2000, for which only MRP estimates are available.

Source: NSSO Household Consumer Expenditure survery 2009-10.

Annexure. 5.1: Wholesale Price Index of Principal Agri-commodities Groups

	April 10	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	March	April 11	May	June	July	Aug	Sept	Oct
All Comm	138.6	139.1	139.8	141.0	141.1	142.0	142.9	143.8	146.0	148.0	148.1	149.5	152.1	152.4	153.1	154.2	154.9	155.8	156.8
Food Art	168.8	172.1	175.4	178.2	176.7	179.9	180.9	181.4	189.4	192.4	181.3	179.0	186.8	186.3	188.8	192.8	193.7	196.5	200.9
Cereals	165.2	165.0	166.3	167.4	168.7	169.3	169.0	171.7	172.6	173.5	175.0	172.3	172.5	174.5	174.7	176.1	177.4	176.7	176.7
Pulses	202.5	206.2	206.8	205.8	201.7	196.5	194.1	187.2	187.2	189.9	193.4	191.0	189.6	187.2	187.5	190.4	193.1	202.0	212.8
Veg	143.9	150.9	175.1	172.0	176.2	189.5	193.9	189.2	240.5	261.1	158.3	143.3	146.8	149.9	163.8	185.4	199.4	216.1	236.1
Fruits	161.1	163.0	162.7	170.7	149.9	152.7	159.7	161.8	159.5	161.8	170.7	184.5	232.7	207.7	194.9	196.0	184.9	177.1	178.8
Milk	170.5	171.9	171.9	174.6	176.5	177.1	177.2	177.9	178.7	179.3	180.4	174.6	175.4	182.4	191.7	193.4	193.1	195.3	196.9
EMF	175.9	185.1	184.3	188.2	190.1	196.1	192.2	192.9	196.2	193.2	192.0	195.4	195.5	197.3	202.5	206.2	209.9	215.1	216.4
Sugar	161.9	158.7	152.8	159.8	157.1	156.1	157.7	161.9	166.5	166.6	163.0	163.9	164.6	164.3	162.2	165.6	166.1	167.1	167.5
Edib Oils	114.3	114.4	115.2	116.5	118.2	119.7	119.9	121.0	122.4	127.2	129.4	128.8	129.7	132.1	133.4	133.7	135.6	135.8	135.6

Annexure. 5.2: Rate of Inflation in Principal Commodities Groups

	April 10	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	March	April 11	May	June	July	Aug	Sept	Oct
All Comm	10.9	10.5	10.3	10.0	8.9	9.0	9.1	8.2	9.4	9.5	9.5	9.7	9.7	9.6	9.5	9.4	9.8	9.7	9.7
Food Art	20.5	21.4	21.0	18.5	15.0	16.3	14.6	10.1	15.1	16.7	11.0	9.4	10.7	8.3	7.6	8.2	9.6	9.2	11.1
Cereals	8.0	7.1	7.4	8.3	8.5	6.7	4.8	3.2	1.6	1.8	3.4	3.5	4.4	5.8	5.1	5.2	5.2	4.4	4.6
Pulses	24.1	24.5	23.0	14.4	7.7	3.9	0.2	-10.0	-11.7	-13.3	-5.2	-4.0	-6.4	-9.2	-9.3	-7.5	-4.3	2.8	9.6
Veg	8.0	7.5	12.2	-3.6	-4.5	11.0	8.1	-1.4	33.6	66.5	14.4	8.6	2.0	-0.7	-6.5	7.8	13.2	14.0	21.8
Fruits	19.6	22.9	25.3	32.4	12.2	13.4	17.1	18.5	17.3	15.7	17.5	26.7	44.4	27.4	19.8	14.8	23.3	16.0	12.0
Milk	27.9	28.4	26.2	26.1	26.9	24.1	21.0	18.0	18.3	13.8	12.5	4.4	2.9	6.1	11.5	10.8	9.4	10.3	11.1
EMF	38.6	45.5	39.0	31.4	27.0	29.5	27.4	18.9	19.4	15.7	12.7	13.5	11.1	6.6	9.9	9.6	10.4	9.7	12.6
Sugar	23.6	17.6	10.9	14.1	2.5	-3.9	-3.8	-8.5	-7.0	-13.9	-15.4	-7.8	1.7	3.5	6.2	3.6	5.7	7.0	6.2
Edib Oils	0.1	-1.3	0.5	2.3	3.5	5.6	6.8	6.4	5.6	9.7	13.0	13.0	13.5	15.5	15.8	14.8	14.7	13.5	13.1

Source: Office of Economic Adviser, DIPP.

Annexure. 5.3: Minimum Support Prices

(Rs. per Qtl.)

Commodity	Variety	2007-08	2008- 09	2009-10	2010-11	(#)increase in MSP 2010-11 over 2009-10	2011-12	(#) increase in MSP 2011-12 over 2010-11
KHARIF CROPS								
PADDY	Common	645$$/850~	850$	950$	1000	50(5.3)	1080	80(8.0)
	Grade 'A'	675$$/880~	880$	980$	1030	50(5.1)	1110	80(7.8)
JOWAR	Hybrid	600	840	840	880	40(4.8)	980	100(11.4)
	Maldandi	620	860	860	900	40(4.7)	1000	100(11.1)
BAJRA		600	840	840	880	40(4.8)	980	100(11.4)
MAIZE		620	840	840	880	40(4.8)	980	100(11.4)
RAGI		600	915	915	965	50(5.5)	1050	85(8.8)
ARHAR(Tur)		1550^^	2000	2300	3000¶	700(30.4)	3200¶	200(6.7)
MOONG		1700^^	2520	2760	3170¶	410(14.9)	3500¶	330(10.4)
URAD		1700^^	2520	2520	2900¶	380(15.1)	3300¶	400(13.8)
COTTON	Medium Staple	1800	2500[a]	2500[a]	2500[a]	0(0.0)	2800[a]	300(12.0)
	Long Staple	2030	3000[aa]	3000[aa]	3000[aa]	0(0.0)	3300[aa]	300(10.0)
GROUNDNUT IN SHELL		1550	2100	2100	2300	200(9.5)	2700	400(17.4)
SUNFLOWER SEED		1510	2215	2215	2350	135(6.1)	2800	450(19.1)
SOYABEEN	Black	910	1350	1350	1400	50(3.7)	1650	250(17.8)
	Yellow	1050	1390	1390	1440	50(3.6)	1690	250(17.4)
SESAMUM		1580	2750	2850	2900	50(1.8)	3400	500(17.2)
NIGERSEED		1240	2405	2405	2450	45(1.9)	2900	450(18.4)
RABI CROPS								
WHEAT		1000	1080	1100	1120&	20(1.8)	1285	165 (14.7)
BARLEY		650	680	750	780	30(4.0)	980	200 (25.6)
GRAM		1600	1730	1760	2100	340(19.3)	2800	700 (33.3)
MASUR (LENTIL)		1700	1870	1870	2250	380(20.3)	2800	550(24.4)
RAPESEED/MUSTARD		1800	1830	1830	1850	20(1.1)	2500	650(35.1)
SAFFLOWER		1650	1650	1680	1800	120(7.1)	2500	700(38.9)
TORIA		1735	1735	1735	1780	45(2.6)	2425	645(36.2)
OTHER CROPS								
COPRA	Milling	3620	3660	4450	4450	0(0.0)	4525	75(1.7)
(Calender Year)	Ball	3870	3910	4700	4700	0(0.0)	4775	75(1.6)
DE-HUSKED COCONUT (Calender Year)		-	988	1200	1200	0(0.0)	1200	0(0.0)
JUTE		1055	1250	1375	1575	200(14.5)	1675	100(6.3)
SUGARCANE		81.18	81.18	129.84¤	139.12¤	9.28(7.1)	145.00¤*	5.88(4.2)
TOBACCO(VFC)	Black Soil (F2 Gr)	32.00						
(Rs. per kg.)	Light Soil (L2 Gr)	34.00						

Source: Dte. of Economics & Statistics

\# Figures in brackets indicate percentage increase.

$ An additional incentive bonus of Rs. 50 per quintal was payable over the Minimum Support Price(MSP).

$$ An additional incentive bonus of Rs. 100 per quintal was payable over the Minimum Support Price(MSP).

^^ A bonus of Rs. 40 per quintal was payble over & above the MSP.

~ From 12.06.2008

[a] Staple length (mm) of 24.5 - 25.5 and Micronaire value of 4.3 - 5.1

[aa] Staple length (mm) of 29.5 - 30.5 and Micronaire value of 3.5 - 4.3

& An additional incentive bonus of Rs. 50 per quintal is payble over the Minimum Support Price (MSP)

¤ Fair and remunerative price.

* At 9.5 percent recovery, subject to a premium of Rs.1.53 for every 0.1 percent increase in the recovery above 9.5 percent.

¶ Additional incentive at the rate of Rs. 500 per quintal of tur, urad and moong sold to procurement agencies is payable during the harvest/arrival period of two months.

Annexure. 5.4: Top 10 Agricultural Exports Items

Sl. No.	Item	2009-10		2010-11		Percentage change in value of export in 2010-11 compared to 2009-10
		Qty in 1000 MT	Value in Rs. Crore	Qty in 1000 MT	Value in Rs. Crore	
1	Cotton	1358	9537	1258	12981	36.11
2	Oil Meals	4671	7832	6798	10846	38.49
3	Rice Basmati	2017	10890	2186	10582	-2.83
4	Sugar	45	110	3241	10339	9281.19
5	Other Cereals (mainly maize)	2892	2973	3188	3596	20.95
6	Castor Oil	398	2179	411	2852	30.85
7	Guargum Meal	218	1133	403	2806	147.57
8	Cashew	122	2802	92	2598	-7.28
9	Fresh Vegetables		2942		2531	-13.97
10	Sesamum Seed	222	1518	355	2236	47.24
	Total Agricultural Exports		89342		120186	34.52
	Country's total Exports		845534		1148170	35.79
	% Share in total Export		10.57		10.47	

Source: DGCI&S

Annexure. 5.5: Top 10 Agricultural Import Items

Sl. No.	Item	2009-10		2010-11		Percentage change in value of export in 2010-11 compared to 2009-10
		Qty in 1000 MT	Value in Rs. Crore	Qty in 1000 MT	Value in Rs. Crore	
1	Vegetable Oils (edible)	8034	26483	6718	29442	11.17
2	Pulses	3510	9813	2591	6980	-28.87
3	Fruits & Nuts (excl. Cashew nuts)		2873		3684	28.23
4	Sugar	2551	5966	1198	2787	-53.28
5	Cashew Nuts	756	3048	504	2480	-18.63
6	Spices	153	1432	108	1359	-5.13
7	Cotton	171	1241	56	604	-51.31
8	Milk & Cream	8	78	37	492	533.90
9	Jute, raw	63	149	75	273	82.65
10	Wheat	164	232	184	236	1.93
	Total agricultural imports		59528		56196	-5.60
	Country's total Imports		1363736		1605315	17.71
	% Share in total Import		4.37		3.50	

Source: DGCI&S

Annexure: 6.1. List of ICAR/DARE Institutions

Deemed Universities

1 Indian Agricultural Research Institute, New Delhi
2 National Dairy Research Institute, Karnal
3 Indian Veterinary Research Institute, Izatnagar
4 Central Institute on Fisheries Education, Mumbai

Institutions

1 Central Rice Research Institute, Cuttack
2 Vivekananda Parvatiya Krishi Anusandhan Sansthan, Almora
3 Indian Institute of Pulses Research, Kanpur
4 Central Tobacco Research Institute, Rajahmundry
5 Indian Institute of Sugarcane Research, Lucknow
6 Sugarcane Breeding Institute, Coimbatore
7 Central institute of Cotton Research, Nagpur
8 Central Research Institute for Jute and Allied Fibres, Barrackpore
9 Indian Grassland and Fodder Research Institute, Jhansi
10 Indian Institute of Horticultural Research, Bangalore
11 Central Institute of Sub Tropical Horticulture, Lucknow
12 Central Institute of Temperate Horticulture, Srinagar
13 Central Institute of Arid Horticulture, Bikaner
14 Indian Institute of Vegetable Research, Varanasi
15 Central Potato Research Institute, Shimla
16 Central Tuber Crops Research Institute, Trivandrum
17 Central Plantation Crops Research Institute, Kasargod
18 Central Agricultural Research Institute, Port Blair
19 Indian Institute of Spices Research, Calicut
20 Central Soil and Water Conservation Research & Training Institute, Dehradun
21 Indian Institute of Soil Sciences, Bhopal
22 Central Soil Salinity Research Institute, Karnal
23 ICAR Research Complex for Eastern Region including Centre of Makhana, Patna
24 Central Research Institute of Dryland Agriculture, Hyderabad
25 Central Arid Zone Research Institute, Jodhpur
26 ICAR Research Complex Goa
27 ICAR Research Complex for NEH Region, Barapani
28 National Institute of Abiotic Stress management, Malegaon, Maharashtra
29 Central Institute of Agricultural Engineering, Bhopal
30 Central Institute on Post harvest Engineering and Technology, Ludhiana
31 Indian Institute of Natural Resins and Gums, Ranchi
32 Central Institute of Research on Cotton Technology, Mumbai
33 National Institute of Research on Jute & Allied Fibre Technology, Kolkata

34 Indian Agricultural Statistical Research Institute, New Delhi
35 Central Sheep and Wool Research Institute, Avikanagar, Rajasthan
36 Central Institute for Research on Goats, Makhdoom
37 Central Institute for Research on Buffaloes, Hissar
38 National Institute of Animal Nutrition and Physiology, Bangalore
39 Central Avian Research Institute, Izatnagar
40 Central Marine Fisheries Research Institute, Kochi
41 Central Institute Brackishwater Aquaculture, Chennai
42 Central Inland Fisheries Research Institute, Barrackpore
43 Central Institute of Fisheries Technology, Cochin
44 Central Institute of Freshwater Aquaculture, Bhubneshwar
45 National Academy of Agricultural Research & Management, Hyderabad

National Research Centres

1 National Research Centre on Plant Biotechnology, New Delhi
2 National Centre for Integrated Pest Management, New Delhi
3 National Research centre for Litchi, Muzaffarpur
4 National Research Centre for Citrus, Nagpur
5 National Research Centre for Grapes, Pune
6 National Research Centre for Banana, Trichi
7 National Research Centre Seed Spices, Ajmer
8 National Research Centre for Pomegranate, Solapur
9 National Research Centre on Orchids, Pakyong, Sikkim
10 National Research Centre Agroforestry, Jhansi
11 National Research Centre on Camel, Bikaner
12 National Research Centre on Equines, Hisar
13 National Research Centre on Meat, Hyderabad
14 National Research Centre on Pig, Guwahati
15 National Research Centre on Yak, West Kemang
16 National Research Centre on Mithun, Medziphema, Nagaland
17 National Centre for Agril. Economics & Policy Research, New Delhi

National Bureaux

1 National Bureau of Plant Genetics Resources, New Delhi
2 National Bureau of Agriculturally Important Micro-organisms, Mau, Uttar Pradesh
3 National Bureau of Agriculturally Important Insects , Bangalore
4 National Bureau of Soil Survey and Land Use Planning, Nagpur
5 National Bureau of Animal Genetic Resources, Karnal
6 National Bureau of Fish Genetic Resources, Lucknow

In XI Plan (total 185)45 Institutes; 6 National Bureaux; 4 Deemed to be Universities; 17 NRCs, 25 PDs; 61 AICRPs, 17 Networks and 10 other programmes

Annexure: 6.2. List of Agricultural Universities

Andhra Pradesh	3	Acharya NG Ranga Agricultural University, Hyderabad
		Sri Venkateswara Veterinary University, Tirupati
		Horticulture University, Venkataramanagudem near Tadepalligudem, West Godawari
Assam	1	Assam Agricultural University, Jorhat
Bihar	2	Rajendra Agricultural University, Pusa, Samastipur
		Bihar Agricultural University, Sabour, Samastipur
Chhattisgarh	1	Indira Gandhi Krishi Vishwavidyalaya, Raipur
New Delhi (deemed to be)	1	*Indian Agricultural Research Institute, Pusa-110012, New Delhi*
Gujarat	4	Junagarh Agricultural University, Junagarh
		Sardarkrushinagar-Dantiwada Agricultural University, Sardar Krushinagar, Banaskantha
		Anand Agricultural University, Anand
		Navsari Agricultural University, Navsari
Haryana	3	Ch. Charan Singh Haryana Agricultural University, Hisar
		Lala Lajpat Rai Univ. of Veterinary and Animal Sciences, Hisar
deemed to be		*National Dairy Research Institute, Karnal-132001, Haryana*
Himachal Pradesh	2	Dr. Yashwant Singh Parmar University of Horticulture & Forestry, Solan, Nauni
		Ch. Sarwan Kumar Krishi Viswa Vidalaya, Palampur
J & K	2	Sher-E-Kashmir University of Agricultural Sciences & Technology, Jammu
		Sher-E-Kashmir University of Agricultural Sciences & Technology of Kashmir, Srinagar
Jharkhand	1	Birsa Agricultural University, Kanke, Ranchi
Karnataka	4	University of Agricultural Sciences, Dharwad
		University of Agricultural Sciences, Bangalore
		University of Agricultural Sciences, Raichur, Karnataka
		University of Horticultural Sciences, Navanagar, Bagalkot, Karnataka
Kerala	3	Kerala Agricultural University, Vellanikara, Trichur
		Kerala University of Animal Sciences, Directorate of Dair development, Pattom, Thiruvantapuram
		Kerala University of Fisheries & Ocean Studies, Papangad, Kotchi, Kerala
Madhya Pradesh	3	Jawahar Lal Nehru Krishi Vishwavidyalaya, Jabalpur
		Madhya Pradesh Pashu Chikitsa Vigyan Vishwavidyalaya, Civil Lines, Jabalpur
		Rajmata VRS Agri. University, Gwalior
Maharashtra	6	Dr. Balaesahib Sawant Konkan Krishi Vidypapeeth, Dapoli, Ratnagiri
		Dr. Punjabrao Deshmukh Krishi Vidyapeeth, Krishinagar, Akola
		Mahatma Phule Krishi Vidyapeeth, Rahuri
		Marathwada Agricultural University, Parbhani
		Maharashtra Animal and Fisheries Sciences University, Nagpur
deemed to be		*Central Institute of Fisheries Education, Mumbai-400061, Maharashtra*

Manipur	1	Central Agri. University, Imphal
Nagaland	1	Nagaland University, Medizipherma, Nagaland
Orissa	1	Orissa University of Agriculture & Technology, Bhubaneshwar
Punjab	2	Punjab Agricultural University, Ludhiana
		Guru Angad Dev Veterinary & Animal Sciences University, Ludhiana
Rajasthan	3	Maharana Pratap Univ. of Agriculture & Technology, Udaipur
		Swami Keshwanand Rajasthan Agricultural University, Bikaner
		Rajasthan Univ. of veterinary & Animal Sciences, Bijay Bhavan Palace Complex, Bikaner
Tamil Nadu	2	Tamil Nadu Agricultural University, Coimbatore
		Tamil Nadu Veterinary & Animal Sciences University, Chennai
Uttar Pradesh	9	Chandra Shekhar Azad University of Agriculture & technology, Kanpur
		Narendra Dev University of Agriculture & Technology, Faizabad
		UP Pandit Deen Dyal Upadhaya Veterinary and Animal Sciences University, Mathura
		Sardar Vallabh Bhai Patel University of Agriculture and Technology, Meerut
		Manyavar Shri Kanshiram Ji University of Agri. & Tech. Banda, UP
deemed to be		*Allahabad Agricultural Institute, Allahabad-211007, Uttar Pradesh*
		Indian Veterinary Research Institute, Izatnagar, Bareilly-243122, Uttar Pradesh
Cus		Banaras Hindu University, Varanasi, U.P.
		Aligarh Muslim University, Aligarh, U.P.
Uttarakhand	2	Govind Ballabh Pant University of Agriculture & Technology, Pantnagar
		University of Horticulture and Forestry, Ranichauri, Tehri Garhwal
West Bengal	4	Bidhan Chandra Krishi Vishwavidyalaya, Mohanpur, Nadia
		Uttar Banga Krishi Vishwavidyalaya, Coach Bihar
		West Bengal University of Animal & Fishery Sciences, Kolkata
deemed to be		Vishwa Bharti, Shantiniketan, West Bengal
Total	6 1	

In XI Plan 51 SAUs, 5 deemed to be Univ., 1 CAU, 4 CUs with Agri. Faculty

Annexure: 7.1. Production of Milk, Egg, Meat and Wool -All India

Year	Milk (Million Tonnes)	Eggs (Million Nos.)	Wool (Million Kgs.)	Meat* (Million Tonnes)
1950-51	17.0	1,832	27.5	-
1960-61	20.0	2,881	28.7	-
1980-81	31.6	10,060	32.0	-
1990-91	53.9	21,101	41.2	-
1991-92	55.7	21,983	41.6	-
1992-93	58.0	22,929	38.8	-
1993-94	60.6	24,167	39.9	-
1994-95	64.0	25,975	40.6	-
1995-96	66.2	27,198	42.4	-
1996-97	69.1	27,496	44.4	-
1997-98	72.1	28,689	45.6	-
1998-99	75.4	29,476	46.9	1.9
1999-2000	78.3	30,447	47.9	1.9
2000-01	80.6	36,632	48.4	1.9
2001-02	84.4	38,729	49.5	1.9
2002-03	86.2	39,823	50.5	2.1
2003-04	88.1	40,403	48.5	2.1
2004-05	92.5	45,201	44.6	2.2
2005-06	97.1	46,235	44.9	2.3
2006-07	102.6	50,663	45.1	2.3
2007-08	107.9	53,583	43.9	4.0
2008-09	112.2	55,562	42.8	4.3
2009-10	116.4	60,267	43.1	4.6
2010-11	121.8	63,024	43.0	4.8

* From organized sector.
- Not Available.
Source: State/UTs Department of Animal Husbandry.