Chapter 1

Performance of Agriculture Sector and Policy Initiatives

Crop segment constitutes about 70 per cent of total output of agriculture sector and performance of this segment is vital for farm income, food security and price stability in the Country. It is almost impossible to sustain 8 per cent growth in economy and 4 per cent growth in agriculture sector if crop sector remains stagnant. Therefore, crop sector has remained in the centre of public measures like institutional reforms, infrastructure creation, generation and dissemination of improved technology, price and trade policy, spreading use of modern inputs, increasing credit, enhancing irrigation facilities etc.

Eleventh Five Year Plan has focused on a model that encompass 4 per cent growth in agriculture. This was considered vital not only for improving food and nutrient security, but also for inclusive growth and checking rural urban divide. It is widely felt – and has also been documented – that high rates of growth experienced by India during the last two decades or so have largely benefited urban and non agriculture population in India. To address this disquiet trend, the ongoing Eleventh Five Year Plan (2007-2012) has placed heavy emphasis on agriculture and rural development and a number of important policy measures have been initiated to address the issues of agrarian distress. Further, right from the Ninth Five- Year Plan onwards, 4 percent growth in Indian agriculture has been targeted, but the actual growth rate has remained considerably lower than this target. The lower than targeted performance of agriculture in the backdrop of an impressive growth of the overall economy has serious implications. Several studies have pointed out to the deceleration in agricultural growth during 1990s continuing towards middle of first decade of the new century. However, it is worth investigating whether measures initiated during the Eleventh Plan made any difference to the growth trajectory or not so that these lessons can be used during the 12th Plan.

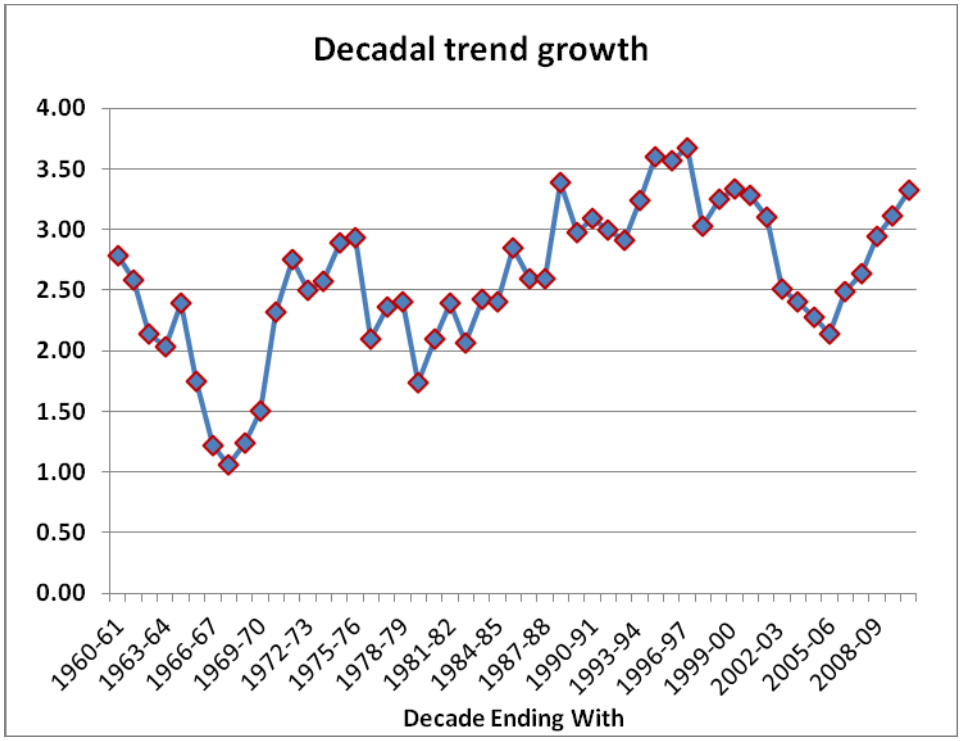
1.1 Performance of Agriculture Sector

There are several ways to assess performance of agriculture sector. The most common indicator is at what rate the sector is growing and whether growth rate is decelerating, stagnant or accelerating. This is examined by looking at performance of total agriculture and crop sector and individual crops separately.

GDP Agriculture

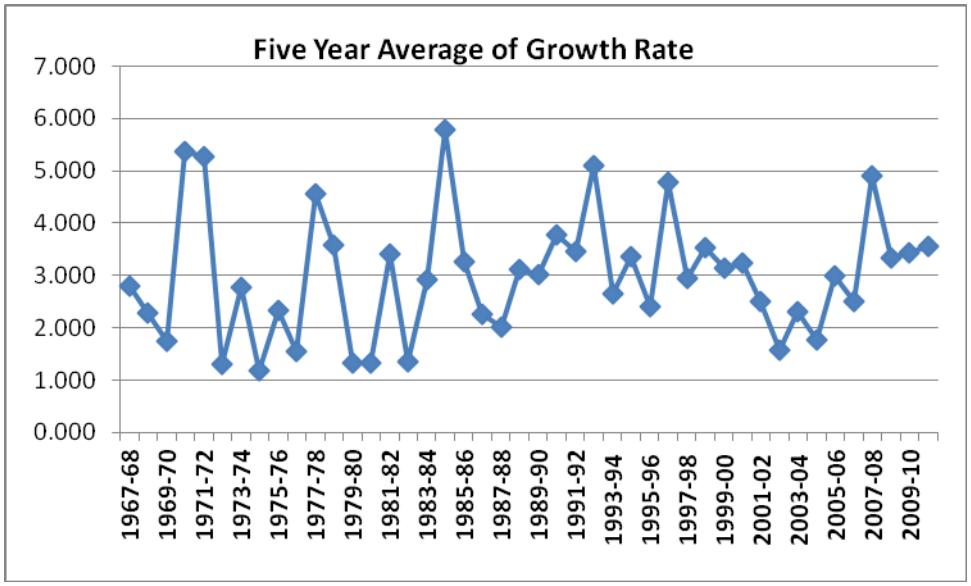
Growth rates are subject to limitations like sensitivity to choice of period, and deviation of base and terminal years from normal trend. In order to overcome this problem a complete series of decadal growth rates beginning from 1950-51 to 1960-61 extending to 2000-01 to 2010-11 was estimated and is presented in Fig.1.1. In order to capture performance during shorter period we have also calculated five yearly growth rates by taking average of annual rate of change in GDP agriculture at constant prices (Fig. 1.2).

Fig 1.1. Trend growth in agriculture based on 10 years period: beginning 1951-61 and extending to 2001-11: Per cent



These figures show that agriculture growth witnessed serious deceleration after mid 1990s. Since the ten years period from 1981-82 to 1990-91 the decadal growth rates in GDP of agriculture and allied sectors remained at or above 3 per cent and kept accelerating. Trend growth rate in GDP agriculture reached peak level of 3.61 per cent during the decade 1987-88 to 1996-97 and then followed deceleration. The deceleration was initially small and then turned sharp after 20001-02. The growth rate dipped to 2.2 per cent per year during 1996-97 to 2005-6. The declining growth rate has been arrested and reversed in the recent years. Following inferences are drawn from the behaviour of agriculture growth at national level.

Fig. 1.2: Five yearly average of annual rate of change in GDP agri at constant prices (%)



- Decadal trend growth rates and average growth of five years since the beginning of XI Plan have been higher than long run growth rate in Indian agriculture, which is 2.86.
- Indian agriculture faced serious slowdown during 1996-97 to 2005-06.
- There is an unambigious recovery from 2006-7 onward.

- It is very important to find out what has contributed to this recovery? How far those factors can go?

Agriculture Performance at Disaggregate Level

The crop sub-sector growth in the first decade of India's planning phase (1950s) was very impressive (3.1%). The First Five-Year Plan accorded highest priority to agriculture and allocated substantial part of the plan outlay to this sub-sector. Further, this period witnessed remarkable progress in land reforms, institutional changes, and operationalization of some major irrigation projects. These initiatives played an important role in achieving higher growth of the sector during the period. The importance and priority given to agriculture was diluted in the Second and Third Five-Year Plans, and as a consequence, the sub-sector witnessed a deceleration during sixties (1.7%). This led to severe shortage of foodgrains, and the country was compelled to import huge quantities of foodgrains. The food aid from the USA came with conditionality, which influenced economic and foreign policies of the country, and forced the country to put greater efforts to increase foodgrain production. In mid sixties, a new agricultural strategy was adopted which emphasized on spreading dwarf and high-yielding varieties (HYVs) of wheat and rice. The new strategy paid dividends and resulted in well-acclaimed 'green revolution'. The crop sub-sector, which was growing at an annual rate of 1.8 per cent in the seventies, grew at the rate of 2.2 per cent in1980s and 3.0 per cent in the nineties. Though the same growth in the crops was maintained, it fell short of the targeted growth rate of 4 per cent in the eleventh five year plans.

The policy support, adoption of improved production technologies and public investment in infrastructure, research and extension contributed to growth in the agricultural sector. However, investment on agriculture declined throughout the nineties, leading to a slowdown in the agricultural growth especially in the late nineties. This led to deceleration in growth of total factor productivity in the north western region, especially in rice and wheat growing areas. The continuous threat to the production and lowered factor productivity of rice and wheat forced government to take

corrective measures to reverse such trends. Conscious efforts have been made in the recent years to raise investment in agriculture.

Table 1.1: Growth Rate in Output of Various Sub-sectors of Agriculture at 1999-00 Prices, 1950-51 to 2008-09 (Per Cent/year)

Period	Crop sector	Live-stock	Horticul-ture crops	Non-Horticulture crops	Cereals
1950-51 to 1959-60	3.06	1.42	0.74	3.52	3.95
1960-61 to 1969-70	1.70	0.41	4.87	1.09	2.10
1970-71 to 1979-80	1.79	3.92	2.86	1.49	2.40
1980-81 to 1989-90	2.24	4.91	2.63	2.12	2.89
1990-91 to 1999-00	3.02	3.79	5.95	2.07	2.24
2000-01 to 2008-09	3.06	3.90	3.35	2.89	2.31

The growth registered by livestock sub-sector was modest till 1970. It was 1.4 per cent per annum in the fifties and as low as 0.4 per cent per annum in the sixties. An upsurge in growth rate output was registered in the seventies when it rose to 3.9 per cent per annum. Livestock sub-sector growth was always higher than crop sub-sector since 1970. This was even during the heydays of green revolution (seventies and eighties); when the policy emphasis was largely focused on the crop sub-sector. The acceleration continued in the eighties (4.9%) but it slackened in the nineties and after 2000s. Even then, this sub-sector was able to maintain a respectable growth rate close to 4 per cent per annum. The impressive performance of the livestock sector is attributed to effective government interventions, success of the Anand Pattern Cooperatives, and rising demands for livestock products in response to rising incomes in urban and rural areas and growing urbanization. Expenditure elasticities for livestock products are high with the tilt in favour of rural areas. Future increases in per caput income and changing consumption patterns would lead to still higher demand for livestock products, which would give further boost to this sector.

Rapid growth in livestock sub-sector is desirable for several reasons. This sub-sector employees about 21 million people. It is an important source of livelihood for

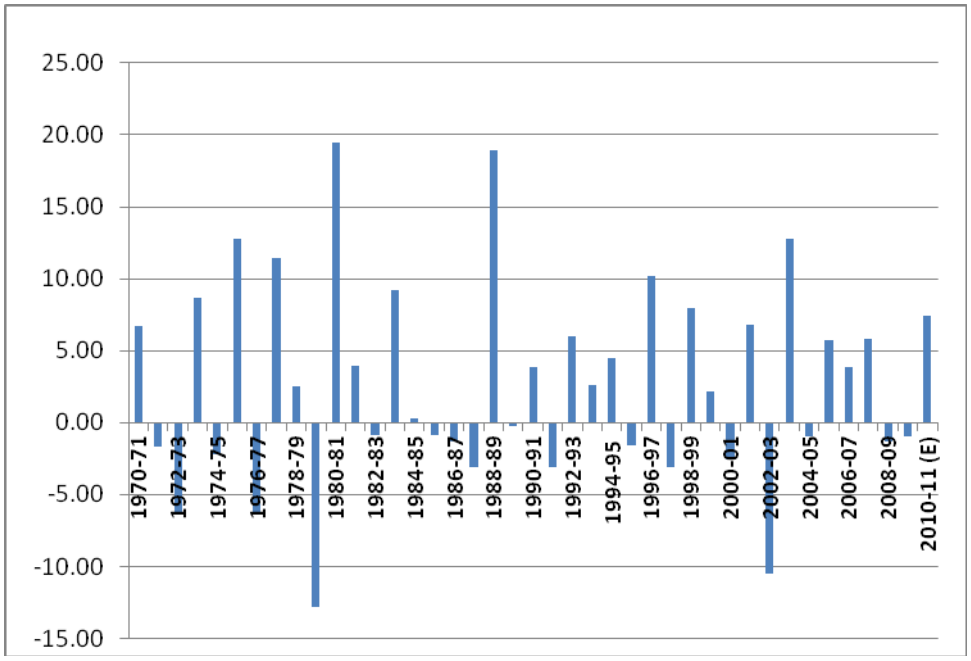
smallholders and landless labourers. And the distribution of livestock is more egalitarian than that of land. The smallholders and landless labourers together control about 71 per cent of cattle, 63 per cent of buffaloes, 66 per cent of small ruminants (goat and sheep), 70 per cent of pigs, and 74 per cent of poultry.

Fisheries have been recognized as a promising source of augmenting income, generating employment and improving nutrition. Fish is also a source of nutritious food. It is also an important source of livelihood for a large section of economically backward population. With the changing consumption patterns, emerging market forces and technological developments, it has assumed added importance and is undergoing rapid transformation in the country. On the whole, the growth of the fisheries sub-sector in India has been remarkable; growth rate of more than 5 per cent per annum in the eighties and nineties and is attributed to the rapid development of aquaculture. However the growth in this sunrise sub-sector has been decelerating since 2000-01.

Crop Sector

More than half of cropped area in India is rainfed. Irrigation also depends to a significant extent on precipitation. Because of these reasons performance of crop output is strongly affected by rainfall which results in sharp year to year fluctuations in growth of crop output. This can be seen from annual rate of change in year on year output (Fig 1.3). As was seen in the case of GDP agriculture, crop sector output also followed sharp deceleration in growth after 1996-97. There are some changes in the growth pattern after 2004-05. The growth rate as measured by average of annual rate of change was 4.33 per cent during the Eight Plan (1992-93 to 1996-97) and then declined to 2.25 per cent. The deceleration continued during the Tenth Plan (2002-03 to 2006-07). There is some increase in the rate of growth of crop output during 11^{th} Plan. Another notable change in growth pattern is that the effect of severe drought of 2009-10 was moderate compared to the previous droughts of similar magnitude. This indicates increased resilience of agriculture to weather shock.

Fig. 1.3: Trend in annual rate of change in crop output at constant prices



Crop Productivity

Performance of crop sector has also been quite variable across crops. Also, area under some crops is rising while some crops show decline. Thus growth in production of various crops show much higher variation than the variation in growth in productivity.

Trend growth rate in productivity of major crops was estimated by fitting log linear trend to two years moving average of productivity beginning with 1999-00. Still, it is pertinent to mention that, despite this smoothening, growth rates can turn out to be totally different with small change in the period. Cotton topped the list with more than 10 per cent annual growth in its productivity, a Bt driven phenomenon which now occupies more than 90 percent area under cotton. Bajra comes second with more than 4 per cent annual growth in yield. Productivity of groundnut, soyabean and jowar increased by more than 3 per cent during 2001 to 2008-9. Maize and sunflower maintained per cent growth in productivity during the last decade. Among the two major cereals, productivity of rice show annual growth of 1.69 percent but wheat productivity

experienced less than half a percent growth. The increase in productivity of pulses remained unimpressive. Productivity of sugar cane remained stagnant (table 1.2).

Table 1.2: Growth rate in productivity of major crops (%/year)

Crops	2000-01 to 2008-09
Cotton	12.96
Bajra	4.38
Groundnut	3.81
Soybean	3.15
Jowar	3.03
Maize	2.58
Sunflower	2.51
Rapeseed & Mustard	1.93
Rice	1.69
Tur	1.43
Gram	0.64
Wheat	0.24
Sugarcane	0.01
Lentil	-0.58

1.2 Performance at State Level

Performance of agriculture at state level was examined by looking at growth rate in NSDP agriculture during 1999-00 to 2008-09 at 1999-00 prices. The growth rates were estimated from two years moving average of the data series. The states were then classified into three categories of growth rate viz. more than 4.00 percent (designated as high); more than 2 but less than 4 per cent (designated as medium) and less than 2.00 per cent (designated as low). As can be seen from (Table 1.3) there is tremendous variation in the growth performance of agriculture across states. NSDP agriculture in the state of Gujarat increased by more than 10 per cent per year during the last decades which appears quite surprising. In fact the growth rate turns out to be more than 15 per cent at 2004-05 prices. Closer examination of data in respect of Gujarat shows that the state made remarkable increase in raising agricultural production after the year 2002-03. Chattisgarh comes second with 6.1 percent growth rate. The other states which recorded

more than 4 per cent annual growth in agricultural output are Madhya Pradesh, Rajasthan, Maharashtra and Andhra Pradesh.

In eastren India, Orissa shows more than 3 per cent growth but other states continue to languish with low growth. Agriculture output in Jharkhand showed negative growth over the last decade. Similarly, Karnataka and Assam experienced below 1 per cent growth despite low level of productivity.

Table 1.3: Statewise Growth rate in agriculture NSDP at constant prices

LOW upto 2.0		MEDIUM < 4 > 2		HIGH > 4	
State	TGR	State	TGR	State	TGR
Jharkhand	-0.9	Uttrakhand	2.2	M.P.	4.1
Karnataka	0.4	H.P	2.4	Rajasthan	4.3
Assam	0.8	Punjab	2.4	Maharashtra	4.7
Kerala	1.0	Bihar	2.5	A.P.	5.2
U.P.	1.6	J&K	3.4	Chattisgarh	6.1
Tamil Nadu	1.8	Haryana	3.5	Gujarat	11.5
West Bengal	2.0	Orissa	3.6		

State wise growth trends show that despite usual explanations for low growth like changing climate, soil degradation, stress on water resources, technology slowdown and policy constrains some states have done exceedingly well. It also shows that action at state level matters a lot in determining performance of agriculture in a state. There is a need to learn from better performing states and replicate relevant experience in low growth states particularly those with high potential.

1.3 Factors Affecting Agriculture Growth

An examination of various factors affecting agriculture at national level shows that following factors have contributed in a big way to the recovery of growth rate in recent years:

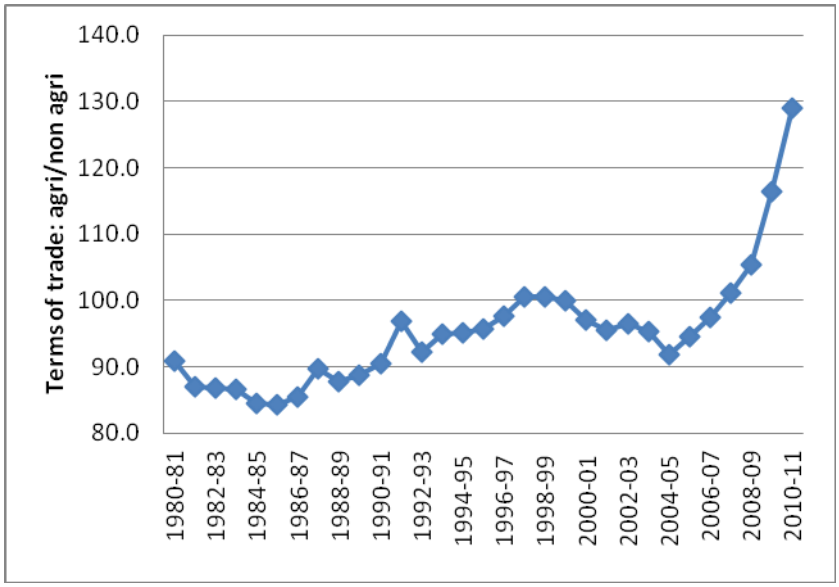
- Improvement in terms of trade
- Public and private investments
- Quality seed, hybrids

- Technology
- Institutional efforts

Terms of trade

Terms of trade for agriculture witnessed a sharp decline during late 1990s to 2004-05. There has been a turnaround in TOT after this. This is evident from terms of trade for agriculture sector relative to non agriculture and from ratio of food price index relative to prices of non food items. Share of agri in total GDP at 2004-05 prices was 18.9 during 2004-05. During 2010-11 it declined to 14.3 per cent at constant prices but rose to 19.0 per cent at current prices. The difference in share of GDP in agriculture at current and constant prices show that farm gate prices received by farmers have turned 30 percent higher than non agriculture prices during six years after 2004-5. Similarly, ratio of implicit price index for GDP agriculture relative to non agriculture prices index with base year 1999-00 shows turnaround after 2004-05 and a steep hike in next six years (Fig.1.4).

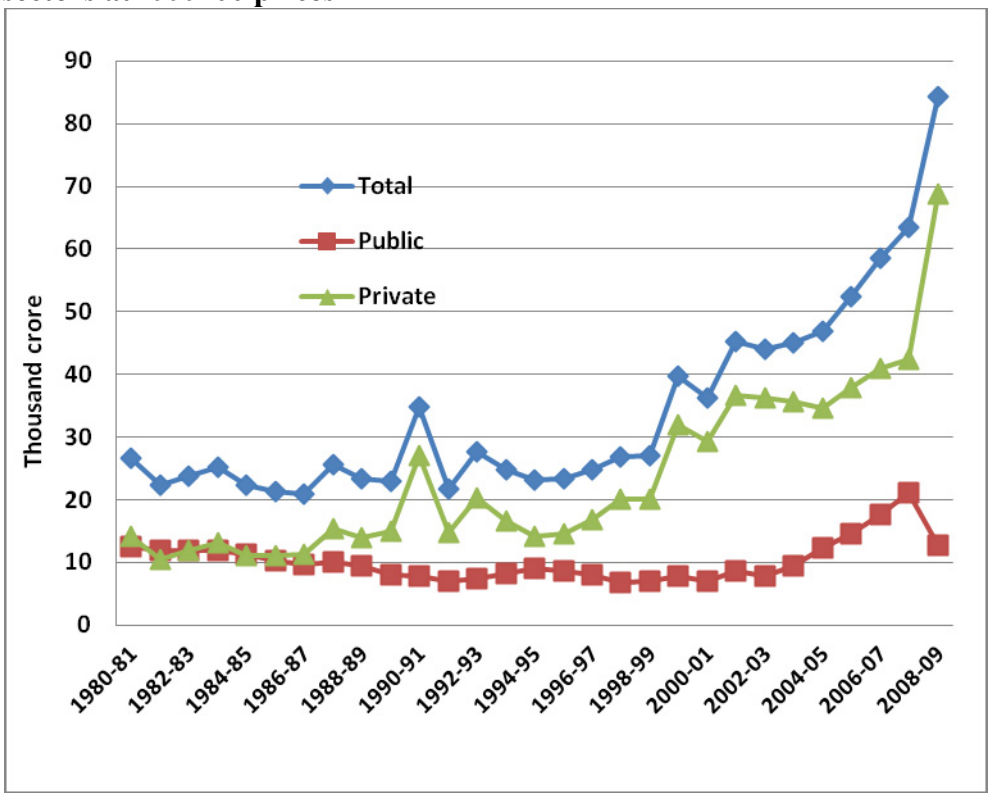
Fig. 1.4 : Terms of trade based on ratio of implicit price index of gdp agriculture to gdp non agriculture



Investment in Agriculture

Both, public as well as private investments are crucial for growth. Indian agriculture had suffered a stagnation and even decline in public investment in agriculture for more than two decades beginning with 1980-81 (Fig. 1.5). As a result share of public investments in agriculture dropped from more than 5 per cent to 1.6 percent during 1980-81 and 2000-01. Private sector investment also showed phases of stagnation during this period. This long stagnation and decline in public investment was reversed during 2004-05 when public investments in real terms (1999-00 prices) were raised by almost 30 per cent in one shot.

Fig. 1.5. Trend in public, private and total investments in agriculture and allied sectors at 1999-00 prices



Both public as well as private investments witnessed sharp increase after 2003-04. However, public investments showed decline again in year 2008-09. Precise change in agricultural investments during 2005-06 to 2009-10 at 2004-05 prices is presented in

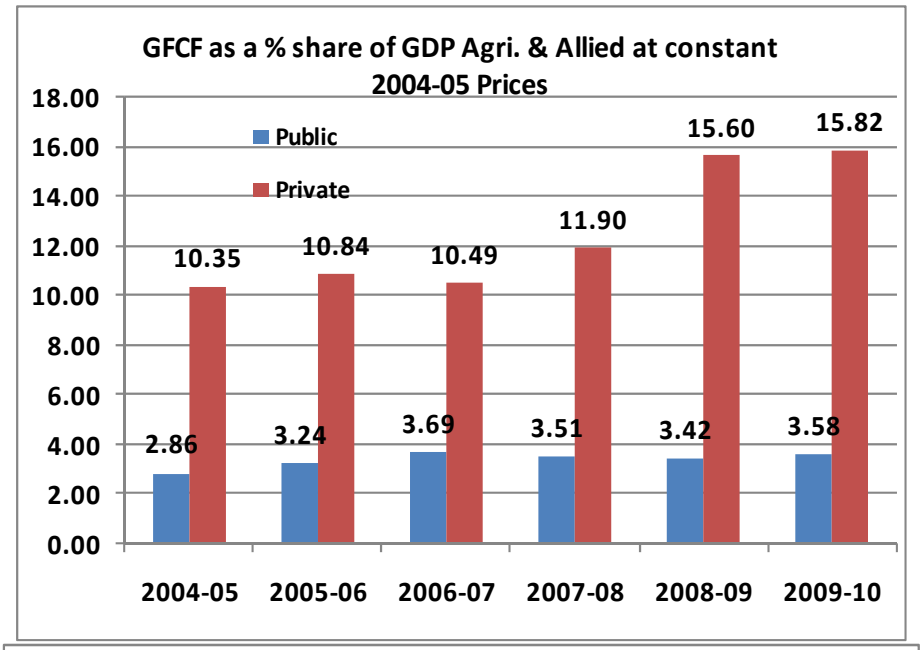
Table 1. 4. The table shows that much of the increase in agricultural investments seen during the recent years is on account of private investments.

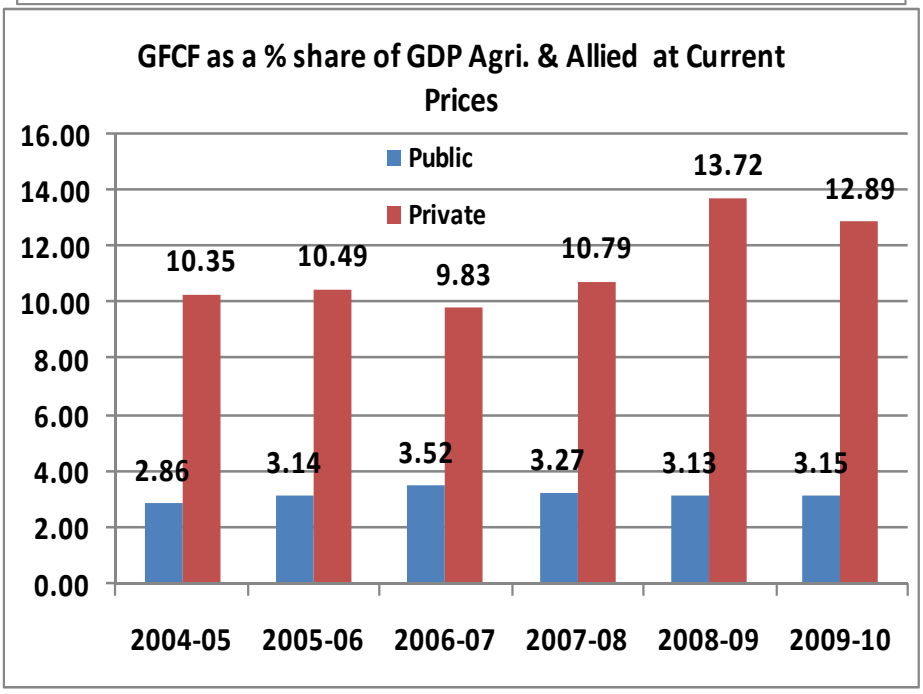
Table1.4: Annual rate of change in GFCF and GDP agriculture at 2004-05 prices (%)

Year	Public	Private	Total	GDP Agri. & Allied
2005-06	19.10	10.16	12.09	5.14
2006-07	18.70	0.78	4.90	4.16
2007-08	0.73	20.07	15.04	5.80
2008-09	-2.66	30.84	23.21	-0.15
2009-10	4.90	1.89	2.43	0.44

To get a deeper and meaningful picture of the situation it is preferable to see the behavior of investment in agriculture, both public and private as a percentage share of the Gross Domestic Product of agriculture sector. These shares at current and constant prices are presented in Fig. 1.6. The story remains more or less the same at constant and current prices. Public investments as percent of GDP agriculture peaked increased during 2004-05 to 2006-07 and then declined. India seems to be investing less than 3.5 per cent of its sectoral GDP for developing infrastructure in agriculture sector. Both public as well as private sector show much lower share in agriculture GDP at current prices compared to constant prices. It seems the 11th Plan could not raise public investments to 4 per cent of GDP of agriculture.

Fig 1.6: Public and private investments as per cent of GDP agriculture and allied sector.





Quality Seed and Hybrid

Seed is carrier of technology. During last six years strong emphasis and support has been provided to seed sector. This has resulted in success in two fronts. One, production of quality seed doubled in four years after 2004-5 (table 1.5). Two, public sector has taken on private sector to compete in seed market. As a result share of private sector in seed production has gone down in the last five years. Still ratio of quality seed to total seed is much lower than norm (Table 1.4) and there is a tremendous scope to raise productivity and production by raising share of quality seed in total seed used by farmers.

Table 1.5: Total seed production by the public and private sectors

Year	Total seed production (lakh qtls)	Share of private sector (%)	Quantity of seed produced by private sector (lakh qtl)	Quantity of seed produced by public sector (lakh qtl)
2003-04	132.27	47.48	62.80	69.47
2004-05	140.51	45.02	63.26	77.25
2005-06	148.18	46.80	69.35	78.83
2006-07	194.31	41.00	79.67	114.64
2007-08	194.23	42.59	82.72	111.51
2008-09	250.40	39.78	99.61	150.79
2009-10	280.00	38.93	109.00	171.00

Source: Seeds Division, Department of Agriculture & Cooperation, Ministry of Agriculture, Viewed on 5 April 2011 (http://dacnet.nic.in/seednet/seeds/material/IndianSeedSector.htm#Role of Public and Private Seed Sector).

Like seed there is discernable change in role of public sector in development of hybrid after 2001-02 in all types of crops (Table 1.6). Till 2001-02, private sector developed 150 hybrids of cotton compared to 15 by public sector. Similarly, in maize the number of hybrids developed by private and public sector was 67 and 3. In the next seven years, share of public sector increased from 8 percent to 19 percent in cotton, 4 percent to 40 percent in maize and 25 percent to 58 percent in rice. Similar changes are observed in the case of other crops also. A sum total of hybrids developed till date by public and the

private sector (for which information was available) and share of private sector in hybrids of different crops is presented in last three columns of Table 1.6. Cotton and maize have been the most favourite crops for development of hybrids both by public and the private sectors, Private sector also evinced strong interest in pearl millet, sunflower and sorghum. Considering all crops together, private sector accounts for three-fourth of the total hybrids developed so far in the country.

The data for the seven years i.e., after 2001-02 show that the gap between private sector and public sector in development of hybrid considerably narrowed down compared to the earlier period even though private sector continued their dominance in cross-pollinated crops like cotton, maize, pearl millet and sorghum.

Table 1.6: Number of hybrids in major field crops developed by private and public sector in India

Crop	Till 2001-02		2002-03 to 2009-10		Total		Private sector share in total hybrids (%)
	Private sector	Public Sector	Private sector	Public Sector	Private sector	Public Sector	
Cotton	150	15	43	10	193	25	88.5
Maize	67	3	36	25	103	28	78.6
Paddy	12	4	11	15	23	19	54.8
Wheat			3	0	3	0	100.0
Pearl millet	60	6	22	7	82	13	86.3
Sorghum	41	5	12	8	53	13	80.3
Pigeon pea			1	2	1	2	33.3
Soybean			2		2	0	100.0
Sunflower	35	6	13	10	48	16	75.0
Jute				23	0	23	0.0
Mesta				11	0	11	0.0
Castor			4	9	4	9	30.8
Green gram			1		1	0	100.0
Mustard			11	1	11	1	91.7
Safflower				2	0	2	0.0
Total	**365**	**39**	**159**	**123**	**524**	**162**	76.4

Source: Seed Association of India, 2002; Websites of various ICAR Crop Research Institutes; Annual Reports and websites of major seed companies (Monsanto, Syngenta, Mahyco, Adventa, Nuzhiveedu, Indo-American, Ankur and Rasi) Viewed on 18 April 2011.

1.4 Recommendations

- Given the vital importance of agriculture for food security, livelihood and income of vast majority of people and importance of the sector for overall growth of the economy and other services provided by the sector, the country need effective strategy to address the problems and challenges being confronted by agriculture sector. There is also a need for policies and strategies to adjust to the new types of technologies, changing demand patterns, upcoming value chains and supermarkets, revolution in communication technology, institutional innovations and globalization and other evolving changes in the system surrounding agriculture.
- No production activity can be sustained in the long run by overlooking the health of the production base and the producers. In this context it is essential that India focus on farmers and natural resource system, comprising land, water, vegetation, which form the production base of agriculture. Often, policies are focused on farming without looking at their implications for the farmers. Unless growth and development of farming leads to improvement in welfare of farmers, it cannot be sustained.
- Agriculture diversification towards high value agricultural commodities like fruit, vegetables and dairy products hold vast potential to accelerate growth and improve farm income in the country. Harnessing full benefit of diversification requires new institutional and contractual arrangements for production and marketing and ensuring that smallholders are not excluded from the process.
- Growth in output and farm income depends upon a large number of factors viz. prices of output and inputs, technology and other non price factors. Raising growth requires remunerative and assured pricing environment for output, access to improved technology, application of quality inputs and machinery. Further, growth has to be achieved from a shrinking natural resource base which implies that growth comes primarily from the increase in productivity.
- Terms of trade for agriculture during 1997 to 2005 remained adverse and are

identified as one of the factors for poor performance of agriculture during this period. Due to increase in use of agricultural production for bio fuel and feed and several constraints on supply side, prices of agricultural products are shifting to higher equilibrium and trend. Till some big breakthrough in technology takes place, agriculture growth will be led by price incentives. Therefore, in order to maintain the tempo of growth, agricultural prices should not be suppressed.

- It was envisaged in the Eleventh Plan that in order to achieve 4 per cent growth rate in agriculture India would need to raise public investment to 4% of GDP agriculture. Public investments are falling short of this target which needs to be met at the earliest.
- There are important lessons from disaggregate growth analysis. Much of what happens in agriculture depends upon the action at state level and the status of technology. Crops which experienced technological breakthroughs are showing robust growth. Thus there is a need to motivate states to take required steps to accelerate agriculture growth alongwith emphasis on technology.
- Technology is the prime mover for growth. Considering the costs and constraints of resources such as water, nutrients and energy, the genetic enhancement of productivity should be coupled with input use efficiency. This can be made possible only by creation and utilization of new and improved technology.
- Electric power is not only cheaper but also much more efficient for undertaking various farm operations. There is need to raise supply of power to rural areas and agriculture sector and to check erratic supply, unscheduled cut and low voltage. This restricts exploitation of irrigation potential in several areas and adoption of efficient technologies like drip and sprinkler. Free or highly subsidised fixed tariff for electric power results in inefficient use of power and also results in indiscriminate use of scarce water resources which has serious implications for future availability of water. Absence of user charges also constrain investments in power generation to raise supply. Unless these issues are addressed power supply to agriculture would remain inadequate.

- Increased use of inputs like quality seed and fertilizer results in instant increase in productivity and production, and demand for such inputs is rising rapidly. Seed is the basic input to raise productivity. In most of the crops use of quality/certified seed in total seed use is awfully low. Inadequate availability at or near to villages, high prices and spurious or low quality seed are the major constraints in promoting use of seed. Weak regulation and almost complete absence of monitoring mechanism are giving way to market for spurious inputs which is damaging farmers interest to use quality inputs and ruins return to investment in such inputs.
- In Central and Eastern states having a large potential like Bihar, East Uttar Pradesh, Orissa, Assam, Chattisgarh and West Bengal, marketing infrastructure is very underdeveloped and private trade is exploitative. As such, the incentives for the adoption of new technology in such areas are very weak. In order to usher in green revolution in these states farmers need to be assured of incentive structure.
- Agriculture in India is highly labour intensive activity. Cost of Cultivation data shows that labour accounts for more than 40 per cent of the total variable cost of crop production in most cases. Therefore, availability of labour to work in agriculture is crucial in sustaining agricultural production. It is generally believed that due to high level of underemployment and unemployment in rural areas there is no shortage of labour in agriculture. However, reality in most of the countryside is different. Evidence from field observations in various parts of the country shows that at peak times either adequate labour is not available or it is available at very high wage rate. Even during normal time, labour dictates its own terms and conditions for work. Thus, despite, labour abundance and poverty in the countryside, farmers face difficulties in getting hired labour. Because of this production choices are strongly influenced by availability of labour. Availability of labour for agriculture has also been severally affected by lack of willingness of members of farm families to undertake manual work in agriculture. Policies that reduce availability of labour for agriculture and hurt production prospects need to be reoriented.

Chapter 2
Performance of Centrally Sponsored Schemers and Programmes

This Chapter review the performance of the central sector and centrally sponsored schemes/ programmes implemented by the Department of Agriculture and Cooperation during the Eleventh Five Year Plan with reference to their objectives and targets. This is followed by suggestion for modifications, continuation or improvement in the efficacy of schemes taking the RKVY model into consideration. Attempt is also made to study the priority in the expenditure on agriculture and allied sectors by the States and the Central government, and suggest ways to augment it.

2.1 Performance Review of the 11th Plan CS and CSS Schemes

The CS and CSS schemes of DAC have performed well as evident from percentage expenditures vis-a-vis RE figures: 101.88% in 2007-08, to 96.60% in 2008-09, 99.18% in 2008-09, and to 99.13% in 2011-12. Except seeds, fertilizers, plant protection Scheme and agricultural implements and machinery, all other schemes have shown performance. Major finding of the analysis of various schemes is that agricultural inputs related schemes have not performed well; which is a serious problems in view of the stagnant or declining factor productivity noticed in a large number of states.

Suggestions on 10 Restructured Schemes proposed for 12th Plan

On the basis of restructuring, that created Central Agricultural Infrastructural Institutes, a new scheme, by juxtaposition of 21 old schemes; and merged some schemes in the RKVY, and created 7 National Mission schemes, and scrapped certain schemes, the following 10 schemes are proposed for inclusion in the 12th Plan.

1. Central Agriculture Infrastructure & Establishment Scheme (CAI&ES)

2. National Agriculture Infrastructure and Information Development Scheme (NAIDS) or RKVY (Infra and Info)
3. Rashtriya Krishi Vikas Yojana (RKVY)
4. National Mission on Seeds and Planting Material
5. National Food Security Mission
6. National Oilseeds and Oil-palm Mission
7. National Horticulture Mission
8. National Water Efficiency and Productivity Mission
9. National Mission on Farm Mechanisation and Energy
10. National Farmers Income Security Scheme

The proposal of the Ministry has been studied in view of the emerging scenario of agricultural development challenges, and path ahead for meeting them.

CAIS&ES Scheme

1. CAIS & ES is a proposed Umbrella scheme carved out of juxtaposition of some 21 full schemes or scheme components that have infrastructure institutes or schemes related to various aspects of agricultural development and statistical data collection, generation and dissemination activities.

Regarding this restructuring the following suggestion are in order:

1. Performance of the schemes/institutes, except a few, are satisfactory.
2. What is required to be done further is:

i) To chaff out component activities with low success rates.
ii) Mark components activities with success stories, and strengthen them for replication in other areas and provide them with more funds.
iii) Use available evaluation reports and field information to see which new activities need to be added in the existing successful schemes.
iv) Finally, it has to be ensured that the quest for reducing number of schemes has not led to dumping too many similar sounding schemes and component activities

under one gigantic Umbrella Scheme creating confusion of organisational control clarity and losing the strategic focus on a scheme.

v) Restructuring exercise is to avoid thin spreading of resources, and make effective implementation and monitoring of schemes when controlled by a few implementing and monitoring agencies, and expedite approval mechanism, which may not prove true when Umbrella Schemes grow too huge themselves.

vi) Instead of merging too many schemes of agricultural research, investigation, extension, training, pest control, statistics, forecasting, and publicity into CAIS&ES, these should be reorganized into three to four Umbrella Schemes, namely: Agricultural Extension, Training and Management; Agricultural Development Information and Data Analysis; Agricultural Marketing Scheme, on the principle of dovetailing activities around the core activity

Merger of Existing DAC Development schemes into RKVY

In view of the fact that RKVY's District Plan document's comprehensiveness remained a matter of serious concern; and its evaluation is still going on, findings of evaluation need to of the document need to be looked at carefully before the merger of the DAC schemes into this is carried out.

Since most of DAC schemes are already doing well, as evident from the 11th Five Year Evaluation carried out by the Ministry, the move for merging them into large unviable Umbrella Schemes by simply placing them under one big scheme needs to be examined carefully. Mere shifting of activities and components from one head or scheme to another without completing serious drills of evaluation and restructuring is not likely to achieve higher physical and financial progress.

State's Comments on RKVY

States are emphasizing that RKVY may have one fixed component and one variable component. The fixed component may be released to the states on the basis of an appropriate formula. The variable component may be incentivized. However, the present formula for incentivizing RKVY, which also determines eligibility for funding during the year under RKVY, may need some modification. The present formula is based on a ratio of two numbers. The numerator consists of expenditure incurred by agriculture and allied departments under the state plan. The denominator consists of the total expenditure under the state plan. Both these numbers are not under the control of the agriculture department. The present formula does not help the Secretary, Agriculture in ensuring eligibility under RKVY. It is suggested that the variable component of RKVY may be incentivized based on fixed numbers on which Secretary Agriculture would have some control so that the expenditure under the state plan could be ensured.

New Restructured Mission Schemes

Ten existing 11th Plan schemes of National Mission are proposed to be merged into 7 national Mission schemes, namely, NFSM, NMSPM, NOOM, NHM, National Water Efficiency and Productivity Mission, NFIS, and NMFME. These schemes should have been assessed on the basis of evaluation studies made or available on their 11th Plan implementation and success stories and lacunae so that the component activities, their operational policies and monitoring mechanism are improved for better results. This should have been done with a focus on removing their fit-for-all modal solutions to evolve them into case-to-case customizable solution based schemes. During an Agro-Economic Research study on NHM in which many states and their districts found that the project had provision for fruits that do no grow in the state.

Views from Major Agricultural States

ISOPOM

- Flexibility for inter component diversion of funds up to **20 %** for **non-seed** components only, there should not be such cap.
- In open pipeline component, benefits are provided only to those who are having sprinkler set already. In spite of this, it should be provided to any farmer in need.

NSFM

- Inclusion of all low production areas need to be ensured.
- Lower salary of contractual staff is a problem.
- Limit of 20% inter-componential changes should be increased.
- Restriction on inter-componential changes from seed to non seed component hinder the progress.
- There is shortage of regular fund release against allocation.
- Approval of DFSMEC at two stages i.e. at planning & at financial disbursement which leads to delay in financial achievements.
- Engaging Secretary level officers lead to a where they don't find time to attend to, so there has to be.
- Sasakawa Global Extension 2000

  Sasakawa Global Extension 2000 experience of the East African and the South African countries should be replicated in India. This programme has such features as: a) mounting knowledge-based efforts; b) an action-oriented approach; (c) developing effective partnership with the national programmes; d) training of extension workers; e) helping its partners in meeting new challenges; and, f) providing flexibility for its country directors to support these programmes.
- Most of CS and CSS schemes have one or two broad components as follows:

  a. Demonstration of a new variety/technology/equipment/etc.

  The broad approach towards demonstration is to provide a package of intervention, such as improved variety seeds agriculture implements, soil improvement, package of practices etc, simultaneously. It does not help the farmers in knowing the efficacy of one or more intervention contained in the

package. It makes its replication and adoption by farmers on their own somewhat difficult. It may be considered if the desired interventions could be taken up in phases.

b. Investment oriented – such as mechanization, soil improvement, irrigation etc.

The investment oriented activities may need to be taken up on selective basis. The investment oriented activities giving higher marginal return may be taken up first but on a large scale. This would help in having demonstrable achievement of programme objectives. This would also facilitate efficient implementation.

Schemes proposed for Scrapping

The list of schemes proposed tor scrapping was examined in the light of the performance of these schemes, and their importance in the emerging priorities. Before taking a final decision on the scrapping of particular scheme, impact evaluation study, if already done, must be consulted.

The main suggestions here are**:**

i) The Technology Mission of Integrated Development of Horticulture In North-Eastern States, Sikkim, J&K, and HP, need to be assessed on the basis of evaluation studies before it is scrapped. The horticultural potential of these North East and Himalayan Hill states need to be tapped by making this 12th Plan scheme more resilient and vibrant.

ii) Agri-Clinic and Agri-Business centres scheme should be evaluated on the basis of inputs from CMA Ahemedad who has done a study on this subject.

iii) The restructuring proposal has identified Macro-Management of Agriculture as superfluous, and has categorized 10 schemes for merger with other schemes, without specifying the scheme into which these are to be merged. Moreover, from the overall agricultural economic imperatives that have emerged, a re-look at the list proposed-to-be scrapped schemes is required.

iv) Agriculture Marketing and Trade Division need to be strengthened and made more comprehensive in view of growing globalization of agriculture, and WTO issues, and importance of foreign trade in making agriculture more remunerative.

Restructuring of DAC Schemes

A close look at the Planning Commission driven restructuring proposal of the existing 11th Plan Schemes, numbering 51, into 10 new schemes falling into three broad categories of CAI&ES, NAID, and 7 National Mission schemes raises certain serious issues about it, as pointed out below:

- DAC's present work/activity division follow, more or less, the golden principle of dovetailing. E&S covers policy and development inputs activities; Crops Div looks after all schemes and activities concerning food grains, schemes; Seeds Div takes care of everything about seeds; and so on and so forth.
- The possibility of further strengthening, weeding and merger only lies within these activity divisions, except some exceptions. The Planning Commission's concern for reducing the multiplicity of schemes can be more effectively done by intra-division merger and scraping. This has dovetailing advantage of contiguity of various activities related to core competence and activity. The opposite scenarios is that of merging similar divisional activities into one or more, as in the case CAI&ES, wherein all support institutions and establishments are merged. The likelihood of poor coordination due to different organisational priorities rendered to these infrastructure and information activities when put under different schemes with different control may lead to delays. However, DAC will have to debate and offer practical solutions to ensure clear organizational and working modalities after the merger.
- The restructuring proposal needs to be seen in view of principles of: a) aligning to structure; b) reducing complexity; c) focusing on core activities; d) creating feasible roles; e) balancing leadership's own roles and supervisory roles; f)

implementation clarity; and, finally, g) flexibility in functioning; h) uniformity in guidelines.

- Restructuring by aligning activities with core-activities, and by dovetailing all activities that fall in the core competence; and shifting all others activities for merger with schemes to whose core competence these schemes can be better aligned without losing on account of effective coordination, etc., can improve the overall physical and financial performance.
- One basic requirement for restructuring of the on-going schemes for the next Plan period is evaluation of their performance. Among the 51 CS and CSS schemes, except few there is no indication of evaluation having been done by either an internal or an external agency. The only basis for evaluation appears to be the physical and financial performance during the 11th Plan period, which is not adequate. Therefore, to firm up the implementation effectiveness of the new 12th Plan Schemes, the following feed back is required for making any decision on it:

i. How many of the 51 CS and CSS schemes have been evaluated by an internal or external agency; and what are the major recommendations.
ii. In those cases where no evaluation has at all been made, the Implementing Divisions Joint Secretaries may state in bullets points their assessment of the schemes.
iii. It must be ascertained whether the District Plan Document provides a reliable district agricultural plan; and secondly whether the implementation experience supports the move to make it the backbone of national agricultural development. Are the states really using DAP document in fixing priorities for budget allocation to the districts.

Therefore, the Sub-Group must seek inputs of all the concerned Divisions regarding the evaluation status of the schemes for which the following information need to be gathered from the Joint Secretaries of the CS and CSS schemes.

2.2 Expenditure Priorities for the 12th Plan

Keeping in view the scheme wise performance, emerging agricultural economic position of India, and the resultant priorities to tackle the challenges, the following need to be given due priority while firming up allocations for the 12th Plan.

1. Agri-Business Clinic need to be continued in view of its good performance, and its importance to the ailing sector, though it might require modifications that its evaluation studies indicate.
2. Poor performance of seeds related schemes in the later years of the 11th Plan was due to non-taking off of its schemes on loan restructuring, poor-show of Seeds Infrastructure and Seeds Research Training. These farm input related schemes need to be strengthened/modified instead of scrapping them or just shifting from scheme to another.
3. In view of lower than expected performance of all three schemes of fertilizers Division, these schemes need to be revamped in view of increasing importance of stagnant or declining factor productivity problems of a large number of states.
4. Plant Protection schemes showed unevenness in their performance; but all that need to be considered while deciding the treat they are to be meted out under restructuring exercise is the undiminished role they have in arresting the declining factor productivity and huge potential of agriculture and horticulture.
5. Agricultural Implements and Machinery scheme needs to be invigorated by all out efforts needed in improving farm productivity and reducing farm labour safety which is one of the focus areas of the 12th Plan under Labour and Employment. The Sub Group strongly recommends much higher investment in agricultural implement and machinery particularly in drought and rain fed areas.
6. Failure of Crops Division schemes of Farming Systems, and Watershed schemes need to be probed into as Crop Division need to give more focus on Farming Systems and Water Management approach.
7. The TM Oilseeds and Pulses schemes need to be assessed whether they are doing enough to tap the developmental potential of technology revolution in molecular

biology, bio-technology, ecology management, which are high potential priorities areas that need action. After evaluation studies, either these schemes should be modified to factor in these visions or new schemes under the 12th Plan should be formulated. A window under RKVY on the pattern of A3P pulses programme is recommended to increase productivity of oilseeds.

8. NE & Himalayan States horticulture having performed well, and being a counter-part of NHM need to be continued with some modifications. Protected horticulture promotion in areas prone to adverse weather phenomena in the light of predicted climate change is a must.
9. SFABC needs to be analyzed in view of the results of CMA study
10. IT Sector schemes should be assessed and strengthened in their achievement towards linking farmers, extension scientists, and policy makers with national and international data banks. This is one of the high potential areas in pushing agriculture ahead.
11. RKVY's component financial performance must be analyzed, and the physical achievements need to be probed in details in view of the much talked-about lack of comprehensiveness of this hurriedly formulated scheme. The results of the evaluations carried out should be looked at seriously for making this scheme which is being termed effective for its implementing agency level flexibility in implementing the schemes according to the ground realities. This very flexibility may prove to be its graveyard if not perfected in time, especially when the DAC has proposed to merge many of CSS schemes RKVY.
12. While formulating New Schemes for the 12th Plan period there is a need to factor in issues regarding which the Vision 2020 Document of Planning Commission has shown concern:

For addressing issues of demographic transition, resource degradations, poverty issue arising out of structural adjustment, globalisation, support for science & technology, deceleration in poverty reduction – the following areas need high priority:

i) Natural Resource conservation and environmental protection.

ii) Tapping vast potential of soil, water and farming system.

iii) Tapping development potential of technology revolution in molecular biology, biotechnology, ecology, and management.

iv) Tapping extension service management potential of ICT revolution by linking farmers, workers, and scientists with national and international data and knowledge base.

v) States with increasing factor productivity should be provided incentives for further increasing productivity; states with constant factor productivity should be provided agricultural inputs and other supports to raise their productivity; and those with decreasing factor productivity should be provided rescue schemes to arrest the declined productivity.

vi) Keeping in view strategic challenges identified in the 12th Five Year Plan, Approached Paper of Planning Commission, there is need for formulation of new schemes for taking care of sustained growth of agriculture.

vii) The investment oriented activities may need to be taken up on selective basis. The investment oriented activities giving higher marginal return may be taken up first but on a large scale. This would help in having demonstrable achievement of programme objectives. This would also facilitate efficient implementation.

Chapter 3
Demand and Supply of Fertilizers, Seeds and Other Inputs

3.1. Fertilizers

The role of chemical fertilizers for increased agricultural production, in particular in developing countries, is well established. In India, fertilizer consumption has been increasing over the years and today India is the second largest consumer of fertilizers in the world, after China, consuming about 26.5 million tonnes of NPK. It accounted for 15.3 per cent of the world's N consumption, 19 per cent of phosphatic (P) and 14.4 per cent of potassic (K) nutrients in 2008. However, average intensity of fertilizer use in India remains much lower than most countries in the world and is highly skewed, with wide inter-regional, inter-state, and inter-district variations.

The importance of fertilizers in yield improvement, which is essential for achieving increased agricultural production, further increases because there is little scope for bringing more area under cultivation as well as majority of Indian soils are deficient in many macro and micro nutrients. The application of essential plant nutrients, particularly major and micronutrients in optimum quantity and right proportion, through correct method and time of application, is the key to increased and sustained crop production. However, the demand-supply gap of fertilizers in India has increased in recent times, thereby leading to increased dependency on imports. Indian imports, which were about 2 million tonnes in early part of 2000s, increased to 10.2 million tonnes in 2008-09. In view of importance of fertilizers in agricultural growth and the possibility of an emerging demand-supply gap, there is need to forecast future demand.

Demand Projections

Various methodologies have been used for projections of demand for fertilizers. Some of important approaches include, normative approach/foodgrains target approach (quantity of fertilizer required to produce specified level of agricultural output), positive approach (quantity of fertilizers required corresponding to different scenarios of variable that affect demand for fertilizers), population nutrition approach (using projected population figures and per capita demand for foodgrains), and multiple regression model. Based on past experience, foodgrains target approach and multiple regression method seem to have projected demand for fertilizers fairly close to actual demand.

Regression Method Estimates

The fertilizer demand function is often referred to as a "derived" demand because it is determined to a large extent by the final demand for the crop produced. In general, the demand for fertilizer depends on (a) the price of the crop(s), (b) the price of fertilizer, (c) prices of other inputs that substitute for or complement fertilizer, and (d) the parameters of the production function that describe the technical transformation of the inputs into an output (i.e., the fertilizer response function). Though prices may be important in determining fertilizer consumption, they are possibly less important than other non-price factors such as introduction of new technology, high yielding crop varieties, expanded irrigation, availability of credit, changing cropping pattern, etc., causing the derived demand for fertilizers to shift over time.

Specifying a forecasting model is always a challenge, especially the model type and relevant variables. The common models are time series models where the forecast is based on past observations of the variable being forecasted. Causal models and qualitative methods have also been used. Causal models such as simple linear regression models are preferable when projections of the exogenous variables are available. Qualitative methods such as expert opinion are popular when insufficient data is available to estimate a model or when there is a need to augment the results of a quantitative method. In a single equation approach, which has been used widely,

typically demand function is estimated using time series of fertilizer use with some price and non-price variables and often a linear trend. We used causal model because time series data on fertilizer consumption as well as variables influencing fertilizer use are available.

The fertilizer demand model using annual time series data, from 1976-77 to 2009-10 using simple linear regression model using ordinary least squares (OLS) method was estimated. We hypothesized that the demand for fertilizer is a function of prices (specifically price of fertilizers and foodgrains), subsidy, as well as non-price factors such as irrigated area, coverage of high yielding varieties, area under foodgrains and non-foodgrains, cropping intensity, rainfall, capital availability, etc. Among a large number of factors considered in the study, the following variables were finally used in the model based on their statistical significance and stability of the functional relationship to estimate demand for the XII Five Year Plan period 2012-13 to 2016-17. Separate nutrient demand functions were estimated for nitrogen (N), phosphorous (P), potassium (K) and total fertilizers (N+P+K) in the country. The empirical model for the fertilizer use is specified as follows:

$$F_{it} = b_0 + b_1 HYV_t + b_2 GIA_t + b_3 CI_t + b_4 Pfert_{it} + b_5 Pr{+}w_t + b_6 Credit_t + U_t$$

Where, F_{it} is fertilizer consumption; i denotes three nutrients N, P and K and total (N+P+K) fertilizer consumption in thousand tonnes; t denotes year

The following independent variables were hypothesized to influence the consumption positively (+), negatively (-), or either negatively or positively (+/-):

HYV = Percentage of area under HYV to gross cropped area (+)

GIA = Percentage of gross irrigated area to gross cropped area (+)

CI = Cropping intensity (%) (+)

P_{fert} = Prices of fertilizers are represented by price of N through Urea, average price of P through DAP and SSP, price of K through MOP and N+P+K price is the price of N, P and K and weighted by their consumption shares (-)

P_{r+w} = Output price is represented by procurement price of rice and wheat (main users of fertilizers) and weighted by the share of their production (+)

Credit = Short term production credit per hectare of gross cropped area (Rs.) (+)

Two forms of functions, namely, linear and Cobb-Douglas, were tried in this analysis. The results of linear regression equation were used for interpretation as it was found better when compared with Cobb-Douglas production function.

Fertilizer Demand Projections

Based on the estimated regression results and the projected values of the explanatory variables, we forecasted the demand for fertilizer. The demand forecasts have been made assuming the growth in explanatory factors according to the last five and 10 year time trend (2005-06 to 2009-10 and 2000-01 to 2009-10) and in case of fertilizer prices, we have assumed an increase of about 5 percent per year. A comparison between the actual fertilizer nutrients consumption and model estimated consumption showed the model tracks historical data well.

The fertilizer requirement forecasts shown in Table 3.1 were generated by an estimated model using historical fertilizer consumption data and based on growth in explanatory variables during the last five years as the models gives better fit than 10 year growth rates. The total demand for fertilizers (N+P+K) is projected to increase to about 36.6 million tonnes by 2016-17. The demand for N is expected to increase to about 20.6 million tonnes, P fertilizers demand is projected at about 10 million tones and K fertilizers the demand is projected to reach about 5.8 million tonnes by the end of XII Plan. The total demand for NPK is estimated at about 36.4 million tonnes by 2016-17.

Table 3.1. Annual fertilizer nutrient projections for 2016-17

	N	P	K	N+P+K
2012-13	17.9	8.4	4.6	30.9
2013-14	18.6	8.8	4.9	32.3
2014-15	19.3	9.2	5.2	33.7
2015-16	19.9	9.6	5.5	35.1

2016-17	20.6	10.0	5.8	36.4
CAGR (%)	3.5	4.5	6.4	4.2

The N demand is expected to increase at an annual compound growth rate of 3.5 percent, P by 4.5 percent and K by 64. Percent with total fertilizer consumption at about 4.2 percent during the XII plan. It is evident that demand for P and K is likely to increase at faster rate compared with N.

Increasing Multi-nutrient Deficiency

Deficiency of secondary and micro-nutrients including organic matter in soils limit crop response to chemical fertilizers. Indian soils are deficient in at least six nutrients, N, P, K, S, Zn and Boron and the extent of deficiency is 89 percent in N, 80 percent in case of P, 50 percent K, 40 percent in sulphur, 48 percent in zinc, 33 percent in boron, iron 12 percent and manganese 5 percent.

Use of organic matter including organic fertilizers is an important instrument for improving crop productivity. There is anecdotal evidence which suggests that use of organic manures is declining in the country. As per agricultural Input Survey 2001-02 conducted by Agricultural Census Division of Department of Agriculture and Cooperation, Ministry of Agriculture, average use of FYM varies from about 0.7 tonnes per hectare in case of large farms to 1.9 tonnes per ha on marginal farms (Table), which is much lower than recommended dose.

Table 3.2. Use of farm yard manure

	Area treated with farm yard manure (%)	Average manure used per ha (MT)
Marginal	30.0	1.9
Small	33.9	1.7
Semi-medium	31.6	1.4
Medium	26.3	1.1
Large	17.7	0.7

All Groups	29.1	1.4

Source: Input Survey 2001-02

3.2 Seed Demand Projections

Seed is a basic and critical input for agricultural production. Quality seed broadly refers to seed of improved variety with high genetic and physical purity, high germinability and vigour, free from seed borne pathogens, need based value addition and long shelf-life and high storability. It is estimated that improved varieties with good quality seed contribute over 40 percent to total crop production where quality seed alone constitute 10-20 percent. The seed division of Department of Agriculture and Cooperation, Ministry of Agriculture has prepared a national seed plan and projected demand for seed during the XII Five Year Plan, which is presented in Table 3.3.

Table 3.3. National Seed Plan: Seed requirement 2012-13 to 2016-17

Crop	Area (lakh ha)	Seed rate (kg/ha)	100% seed requirement (lakh Q)	Existing SRR (%)	Recomm-ended SRR (%)	Seed demand based on recom. SRR (lakh Q)
Cereals						
Paddy	453.52					
Hybrid	16.53	15	2.48	100	100	2.48
Varieties	391.64	44	172.32	25	33	56.87
Broadcasting	43.35	100	45.35	25	33	14.97
Wheat	284.57	100	284.57	25	33	93.91
Maize	76.78					
Hybrids	46.07	20.0	13.22	100	100	13.22
Varieties	30.71	20.0	3.20	30	33	1.09
Jowar	76.78					
Hybrids	46.07	7.5	3.46	100	100	3.46
Varieties	30.71	7.5	2.30	30	33	0.76
Bajra	89.04					
Hybrids	53.42	4.0	2.14	100	100	2.14
Varieties	35.62	4.0	1.42	30	33	0.47
Ragi	13.87	5.0	0.69	25	33	0.23
Barley	6.24	100.0	6.24	25	33	2.06
Pulses						

Gram	79.73	75	59.8	25	33	19.73
Lentil	13.05	25	3.26	25	33	1.08
Peas	6.25	75	4.69	25	33	1.55
Urd	26.04	20	5.21	25	33	1.72
Moong	28.03	20	5.61	25	33	1.85
Arhar	34.02	10	3.40	30	50	1.70
Moth	11.00	15	1.65	25	33	0.54
Cowpea	6.00	25	1.50	25	33	0.50
Horsegram	2.70	30	0.81	25	33	0.27
Rajmash	1.00	60	0.60	25	33	0.20
Oilseeds						
Groundnut	62.19	150	93.29	25	33	30.78
Mustard	61.90	5	3.10	30	50	1.55
Soybean	97.35	75	73.01	25	33	24.09
Sunflower	18.33					
Hybrids	10.66	10	1.07	100	100	1.07
Varieties	7.67	10	0.77	30	50	0.38
Linseed	3.63	25	0.91	25	33	0.30
Castor	8.01					
Hybrids	6.41	12.5	0.80	100	100	0.80
Varieties	1.60	12.5	0.20	30	33	0.07
Safflower	2.88	12	0.35	25	33	0.11
Sesamum	19.42	5	0.97	25	33	0.32
Fibre Crops						
Cotton	101.32					
Hybrid	89,06	2.25	2.0	100	100	2.00
Varieties	12.26	25	3.07	30	50	1.53
Jute	8.11	5	0.41	100	100	0.41
Mesta	2.01	10	0.20	30	50	0.01
Sunhemp	0.06	25	0.02	30	50	0.01

Source: Seed Division, Department of Agriculture and Cooperation, Ministry of Agriculture

Seed Sector Related Issues and Suggestions

Inadequate availability of quality seeds, planting material and germplasm are major constraints limiting productivity. Supply of quality seeds is, therefore, absolutely essential for increasing productivity of crops and total agricultural production. The major issues related to seed sector include:

- Seed germination rate: The germination rate determines the minimum plant population in the field which ultimately decides the yield levels. Often the farmers face the problem of poor seed germination rate. A minimum seed germination rate of 90 % is to be ensured by seed industry. Necessary regulatory mechanism is needed to ensure supply of quality seed to the farmers by the industry.
- Seed Replacement Ratio (SRR)/ Variety Replacement Ratio (VRR): SRR coupled with VRR is a major cause of concern affecting the yield of major crops in the country. The reported SRR for cereal crops was 15-20% and it was as low as 2-3% in case of pulses. Therefore, there is an urgent need to create awareness on seed and variety replacement among farmers for important food crops.
- High Cost of Seeds: The cost of good quality seeds especially hybrid seeds are very high and farmers at times are not able to purchase the seed at high cost. Considering the land holding size of small and marginal farmers who will be affected by the high cost of hybrid seeds, the seed producing companies should bring down the cost of quality seed. Supply of seed to small and marginal farmers must be at subsidized rates with Government support.
- High cost of transportation: Cost of transportation for some of the seeds e.g. Potato seeds is high because the seed production centres are located far away from the areas where potato production takes place. Localized seed production centres may be created to avoid the high cost of transportation.
- Credit Flow: Non availability of credit for seed production to the seed producers, especially the private seed companies at concessional rates is an issue. Therefore, there is an urgent need to enhance the credit flow to the seed industry especially term loan for creating infrastructure like storage, processing etc.
- Quality Research: There is a need for development of multi-resistant (resistant to pests, diseases, drought, frost, soil salinity/ acidity etc) crop varieties. The seed industry/ICAR/SAUs may undertake quality research for development of multi-resistant crop varieties and production of seeds of such varieties.
- Seed storage: The viability of the seed requires to be maintained to get satisfactory germination percentage. Therefore seed storage is a major concern

especially in the eastern region due to humid climatic conditions. Adequate storage infrastructure is to be created to save the seed from damage.

- Protecting Germplasm: There has been an incidence of erosion in germplasm from the country. The stakeholders of the seed industry may ensure that this type of situation does not arise in the seed sector. Sharing of germplasm between public and private seed companies is an option to protect the precious germplasm.
- Diversity in Seed Production: India has as many as 45 major crops for which the seed has to be produced within the country. It is a challenging task to seed sector to meet the seed requirement of such a diversified crop range. Seed hubs are to be identified to produce seed and supply the same to the farmers in the area. This also saves cost of transportation of seed and thus reduces the cost of seed supply at farmer level.
- Infrastructure: Infrastructure is required for seed processing, storage, transportation and distribution. The existing infrastructure facilities of public seed agencies for meeting the above requirements are not satisfactory.
- Plan for Seed Production: The existing seed production plans are mainly one year plans. There is an acute shortage of seed in cases of natural calamities. Under such circumstances, the seed companies should be able to supply the required seed to meet such exigencies. Therefore existing seed production plans may be changed to a long term perspective plans (considering the viability of the seed) so as to keep buffer stock of seed to meet any eventuality of natural calamities.
- Insurance: As seed production involves intensive crop cultivation practices, the cost of cultivation is more than the normal cultivation. At times the seed crop may get damaged due to natural calamities. Therefore, it was suggested that the seed producers, processors and farmers should be adequately covered with appropriate insurance.
- Seed Banks: Seed Banks are very popular in rural areas especially with tribals. There are incidences of managing seed banks in tribal districts of Orissa. The tribals save seeds of millets for distribution to the members during the next cropping season. The seed banks not only protect the existing crop varieties but

also ensure supply of seed to the farmers. There is a need for creation of more seed banks by implementing seed bank scheme.

- Technology upgradation: The seed processing machinery available with the seed companies is old, suitable to process seed of one or two crops only which affects the performance of processing units and also the quality of seed. The seed processing units are required to upgrade the processing equipment with multi-grain processors. Adoption of new technologies in seed production and transfer of available technologies are important aspects in seed production.
- Awareness creation: Lack of awareness on importance of quality seed in crop production resulting in low Seed and Variety Replacement Ratio. Efforts by the Agriculture Extension personnel are required to create awareness in the farmers on importance of seed.
- Involvement of Voluntary Organizations: The involvement of Voluntary Organizations in seed production has already been reported from the eastern region (voluntary organizations like LALL have been doing good work in seed production in Orissa). The seed producing agencies in other parts of the country may involve the local voluntary agencies in seed production process especially for mobilizing the farmers to take-up seed production, training of farmers etc.
- Seed Business Ventures Model: Promoting rural self sustainable micro seed ventures by Seed Business Ventures Model. Seed Business Incubator provides holistic support to the entrepreneurs in terms of basic seeds, capacity building, quality control, business consultancy, branding and marketing by commercializing new cultivars and benefiting the farmers.
- Public Private Partnership (PPP): At present, the public seed agencies owing to their social responsibility are engaged mostly in production and supply of high volume- low value seed; whereas, the private seed agencies concentrate on production of low volume - high value seed. Under the circumstances, the PPP model in seed production is an innovative idea where the public and private seed companies share knowledge on seed production, share the responsibility of seed

production for supply to the farmers and share germplasm. The private seed agencies may pay royalty for sharing germplams for seed production.

- Lending rates for seed production: Lending to the seed industry should be 'on par' with other agricultural lending as far as interest rate is concerned.
- Seed certification: Seed certification charges are on a higher side and there is need to reduce the certification charges.
- Forage Seed Production: There is huge demand supply gap in forage seed production. The seed companies are not coming forward for production of forage seeds. This is a major cause of concern for development of Dairy sector in the country. The Seed companies and SAUs have to take-up forage seed production on a priority basis.

Suggestions:

- In view of the difficulties encountered by hybrid seed producers with respect to shortage of trained labour, capacity building programmes on seed pollination have to be organized.
- Subsidy under Government programmes may be extended for production of truthfully labelled seeds also.
- Participation of Voluntary Agencies to take-up seed production is to be encouraged by supplying foundation seed.
- Regulatory measures for quality seed production have to be tightened so as to avoid supply of spurious seeds to the farmers.
- PPP model for seed production is to be encouraged for the benefit of farmers.
- Quality foundation seed of forage crops should be made available to private seed companies for producing quality fodder seeds & supply to farmers
- The seed companies should be made responsible for poor performance of seed supplied by them. The details of seed traits should be displayed on seed agency website.

- The breeder seed of popular varieties may be made available to the private seed producers for production of foundation and certified seeds. The private seed companies may consider paying royalty to public sector seed agencies for sharing the germplasm available with them.
- The "truthfully" labelled seed produced through Govt. supported schemes like 'Seed Village Programme' may be labelled in the farmers field itself so as to ensure traceability.
- The public seed agencies may create adequate storage facilities for seed. A Capital investment subsidy scheme for seed storage and processing units may be formulated on the lines of similar scheme for Rural Godown for encouraging Private Sector to build such infrastructure.
- There is a need for 'Phytosanitary' certification, especially for export / import of seeds. The State Seed Corporations may establish at least one such certification centre in each State.
- The seed companies should provide adequate compensation package / insurance for farmers in case of failure of seeds/ low germination of seed purchased from the companies.
- Govt. sponsored seed village programme needs to be expanded by including more crops under the scheme.
- At present private seed industries are not undertaking the production of Forage seeds. Therefore there is huge gap between the demand and supply of forage seed. The seed Industry may explore to bridge the gap.
- Seed Industry – Research Institutions linkage has to be strengthened for taking advantage of the positive aspects of both the segments and utilize the same for farmers' benefit.
- The seed agencies may sponsor need based research on the farms of the Agricultural Universities to develop location specific crop varieties.
- Research Institutions and Universities should share knowledge on Good Agricultural Practices (GAP) with all stakeholders for production of quality seed with desired genetic purity.

- Farmers have to be involved in more extensive manner for production of foundation/ breeder seed.
- Working capital requirements of seed companies have to be realistically assessed and extended by banks.
- Term loan to be extended for creating infrastructure for seed processing and storage by banks.
- Credit to seed sector may be treated as agricultural credit and the rate of interest charged may be on par with agriculture.

3.3 Judicious Management of Agricultural Inputs

Intensive agricultural practices, over the years, to enhance agricultural productivity have been eroding native agro-ecosystems through soil erosion, water depletion/contamination, biodiversity loss and disruption in flow of various ecosystem services threatening the agricultural bio-security. The intricate interdependence between agriculture and the natural resources especially in the context of the looming threat of Climate Change make it imminent to revisit the present agricultural strategies to evolve measures for judicious use of various agricultural inputs to ensure sustainable agriculture.

There should be a major effort on educating the farmer on the critical role the soil health plays in productivity. Moreover soil testing is essential to determine the exact requirement of type and quantity of Macro and Micro Nutrients. Suitable fertilizer selection, proper dose, appropriate methods of application and judicious use plays a significant role in plant physiology and crop productivity.

The need for achieving optimal seed replacement rates throughout the country should be one of the focus areas besides putting in place mechanisms for supplying quality and appropriate seed varieties taking into account the native agro-ecosystems and the pest profile of the region. Appropriate practices for enhancing the quality of the crop by right

choice of seeds and seed health practices should be developed and the knowledge disseminated to the farmers.

Since early 1990s, Government of India has been promoting Agro-ecosystem analysis (AESA) based IPM through Farmer Field Schools (FFS) to promote environmentally sustainable agriculture and enhance productivity. AESA, relies on holistic approach and takes into account plant health, pest and beneficial insect dynamics, weather and soil factors and farmers experience. Studies have shown that adoption of AESA based IPM in a scientific manner through FFS programmes encouraged reliance on biological control agents as well as substantial reduction in consumption of chemical fertilizers and pesticides and consequently cost reduction. AESA also enlists active participation of farmers in decision making based on experiential learning besides enhancing productivity and protecting the native agro-ecosystems. The FFS schemes are currently promoted departmentally and through some NGOs. However, most of the field level extension functionaries have not undergone season long training in crop specific AESA based programme. Moreover the State departments of Agriculture and Horticulture in the country are facing staff crunch and the existing officers are burdened with multifarious activities, as a result they are not able to focus on the qualitative aspects of FFS. If quality of FFS is not maintained, the productivity can be negatively impacted at farm level. There is a need to focus on the qualitative aspects of capacity building of the trainers and the farmers. The extension officers who are responsible for building the capacity of the farmers, themselves require intensive training in AESA based plant health management. Ideally a separate cadre of Extension officers, through the government machinery or through PPP, should be developed and made responsible for organizing the FFS.

Bio-security

Bio-security risk management has implications for food, social and economic security in the country. Understanding patterns and probabilities of introduction of new pests and

diseases is important to assess bio-security risk. As recommended by the core group, constituted by Government of India, on plant and animal bio-security for national agricultural bio-security system there is a need to tackle the issue of bio-security at a sub-region level in collaboration with countries with whom India shares contiguous boundaries for complete regional bio-security. Collaboration among South Asian Nations (SANs) for creating a bio-secure region is required.

There is a need to make our agro-ecosystems more resilient to biological invasion. Opportunities for improving resilience are considerable and include, for example:

- breeding of disease resistance into crops, assisted by new biotechnological tools for incorporating existing or new resistance mechanisms
- strategies of deployment of crops which reduce the risk of pest and disease outbreaks such as crop varietal mixtures and
- Monitoring the crop situation through Global Positioning System (GPS) based pest surveys and surveillance and timely advisories to prevent epidemics or the development of endemic areas.
- Diversification of local production systems to be ecologically and economically resilient, reducing unnecessary movement of plants and animals.
- Promotion of ecological approaches such as AESA based plant health management, which takes in to account the intricate interdependence of biotic and abiotic components of the ecosystems.
- Need for greater communication and coordination among (and within) agencies.

Chapter 4
Demand and Supply Projections for Agri-Food Commodities

4.1 Demand Projections

Four approaches have been used to estimate demand for various agricultural committees during the 12th Plan. These are:

- Household Consumption Approach (NSSO plus Feed, Seed, Wastage and other uses)
- Normative Approach: Based on ICMR recommendation
- Behavioural Approach: Based on demand elasticities
- Absorption Approach: based on past and current absorption

Total demand for any food commodity is divided in two parts; (1) household food demand (2) Indirect demand which includes seed, feed, wastage, industrial use and any other demand not captured by direct household consumption. Food demand for human consumption was obtained by multiplying the projected per capita consumption with the projected population. Indirect demand for food also includes the home-away demand for food which is growing with urbanization and increasing employment opportunities for the urban women. Looking demand (home consumption, home away consumption, industrial use, export, wastages and requirement for seed and feed) and supply (production, imports and government stock) food balance, the indirect demand (seed, feed, industrial use, home away human consumption and wastages) can easily be estimated under the assumption that total supply equal to total demand as follows:

Total supply = Production +Import - Change in government stock
Total demand = Household demand +Indirect demand
Indirect demand=home away demand+industrial demand+seed +feed+Export+ wastages

Total supply = Total demand

Thus, Indirect demand = Production + Import+ Change in stock – Household demand

Share of indirect demand in total demand/supply =

1- [household demand / (Production +Import +Change in Stock)]

4.1.1 Household Consumption Approach

Demand for any commodity includes household consumption demand and demand for other uses like seed, feed, industrial use etc. A part of supply also goes as waste. Demand for household consumption is estimated from monthly per capita consumption of various commodities as reported in the Household Consumption Expenditure Survey of National Sample Survey Office (NSSO). Per capita demand is multiplied by mid year population to arrive at total demand. Two main issues in this projection are (a) Choice of base year like should it be 2004-05 or 2009-10 which is more recent (b) allowance for SFW and Industrial use. It is assumed that "Seed and wastage will remain unchanged in the next plan and higher growth of animal husbandry sector, would put stronger pressure on feed requirement.

Total demand is given by direct demand captured by NSSO plus indirect demand or consumption not captured by NSSO data. Thus, total demand is:

Direct household demand as captured by NSSO +

Seed, feed, wastage+

industrial demand and +

any other demand not captured by NSSO like snacks, meals taken outside home, cookies etc. not captured by NSSO consumption data

It is seen that the seed, feed, wastage and industrial use are not estimated scientifically for quite some time. While estimating the total demand for various agricultural commodities in the previous Plans, proportion of seed, feed and wastage have been based on historical convention rather than based on any systematic study. Long back

Directorate of Economics and Statistics, GOI, prepared some estimates of SFW which have been used to represent demand other than direct consumption by the household. However, these estimates have been kept same since 1950-51. Some studies have shown that proportion of SFW and demand not captured by NSSO consumption expenditure has been on a rise and it is much higher than decades old estimates of DES. A comparison of share of demand outside NSSO as reported by DES and as estimated by NCAP is shown in Table 4.1 below:

Table 4.1: Share of SFW and other demand in total demand for various food commodities (%).

Items	DES (SFW)	NCAP (SFW+Ind. Use+ any other demand not captured by NSSO)
Rice	7.6	13.77
Wheat	12.1	18.13
Coarse Cereals	26.5	59.53
Pulses	12.5	42.75
Oilseeds	Rec. : 28	41.23
Sugarcane	SFW: 11.7, Rec.: 10.2	51.33

The NCAP estimates of share of demand not captured by NSSO are based on residual approach which compute other demand as:

Total production + Import - Export- Change in stock over year - NSSO based consumption.

These estimates for foodgrains are reported in table 4.2. These estimates show that share of demand for SFW and other uses not captured by NSSO household consumption data has been steadily rising. In the latest year close to one fourth of production is not accounted for by NSSO consumption. These changes show that demand for non NSSO items has been rising much faster than the demand included in NSSO. This demand appears to be settling around one fourth of the total demand for foodgrains.

Table 4.2: Changes in share of demand for SFW and the demand not captured by NSSO consumption data since 1983

Period	Foodgrain absorption not accounted by NSSO %
1983-84 to 1987-88	9.0
1989-90 to 1993-94	15.5
1995-96 to 1999-00	19.0
2000-01 to 2004-05	21.3
2005-6 to 2009-10	22.3
2009-10	24.2

Coming to the issue of base year it is observed that year 2009-10 show a very steep fall in the per capita consumption of cereals and total foodgrains (Table 4.3). One reason for this seems to be severe drought of year 2009-10 which brought down production of cereals by 17 million tonne (8%) and course cereals by 76.5 million tonne (16%) over the previous year. Therefore any projection that uses 2009-10 as a base will underestimate future demand. Thus we have prepared demand estimates for 12th Plan by using base 2004-05 and 2009-10.

Table 4.3: Annual Consumption NSS: Kg/per capita

Item	**1993-94**	**1999-00**	**2004-05**	**2009-10**
Rice	72.51	71.11	71.93	69.67
Wheat	53.29	54.14	51.56	52.97
Coarse cereals	20.20	15.51	16.54	8.74
Cereals	146.00	140.77	140.03	131.39
Pulses	9.86	11.19	9.01	8.39
Foodgrains	155.86	151.96	149.05	139.78
Edible oils	5.66	7.42	6.45	8.35
Sugar			9.49	9.46

Population Projection

The Mid Year (1st October) projected population figures for different years, post census, are usually brought out by the Registrar General of India (RGI). However, post 2011

census no such projections have yet been issued by RGI. RGI had earlier projected the population of the country for each year upto 2026 based on the observed rate of growth in 2001 census with suitable adjustments for age specific growth. As per 2001 census India's population on 1st April 2011 was projected at 1192.5 million. However as per 2011 census the actual population on 1st April 2011 was 1210.193 million. Thus there was an under estimation of 1.48% between the projected population and actual population as on 1st April, 2011. Accordingly, the WG has inflated the projected population by 1.48% for each year of the 12th Plan. The Mid-Year projected population for 12th Plan works out as under:

Table 4.5: Projected population during 12th Plan

Year	Projected: Million	AGR
2011	1219.64	
2012	1235.39	1.29
2013	1250.99	1.26
2014	1266.43	1.23
2015	1281.68	1.20
2016	1296.73	1.17
12th Plan	CAGR	1.23

It may be mentioned that this approach assumes short term static behaviour of consumption, i..e. increase in income have no effect on consumption.

Foodgrain Demand Based on Household Consumption Approach

Demand for foodgrains by the end of 12th Plan based On Household Consumption Behaviour is presented in Table 4.5 under four scenarios. These include, per capita household consumption of 2004-05 as a base assuming SFW and other types of demand to be 12.5 % and 24.1%. The other two scenarios use per capita household consumption of 2009-10 as a base assuming SFW and other types of demand to be 12.5 % and 24.1%. It will be seen from Table 4.5 that the scenario which assume 12.5% of total

demand going for SFW and other uses is highly underestimate. According to this scenario demand for foodgrain during 2016-17 turns out to be 207.1 mt based on per capita consumption (PCC) of 2009-10 and 220 mt based on PCC of 2004-05. As the country has been already consuming much higher than 220 million tonne of foodgrain it is not realistic to expect total demand for foodgrain to come down when population is growing at annual rate of 1.23 per cent per year. Alternatively, foodgrain demand is projected to be between 239 -254 mt depending on choice of base for PCC.

Table 4.5: Demand for foodgrain by 2016-17

Base	SFW and Other Demand	Total Demand mt
2009-10	12.5%	207.1
2009-10	24.1%	239.0
2004-05	12.5%	220.9
2004-05	24.1%	254.8

4.1.2 Normative approach

This approach uses ICMR recommended quantity for per capita direct consumption to arrive at demand at household level. ICMR's recent recommendation is 122 kg cereals and 25 kg pulses per person involved in sedentary activities and 146 and 25 kg for those involved in sedentary activity. Assuming that the norm for sedentary activity represent the requirement of total population, demand for foodgrain at the end of 12th Plan is projected to be 217.8 mt when SFW and other demand is assumed to be 12.5 per cent of total demand and 251.3 mt when SFW and other demand is taken as 24.1 per cent. If ICMR recommendation for moderate activity is taken to represent average requirement of the whole population the level of foodgrain demand increase to 259.3 and 299.2 mt corresponding to 12.5 and 24.1 per cent levels of non household demand.

Table 4.6: Demand for foodgrain (2016-17) based on Normative Approach (ICMR)

Base	Norm Kg/person	SFW and Other Demand	Total Demand mt
Sedentary activity	Cereal: 122 kg Pulses: 25	12.5%	217.8
Sedentary Activity	Cereal: 122 Pulses: 25	24.1%	251.3
Moderate Activity	Cereal: 146 Pulses: 29	12.5%	259.3
Moderate Activity	Cereal: 146 Pulses: 29	24.1%	299.2

4.1.3 Behavioural Approach

This approach is based on the behaviour of consumption on account of changing per capita income in a growing economy and the elasticity of consumption of various items to changes in income. The demand for year 't' is estimated as under:

$D_t = P_t * D_0 (1+ \eta * y)^t$

Where,

D_t = Demand in period t,

P_t = Mid-year projected population in year t,

D_0 = Per capita demand in base year,

η = Expenditure elasticity of Demand,

Y = rate of growth in per capita income.

The assumptions used in the projection based on this approach are:

- Demand elasticities estimated separately for four income classes, rural and Urban and for six regions of the country

- Demand estimated separately for 35 states then aggregated.
- GDP growth: at 9 % per annum and per capita income @ 7.7 % per annum after adjusting for population growth at 1.3 per cent.
- Base year consumption is taken from NSSO 2004-05.

Indirect Demand for Food

The indirect demand was computed for years from 1998 to 2008 and predicted using trend analysis till the years 2016-17 for various food commodities. Share of indirect demand in total demand of various food commodities is presented in Table 4.7.

Table 4.7: Indirect demand for food commodities in India, 1998 to 2026 (% of the total demand)

Commodity	2004-05	2011-12	2016-17
Rice	12.97	13.43	13.77
Wheat	17.08	17.69	18.13
Coarse cereals	56.07	58.06	59.53
Maize	78.03	80.82	82.88
Total cereals	21.39	22.06	22.49
Pulses	37.00	41.71	42.75
Chickpea	70.06	71.24	72.21
Pigenpea	19.41	20.12	20.60
Foodgrains	22.49	23.61	24.19
Edible oils	29.53	40.20	41.23
Rapeseed & mustard	21.98	22.77	23.32
Ground nut	22.52	23.36	23.88
Sugar	48.35	50.07	51.33
Vegetables	37.76	38.43	38.91
Potato	40.18	40.88	41.40
Onion	30.93	31.48	31.88
Fruits	81.47	82.90	83.95
Milk	40.58	41.58	42.10
Meat, fish & eggs	39.45	40.83	41.85
Fish	57.13	59.89	60.66

The share of indirect demand in total demand was estimated to be 13% to 81% in the year 2004; the maximum share was found for fruits and maize, followed by sugar, pulses, oilseeds, wheat and rice. The higher indirect demand for maize was due to higher demand for feed of the livestock and corn oil processing industry. Hotels, processed food and sweet makers etc are contributing to high demand for sugar, edible oils, and pulses. The higher indirect demand for fruits might be high post harvest loses, process food and export.

Total Demand for Food Commodities based on Behaviouristic Approach

Total demand projections at domestic level are arrived at by adding the direct demand (human consumption) and the indirect demand (seed, feed, wastages, home away demand, and export) and presented in Table 4.8 at the national level.

Table 4.8: Total demand for Food based on Behaviouristic Approach

Commodity	2004-05	2011-12	2016-17	Growth rate %
Rice	93.96	103.48	110.21	1.10
Wheat	70.04	80.79	89.06	1.90
Coarse Cereals	31.49	34.60	36.40	0.27
Maize	13.88	16.86	19.27	2.43
Total Cereals	195.49	218.86	235.67	1.29
Pulses	14.91	18.84	21.68	3.09
Chickpea	5.71	7.02	8.22	3.47
Pigenpea	3.80	4.48	5.10	2.86
Foodgrains	210.40	237.71	257.34	1.45
Edible Oils	10.16	14.23	16.64	3.54
Rapeseed & Mustard	3.75	4.48	5.19	3.32
Ground nut	1.75	2.12	2.48	3.48
Sugar	20.24	23.70	26.50	2.22
Vegetables	116.12	139.17	161.01	3.30
Potato	29.95	35.76	41.19	3.15
Onion	12.47	15.00	17.42	3.39
Fruits	59.54	77.38	96.86	5.09
Milk	94.21	117.83	141.14	4.17
Meat, Fish & Eggs	9.62	12.47	15.75	5.87
Fish	6.31	8.48	10.68	5.83

4.1.4 Actual Absorption approach

This approach is more direct and pragmatic and it is based on recent situation. In this approach we first estimated actual absorption for year 2010-11 which is the base for twelfth plan. It estimates total absorption in the year as under:

- Base year: 2010-11 (1.4.2010 to 31 March 2011)
- Total absorption: 235.26 million tonne worked out as under:
  Production (rabi 2009-10 + kharif 2010-11): 114.16+120.36 =234.5 mt
  Less: Export+import: 2.88-2.02 = 0.86 mt
  Change in stock (1 April 2010 and 1 April 2011): 16.1 -14.5= (-)1.6 mt
- Absorption represents demand when there is no supply constraint like 2010-11. Thus, absorption during 2010-11 can be taken as demand
- Future growth in domestic demand:
  - Growth in direct consumption
  - Growth in seed, wastage, feed, industrial use, other demand

Projected absorption is estimated by computing aggregate growth rate in demand which is taken as weighted sum of growth in various components of demand. These computations are shown in table 4.9.

Table 4.9: Projected foodgrain demand during 2016-17 based on actual absorption and growth in different components of demand

Source	Composition	Growth rate	
1. Household direct	0.76	-0.40	-0.20
2. Seed	0.03	0.00	0.00
3. Wastage	0.03	1.50	1.50
4. Other uses: feed, industrial use and demand not captured by NSSO	0.18	2.70	2.70
Weighted sum (1 to 4)		0.23	0.38
5. Population growth		1.30	1.30
All sources (1 to 5)		1.53	1.68
Foodgrain demand mt		**257.7**	**260.0**

Total demand for foodgrain comprises 76 per cent of demand for direct household consumption, 3 per cent as seed, 3 per cent as wastage and 18 per cent as feed, industrial use, and home away demand etc. Past trend shows that per capita household consumption of foodgrains has been declining. The rate of decline was found to be 0.4 percent per annum during 1993-94 and 2004-5. As PCC can't keep on declining, the rate of decline is presumed to fall from 0.4 per cent to 0.2 per cent in the second scenario. Demand for seed is assumed to remain at current while the wastage is expected to increase annually by 1.5 percent which is same as the growth in demand. Per capita demand for feed, industrial use and home away food was arrived at by multiplying rate of growth in per capita income with expenditure elasticity of livestock product, which gives growth in per capita demand for livestock products. This was estimates at 2.7 per cent. It was assumed that demand for feed etc. will grow at this rate. Population growth rate is taken to be 1.3 per cent per annum for the 12th Plan. Adding up weighted growth rate of various components of demand indicate 0.23 percent annual growth in per capita foodgrain demand. Thus total demand for foodgrain is projected to rise annually by 1.53 per cent. This growth rate will raise total demand for foodgrain from 235.2 million tonne during 2010-11 to 258-260 million tonne during 2016-17. This demand excludes export demand.

4.2 Supply Projections

Supply projections are estimated based on five approaches as follows:

- Simple Regression
- Exponential Growth
- Multiple Regression
- Average Annual Growth Rate
- Compound Annual Growth Rate

For the simple regression, exponential growth and the multiple regression, data for the past 10 years (2000-01 to 2009-10) have been used to work out various constants as per the following model:

Simple Regression Approach

$Y=a+bx$

a, b are constants, x is time in years.

(For pulses and sugarcane data for past 20 years

(1990-91 to 2009-10) were used because of erratic growth trend in recent decade.

Exponential Growth

$y=a\ (b)^T$

a, b are constants and T is time in years.

Multiple Regression

$y=a+bx1+cx2+dx3$

a,b,c, d are constants,

x1: area under the crop

x2: fertilizer consumption per hectare

x3: percentage of irrigated area

For working out supply projections on the basis of average annual growth rate and the compound annual growth rate, production data for the period 2005-06 to 2009-10 have been used.

The estimates of supply projection for selected crops are presented in Table 4.10.

Table 4.10: Supply projection for selected crops during 12th Plan, million tonne

Crops	Simple Regression Method	Exponential Growth	Multiple Regress	Average Annual Growth Rate	Compound Annual Growth Rate
Rice	104	106	103	98	102
Wheat	93	95	93	104	99
Coarse cereals	45	46	44	49	42
Cereals	242	247	240	251	243
Pulses	18	19	19	21	18
Food grains	261	266	259	272	261
Oil seeds	37	41	36	33	30
Sugarcane	365	371	369	411	396
Cotton	45	74	44	60	49
Jute & Mesta	11	11	11	11	11

4.3 Working Group Recommendations

After taking into account the demand and supply projections based on various methods the Working Group arrives at following estimates of demand and supply during the year 2016-17, which is the terminal year of Twelfth Plan:

Table 4.11: Working Group Recommendation on Demand

Crop/Group of Crops	Demand mt	Supply mt
Cereals	235	240-251
Pulses	22	18-21
Food grains	257	258-272
Oilseeds / Edible oils	59/16.64	33-41
Sugarcane / Sugar	279/26.5	365-411
Cotton	na	44-74
Jute & Mesta		11
Vegetables	161	
Fruits	96.86	

Demand for cereal is projected to reach 235 mt and demand for pulses is projected to reach 22 mt by the year 2016-17. The demand for the total foodgrain is expected to reach 257 mt. Supply projections for the same indicate that India is likely to have small surplus in cereals whereas, pulses will remain in short supply. Edible oil demand is projected to reach 16.64 mt which will require 59 mt of oilseeds. Even in the best production scenario India remains deficit in oilseeds. The deficiency in terms of oilseeds is expected to raise between 18 to 26 mt of oilseeds. Demand for sugar is projected to grow to 26.5 mt which can be met through sugarcane production of 279 mt. Available trend show that India will be having surplus of sugar during the 12^{th} Plan. Demand for vegetables and fruits is expected to reach 161 and 97 mt.

Chapter 5

Agriculture Mechanisation

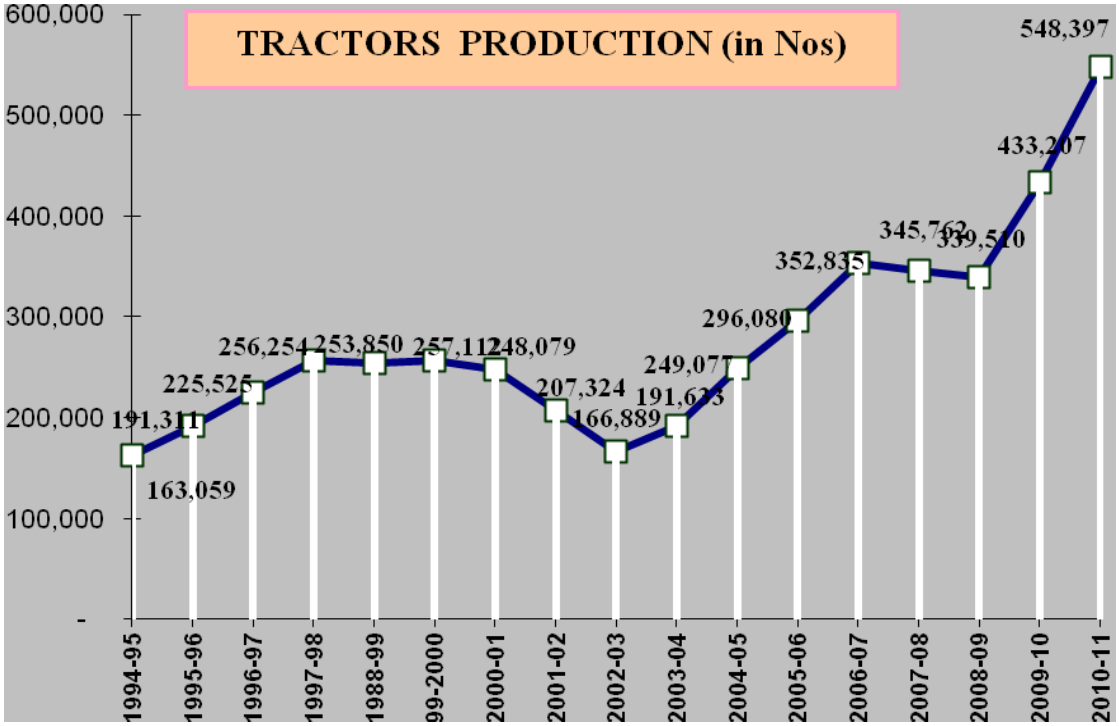
Contributor/Sub Group

1.	Dr. Pitam Chandra, Director, CIAE	Convenor
2.	Shri Himat Singh, Deputy Commissioner (M&T)	Member
3.	Er. Baldev Singh, President, AMMA	Member
4.	Dr Surendra Singh, PC, AICRP on FIM	Member
5.	Sri RN Patil, Advisor, M/s John Deere	Member

Farm mechanisation is getting increased attention due to three main reasons. One, rising wages for labour, two, for achieving operational efficiency and three, rising cost of energy.

India has witnessed steady growth in production and use of electro-mechanical power sources particularly 4-wheel small tractors, power tillers, diesel engines and electric motors and matching equipment since 1960s. The annual rate of growth in the sector is high 8-10 % per annum. During year 2010-11 India produced about 5.48 lakh tractors (Fig. 1). Though power tiller manufacture started about the same time as tractor but their demand has been low, possibly due to wetland cultivation in *kharif* and upland during *rabi* for which power tillers are not very suitable unless soil is in friable range.

Fig. 5.1. Tractor production trend in India



(Automotive Component Manufacturers Association of India)
http://www.acmainfo.com/doc/Industry_Statistics_Vehicle_10-1.xls

While developed world mechanised its agriculture to create surplus labour for the industrial sector, in India it has been directed to help farmers and farm worker do their job speedily, with high quality job, acquire additional capacity to achieve timeliness in field operations without much hardship and drudgery. It also helps in achieving precision in metering and placement of inputs for better crop stand, better response to inputs and increased productivity. Farm mechanization imparts dignity to farm work. Bullocks and other draft animals continue to have relevance in India for socio-economic reasons particularly to marginal and small farmers. However, animate power per unit energy supply is costlier than electro-mechanical sources. Animals need to be fed and maintained even when not in use and are vulnerable to morbidity and mortality due to

disease and pest, paucity of feeds and fodders, harshness of climate etc. With mechanization, farm power availability has increased, yet a lot of efforts and investments are needed particularly in Eastern and North Eastern states, hill & mountain areas and tribal areas.

Table 5.1 Status of farm power sources in India

Year	Argil Workers		Draft Animals		Tractors		Power Tillers		Diesel Engines		Electric Motors	
	Number (million)	Power (million) (kW)	Number (million)	Power (million) (kW)	Number (million)	Power (million) (kW)	Number (million)	Power (million) (kW)	Number (million)	Power (million) (kW)	Number (million)	Power (million) (kW)
1960-61	131.10	5.8	80.4	30.6	0.037	1.00	0	0	0.230	1.298	0.200	0.74
1965-66	128.89	6.0	81.4	30.93	0.063	1.64	0.0015	0.008	0.5	2.8	0.5	1.85
1970-71	125.70	6.21	82.6	31.39	0.168	4.38	0.0096	0.054	1.7	9.52	1.6	5.92
1975-76	139.97	6.81	83.4	31.69	0.292	7.62	0.0179	0.1	2.32	12.99	2.28	8.44
1980-81	148.0	7.46	73.4	27.89	0.531	13.86	0.0162	0.091	2.88	16.13	3.35	12.39
1985-86	162.46	8.29	72.6	27.59	0.81	21.14	0.0196	0.11	5.4	30.24	4.33	16.02
1990-91	185.30	9.17	70.9	26.94	1.192	31.11	0.0323	0.181	4.8	26.88	8.07	29.86
1995-96	200.46	9.95	65.2	24.77	1.739	45.38	0.0659	0.369	5.2	29.12	11.13	41.18
1999-00	206.19	10.6	60.0	22.8	2.369	61.83	0.1046	0.586	5.9	33.04	12.85	47.55
2000-01	213.83	10.7	60.3	22.9	2.531	66.06	0.1147	0.642	6.226	34.86	13.25	49.03
2001-02	234.09	10.9	59.3	22.5	2.643	68.98	0.1232	0.690	6.523	36.53	13.601	50.32
2002-03	235.26	11.1	58.4	22.2	2.736	71.41	0.1333	0.747	7.053	39.5	13.921	51.51
2003-04	236.44	11.2	57.5	21.8	2.855	74.52	0.1449	0.811	7.028	39.36	14.21	52.58
2004-05	237.62	11.4	56.5	21.5	2.992	78.09	0.1555	0.871	7.595	42.53	14.467	53.53
2005-06	238.81	11.47	55.8	21.2	3.153	82.29	0.1659	0.929	7.627	42.71	14.75	54.57
2006-07	240.00	11.63	54.9	20.86	3.37	87.96	0.1785	1.000	7.822	43.8	15.054	55.7
2007-08	241.00	11.7	54.0	20.52	3.553	92.73	0.1921	1.076	7.900	44.24	15.8	58.46
2008-09	242.21	12.10	53.32	20.26	3.689	96.28	0.2221	1.244	8.173	45.77	16.203	59.95
2009-10	243.42	12.17	52.65	20.01	3.915	102.18	0.2571	1.439	8.456	47.35	16.6161	61.48

Note: 1 Human = 0.05 kW, Drought animal = 0.38 kW, Tractor = 26.1 kW, Power tiller = 5.6 kW, Electric motor = 3.7 kW, Diesel engine = 5.6kw

Source: Singh et al (2011), Agril. Enng. Today, Vol. 35(2)

5.1 Energy and Agriculture

Agriculture is becoming more and more energy intensive activity (table 5.2 and 5.3). It uses energy directly for tractive work using draft animals, tractors and power tillers, run on diesel, for field operations and transport. For stationary farm operations usually engines and electric motors are used for water lifting, threshing and cleaning, feeds and

fodder processing etc. Stationary operations carried out using tractors and power tillers are convenient but not efficient. Agriculture also uses large quantities of energy indirectly in the form of seed, fertilizers, growth hormones, pesticides, machinery, etc (Fig.5.2). Traditional agriculture used human labour and draft animal mostly, seeds were on-farm produced or acquired through barter and plant nutrients were mostly solid and liquid wastes of domestic animals, decomposed vegetation, green manuring etc. Plant protection was mostly through crop rotation, physical, use of ash, plant extracts, cow urine etc.

Table 5.2: Trends in number and growth rates in mechanical farm power sources in India

	1950	1960	1970	1980	1990	1997	2000	2009-10*	Growth rate (%) Base year 1970
Tractive power (number in million)									
Tractor	0.008	0.031	0.148	0.518	1.222	2.037	2.471	3.916	10.36
Power Tiller	-	-	0.003	0.021	0.040	0.085	0.110	0.192	12.7
Stationary power (number in million)									
Electric pump	0.020	0.100	1.629	4.330	6.01	8.254	9.525	16.194	6.06
Diesel pump	0.083	0.230	1.546	3.101	4.659	5.899	6.465	8.456	4.88
Others (number in million)									
Power sprayer/duster	-	-	0.045	0.124	0.200	0.245	0.311	-	6.66

*SP Singh et al (2011), Agril. Enng. Today, Vol. 35(2)

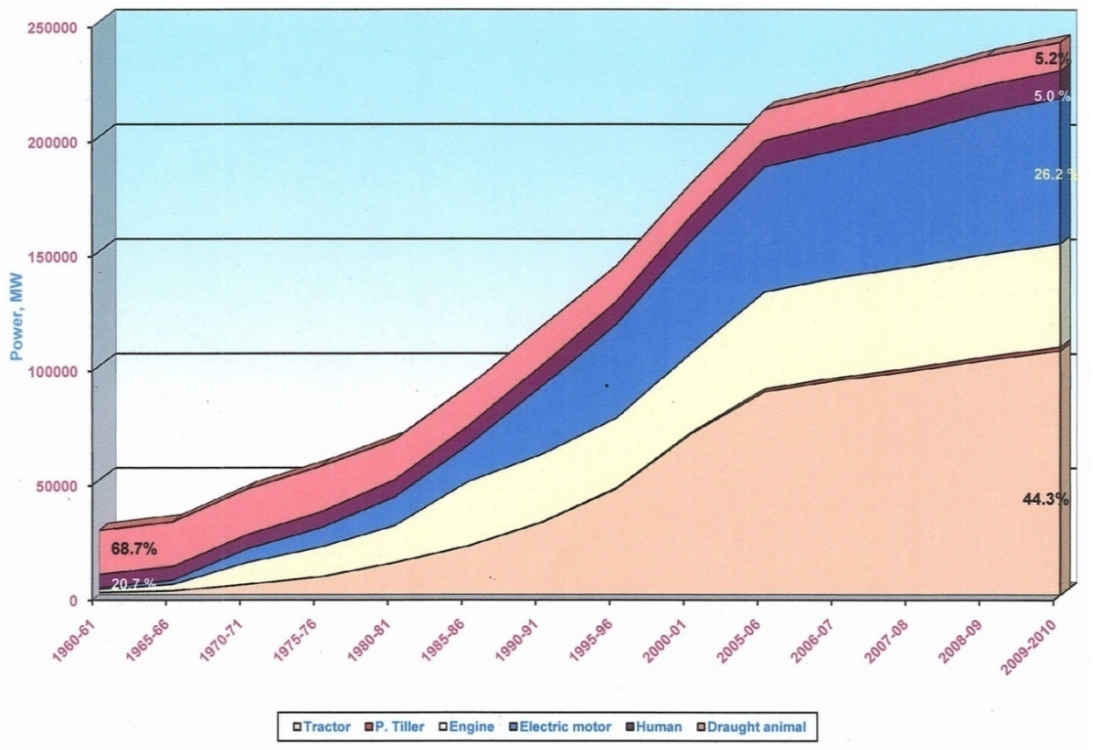
Table 5.3: Sector-wise electricity consumption in India

(Giga Watt hour)=106x kilo watt hour

Year	Industry	Agriculture		Domestic	Commercial	Traction & Railways	Others	Total Electricity Consumed
1	2	3	kWh/ha	4	5	6	7	8=2 to 7
1970-71	29579	4470	32	3840	2573	1364	1898	43724
1975-76	37568	8721	62	5821	3507	1855	2774	60246
1980-81	48069	14489	103	9246	4682	2266	3615	82367
1985-86	66980	23422	167	17258	7290	3182	4967	123099
1990-91	84209	50321	359	31982	11181	4112	8552	190357
1995-96	104693	85732	612	51733	16996	6223	11652	277029
2000-01	107622	84729	605	75629	22545	8213	17862	316600
2005-06	151557	90292	645	100090	35965	9944	24039	411887
2006-07	171293	99023	707	111002	40220	10800	23411	455749
2007-08	189424	104182	744	120918	46685	11108	29660	501977
2008-09	209474	109610	783	131720	54189	11425	37577	553995
2009-10(p)	236752	120209	859	146080	60600	12408	36595	612644
Growth rate of 2009-10 0ver 2008-09 (%)	13.02	9.67	-	10.9	11.83	8.61	-2.61	10.59
CAGR 1970-71 to 2009-10(%)	5.34	8.58	-	9.52	8.22	5.68	7.68	6.82

The energy use efficiency also needs to be viewed in the context of use of power for irrigation. According to Central Electricity Authority, the total electricity consumption during 2009-10 was 120209 million kWhs (Table 5.3). This translates into about 859 kWh per hectare per annum corresponding to 140 million hectare net sown area. There is competing eagerness amongst farmers to apply tubewells disproportionate to the size of their holdings. This has serious consequences both on energy use as well as water use efficiency in agriculture. The formation of tubewell societies in villages will not only encourage water use efficiency, would also bring down energy consumption per hectare.

Fig 5.2. Source-wise energy consumption in India agriculture



Total energy use in production of principal crops in India has increased 4-5 times between 1970 and 2005 during which average productivity increased from 837 to 1583 kg/ha (Fig. 5.3). It is evident that share of animal energy has significantly decreased from 43.9% to 5.8% and that of human energy decreased from 36.7% to 7-9% though in absolute terms decrease is not so enormous only electro-mechanical energy use has increased phenomenally. Commercial energy use increased significantly - electrical energy from 0.19% to 38.1%, diesel from 2.4 to 18.3%, and chemical fertilizers from 16.4% to 29.7%.

Fig. 5.3: Impact of farm power availability on food grain productivity

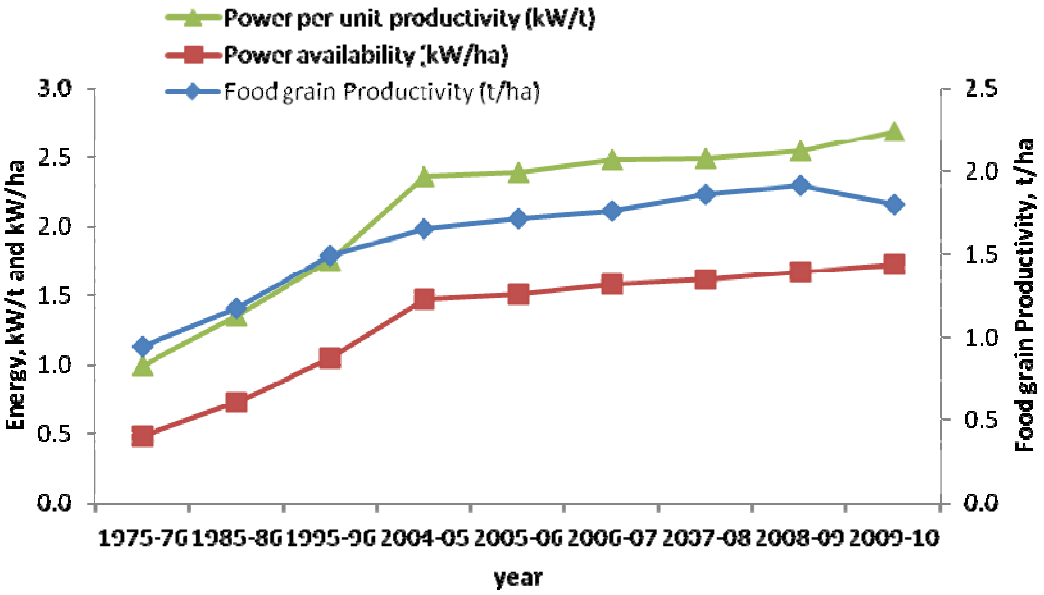


Table 5.4: Farm power availability on Indian farm

Year	Cropping Intencity (%)	Food grain Productivity (t/ha)	Power availability (kW/ha)	Power per unit productivity (kW/t)	Net sown area per tractor (ha)
1975-76	120.0	0.944	0.48	0.51	487
1985-86	127.0	1.175	0.73	0.62	174
1995-96	130.0	1.491	1.05	0.70	84
2004-05	135.7	1.652	1.47	0.89	47
2005-06	136.4	1.715	1.51	0.88	45
2006-07	138.1	1.756	1.58	0.90	42
2007-08	139.0	1.860	1.62	0.87	40
2008-09	139.0	1.909	1.67	0.87	38
2009-10	139.2	1.798	1.73	0.96	36

There is increasing dependence of Indian agriculture on commercial energy. By 1990 about 80% of the total operational energy was electro-mechanical (Fig. 5.2). There is close correlation between degree of agricultural mechanization, energy use and agricultural production and productivity (Table 5.4). However, over mechanization as in Punjab resulted in indebtedness of the farmers as the acquired farm power and

machinery assets are not fully utilized. Farm power availability in Punjab is highest in the country so is foodgrain productivity (Table 5.5).

Table 5.5: Farm Power Availability and Average Productivity of Foodgrains in India in 2001

S.No.	Name of the State	Farm Power Availability (kW/ha)	Food grain productivity (kg/ha)
1	Punjab	3.50	4032
2	Haryana	2.25	3088
3	Uttar Pradesh	1.75	2105
4	Andhra Pradesh	1.60	1995
5	Uttranchal	1.60	1712
6	West Bengal	1.25	2217
7	Tamil Nadu	0.90	2262
8	Karnataka	0.90	1406
9	Kerala	0.80	2162
10	Assam	0.80	1443
11	Bihar	0.80	1622
12	Gujrat	0.80	1169
13	Mdhya Pradesh	0.80	907
14	Himachal Pradesh	0.70	1500
15	Maharashtra	0.70	757
16	Rajasthan	0.65	884
17	Jharkhand	0.60	1095
18	Jammu & Kashmir	0.60	1050
19	Orissa	0.60	799
20`	Chhattisgarh	0.60	799
	All India	**1.35**	**1723**

Average energy utilized in production of some of the major crops is shown in Table 5.6. Energy productivity among cereals is highest for paddy at 0.234 kg/MJ, whereas that of wheat, maize and sorghum is relatively lower. Amongst pulses Bengal gram energy productivity is highest at 0.19 kg/MJ. In case of oilseeds soybean production is more energy efficient than mustard. Sugarcane and potato are most energy consuming crops per unit are but energy productivity is favourable. However, gain in productivity has diminishing return as energy input use increases (Table 5.7) i.e. it is relatively more energy efficient to pay greater attention to rainfed crop through increased input use than

irrigated high productivity situation. Total energy use in irrigated paddy cultivation ranges between 17500-33500 MJ/ha while in rainfed it

ranges between 6600-1100 MJ/ha but productivity is considerably low.

Table 5.6: Energy use and energy productivity of some major crops in India

	Crop	Total energy, MJ/ha	Energy productivity (kg/MJ)
	Paddy	13076	0.239
	Wheat	14657	0.196
Food grains	Maize	9956	0.215
	Sorghum	4745	0.200
	Green Gran	4315	0.118
Pulses	Black gram	3870	0.105
	Bengal Gram	5464	0.190
	Mustard	8051	0.119
Oilseeds	Soybean	6382	0.171
	Sugarcane	59192	1.039
Cash crop	Cotton	9972	0.094
	Potato	31352	

Table 5.7: Energy Uses for transplanted paddy cultivation in different areas

Energy resource	High yielding zone irrigated	Medium yielding zone irrigated	Medium yielding zone rainfed
Direct energy, MJ/ha	14716	7586	7139
Indirect energy, MJ/ha	18803	9916	3990
Total energy	33519	17502	11129
Energy productivity, kg/MJ	0.139	0.191	0.250

Wheat crop is mostly irrigated. However, in some areas where soil moisture and precipitation are favourable it is grown in rainfed conditions too of course with low productivity levels. Total energy consumption of irrigated wheat in Punjab, UP is about 18,000 MJ/ha (14,000-19,000 MJ/ha) where as in rainfed wheat it ranges between 6,500 to 14,000 MJ/ha (Table 5.8). Use of diesel and electricity in irrigated areas is about 60-80% of total direct energy and about 40% of total energy consumption. In areas of intensive irrigated agriculture, renewable energy consumption component is low just about 14% of total energy where as in rainfed wheat in MP it is high (about 80%). In intensive wheat production irrigation accounts for 40% of the total operational energy consumption, harvesting and threshing about 30%, and seedbed preparation about 17%.

Table 5.8: Energy consumption in wheat cultivation in different States

	Punjab	West Bengal	M.P.	Uttar Pradesh
Direct energy MJ/ha	8739	10000	4690	7816
Indirect energy, MJ/ha	10142	4000	3806	9670
Total energy, MJ/ha	18881	14000	8496	17486
Yield,kg/ha	4183	2450	2100	4516
Energy intensity (MJ/kg)	4.51	5.71	4.05	3.87
Non-renewable: renewable	6.1:1	2.4:1	1.02:1	6.3:1
Energy ratio	5.78	2.34	7.22	6.54

Source : AICRP Energy Requirement (ICAR)

5.2 Improved Implements and Machines for Farm Mechanization

Improved tools, implements, and machines have always been means for advancing agriculture since prehistoric period. Major developments in farm mechanisation and improvement in implements have occurred in post-independence period more so after on-set of Green Revolution in late 1960s. State Agricultural Universities and their Faculty of Agricultural Engineering, ICAR Institutes took lead in agricultural mechanization. Establishment of Central Institute of Agricultural Engineers (CIAE) at Bhopal, M.P. was a major step which organized R&D in the areas of agricultural mechanization and allied issues. ICAR launched a number of All Indian Coordinated Schemes - Farm Implements and Machines; Energy Requirement in Intensive Agriculture; Power tillers; Optimization of Ground Water Use through Wells and Pumps; Agricultural Drainage; Utilization Animal Energy with Enhanced System Efficiency; Renewable Energy Sources; and Harvest and Post-Harvest Technology which contributed a great deal in adoption, development, commercialization and pilot introduction of improved implements and machines. Eventually, linkages were developed with State Departments of Agriculture and Directorates of Agricultural Engineering, manufacturers, furthering the cause of mechanization. Department of Agriculture and Cooperation (DAC), Govt. of India promoted agricultural mechanization. To protect farmers' interest it established Tractor Testing and Training

Stations. DAC also launched promotional schemes providing subsidy to the farmers, bank-loans for the tractor and other machinery. It also established Central Farm Machinery Review and Release Committee. Promotional efforts towards agricultural mechanization are still on. Every year there is interaction meet between DAC and ICAR where agricultural mechanization and on-farm processing and value addition related equipment, practices, and required promotional measures are discussed, progress monitored and future action plans are formulated. Progressive State Governments also take similar measures.

Table 5.9 gives traditional and improved implements and machines available for different unit operations of agriculture. Farm Machinery and Power industry accounts for over Rs. 50,000 crores excluding FIM manufactured/fabricated by the craftsmen.

5.3 Strategy

The expectations from farm mechanization are as follows.

- Sustainable increase in productivity and cropping intensity
- Conservation of inputs through precision in metering and placement
- Enhancement in income of agricultural workers
- Benefits to all categories of farmers
- Creation of worker-friendly environment
- Reduced cost of production leading to greater profitability

Table 5.9 : Tradition and Improved Implement and Machines available for Different Unit Operations

Items	Traditional implements	Improved implements
Seed bed preparation	Spade Deshi plough Bakhar	Disc plough, Mould board plough Cultivator, Disc harrow Rotavator, Roto-tiller Puddler, Chisel plough Patela harrow, Pulverizer roller Leveler, Reversible plough
Sowing/Fertiliser application device	Broadcasting Dibbling Transplanting Line sowing Behind plough Pora/Khera Multi seed drill	Naveen dibbler, Rotary dibbler Mechanical transplanters, Manual 4-row rice transplanter, Pneumatic planter Tractor drawn 2-4 row vegetable sapling transplanter, Planter, Raised bed planter, Seed drill, Seed-cum-fertilizer drill, Zero till drill, Tractor drawn roto till drill, Tractor drawn strip till drill, Drum seeder for rice, Self propelled rice transplanter, Till planter, Fertiliser broadcaster Ammonia applicator, Potato planter, Groundnut planter, Sugarcane planter, Animal and tractor drawn inclined plate planter, Tractor drawn pneumatic planter
Irrigation and drainage	Leather bag Swing basket Dhenkli Chain pump Washer pump Persian wheel	Centrifugal pump, Submersible pump, Sprinkler Drip irrigation, Propeller pump, Axial flow pump Pressure compensated micro sprinkler, Micro sprinkler, Mole plough
Interculture/Plant Protection	Khurpi Spade Plough Blade harrow (dora)	Hand weeders, Cultivator, Wheel hoe, Rakes, Rotary tiller, Grubber-Cono weeder, Cycle Wheel hoe, Ridger/Furrower/sweep, Sprayer, Duster, Granular weedicide applicators, Power weeder, Rotary weeder
Harvesting / Digging	Sickle, Khurpi Spade	Serrated sickle, Reaper, Combine, Digger' Digger shakers
Threshing / Shelling Decortication	Beating, Rubbing, Animal treading, Olpad threshing	Pedal thresher, Power thresher, Combines, Decorticator, Axial flow thresher, Multi-crop thresher, Maize dehusker cum sheller, Ground nut thresher, Tractor operated high capacity multicrop thresher

Mechanization can contribute in achieving higher agricultural growth through:

(i) timeliness in field operation. Seedbed preparation and sowing can be completed in 1-2 days before soil becomes too dry. Delay of every day beyond optimum results in loss of about 0.5-1.0% in productivity. Conventional seedbed and sowing with paleva irrigation can easily take 8-10 days, thus gain of 4-5% minimum and can be up 8-10% or even more.

(ii) achieving optimum plant population through precision in metering and placement of seed and fertilizer, more so if a planter is used which can increase yield by 5-10% or more.

(iii) practising raised-bed-farming where crop could be raised under aerobic conditions contributing in yield increase by 5-10%. It facilitates furrow irrigation conserving water by 20-30%.

(iv) sowing of wheat after paddy harvest with Zero-till Drill which enhances yield by at least 4-5%, but could be upto to 10% or more.

(v) line sowing and mechanical weeding in rice leading to increase in yield by 10-15% both in upland and wetland crops

(vi) pressurized irrigation like drip & fertigation for increasing productivity by 25-50% and irrigation water saving in same measure.

(vii) power sprayers bringing timeliness in plant protection measures due to high field capacity,thus, saving the crop from pest damage and improving the harvest by easily 10-15%.

(viii) harvesting by VCR and power threshing to speed up operations and prevent wastage due to untimeliness and eliminate vulnerability to adverse weather condition. Combining does it even better besides being a cheaper option.

(ix) enabling crop intensification by clearing field for next crop early, preparation of seedbed and sowing quickly making use of available soil moisture.

The summary of current issues related to Farm Mechanization is as follows –

- Diminishing availability of farm labor due to growth in other sectors of economy as well as rural schemes related to socio-economic development
- Increasing levels of awareness about the role of machinery on farm
- Availability of farm tools, implements and machines is improving in several States.
- Improved farm credit availability
- Cost of production is increasing
- Drudgery reduction and workers' safety are becoming important to retain youth in farming
- Hill agriculture has huge mechanization deficit
- Gender friendliness of farm implements and machines
- Climate change and environmental safety
- Mechanization of operations in horticulture animal husbandry and fishery
- Manufacture of implements and machinery by industry
- Mechanization of organic farms
- Mechanization for improving the farm profitability
- Mechanization for climate resilient agriculture

While tractorization and mechanical power based mechanization would cover large, medium and, to some extent, small farms; inclusive farm mechanization strategy must include effective utilization of draft animal power and human labor. There is a need for integrated models of farm mechanization utilizing all the three modes of farm power supply.

The power availability on Indian farms is about 1.7 kW/ha at present and by the end of 12^{th} plan; the farm power availability must increase to 2.1 kW/ha to achieve the national agricultural production targets. There is an essential need to utilize surplus bio-residues

as fuel in agriculture through conversion into green fuels for both production and postproduction operations.

There have been increased mechanization rates during 2009-10 and 2010-11 as evidenced by the tractor sales during the period. The increased mechanization rate appears to be well correlation with the national agricultural growth rate during 2010-11. As reported by the Directorate of Agricultural Engineering, Madhya Pradesh, the specific experience in Madhya Pradesh spread over 25 villages under the '*Yantradoot*' scheme where crop specific farm implements were introduced resulted into 40% and 25% increased yields with respect to wheat and gram during Rabi 2010-11 with concomitant reduction in the cost of production and enhanced farm income. The need has been felt for intensification of farm mechanization efforts in the country during the 12^{th} plan through consolidation of the existing schemes and additional strengthening in terms of new programmes, human resource development and infrastructure.

Farm mechanization is a costly input requiring higher skills. Considering the farm sizes and prevailing skills, farm mechanization penetration would have to be enhanced through a combination of promotion of custom hiring models as well as individual ownership. While draft animal power based implements and manual tools could be owned by individual farmers (with appropriate financial incentives), the expensive machinery could be promoted thorough custom hiring. Contract farming, cooperation farming and other similar farming models would also promote appropriate farm mechanization.

Greater impetus is required in the development of need based and regionally differentiated farm machinery by the National Agricultural Research system. The on-going efforts need to be suitably strengthened with appropriate participation of agricultural machinery manufacturers to fill the critical mechanization gaps. CIAE Bhopal has carried out successful development of appropriate machinery in partnership with machinery manufacturers leading to elimination of gestation period in the

development of machinery and its availability to stakeholders. Similar experiences need further replication across the NARS

5.4 Recommendations:

In view of the potential of farm mechanization to enhance productivity, profitability and sustainability across the entire landscape of Indian agriculture, there is a need for a quantum increase in the budgetary allocation of farm mechanization during the 12th plan. The total budget of farm mechanization proposed is Rs.20,000 crore. The programmes on promotion of farm mechanization would need to be implemented through a mission by the Department of Agriculture and Cooperation. The specific components of the proposed mission are as follows:

- Financial incentives of 50% on the purchase of mechanical power operated farm machinery to individual farmers, farmers' cooperatives and custom hiring entrepreneurs. Financial institutions may provide machinery loans with reduced interest rates and easy payment terms. State governments may consider top-up subsidy.
- Financial incentives of 80% on the purchase of manual tools and draft animal power based implements and machinery to individual farmers, farmers' cooperatives and custom hiring entrepreneurs. Financial institutions may provide machinery loans with reduced interest rates and easy payment terms. State governments may consider top-up subsidy.
- Encouraging tractor, power tiller and machinery manufacturers to integrate safety gadgets to reduce farm machinery related accidents. In addition, all States must have adequate compensation packages for farm mechanization related accidents.
- District level training, demonstration and entrepreneurship development through farm mechanization centres. This includes training of youth in machinery

operation and maintenance with a view to promote machinery service centres in production catchments.

- Intensive farm mechanization programme on the lines of '*Yantradoot*' programme of M.P. Government in 10,000 villages in the country.
- Identification of critical farm mechanization gaps for immediate attention and providing budgetary support for finding solution in joint institution-industry mode.
- Promotion of local fabrication of farm tools and DAP based implements through local artisans.
- Expansion and strengthening of machinery testing facilities to ensure quality of construction and field performance the machinery.
- Special emphasis for hill and tribal areas to promote appropriate mechanization.
- Promotion of custom-hiring of farm machinery.
- Exposure of agricultural machinery manufacturers to the machinery manufacturing industry in developed countries.
- Awareness creation through workshops, field days, exposure visits.
- Data acquisition on the level of mechanization and agricultural machinery manufacturing industry for better planning and course corrections. This has become more important since the machinery data acquisition has been discontinued in Livestock census
- Custom duty exemption on the import of critical farm machinery and machinery components to promote mechanization.
- Abolition of excise duty and VAT on agricultural machinery for the next 10 years.
- Appropriate human resource reinforcement at the Central as well as State levels to implement and monitor the agricultural mechanization mission as proposed above

Chapter 6
The Indian Agricultural Statistics System, It's Problems and Some Solutions

The agricultural statistics system has been subjected to review a number of times after independence so that it can respond to the various challenges being faced from time to time. As early as 1949 the Technical Committee on Coordination of Agricultural Statistics in India stressed the need of uniform concepts and definitions and devising uniform forms of returns for collection of data. The National Commission on Agriculture (1976) made a critical assessment of the agricultural statistics system of the country and made far reaching recommendations which put the agricultural statistics system on a sound footing. Many schemes were initiated on the recommendations of the National Commission of Agriculture. The high Level Evaluation Committee (1983) under the chairmanship of Professor A.M. Khusro highlighted the problem of data gaps and methodological gaps and made recommendations so that a solution is possible. It also pointed out some emerging areas where mechanism should be put in place for collection of data. Specifically, it highlighted the need of generating estimates at the local level. A workshop was organised in 1998 to focus on modernization of the statistical system in India. The highlight of this workshop was that a number of suggestions were made regarding use of communication tools to improve the timeliness, reliability and adequacy of agricultural statistics.

The National Statistical Commission in its Report published in the year 2001 has made a number of recommendations on almost all aspects of agricultural statistics. Some of the recommendations are given below.

It has highlighted the need to

- Have accurate crop production statistics at the small area level
- Use of remote sensing technology for crop acreage estimation for the North-Eastern States

- Have an objective method of crop forecasting
- Have an alternative methodology for horticultural crops based on information from all the sources i.e. market arrivals, exports and growers association
- Have an enlarged land use classification having categories such as social forestry, land under still water and marshy and water logged land
- Have agriculture census on a sample basis with an element of household inquiry
- Have livestock census on a sample basis
- Merge livestock and agriculture census
- Improve recording of area under still water
- Appropriate methodology for estimation of production of inland fisheries
- Use remote sensing tools for development of forestry statistics.

More recently, the Vaidyanathan committee was constituted in the year 2009 to review the current methodology used in Timely Reporting Scheme (TRS), Establishment of an Agency for Reporting Agricultural Statistics (EARAS), Improvement of Crop Statistics (ICS) & General Crop Estimation Surveys (GCES) for estimating land use, crop-wise area, irrigated area, yield and production etc. and suggest institutional framework for improvement of agricultural statistics, review experience of remote sensing technology for estimating area and yield of important crops, assess its potential for generating reliable and timely data and suggest measures to effectively exploit this potential.

The committee observed that the system does not deliver complete, timely and reliable data. One of the reasons for the failure is the scale of effort required. The area estimates require complete enumeration of plots in large number of villages by exclusive reliance on a large number of poorly trained, over burdened and poorly supervised village officials. Fragmentation of responsibilities for data collection, supervision and validation among different organizations working more or less independently has compounded the problem. Indiscriminate increase in the number of crop cutting experiments to generate yield estimates at district and sub-district levels has made it very difficult to ensure that they are done properly and without any bias.

The committee suggested radical restructuring of the system. It suggested setting up of a National Crop Statistics Centre (NCSC), an autonomous, professional organization in the Ministry of Agriculture of the Government of India for generation of crop area and production statistics at the state and national level. The committee observed that Remote Sensing technology should be complementary to, rather than a substitute for, improving conventional methods of collecting agricultural statistics. Further, the committee commented on some methodological issues in the application of remote sensing technology for crop acreage and production estimation. Vigorous research efforts are needed to resolve some of the remote sensing related issues.

Some of the typical problems facing Indian agricultural statistics system are:

- Limited staff and capacity of the units that is responsible for collection, compilation, analysis, and dissemination of agricultural statistics.
- Inability of the system to use modern technology and tools to the extent it is desirable.
- Insufficient funding allocated for agricultural statistics
- Lack of institutional coordination which results in the lack of harmonized and integrated data sources.
- Lack of capacity to analyze data in a policy perspective, which results in a significant waste of resources as large amounts of raw data are not properly used.
- Difficulty for data users in accessing existing data especially disaggregated data

6.1 Revamping The Indian Agricultural Statistics System

The revamping of the agricultural statistics system needs to be carried out keeping in view the global strategy to improve agricultural and rural statistics. The global strategy views agriculture as essentially an economic activity. However, it acknowledges increasing relationship of agriculture with social and environmental issues.

The economic dimension of agriculture includes land, labour and capital which are critical inputs in the production process. Use of inputs, result in output in the form of production. Some of the output is self consumed, part of the output is used as seed/feed and the bulk of the remaining amount goes in the market. The economic dimension, therefore, also covers agricultural production, markets and farm and nonfarm income. Agriculture production has direct bearing on food security, poverty and economy of the country.

The environmental dimension of agriculture arises out of use of natural resources in agriculture. The environmental dimension comprises land, water, land cover and land use, including forestry. The environmental aspect also includes waste and emission by-products produced in the process of production. Agriculture is directly linked to climate change and biodiversity. This points out towards the need of producing statistics on role of agriculture in economy and environment.

The social dimension covers the need to reduce risk and vulnerability, including food security, and issues related to gender**.**

Under the global strategy a conceptual framework has been developed keeping into account the user's needs. The conceptual framework points to many emerging requirements from user's point of view. The emerging requirements are in the form of issues related to agriculture like poverty and hunger, environment and climate change, land and water use and biofuels production. Thus, under the conceptual framework, besides agricultural statistics the other items included are fisheries, forestry and rural development. The conceptual framework highlights the need for survey framework to link farm as an economic unit, household as the social unit and the occupied land as the natural environment. It identifies the three pillars of global strategy i.e. identifying a minimum set of core data, the integration of agriculture into the national statistical

system; and the sustainability of the agricultural statistical system through governance and capacity building.

The global strategy provides a framework for national and international statistical systems which will enable the countries to produce the required data and use the data for decision making in the 21st century. The global strategy is based on three pillars:

The first pillar is the establishment of a minimum set of core data that needs to be collected to meet current and emerging needs. The core data set shall meet the national as well international need. Core data items can be selected on the basis of their importance to agricultural production globally. For example, only about 10 crops and 4 livestock species account for over 95 percent of the world's production of cereals, meat, and fibre. A core item is one whose data enter into a multitude of indicators needed to monitor and evaluate development policies, food security, and progress toward meeting the Millennium Development Goals (MDG). In what follows, various items are given which may form part of minimum set of core data.

Core crop items: Wheat, maize, barley, sorghum, rice, sugar cane, soybeans, and cotton are core crop items.

Data required for these core items include:

a. Area planted and harvested, yield, and production.
b. Amounts in storage at the beginning of harvest.
c. Area of cropland that is irrigated.
d. Producer and consumer prices.
e. Amounts utilized for own consumption, food, feed, seed, fibre, oil for food, bio-energy, and net trade or imports and exports.
f. Early warning indicators such as precipitation, windshield surveys of crop conditions, and vegetative indices provided by satellite observations.

Core livestock items: These include cattle, sheep, pigs, goats, and poultry. These are major sources of food supply and agricultural income. Consumption increases as countries develop and incomes grow. Increased demand for livestock products leads directly to increased usage of feed grains, and can lead to situations in which feed production competes with food production, even though the feed is ultimately an input to food production. Livestock are also sources of methane emissions, water pollutants, and disease risk. All of these factors can be affected by policy decisions.

Data required for these livestock items include:

a. Inventory and annual births.
b. Production of products such as meat, milk, eggs, and wool, and net trade or imports and exports.
c. Producer and consumer prices.

Core aquaculture and fisheries products: These contribute significantly to food supplies. Data under this head comprise

a. Area cultured, production, prices, and net trade or imports and exports for aquaculture.
b. Quantity landed and discarded, number of days fished, amounts processed for food and non-food uses, prices, and imports and exports.

Core forestry production: Forestry is a major land use. It is another source of income and has a significant role in understanding the forces affecting climate change. Data required under this head include:

a. Area in woodlands and forests, quantities removed, and their prices for land associated with agricultural holdings.

b. Area in woodlands and forests, quantities removed, and their prices for products from non-agricultural holdings and respective utilizations.

Core agricultural inputs: Core inputs to agricultural production include labor, chemicals, water, energy, and capital stocks. Inputs are considered core because, in combination with data about outputs, they provide measures of agricultural productivity important to monitoring and evaluating steps to reduce poverty and hunger. Core data required for this purpose are the following:

a. Quantities of fertilizer and pesticides utilized.
b. Water and energy consumed.
c. Capital stocks such as machinery by purpose (i.e.tillage or harvesting).
d. Number of people of working age by sex.
e. Number of workers hired by agricultural holders.
f. Employment of household members on the agricultural holding.

Core socioeconomic data: Data under this head is required on household income by source. Besides, data about the number of households, employment, population, age, gender, and education levels are required.

Land cover: Land use and land cover are the two important indicators for assessment of affect of agriculture on environment. Land cover does not change rapidly and data are not, therefore, required on an annual basis. However, mapping products or digitized data from remote sensing should provide complete coverage for the entire land mass of a country with the following classifications:

a. Cropland b. Forest land c. Grassland d. Wetlands e. Settlements f. Other land g. Water

Public expenditures on subsidies, infrastructure, and health and education in rural areas are core items. This should include the availability of roads, transport services, communications, and extension services.

The data on core item ought to be collected every year. However, data on minor commodities can be collected after a gap of 5 or 10 years.

The second pillar is the integration of agriculture into national statistical systems. This will provide the administrators and policy planners comparable data across locations and over time for better decision making. One of the major defects of the agricultural statistics system prevailing in our country is that the data are collected sector wise using different sampling frames and surveys. It becomes difficult to integrate data from different surveys. Thus, cross-tabulation for different variables is not possible. As an example, crop and livestock related data are collected through different samples. It is, therefore, not possible to analyse the characteristics of farms having both or to compare farms which possess either crop or livestock. Similarly, household surveys are carried out independently of production surveys which make integration of data impossible. A similar situation prevails with respect to agriculture, fishery and forest data. Sometimes it is seen that more or less same set of data are generated by more than one agency and there are considerable variations in data emanating from different sources. All these factors make interpretation difficult. Integrated statistical systems can resolve many of these problems by avoiding duplications of effort, preventing the release of conflicting statistics, and ensuring the best use of resources. One big advantage with an integrated system is that the concepts, definitions, and classifications become standardized, allowing more systematic data collection across sources.

Development of a master sample frame is a prerequisite to the development of an integrated system. Samples selected from a master frame will ensure comparability, avoid unnecessary duplication, facilitate concentration of resources from multiple sources and help in data management. The basic units of sampling are either household,

holding or land parcel. A link between these can be established by geo-referencing. In this context the use of area frame methodologies is very important. The FAO advocates the multiple frame approach to create a master frame that utilizes both area frames and registers. The master frame will have the capability to link farm with the households. These two in turn can be connected to land cover and land use. The area sample frame meets this requirement. The methodology for use of population census is recommended for the *World Program for the Census of Agriculture* (FAO 2005). This will also meet the requirement—if households from the population census are geo-referenced and used as the frame for the agricultural census and linked to satellite images of land use.

A master sample frame can be developed in a number of ways. It can be developed through *coordinated population and agricultural census data. Many countries develop Master sample frame with an agricultural census.* The development of the master sample frame using the agricultural census includes the need to associate farms with households and both with land use. The basic reporting unit in the agriculture census is the farm. For the purpose of development of master frame there is a need to connect the farm with the household i.e. to obtain information about the household as well its various characteristic. It should therefore be possible to develop a register containing items related to household and its characteristic.
Ultimately land associated with each farm and associated household needs to be linked to the appropriate geo-referenced census enumeration areas or administrative units, or both. In this example, the master sample frame for agriculture will be a register of farms or households and commercial farm enterprises with their land geo-referenced to enumeration areas or administrative units. The only additional work required for this is that the register needs to be updated in the interval between the two censuses.

Wherever a full census is not possible the required information can be generated using, for instance, a two stage sampling design with first stage units as enumeration areas. The first stage units need to be updated at regular interval. The geo-referencing of farms or households to the census enumeration or the administrative units that are part of the

data layer in the satellite imagery in effect establishes an area sample frame—and becomes the master sample frame for agriculture.

An alternative way to develop master frame is to use administrative data to develop registers of farms. Thus, information obtained from tax record, licenses etc. can be used to develop register of farms. In some cases information on small farms may not be available. Data on these farms can be obtained through specialised efforts on sample basis. Again, the geo-referencing of the farms or households in the business register to either census enumeration or administrative areas is required for establishing an area sampling frame. This becomes the master sample frame for agriculture.

Master sample frame when there is not a recent agricultural census. The starting point should be the development of an area sample frame. The geo-referenced satellite imagery by land-use category can also be used as the basis for an area sample frame. Plenty of literature is available to achieve this.

6.2 Steps to Implement an Integrated Survey Framework

The various steps are

a) Identification of core data items for which data are required annually
b) Select replicated sample. This means some sample units can be selected at different time points for longitudinal analysis
c) Designing a questionnaire
d) Each year, one of the sets of panel data (data to be collected periodically) will be linked to the annual core items

Surveys can be conducted on sub-sample basis within a year.

The additional data sources needed for integrated survey frameworks are:

a. **Administrative data** Governmental interventions such as subsidies, regulation, and legislation often require agricultural holders to report production information. Land ownership and cadastral surveys provide useful information for constructing registers. Food inspections, animal health inspections, and trade data provide input to the utilization accounts.
b. **Remotely sensed data** These include vegetative indices that show overall crop conditions and information about changes in land cover and use. The survey framework should include the need to provide ground truth data if remote sensing information is to be used to estimate cropland areas.
c. **Agribusinesses** are the source of utilization data and prices.
d. **Expert judgment and windshield surveys** can be used to collect data from experts whose judgments inform evaluations of agricultural conditions. For instance, the *Sourcebook* (World Bank 2008b) refers to a procedure in which experts travel a specified route on a periodic basis and record the condition of crops, which provide an input into crop yield forecasts.
e. **Community surveys** *The World Programme for the Census of Agriculture* (FAO 2005b) provides an overview of data that can be collected at the village level. These data include information about the infrastructure and services available to households and agricultural holdings, occurrences of food shortages, frequency of natural disasters, etc.

6.3 The Data Management System

The data management system fulfils three functions—access to official statistics for dissemination purposes; storage and retrieval of survey results; and access to farm, household, and geo-referenced data for research. The data management system should:

i. Support the dissemination of data to ensure that the official statistics are readily available, clearly identified by source and time, and are comparable for aggregation purposes, both within and across countries. If more than one institution is involved in

the national statistical system, there should either be a single database, or the databases should be coordinated to avoid duplication of official statistics. Such duplication can lead to different numbers, causing confusion among those using the data. These data should become part of FAOSTAT, the FAO statistical data base, which becomes a public good for data access.

ii. Provide the framework for the storage of the aggregated survey results and geo-referenced land use data along with the supporting administrative and other data sources built on the capabilities provided by the master sample frame's link to land use. The data management system should provide for the storage and maintenance of the farm and household survey data and for the link between the different sets of data that are geo-referenced to a common land use.

6.4 Governance

Effective governance is must for efficient functioning of the system. Although the Indian Agricultural Statistics System is built on a very strong foundation, it needs to be ensured that there is no unnecessary duplication in the system. There is a need for coordinating mechanism to ensure that duplication does not happen. This will avoid the embarrassment of conflicting data for the same variable. It may be noted that the creation of a position of Chief Statistician in the Indian Statistical System is a welcome development.

Further, it is necessary to adopt internationally recognized definitions, concepts, classifications and codes for agricultural production and prices data, and application of a web based information technology system for food and agricultural statistics at national, sub-national and district levels which could provide decision makers access to statistics, support analysis and monitoring across thematic area such as production, prices, trade etc.

6.5 Capacity Building

The use of remote sensing technologies, the design of an integrated survey framework, and the use of a data management system require experienced technical personnel. While building and maintaining technical capacity in every country will be problematic, there are ways to solve this problem. One of the way out is to establish regional centres of excellence that can provide remote sensing capabilities, develop statistical methods, and guide the implementation of information technologies in providing support to national institutions. These centres can be established with support from donors and international organizations.

Capacity building should, therefore, focus on to:

- Develop national strategies for the development of statistics; where such strategies are in place, review them to determine where revisions are needed.
- Build a network of statisticians and supporting staff including data collectors.
- Educate staff on statistical methodology for sampling, survey design, data compilation, and data analysis.
- Develop and maintain the master sample frame, implement the new survey framework, and develop the data management system.
- Provide computers, software, and other technical equipment.
- Provide the satellite imagery geo-referenced by land use.
- Disseminate the results and respond to requests.

6.6 Recommendations

1. Generation of Crop Estimates at Lower Level

In view of decentralised system of planning in our country, reliable micro level estimates are required. The traditional approach of estimation is not suitable for

generation of reliable estimates at micro level. In such situations, newer methodology such as small area estimation techniques needs to be explored to develop estimates at the lower level. For this activity which is highly technical in nature, the first step is to strengthen different agencies with suitable and qualified personnel with adequate statistical as well as computer background and knowledge.

2. Use of Remote Sensing and GIS Technology

The potential of remote sensing technology and Geographic Information Systems (GIS) need to be exploited for development of master frame either through the use of agricultural census or the administrative data. Samples selected from a master frame will ensure comparability, avoid unnecessary duplication, facilitate concentration of resources from multiple sources and help in efficient data management. Further GIS can usefully be employed for acquisition, verification, compilation, storage, and analysis of data. These techniques have many advantages like integration of data from many different sources, identification of the spatial relationships between map features, analysis, and visualization of the data etc.

3. Suggestions of Vaidyanathan Committee

The Vaidyanathan committee has recommended setting up a National Crop Statistics Centre. This is a very good suggestion and should be implemented for improving the quality of agricultural statistics in India. Secondly, the committee has suggested significant reduction in the crop cutting experiments. This recommendation relating to reduction of sample size for area and crop yield estimation needs to be verified thoroughly on the basis of in depth analysis of available data for arriving at valid estimates of sample size. Further, the committee has recommended two different mechanisms for generation of national/state level and district level estimates. It is visualised that these two sets of estimates are not likely to match with each other and may create confusion. A mechanism thus needs to be identified for reconciliation of two

sets of estimates before implementation of committee's recommendations. In this endeavour exploitation of small area estimation techniques prove to be useful for such situations i.e. generating district level estimates.

4. Additional Information for Official Records

The scope of khasra register need to be expanded to include details like crop variety (local/desi/improved/hybrid), chemical fertilizer used or not, irrigation source owned by the farmer or borrowed/hired, source of energy used for lifting the irrigation water i.e. electricity/diesel/animal etc., total number of fruit trees and number of bearing fruit trees. This information will help in designing future surveys in a better way.

5. Assessment of True Area under Crop

For ascertaining the reliability of land utilisation statistics in the context of high diversion of agriculture land to other uses for residential, industrial, urbanisation, roads etc., there is a need for conducting a study for checking the land records through khasra registers/other records of those villages where the area have come under diversion of agriculture land to non-agriculture uses particularly in the vicinity of the metropolitan cities. There is also a need for checking up about the type of land/agriculture land diverted for the above purposes as well as area reclaimed for agriculture purposes.

6. Methodology for Horticultural Crops

The estimates of area and production of important fruits and vegetables are being obtained under the scheme of Crop Estimation Survey on Fruits and Vegetables (CES-F&V). A simplified methodology has been developed by the IASRI. The methodology developed at IASRI needs to be tested in some more states before it can be recommended for adoption. Further, the existing data base relating to horticulture sector needs to be strengthened. Efforts need to be made for the conduct of horticulture census.

An effective Horticultural Information System is also needed for quick assessment and dissemination of data.

7. Methodology for generation of Fishery Statistics

There is a need to fine tune the existing methodology for generation of fishery statistics. Possibility of application of remote sensing and GIS tools need to be explored for improving the efficiency and timeliness of the statistics.

8. Methodology for estimation of feed consumed by the livestock

Considerable amount of feed is consumed by the livestock population of the country. Development of appropriate methodology for estimation of feed consumed by livestock will help in updation of ratios which are currently used by the National Accounts Division.

9. Need for Availability of Data Relating to Mechanization

The information on different power sources e.g. Tractors, Power Tillers, Diesel Engines, Electric Pumps and other power-operated agricultural implements and machinery used to be collected through the Livestock Census. However, these data items have been deleted in the 18th Indian Livestock Census, conducted by Department of Animal Husbandry, Dairying and Fisheries (DAHDF), Ministry of Agriculture, Government of India. The total annual investment on Agricultural Implements and Machinery is more than Rs. 50,000/- crores. Moreover, data on these power sources and power-operated agricultural implements and machinery shall be required by the policy makers/planners for formulation of appropriate mechanization strategies. Accordingly, it is recommended that regular data on the above-mentioned aspects need to be collected by some government agency.

10. Methodology for generation of acreage statistics under agro-forestry

Reliable estimates of area under agro-forestry are currently not available. There is a need to develop implementable methodology using remote sensing and GIS tools for estimation of area under agro-forestry for mono species as well as multiple species. There is an urgent need to undertake pilot studies in this direction.

11. Precision of Estimates

Generally in official statistics system, only estimates of parameter of interest are made available. If the precision of these estimates are also made available along with the estimates of different crops, this will add very useful information and knowledge to policy planners. Thus it is suggested that it may be obligatory on the part of official agencies to provide standard errors or confidence intervals of the estimates. This will provide an idea about the reliability of the estimates and help in decision making on appropriateness of sample sizes.

12. Use of Modern Data Capturing, Geographical Position System (GPS) and Information Communication Technology (ICT) Tools

For an efficient statistical organization, the capacity and activities of existing data collection agencies have to be strengthened through the effective use of existing Information Communication Technology (ICT) and GPS for its data collection, data capturing, data processing, analysis and dissemination. In addition, provision of data also involves harmonizing and integrating statistical data, filling the gap between data produced and data available, laying down efficient ICT infrastructure, improving the quality and comparability of data, solving the challenges emerging from data and metadata exchange and harmonizing different standards with the data management system. All these need strengthening and proper utilization of ICT at all levels

The use of (Personal Digital Assistant) PDA in data collection in different surveys and censuses need to be encouraged. This will reduce the delays caused in data entry as well as various non-sampling errors. The traditional paper based data collection system need to be fully replaced by the digital system. In order to further reduce data processing time an automated excel spreadsheet need to developed. This further reduces the time for data collection to data dissemination on the web. A manual on the utilization of the automated spreadsheet needs to be developed by subject matter specialists. Data quality is a critical issue to meet the statistical objectives and is expected to be significantly improved by the introduction of these small initiatives.

One of the important variables in terms of generating reliable agricultural data is data on land, be it cultivated land, grazing land, fertilized land or wood land. This thus requires a reliable method of measuring the specific land size with its purpose. The total production itself is associated with the yield and the total area cultivated. Therefore, a reliable statistics in area is a very determining factor for agricultural statistics. In most of developing countries, farmers are not able to provide the land size in standard units and as such there is no standard conversion factor to the local units either. The traditional rope and compass method of area measurement has been in place for several years with its limitation and increased non sampling error due its complication. Moreover, as this traditional method requires more time in the field, provision of estimates on a timely fashion cannot be easily attained. Area estimates are provided by revenue agencies and they generally employ either traditional method of measurement or from already collected information. There is a great degree of subjectivity. Thus there is strong need to obtain reliable estimates of area cultivated in the possible shortest time. Taking advantage of new technological advances in geo-positioning, there is a need to test this new technology for crop area measurements. The GPS provides the cropped area directly thus doing away with the need of cumbersome distance and angle measurements. This thus leads to objective way of area measurements.

13. Development of Information System similar to Country STAT of FAO

CountrySTAT of FAO is a statistical framework and applied information system for analysis and policy-making designed in order to organize, integrate and disseminate statistical data and metadata on food and agriculture coming from different sources. CountrySTAT gathers and harmonizes scattered institutional statistical information both at country and international level. The main objectives are to facilitate decision-maker's access to information and to bind data sources that are currently spread across the different institutions. It also helps to sustainably improve the quality, accessibility, relevance and reliability of national statistics particularly related to food and agriculture. It is an integrated information system with fast web-based interface and it is accessible from anywhere. The CountrySTAT approach is based on the application of data and metadata standards of FAOSTAT and SDMX (Statistical Data and Metadata Exchange promoted by IMF, WB, UNSD, EUROSTAT, FAO, OECD, BIS and ECB) and GAUL (Global Administrative Unit Layers). Many countries have shown interest and are adopting it into their national statistical system. Furthermore, CountrySTAT is accompanied by a capacity-building strategy at country level to make the system sustainable in the long-term. CountrySTAT is networking with FAOSTAT and other sister information systems like GIEWS workstation.

The Indian Agricultural Statistical System needs a similar type of web based information system wherein the timeliness and quality of data will be ensured.

14. Capacity Building

There has been rapid growth in remote sensing technology, small area estimation techniques, information communication technology and various survey data related packages. Effective capacity building in these areas is utmost important to achieve the desired goal of quality and reliable agricultural statistics in the country.

15. E-Governance

Although the Indian Agricultural Statistics System is built on a very strong foundation, it needs to be ensured that there is no unnecessary duplication in the system. There is a need for coordinating mechanism and e-governance to ensure that duplication does not happen. This will avoid the embarrassment of conflicting data for the same variable.

Annexure I

File No. M-12043/10/2011-Agri.
Government of India
Planning Commission
(Agriculture Division)
…

Yojana Bhavan, Sansad Marg,
New Delhi-110 001
Dated: 8th March, 2011

OFFICE MEMORANDUM

Subject: Draft Constitution of Working Group on Crop Husbandry, Agricultural Inputs, Demand and Supply Projections and Agricultural Statistics for the Twelth Five Year Plan (2007-12)- Regarding

It has been decided with approval of the competent authority, to set up a Working Group as cited above in the context of preparation of XIIth Five Year Plan with the following composition and ToRs.

2. The composition of the Working Group:

(i)	Dr. Ramesh Chand, Director, National Centre for Agricultural Economics and Policy Research(NCAP),D.P.S.Marg, Pusa, P. B. No. 11305, New Delhi – 110012 (Tel. 91-11- 25847628, 25848731, X 91-11-25842684Email : director@ncap.res.in)	- Chairman
(ii)	Pr. Adviser, Department of Agriculture and Co-operation, Krishi Bhawan, New Delhi	Co-Chair
(iii)	Dr. Gurbachan Singh, Agricultural Commissioner, Department of Agriculture and Co-operation, Krishi Bhawan, New Delhi.	- Member
(iv)	Dr. D.M. Hegde, Projects Director, Directorate of Oilseeds Research, Rajendra Nagar, Hyderabad-500030 Tel: 040-24015463, Fax:040-24017969	- Member
(v)	D.G., National Institute of Plant Health Management (NIPHM), Rajendranagar, Hyderabad-500030.	- Member
(vi)	Dr. V.K. Bhatia, Director, IASRI, PUSA, New Delhi-110012	- Member
(vii)	Director, Indian Institute Pulses Research, Kanpur-208024.	- Member
(viii)	Director, Central Institute of Agricultural Engineering, Bhopal.	- Member
(ix)	Joint Secretary (Crops), Department of Agriculture and Co-operation, Krishi Bhawan, New Delhi.	- Member
(x)	Joint Secretary (Seeds), Department of Agriculture and Co-operation, Krishi Bhawan, New Delhi.	- Member
(xi)	Joint Secretary, Department of Fertilizers, Nirman Bhawan, New	- Member

	Delhi	
(xii)	DDG (Crops), ICAR, Krishi Bhawan, New Delhi-110001.	- Member
(xiii)	Prof. Pramod Kumar, Head, ADRTC, Institute of Social and Economic Research, Bangalore.	- Member
(xiv)	Pr. Secretary, (Agriculture), Government of Gujarat, Sachivalaya, Ahmadabad.	- Member
(xv)	Pr. Secretary, (Agriculture), Government of Punjab, Secretariat, Chandigarh.	- Member
(xvi)	Dr. Praduman Kumar, Senior Consultant, National Centre for Agricultural Economics and Policy Research(NCAP), D.P.S. Marg, Pusa, P. B. No. 11305, New Delhi – 110012 (e-mail: aeraindia@gmail.com) (Mob No.8010099082).	- Member
(xvii)	Pr. Secretary, (Agriculture), Government of Andhra Pradesh, Secretariat, Hyderabad.	- Member
(xviii)	Pr. Secretary, (Agriculture), Government of West Bengal, Kolkatta.	- Member
(xix)	Executive Director, National Horticulture Board, Gurgaon.	- Member
(xx)	Managing Director, NABARD, Bandra, Kurla Complex, Mumbai.	- Member
(xxi)	DDG, NSSO, Patel Bhawan, New Delhi-110001.	- Member
(xxii)	DDG, CSO (National Accounts), Patel Bhawan New Delhi-110001.	- Member
(xxiii)	Dr. S. Radhakrishnan, Member-Secretary, Commission for Agricultural Costs and Prices, Krishi Bhavan, New Delhi.	-Member
(xxiv)	Director, Directorate of Cotton Development, 4, Ramjibhai Kamani Marg, Ballard Estate, PB No. 1002, Mumbai-400 030 (Maharashta) (Tel: 2611449)	- Member
(xxv)	Director, Directorate of Millets Development, Mini Secretariat Building, Bani Park, Jaipur, Rajasthan (Tel: 200038)	- Member
(xxvi)	Dr. V. Raghunathan, Former Plant Protection Adviser, H-23/G-3, Sea Breeze Apts, Thiruvallur Nagar, Thiruvanmiyur, Chennai - 600041 Tel 91-44-2451 3892 ® E-mail raghunathan_v@yahoo.com	- Member
(xxvii)	Adviser (Agriculture), Planning Commission.	-Member
(xxviii)	Economic and Statistical Adviser, Directorate of Economics and Statistics, Deptt. of Agriculture and Cooperation, Krishi Bhavan, New Delhi.	-Member-Secretary

3. The **Terms of Reference (ToR)** of the Working Group will be as follows:

(i) To study and analyze the trends in agricultural sector, agricultural productivity, investment in agriculture sector and farmers' income and suggest policy initiatives and other interventions required to increase these.

(ii) To review the performance of the central sector and centrally sponsored schemes/programmes implemented by the Department of Agriculture and

Cooperation during the Eleventh Plan with reference to their objectives and targets and to suggest modifications, if to be continued, to improve the efficacy of schemes taking RKVY into consideration.

(iii) To assess the demand and supply of fertilizers, seeds, and other inputs during the XII Five Year Plan and suggest measures to meet the demand and to suggest measures for judicious management of inputs to achieve higher use efficiency and to effectively address issues concerning adverse impact of imbalanced/ excessive input use and over-exploitation of natural resources on environment.

(iv) To assess the extent of farm mechanization and suggest strategies for its promotion, also covering small farm implements and indigenously developed machines/equipments.

(v) To study the priority in the expenditure on agriculture and allied sectors by the States and the Central Government, suggest ways to augment it.

(vi) To work out the requirements of rice, wheat, maize, other coarse serials, foodgrains, oilseeds, sugarcane, cotton, jute and other commodities including their demand for export, domestic use and make the supply projections for the terminal year of the Twelth Five Year Plan.

(vii) To review the present system of reporting of agricultural statistics, re- look on the recommendations of the National Commission/any other Expert Committee Statistics, suggest measures to improve the quality and efficiency of agricultural data-base and identify training needs of the statistical officials.

4. The Chairman of the Working Group may co-opt any other official/ non-official expert/ representative of any organization as a member(s), if required.

5. The Working Group may examine and address any other issues which are important though not specifically spelt out in the ToR. The Working Group may devise its own procedures for conducting its business/meetings/field visists/constitution of Sub-Groups etc.

6. The expenditure of the members on TA/DA in connection with the meetings of the Working Group or any work incidental to the functions of the Working Group/ Sub Group will be borne by the parent Department/Ministry/Organization/State Government for official members, and by the Planning Commission for non-officials members as admissible to Class-I Officers of the Government of India.

7. The Working Group will submit its Draft Report to the Planning Commission by June 2011 and final one by Sept. 2011.

8. Shri Daljeet Singh, Director (Agriculture), Room No. 466. Yojana Bhawan, New Delhi-110001, (Telfax. No. 23096543, e-mail daljeet@nic.in) will be the nodal officer for this Group in Planning Commission. Any further queries/correspondence in this regards may be made with him, and also with the Member-Secretary of the Working Group.

(G Rajeev)
Under Secretary to the Go

Annexure II

Formation of Sub Groups

S. No.	ToR	Team
1.	To study and analyze the trends in agricultural sector, agricultural productivity, investment in agriculture sector and farmers' income and suggest policy initiatives and other interventions required to increase these.	**1) Dr. Ramesh Chand, Director, NCAP- Convener** 2) Director, IIPR, Kanpur 3) Dr. D. M. Hegde, Project Director, DOR, Hyderabad 4) Prof, Pramod Kumar, Head, AER Unit, ISEC, Bangalore 5) Dr. S. Radhakrishnan, Member Secretary, CACP. 6) Dr. B.S. Bhandari, Adviser, DES, DAC 7) Dr. Praduman Kumar
2.	a) To review the performance of the central sector and centrally sponsored schemes/ programmes implemented by the Department of Agriculture and Cooperation during the Eleventh Plan with reference to their objectives and targets and to suggest modifications, if to be continued, to improve the efficacy of schemes taking the RKVY model into consideration. b) To study the priority in the expenditure on agriculture and allied sectors by the States and the Central government, suggest ways to augment it.	**1) Dr. Gurbachan Singh, Agricultural Commissioner, DAC, Convener** 2) Pr. Secretary, Agriculture, Govt. of Gujarat, Ahemdabad 3) Pr. Secretary, Agriculture, Govt. of Punjab, Chandigarh 4) Pr. Secretary, Agriculture, Govt. of Andhra Pradesh, Hyderabad 5) Pr. Secretary, Agriculture, Govt. of West Bengal, Kolkata 6) Sh. Mukesh Khular, Joint Secretary, Crops, DAC 7) Sh. S.C. Garg, Joint Secretary, RKVY, DAC 8) Horticulture Commissioner, DAC 9) Sh. Atanu Purkayastha, Joint Secretary, Plan Coord., DAC 10) Executive Director, National Horticulture Board, Gurgaon 11) Adviser (Agriculture), Planning Commission. 12) Shri P C Bodh, Additional Economic Adviser, Directorate of Economics and Statistics, DAC, New Delhi
3.	a) To assess the demand and supply of	**1) Prof. Vijay Paul Sharma,**

	fertilizers, seeds and other inputs during the XII Five Plan and suggest measures to meet the demand and to suggest measures for judicious management of inputs to achieve higher use efficiency and to effectively address issues concerning adverse impact of imbalanced/excessive input use and over-exploitation of natural resources on environment. b) To work out the requirements of rice, wheat, maize, other coarse serials, foodgrains, oilseeds, sugarcane, cotton, jute and other commodities including their demand for export, domestic use and make the supply projections for the terminal year of the Twelfth five Year Plan.	**Chairman, CMA, IIM, Ahmedabad, Convener** 2) D. G., NIPHM, Hyderabad 3) Joint Secretary (Crops), DAC, Krishi Bhawan, N. D. 4) Joint Secretary (Seeds), DAC, Krishi Bhawan, N. D. 5) Joint Secretary, Department of Fertilizer, Nirman Bhawan, N. D. 6) Joint Secretary, Department of Water Resources 7) CGM, Technical Services Division, NABARD, Mumbai 8) Dr. V. Raghunathan, Former Plant Protection Adviser, Chennai 9) Mr. Sudhir Bhargav CEO, Agro-Man Systems Pvt. Ltd., Mumbai 10) Dr. B.S. Bhandari, Adviser, DES, DAC 11) Sh. Abinash Mishra, Deputy Adviser (Irrigation), Planning Commission **1) Dr. Praduman Kumar, Senior Consultant, NCAP, New Delhi Convener** 2) Dr. D. M. Hegde, Project Director, DOR, Hyderabad 3) Director, IIPR, Kanpur 4) Prof, Pramod Kumar, Head, ISEC, Bangalore 5) Director, DCD, Mumbai 6) Director, DMD, Jaipur, Rajasthan 7) DDG(Crops), ICAR 8) DDG(NSSO-Household Expenditure Survey) 9) Dr. B.S. Bhandari, Adviser, DES, DAC
4.	To assess the extent of farm mechanization and suggest strategies for its promotion, also covering small implements and indigenously developed machines/equipments.	**1) Dr. Pritam Chandra, Director, CIAE, Bhopal, Convener** 2) Dr. D. M. Hegde, Project Director, DOR, Hyderabad 3) Mr. G. Shankar, NIPHM, Hyderabad 4) Director, IIPR, Kanpur

		5) Director, DCD, Mumbai 6) Er. Baldev Singh, AMMA
5.	To review the present system of reporting of agricultural statistics, re-look on the recommendations of the National Commission/any other Expert Committee on improvement of Agriculture Statistics, suggest measures to improve the quality and efficiency of agricultural data-base and identify training needs of the statistical officials. With a view to promote consistency and comparative information across the countries, the sub group may explore the possibility of recommending adoption of internationally recognized definitions, concepts, classifications and codes such as International Standard Trade Classification (SITC), Central Product Classification (CPC) or the Harmonized System Classification (HS) for agricultural production and prices data. Further, the sub group may explore the possibility of using some web based information technology system for food and agricultural statistics at national, sub-national and district levels to provide decision makers access to statistics, support analysis and monitoring across thematic area such as production, prices, trade etc.	**1) Dr. V. K. Bhatia, Director, IASRI, Pusa, New Delhi, Convener** 2) DDG, NSSO, New Delhi 3) DDG, CSO (National Accounts), New Delhi 4) Shri A. K. Jena, Adviser (Cost), CACP. Shastri Bhawan, New Delhi 5) Director, DCD, Mumbai 6) Sh. U.C. Sood, 7) Sh. Rajeev Lochan, Adviser, DES, DAC 8) Dr. B.S. Bhandari, Adviser, DES, DAC