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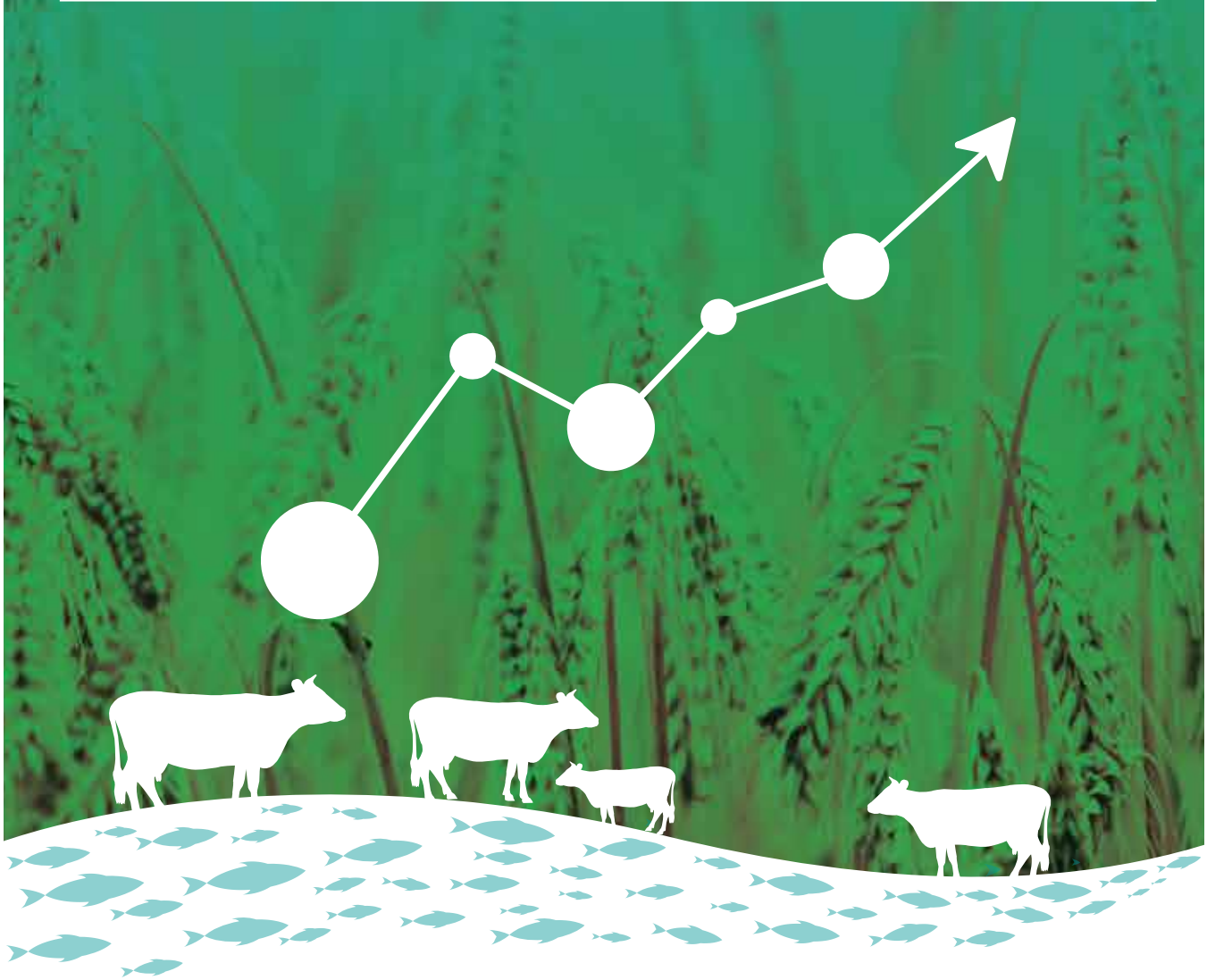
NITI Aayog

DEMAND & SUPPLY PROJECTIONS TOWARDS 2033

CROPS, LIVESTOCK, FISHERIES AND AGRICULTURAL INPUTS



THE WORKING GROUP REPORT

FEBRUARY, 2018

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PREFACE

National Institution for Transforming India (NITI) Aayog, Government of India vide their order number Q-11018/0202016-Agri, dated 29th July 2016 constituted a Working Group on Crop Husbandry, Agricultural Inputs, Demand and Supply Projections under the Chairmanship of Dr. Parmod Kumar, Professor Institute for Social and Economic Change, Bangalore. The terms of reference (TOR) of the Working Group included the following: (i) To study and analyze the trends in agricultural sector, agricultural productivity, investment 'in' and 'for' agriculture and farmers' income and suggest policy initiatives and other interventions required to increase these; (ii) To examine the changing preference and consumption habit of consumers for food and related items; To estimate the requirements of rice, wheat, maize, other coarse cereals, pulses, food grains, oilseeds, sugarcane, cotton, jute, fruits, vegetables, flowers and animal products viz. milk, meat, egg, fish and wool etc., including their demand for export, domestic use and make the supply projections for the terminal years 2019-20, 2023-24 and 2032-33. (iii) To assess the demand and supply of fertilizers, seeds, credit, feed & fodder and other inputs for 2019-20, 2023-24 and 2032-33 and suggest measures to meet the demand and judicious management of inputs to achieve higher use efficiency; (iv) To assess the extent of farm mechanisation and suggest strategies for its promotion, also covering all farm implements and machines / equipment. (v) To review the performance of centrally sponsored and central sector schemes implemented by the Ministry of Agriculture & Farmers Welfare during 12th Plan with reference to their targets of production and suggest modifications to improve the schemes, if to be continued; and to analyze the priority in the expenditure on agriculture and allied sectors by the States and the Central Government to suggest ways to augment it.

The composition of Working Group was broad based which included experts from Academia, Research Institutions, Representatives of the Union and State Governments including the representation of concerned Ministries/Departments and experts from various related fields (Working Group composition is given in Annexure I at the end of the report). To facilitate the functioning of the Working Group and to draft its report, Five Sub Groups were constituted, each one headed by the expert belonging to the main theme of the sub group and a Convener for each of the Sub Group (details given in Annexure II). The First Sub Group was headed by Dr. Ganesh Kumar, Professor IGIDR who looked into the issues related to investment 'in' and 'for' agriculture and farmers' income and desired policy initiatives. The Second Sub Group was constituted under the leadership of Dr. C. Ravi, Professor, CESS who deliberated on issues related to changing preferences and consumption habits of consumers for food and related items. The second part of consumption related to estimates of the requirements of cereals, pulses, oilseeds, fruits, vegetables, animal and other products and their demand and supply projections were worked out by the Chairman of the Working Group Dr. Parmod Kumar. The Third Sub Group to assess the demand and supply of fertilizers, seeds,

credit, feed & fodder and other inputs was chaired by Dr. S.K. Malhotra, Agriculture Commissioner, Ministry of Agriculture and Farmers Welfare. The Fourth Sub Group on farm mechanisation was chaired by Dr. K K Singh Director CIAE, Bhopal. The Fifth Sub Group to review the performance of centrally sponsored and central sector schemes was chaired by Shri Ashok Dalwai, Additional Secretary, DAC&FW. The Working Group conducted four meetings at the NITI Aayog and the Sub Groups also held meetings to deliberate on various issues related to each sub group.

The report constitutes of five chapters. The first chapter provides the background information on performance of Indian agriculture and growth trends. Second chapter is detailed on inputs whereby Working Group three chaired by Dr. Malhotra has provided the crucial inputs on policy and programmes of the Department of Agriculture and also forecasts for fertilizer, seed, feed and fodder and other inputs. Third chapter presents forecasts of demand and supply of agricultural commodities for the medium term future and policy interventions required to maintain food security. Chapter 4 is focused on mechanisation and mainly drafted by the Sub Group four headed by Dr. K K Singh. Chapter 5 presents not only the performance appraisal of Central and Centrally Sponsored Schemes but also puts forth future guidelines and policy interventions required from the concerned Departments and State Governments. Sub group five headed by Shri Ashok Dalwai has provided the major inputs in drafting this chapter.

I am thankful to the members of the Working Group, Chairman and Conveners of Sub Groups for their crucial inputs in compiling this report. Special thanks to Dr. J.P. Mishra, Adviser Agriculture, NITI Aayog and Member Secretary for this Working Group who not only arranged meetings of the Working Group and Sub Groups but also provided crucial role in the formation of Sub Groups and in drafting the report and the contributions of other team members (Sh. Manash Choudhury, Deputy Advisor; Dr. Ramanand, Senior Research Officer; Shri Ganesh Ram, Research Officer and others) of the Agriculture Vertical, NITI Aayog are thankfully acknowledged. Professor Ramesh Chand, Member NITI Aayog attended the first meeting and provided the key guidelines on how to go about in planning the strategy for the Working Group. He also attended the last meeting where preliminary draft of the Working Group was presented and his inputs played a key role in finalizing the demand and supply estimates and giving this report a final shape. The help and guidance of Dr. P.K. Joshi, Director IFPRI and Dr. Shashaka Bhide, Director MIDS are thankfully acknowledged. Finally, I thank Director ISEC and my colleagues at ISEC for their support and encouragement in drafting this report.

Parmod Kumar
Chairman

February, 2018

EXECUTIVE SUMMARY

National Institution for Transforming India (NITI) Aayog, Government of India vide their order number Q-11018/0202016-Agri, dated 29th July 2016 constituted a Working Group on Crop Husbandry, Agricultural Inputs, Demand and Supply Projections under the Chairmanship of Dr. Parmod Kumar, Professor Institute for Social and Economic Change, Bangalore. The terms of reference (TOR) of the Working Group included the following: (i) To study and analyse the trends in agricultural sector, agricultural productivity, investment 'in' and 'for' agriculture and farmers' income and suggest policy initiatives and other interventions required to increase these; (ii) To examine the changing preference and consumption habit of consumers for food and related items; (iii) To estimate the requirements of rice, wheat, maize, other coarse cereals, pulses, food-grains, oilseeds, sugarcane, cotton, jute, fruits, vegetables, flowers and animal products viz. milk, meat, egg, fish and wool etc., including their demand for export, domestic use and make the supply projections for the terminal years 2019-20, 2023-24 and 2032-33; (iv) To assess the demand and supply of fertilizers, seeds, credit, feed & fodder and other inputs for 2019-20, 2023-24 and 2032-33 and suggest measures to meet the demand and judicious management of inputs to achieve higher use efficiency; (v) To assess the extent of farm mechanisation and suggest strategies for its promotion, also covering all farm implements and machines/ equipment and (vi) To review the performance of centrally sponsored and central sector schemes implemented by the Ministry of Agriculture & Farmers Welfare during 12th Plan with reference to their targets of production and suggest modifications to improve the schemes, if to be continued; and to analyse the priority in the expenditure on agriculture and allied sectors by the States and the Central Government to suggest ways to augment it. A brief summary of major recommendations and policy suggestions is provided in the following pages:

The agricultural developmental plans especially those oriented towards production of food commodities and related infrastructure are based on the demand and supply projections for the growing population and other uses. To impart proper planning for the future, it is important to have reliable projections for demand and supply of agriculture including the critical inputs such as fertilizers, seeds, credit, and feed and fodder and others. It would be prudent to make projections for 2019-20, 2023-24 and 2032-33 which coincides the 3 years action plan, 7 years strategy and 15 year's vision document being prepared by NITI Aayog. Apart from that, the prices of agricultural commodities such as pulses have fluctuated significantly in recent years causing much concern. Any intervention to moderate such fluctuation would critically depend on the estimates of demand, production and associated shortfall, if any, that has to be met through imports. Hence, for a sustainable planning for the commodities which are important for food and nutritional security, there is an urgent need to assess the projected/estimated demand and supply in short, medium term and long term.

The average annual agricultural growth rate at 4.1 percent was achieved in 11th Plan. A target of 4 percent growth of Agri-GDP was retained in the 12th plan. The Agri-GDP growth was 1.2 percent in 2012-13, which improved significantly to 4.3 percent during 2013-14 due to record production of food grains, oilseeds, fruits and vegetables, other crops, livestock products and forestry and fisheries. During 2014-15, low rainfall and stressed weather during winters affected the crop output and consequently the Agri-GDP growth declined sharply to 0.2 percent but again recovered to rise to 1.1 percent in 2015-16. An impressive turnaround has happened in 2016-17 with growth touching to 5 percent and all time record production of almost all the commodities of agriculture and allied sector. While this is a noticeable achievement with all tall claims of technology innovations, infrastructure for irrigation and water resources, it strongly demonstrates that the monsoon and weather are still the deciding factors for agrarian economy growth. On average, the total investment in agriculture & allied sector increased at a rate of 11.6 percent during 11th Plan primarily on account of private investment growing at 15 percent (NAS release). Public investment in agriculture increased from 2.8 percent of GDP in 10th Plan to 3.1 percent in 11th Plan and remained at the same level in 2012-13. The private investment increased from 15.9 percent of agricultural GDP in 11th Plan to 18.1 percent in 2012-13. In order to attain 4 percent agricultural growth, higher investment in agriculture is required both from public and private sector.

As a percentage of agri-GDP, the GCF in agriculture has more than doubled during the last decade. The consequence of increase in agriculture investment has been the revival of agriculture growth from less than 3 percent in the Ninth and Tenth Plan to above 4 percent growth during the Eleventh Plan. However, recent decline is once again a cause of concern as it might slow down the growth process of agriculture sector. It is interesting to note that while public investment in agriculture is critical and important, in actual terms, it forms less than 15 percent of the total investment in agriculture while more than 85 percent comes from the private sector. Moreover, the private sector responds much better and faster to the incentive structures in agriculture. Hence, along with bringing in greater public investment in agriculture, there is a need for bringing in reforms in the incentive structure as well. There is a need to formulate a long-term perspective plan for rural infrastructure that focuses on infrastructural projects that have the highest total impact and strongest linkages. The convergence of resources of centre and state governments is also important, as it would avoid duplication or concentration of activities in particular areas.

For raising agricultural productivity, seed is the most critical input. Use of good quality seeds can enhance 15 to 20 percent productivity. Therefore, raising yield rate in agriculture largely depends on higher replacement rate of quality seeds of high yielding varieties/hybrids. For achieving the desired levels of SRR, adequate seeds of good variety need to be produced. Each state needs to prepare a State Seed Plan to meet the region specific requirements. Also, as a social commitment, the seed producing companies have to come forward to

include some low-profit crops in their baskets in the interest of small/resource poor farmers. In this context, an effective partnership between public and private seed organizations will be highly desirable. Even emerging concept of contract farming through Public-Private-Partnership will be highly beneficial. The whole range of production and availability of quality seed and planting material require a vibrant public-private partnership, nurtured and supported through suitable agreements, contracts and sharing of resources. Such alliances should come into existence in the very near future. The seed production and availability of different crops must be governed through appropriate quality standards and certification practices so that stakeholders along the value-chain are benefited. Given the increasing requirement for seed, the working group proposed to increase the traditional 12.5 percent of total production of grain meant for seeds to 20 percent especially for self-pollinated crops in the country. The remaining requirement of seed to sow the 80 percent area is met through the farmers' saved seeds, which often is degenerated and poor in vigour. This is adversely affecting crop productivity as the potential of a crop variety is not being exploited. Though the situation is likely to improve gradually, a large area of crops continues to be sown with farmers' saved seeds.

To meet the growing demand for agricultural products, it is necessary to increase productivity of available land through proper planning and optimum utilization of resources such as fertilizers, seeds, water, etc. Balanced fertilizer use is essential for raising agricultural productivity. Though there has been substantial increase in production and consumption of fertilizer over the years, nutrient response ratio is not so encouraging in our country mainly due to imbalanced use of fertilizer and lack of use of micro and secondary nutrients. Although India has diverse types of soil but most of them are deficient in nitrogen and phosphorus. The average consumption per hectare of arable land in India is far less in comparison to some of the other high consumption countries such as Egypt, Chile, China, South Korea, Japan, Malaysia, Vietnam and so on. Not only the fertilizer consumption is low in India its usage is also uneven. The ideal NPK (nitrogen, phosphorous, potassium) proportion for the Indian soil is 4:2:1. The ratio of NPK in Punjab and Haryana was 19.2:5.5:1 and 20.6:6:1, respectively in 2011. The disparity in the prices of urea and P and K fertilizers led to a distortion in the consumption pattern of NPK fertilizers. In order to address the issue of price disparity, improvement in fertilizer policy is a must. Balanced use of organic and inorganic fertilizers has a direct impact on soil fertility. Present policy may be revisited to promote both inorganic and organic fertilizers. Efforts may be made to move towards direct cash transfer on unit area basis so that farmers are free to choose between chemical fertilizers and organic fertilizers on their own as per soil health status/fertility.

The increase in food production cannot be achieved without providing for and maintaining soil fertility. It is envisaged that given the scarcity of organic materials, this will need to be achieved mainly through a substantial increase in the fertilizer use levels. It is estimated that the fertilizer (N,P&K) use will need to increase from 25.58 million tons in 2013/14 to about 35

million tons in 2031/32. Per hectare (cropped area) fertilizer use will need to increase from 128.1 kg/ha to 175 kg/ha at a growth of 2.25 percent per year.

In order to transform agriculture more effectively, credit plays a pivotal role especially among small and marginal farmers. The growth in credit has been significant during last 7-8 years. It is an urgent need to assess the projected/estimated demand for credit in view of changing scenario of agriculture and more paid out costs for inputs, farm implements and other critical activities. The long term credit requirement needs to be spell out keeping in view the changing dynamics of agriculture and allied activities.

The dairying, fisheries and poultry are the dominant sub sectors of agriculture which contribute significantly towards the agricultural GDP. NITI Aayog in their three year action agenda on shift into High Value Commodities, inter-alia, indicated an important challenge in the development of animal husbandry concerns fodder. Rapidly growing numbers of unproductive male cattle and weak fodder base due to problems in pasture management and shrinking of common properties make this problem doubly serious. We need innovation in institutional aspects of pasture protection and management. Also necessary is greater coordination between agencies responsible for livestock and those for crops that produce fodder. Timely availability of quality forage seeds is one of the important limiting factors. The seed chain from breeder to certified seeds does not exist at NSC and SSC level and also the institutional mechanism in most of the states. Our approach should be ensuring timely seed availability for 9 million ha. Besides, for increasing 5 million ha additional gross fodder area under catch fodder crop (April to June) in rice–wheat crops rotation area where assured irrigation exists as well as in Rice fallow land in Eastern India.

Planning for food security and management of grain supply in the immediate future depends on the empirical prediction of demand and supply of food-grains. The demand of agricultural commodities is linked to their requirement as final human consumption and intermediate consumption in the supply chain in addition to their requirement as seed and feed for animal consumption. The supply for the consumption requirement during the reference period gets sourced either from the domestic production, its net inventory from the carry-over stocks or through imports, depending upon the capacity of domestic supply resources. Demand projections relate to future requirements arising out of growth in population, increased per capita income and changes in income distribution, if any. In addition to direct demand for household consumption, there is demand of food-grains for seed, feed and industrial uses (for agro processing) and also some wastage in the process of harvesting, collection etc. The Working Group calculated the aggregate indirect demand for major food-grains as residuals using the trend analysis of gap between aggregate food supply and demand after adjusting for net imports (imports and exports) and changes in the government stocks. Among food-grains, the use of coarse grains for indirect demand is expected to increase at a rapid pace, e.g., increasing use of maize for poultry feed. The

overall food-grains use as SFWI is estimated to increase from 34 million tonnes in the early 1990s to around 76 million tonnes up to 2015-16. It is expected to cross 95 million ton by the end of 2025-26 and cross 120 million ton by 2032-33. The ratio of SFW to total food-grains' demand would increase from less than 25 percent in TE 2012-13 to around 40 percent by 2032-33.

Both demand and supply estimates were worked out using three different methods that provide the possible ranges for the forecast period. Whereas the static approach demand estimates arrived at 334-350 million tonnes of food-grains demand during 2032-33, the behaviouristic approach provided the range of 326-340 million tonnes. Similarly, the supply estimates based on all India and state trends work out around 378-415 million tonnes of food-grains production while three stage least square model provided the range of 343 to 380 million tonnes in the terminal year of 2032-33. The balance sheet looks quite affirmative for food-grains except the case of pulses and oilseeds in which case India is already in acute deficit. India is poised for some surplus in rice and wheat while coarse grains will be sufficient to meet the domestic demand whereas pulses will have deficit of around 5 to 7 million tonnes. The overall food-grains will have quite comfortable position as far as food security is concerned. However, the biggest worry would remain that of oilseeds in which case a massive deficit of more than 50 million tonnes will appear which was worked out without including the imported palm oil whose import already exceeded 9 million tonnes in 2014-15. Unless India succeeds in achieving nothing less than second **Yellow Revolution** either through technological breakthrough somewhat similar to BT Cotton, or there is massive expansion in area under oilseeds along with transformation achieved in the yield rate. There is huge possibility of expanding area under oil palm which has much better yield rate compared to oilseed field crops. In other commodities including milk, meat, fruits and vegetables and sugar there appears to be fine balance between demand and supply given the assumptions on supply side turns true.

While the population of agricultural workers as percentage of rural population has gone down from about 69 percent in 1951 to about 55 percent in 2014-15 but in absolute terms, due to increase in overall population, the number of agricultural workers available in rural areas increased from 131 million in 1960-61 to 263 million in 2010-11 and corresponding power increased from 6.55 million kW to 13.15 million kW during the same time period. It is estimated that number of agricultural workers will increase to about 336 million and power available from agricultural workers will be 16.84 million kW in 2032-33.It is observed that on average a tractor is replacing about 5 pairs of animals and power tiller about 2 pairs of animals. Draught animal power availability in India is likely decreased from 0.22 kW/ha in 1960-61 to 0.09 kW/ha by 2032-33.Human power availability for agriculture was about 0.046 kW/ha in 1960-61 which is forecasted to be about 0.12 kW/ha in 2032-33.Farm power availability from tractor has consequently increased from 0.007 kW/ha in 1960 to 1.03 kW/ha in 2013-14 at an overall growth rate of 10 percent per annum during the last 54 years. It is estimated that power

availability from tractor will reach 3.74 kW/ha in 2032-33. Over the years the shift has been towards the use of mechanical and electrical sources of power. In 1960-61 about 93 percent farm power was coming from animate sources, which has reduced to about 12.6 percent in 2010-11. On the other hand, mechanical and electrical sources of power have increased from 7 percent to about 87.4 percent during the same time period. It is estimated that by 2032-33 the share of animate source will be reduced to 4.1 percent in total farm power.

The operation-wise farm mechanisation in the country is about 40 percent for tillage and seedbed preparation, 30 percent for seeding/planting, 35-45 percent for plant protection, 60-70 percent for harvesting and threshing for rice and wheat and less than 15 percent for other crops. The level of mechanisation varies greatly by region. States in the north (Punjab, Haryana and western Uttar Pradesh) have high level of mechanisation (70-80 percent overall; 80-90 percent for rice and wheat) due to high productive land as well as declining labour force and also full support by state governments. The eastern and southern states have lower level of mechanisation (35-45 percent) due to smaller and more scattered land holdings. In the north-eastern states, the level of farm mechanisation is extremely low mainly due to hilly topography, high transportation cost of farm equipment and socio-economic conditions of the farmers.

Farm mechanisation in India stands at about 40-45 percent and it is low in comparison to US (95 percent), Brazil (75 percent) and China (57 percent). The farm power availability has grown from 0.28 kW/ha in 1960-61 to 1.83 kW/ha in 2010-11 and expected to be increased to 5.17 kW/ha in 2032-33. Horticulture mechanisation and mechanisation of hill agriculture are areas where mechanisation has to go in a long way to increase the farmer's income by reducing labour requirement. Business and enterprise friendly policies, laws, and regulations as well as physical and institutional infrastructures, which encourage commercial activities and entrepreneurship in farming, input supply, produce handling, processing and marketing as well as in manufacturing will be key factors to the success of agricultural mechanisation in the different states of India.

During the XI Plan (2007-11), a series of new programmes and initiatives were put in place such as the National Horticulture Mission, National Food Security Mission, Rashtriya Krishi Vikas Yojana (RKVY), etc., which were revamped during XII Plan with increased spread and scope. During XII Plan some of the umbrella schemes were initiated with multidisciplinary and multi-functionary nature to infuse convergence and optimize the use of available resources. *Pradhan Mantri Krishi Sinchai Yojana* is one such scheme under centrally sponsored category. The Government has also introduced two innovative programmes under central sector schemes e-NAM and Soil Health Card. While one addresses the farmer's price realization, another about the soil productivity and economizing the fertilizer use. The Pradhan Mantri Fasal Bima Yojana (PMFBY) is an initiative introduced since 2016-17 to minimize the risk associated with cropping.

Following the implementation of recommendations of the 14th Finance Commission, the fund sharing pattern between Centre and State for many schemes for agriculture have changed. The funding pattern of major schemes of Ministry of Agriculture like Rashtriya Krishi Vikas Yojana, National Food Security Mission, Mission for Integrated Development of Horticulture, National Mission for Sustainable Agriculture, National Mission for Agriculture Extension and Technology and National Livestock Mission has changed from earlier 100 percent or 90:10 (Centre:State) funding pattern to 60:40 for mainstream states and 90:10 for hilly and NE States. This has affected the performance of the CSSs and CSs in some States.

Sub-schemes namely Bringing Green Revolution to Eastern India (BGREI), Saffron Mission, Vidharbha Intensive Irrigation Development Progarmme (VIIDP), Crop Diversification in Original Green Revolution areas and Additional Fodder Development Programme (AFDP) are important to name. The sub-schemes implemented under RKVY since its inception are Integrated Development of 60,000 pulses villages in rain-fed areas; Promotion of Oil Palm; Vegetable Initiative for Urban Clusters; Nutri-cereals and Nutri-farm; National Mission for Protein Supplements; Accelerated Fodder Development Programme; Saffron Mission (implemented in J&K); Vidarbha Intensive Irrigation Development Programme; Crop Diversification in original green revolution states.

The future growth in agriculture will primarily be knowledge and technology driven. This demands more investment in agricultural R&D, innovations and institutions to bring about significant change in technologies for resource conservations and productivity enhancement. During 11th Plan, the investment on Agri-R&D was about 0.7 percent of agri-GDP which needs to be enhanced to minimum of 1 percent of agriculture GDP by 2022-23 and 2 percent by 2032-33. However, there has been slow progress in finalizing the new and existing projects for research during the 12th Plan which needs a serious review. Besides, reforms in Agri-R&D should be the major agenda for years to come. Despite low participation in agriculture R&D, private sector has come out with some impressive technologies like Bt cotton and hybrids in maize and vegetables. Private sector need to be facilitated and encouraged to invest more in R&D in the country. The multiplicity of institutions with overlapping activities in agriculture research and structural reorientation in Krishi Vigyan Kendras (KVKs), etc., are some of the core issues that require immediate attention. KVKs should promote village level knowledge and entrepreneurship models through shared investment to empower the farmers not only as users of technology but also as producers of knowledge. A large number of new varieties are developed each year through public funding but often not adopted by the farmers due to lack of confidence in the variety, poor dissemination, issues in varietal identification, breeder seed production and further multiplication and distribution.

WAY FORWARD

Though the share of agriculture in GDP has declined over the years, yet without the growth of this sector, it would be extremely difficult to achieve the overall growth targets for the economy. Hence, strategies for faster, more inclusive and sustainable growth must necessarily address the issues faced by millions of people living in the rural areas. People and Produce in agriculture sector are subjected often to number of serious stresses related to untimely monsoon or other calamities like floods, hailstorms, etc. The Pradhan Mantri Fasal Bima Yojana is a right step which needs to be continued. Also similar initiatives are required for addressing the risks in livestock sector. The farmers must get a larger share of the price ultimately paid by the consumers. While MSP related interventions need to be continued, the alternatives to physical procurement like Price Deficiency Payment must be piloted by the States for some commodities and select districts.

The economy of scale of land holding is the major issue and land is the important input for any agricultural activity. Rising absentee landlordism in many States has put large tracts of land out of productive use, as the landowners do not lease it due to fear of losing ownership to tenants. Further, small and marginal farm holders are looking for opportunities to raise their operational holdings by leasing-in land. The net result is that some land is not used optimally and many smaller holdings are suffering from scale disadvantages. This requires substantive reforms in the land policy particularly at the State level, to achieve the economies of scale in agriculture. Promotion of contract farming, legislation on land leasing and encouragement of land sharing among both farmers and landowners is requisite. The model land leasing act suggested by NITI Aayog needs to be adopted by the States to enact their leasing laws.

The enhancement of investments in agriculture is the core area to enhance productivity, infuse profitable commercialization and competitiveness. The large scale dependence on rainfall and low level of investments both on-farm and off-farm are major reasons for low average productivity which is dismally less as compared to any global standards. The enhanced investment, both public and private is required to enhance productivity in agriculture. The Centre and States while invest more through the CSSs, they need to evolve policies to channelize greater private investments in farm inputs, irrigation, marketing, post-harvest management, risk management, land development and capacity of institutions. Much of the future growth in agriculture will come from non-crop sector, the investment in horticulture, dairy, livestock, fisheries, etc., must be provided necessary impetus so as to meet the future requirements and also enhance and double the farmers' income.

The National Agricultural Market has got initial issues which need to be settled early and one comprehensive e-platform which can speak and transact with both public and private platforms needs to be developed on priority. The opportunities for livelihood of rural

people outside the agriculture sector and linking them to the value chain must also be created simultaneously.

Climate change remains the major challenge impacting yields of crops, livestock, dairy and fisheries; and further impacting price behaviours often locally and sometimes globally. Government introduced two major responses to climate change-National Mission for Sustainable Agriculture (NMSA) for development and National Innovations on Climate Resilient Agriculture (NICRA) for research. These key initiatives aimed at transforming agriculture into a climate resilient production system through adaptation and mitigation measures. While initial learnings are promising, a greater convergence of these initiatives with Pradhan Mantri Krishi Sinchai Yojana (PMKSY), MGNREGA, etc., is a must to scale up the initial learning.

While public R&D system in agriculture is inevitable in view of the diversity of the sector and its clientele, the reforms in the public R&D should be the core agenda for next 15 years for greater autonomy, larger participation of private sector and accountability for the public investment. Make In India, must be viewed as an essential service to nation as millions of the farmers with low purchasing capacity still resort to public evolved technologies and support as the private sector evolved technologies, many a times, are beyond the normal capacity of small & marginal farmers. Private investments and engagements are often limited to select commodities and geographies.

HIGHLIGHTS AND POLICY RECOMMENDATIONS

1. The longer term growth in agriculture has been sustained while short term fluctuations are palpable. Among sub sectors, animal husbandry and fishery given their past performance have comparatively high growth potential compared to crop husbandry and forestry. The growth potential within crop sector lies more in horticulture and other high value commodities compared to traditional foodgrains sector.

2. Transformation of fibres highlights the importance of technology in crop sector for achieving high growth. The technology, especially the bio technology needs adoption in other possible crops like maize, canola, brinjal, mustard and so on, and new form of precision farming need adoption at a larger scale. There is huge potential for future growth in high value commodities, like fruits and vegetables, milk and meat products and fisheries. For achieving self sufficiency in pulses and oilseeds, rabi pulses and kharif oilseeds have more potential in area and yield expansion and need to be fully utilised.

3. To balance labour productivity in agriculture (where almost 50 percent of the population is contributing less than 15 percent of output), there is dire need to

strengthen linkages between agriculture and allied activities and rest of the economy through the development of rural non-agricultural enterprises, particularly agro-processing sector and SMEs in peri-urban areas. This has to be top priority of the reform agenda for the future.

4. Maintaining productivity growth to sustain the growth of food crops and other food products that form the main staples of the population is essential for more balanced growth. Policies should focus on measures that provide incentives for efficient utilisation of both capital investments as well as natural resources. Increasing productivity calls for investments in technology, extension, research and logistics to raise output through efficient usage of natural resources and also minimising wastage. Technology needs to be brought in to the centre stage.

5. Shift in consumer preferences and increasing numbers of the middle income class have altered the domestic demand for agricultural commodities and globalisation has connected Indian farmer as well as consumer to international markets. As a result, the demand for dairy products, meat and meat products, fruits and vegetables and their processed products is growing fast and will continue to do so in the future. To meet this growing demand and maintain competitiveness, more investments in the entire food chain that involves collection, grading, storage, packaging, and transport to help take produce from farms to markets and factories is the key to the future growth of the agricultural and allied sectors.

6. The fragmentation of land holdings means that to achieve economies of scale, bulk-buying and sale of produce have become extremely important to generate more incomes. Therefore, large-scale retail and supermarket operations can lead to the development of necessary infrastructure that improves supply logistics and also help in dealing with price volatility through risk pooling. For the desired changes to take place there is a need to look beyond production and pay due attention to post-harvest supply chain which facilitates especially the small holders.

7. Bringing more area under high yielding new varieties and hybrids would be helpful in enhancing the yield. Substantial increases in the yield potential of different food crops need to be achieved through intensive research in terms of using the latest bio-technology

8. Need to educate and guide the farmers in intensive soil fertility management, soil health cards, application of organic materials to the maximum extent possible and application of micro-nutrients. The use of bio-pesticides needs to be encouraged.

9. Bridging the gap between demand and supply of green fodder, dry fodder and feed of livestock is required for achieving high growth in animal husbandry. Diversification

of agriculture to livestock based farming system needs large scale adoption. Setting up of Agro-based feed industries in rural areas will give impetus to this sect

10. The increasing complexity of production environments demands efficient information dissemination and training in the use of modern technologies. An appropriate extension services need to be created to stimulate and encourage both top-down and bottom-up flows of information between farmers, extension workers and research scientists to promote generation, adoption and evaluation of location-specific farm technologies.

11. Strengthen support services for research and development, testing and standardization, as well as for human resource development in support of agricultural mechanisation.

12. An *inter-se* comparison within the Departments of the Ministry indicated lower fund availability to research which needs to be improved in view of thrust on developing new technologies, for productivity enhancement and risk adaptation & mitigation against climate change, etc.

13. Over the years, landholdings in India have become smaller & fragmented thereby many farmers are now seeking alternative sources of income. However, stringent tenancy laws in most of the States have meant that these farmers hesitate to lease the land they leave behind. As a result, an increasing amount of farmland is left fallow. The introduction of a modern land leasing law that balances and protects the right of tenant and landowner would be potential solution.

CHAPTER I

CHAPTER I

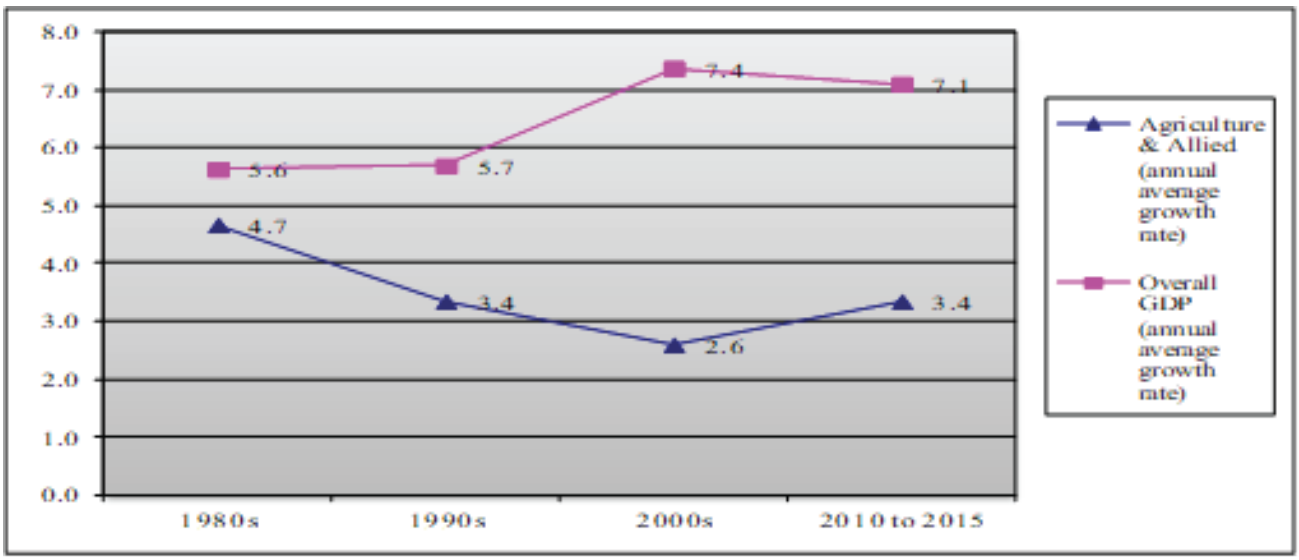
PERFORMANCE OF INDIAN AGRICULTURE IN THE PAST

Agriculture remains a crucial sector for the Indian economy. Although its contribution to the overall Gross Domestic Product (GDP) has come down from 30 percent in the early 1990s to less than 13 percent in 2014-15, however, its employment share still has been recorded around 45.7 percent during the same year. Due to the vast size of agriculture and its importance for livelihood and it being the primary source of employment for the rural masses, growth of this sector has important implications for poverty reduction in the rural areas. The sector is a major source of food security for a vast majority of low income, poor and vulnerable sections of society. The experience from BRICS countries indicates that a one percentage growth in agriculture is at least two to three times more effective in reducing poverty than the same growth emanating from non-agriculture sectors. Therefore the performance of this sector remains crucial for the overall growth of the economy.

AGRICULTURAL PERFORMANCE IN THE LAST THREE AND A HALF DECADES

Agricultural sector, broadly defined to include livestock, forestry and fishery, has been trailing in growth performance compared to other sectors in the post liberalisation period. Agriculture has languished when the trend rate of growth in rest of the economy has been mounting. Divergence in growth rates of overall and agricultural GDP have persisted and even widened after India adopted the reform process in 1991 (Figure 1.1). The GDP growth rate of agriculture peaked in the 1980s (i.e. 1980–89) at above 4 percent, while overall GDP grew at a rate of 5.6 percent during the same time period. Growth rate in agricultural GDP came down to 3.4 percent in the 1990s (i.e. 1990-99) and further to 2.6 percent during the decade of 2000s (i.e. 2000-09). In comparison, the overall GDP jumped from 5.7 percent in the 1990s to 7.4 percent during the 2000s. Thus, while the overall economy accelerated, the agricultural sector decelerated. As a result, the gap between the growth of agriculture, including allied sectors, and that of the rest of the economy continued to widen. There has been some recovery in the current decade of 2010s whereby the overall GDP growth has plummeted while agriculture growth has shown some recuperation. The widening wedge between agriculture and non agriculture sectors have led to a steeper fall in the share of agriculture and allied sector in the rest of the economy, although no major changes have taken place in the employment structure.

Figure 1.1: Trends of Agricultural and Overall GDP



AGRICULTURAL GROWTH ACHIEVEMENT DURING FIVE YEAR PLANS

The performance of agriculture sector in India during five year plans has been a mixed phenomenon with very high growth in some periods but dismal performance in others especially the periods that witnessed abnormal monsoon and adverse climate. Table 1.1 presents realized annual average growth rates in agriculture and allied activities vis-a-vis growth achieved in overall GDP during five year plan periods. At the beginning of planning era highest priority was accorded to increase agricultural production with nearly one third of plan funds allocated to agriculture sector. Several irrigation projects and fertilizer plants were established. However, subsequently focus of growth shifted from agriculture to industry with the beginning of second five year plan. The performance of agriculture (that also includes livestock hereafter) in the first two plans was phenomenal with growth exceeding 3 percent per annum in the first plan and more than 3 and a half percent in the second five year plan. The overall GDP grew at 3.6 and 4.3 percent per annum, respectively during this period. During the third plan period, green revolution programme was started on a small scale. However, due to two battles, Chinese aggression in 1962 and Indo-Pak war in 1965 and also because of severe and prolonged drought during 1965-66, agriculture performed negative growth during this plan and the country faced a great food crisis. Next three years were the period of annual plans from 1966 to 1969 during which agriculture recorded 6-9 percent per annum growth under the impact of Green Revolution. In the subsequent two and a half decades of green revolution (from 4th to 8th plan), the agriculture sector in India kept pace with the rising food demand of a growing population. The sector grew at an average growth rate of above 4 percent per annum. The growth rate of overall GDP during this period was slightly above 5 percent per annum. High yielding variety (HYV) seeds, fertilizer use, new agriculture techniques and irrigation facilities led to expansion of area of green revolution which by the mid 1980s covered almost whole of India.

However, this performance of satisfaction and optimism lost its momentum in the early 1990s. The mid 1990s witnessed a tendency of stagnation in foodgrain production while oilseeds which registered peak production under Oilseeds Mission in the mid 1980s to early 1990s seen stagnation once again. Thus, ninth and tenth plan was a period of despair for Indian agriculture. From above 4 percent growth, the agriculture plumed to less than two and a half percent per annum growth rate during the decades between mid 1990s to mid 2000s. As a corrective measure, *National Agricultural Policy 2000* was framed and *National Commission on Farmers,* Chaired by Prof. M. S. Swaminathan was constituted during this period. The Commission submitted its final report in October 2006. National Policy on Farmers 2007was adopted in which several measures were announced including, watershed management, development of horticulture, agricultural credits, insurance scheme for crops, agricultural marketing reforms and so on. As a result of re-emphasis imposed on agriculture, the negative trend of public investment in agriculture was reversed. The 11th plan targeted a rapid growth of 9 percent per annum increase in economy and 4 percent per annum growth in agriculture sector. The growth target was successfully met with agriculture once again jumping up from 2.5 percent growth of previous two plans and achieved 4.3 percent more than the target set of 4 percent growth. With agriculture achieving 4 percent growth it enabled the economy to achieve above 8 percent growth first time in the planning era in India. The advanced estimates indicate that 12th Plan once again lags behind the targeted growth of 4 percent per annum for agriculture and 9 percent growth for the overall economy. The agriculture and allied activities have achieved around 2.4 percent growth while overall economy also falls behind at 6.9 percent per annum growth rate. This manifests the fact that if the country wants to achieve double digit growth then agriculture must contribute four percent plus growth rate for fairly a longer period. This Working Group will look into the possibilities of achievement of 4 percent growth in agriculture and what is policy changes needed to get this targeted growth rate.

Table 1.1: Growth rate in Agriculture and Allied Activities during Five Year Plans

Five Year Plans	Period	Agriculture including livestock	Forestry & logging	Fishing	Agriculture forestry & fishing	Overall GDP
GROWTH IN FIVE YEAR PLANS (% PER ANNUM)						
I	1951-52 to 1955-56	3.22	-0.20	5.89	2.88	3.61
II	1956-57 to 1960-61	3.59	0.81	5.10	3.35	4.27
III	1961-62 to 1965-65	-0.75	4.33	3.41	2.77	2.84
IV	1969-70 to 1973-74	2.96	1.06	3.40	3.59	3.35
V	1974-75 to 1978-79	3.97	0.42	3.05	5.78	4.88
VI	1980-81 to 1984-85	6.28	-0.67	5.60	3.03	5.51
VII	1985-86 to 1989-90	3.06	1.37	5.38	4.78	5.66
VIII	1992-93 to1996-97	4.88	0.19	7.88	4.78	6.54
IX	1997-98 to 2001-02	2.48	2.76	2.67	2.49	5.70
X	2002-03 to 2006-07	2.48	1.34	3.63	2.38	7.59
XI	2007-08 to 2011-12	4.27	2.08	4.66	4.06	8.05
XII$^{\$}$	2012-13 to 2016-17	-	-	-	2.40	6.85
LONG TERM GROWTH (% PER ANNUM)						
Pre GR (1950 to 1968)		2.33	1.40	4.69	2.27	3.84
Post GR (1969 to 1991)		2.84	-0.51	3.75	2.62	4.16
Post Lib (1992 to 2013)		2.97	1.90	3.98	2.98	7.00
Full Period (1950 to 2013)		2.73	0.79	4.33	2.66	4.77

Note: $ Based on third revised estimates for 2012 and 2013, second revised estimates for 2014, first revised estimates for 2015 and second advanced estimates for 2016 as provided by the CSO, GoI.

Comparing the growth performance of agriculture with other allied activities during the plan period, fishery sector growth was much higher while forestry and lodging observed much lower overall performance as compared to agriculture crop and livestock sector. During the first two plans fishery sector growth was phenomenal, above 5 percent per annum that was even higher than the overall growth of the economy. Subsequently there was some slow down in the growth in the fishery sector but still the overall performance remained above 3 percent per annum during third, fourth and fifth plan. In the next two plans, fishery sector, once again, recuperated above 5 percent per annum growth rate which almost touched 8 percent per annum during 8th plan period. In the next one decade fishery sector observed slight decline in the growth rate while there was some upsurge during the 11th plan period. Compared to

fishery, forestry sector performance remained dismal throughout except the 3rd plan period when the sector observed above 4 percent growth rate.

Exponential trend growth rate evens out the yearly fluctuations and tells us performance of a sector over a longer period of time. The bottom segment of Table 1.1 presents exponential growth in agriculture and allied activities. The entire period is divided into three phases namely, period before green revolution; period of post green revolution and the beginning of liberalisation era; and the post liberalisation era. The performance of agriculture (including livestock) sector as well as the aggregate agriculture sector (including allied activities) not only remained fairly stable throughout but also consolidated quite clearly. The sector observed 2.3 percent per annum growth rate before green revolution that increased up to 2.8 percent in the post green revolution era and reached to almost 3 percent per annum in the post liberalisation era. This performance indicates that despite increasing climate adversities, increasing resource constraints and shrinking holding size, the Indian agriculture has moved upwards in growth performance and has the potential to raise the growth further to the set target of 4 percent per annum in the coming decades.

Figure 1.2: Growth Comparison between Agriculture and Aggregate GDP

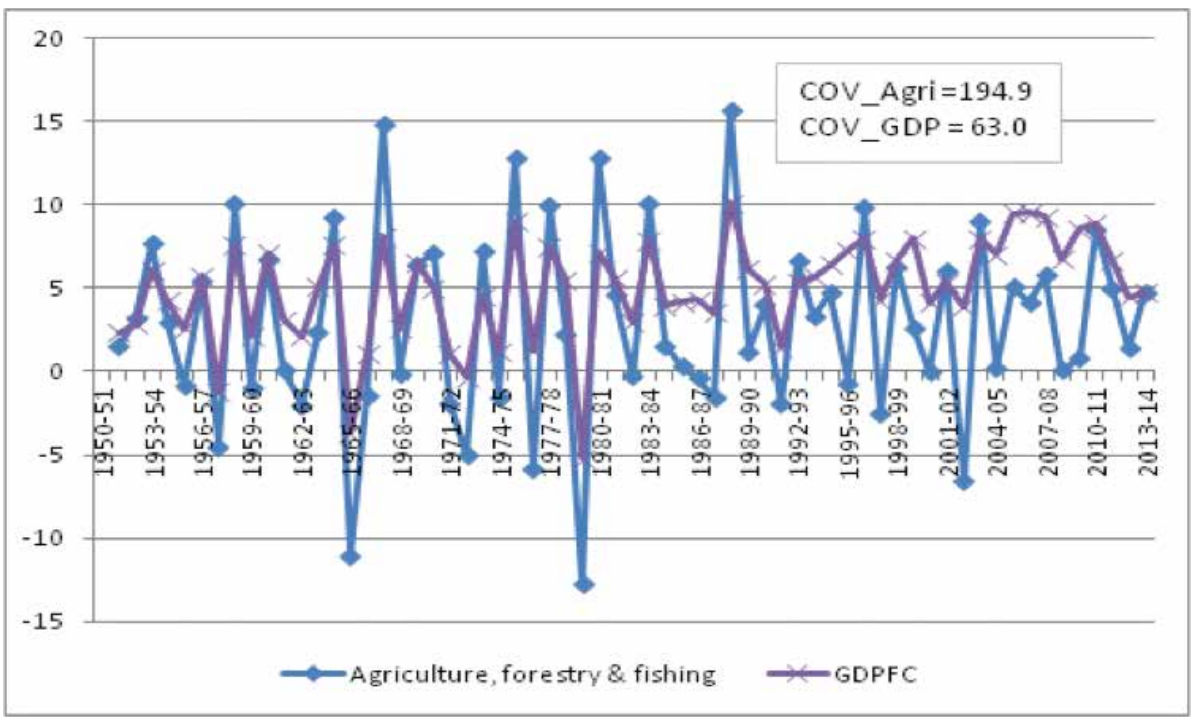


Figure 1.2 presents growth comparison between agriculture and overall GDP which depicts that compared to overall GDP agriculture sector still remains subject to wider fluctuations. The coefficient of variation is found almost three times higher in agriculture and allied sector GDP as compared to overall GDP. These wider fluctuations in agriculture performance are observed because the sector still depends on the vagaries of monsoon whereas the overall economy has developed resilience to agriculture fluctuations over time as share of agriculture sector in the overall GDP has rapidly reduced as explained in the next paragraph.

Table 1.2 provides percentage share of agriculture and sub sectors in the overall contribution of GDP. It is visible from the statistics that share of all the three sub sectors have declined over the plan period. This is the outcome of long-term development process which tells us that agricultural sector accounts for the bulk of production and consumption in the beginning of growth process. As countries develop, manufacturing and services sectors expand at a more rapid rate, and as a consequence the shares of these sectors in overall GDP expand. The labour force also starts moving out of agriculture to these sectors. These changes lead to a fall in the share of the agricultural sector in GDP and also the share of labour force employed in the agricultural sector. Similarly, the process of development also diversifies our consumption pattern. The food demand shifts from basic cereals to high value products such as dairy, milk and meat products, fruits and vegetables and processed products. Accordingly, the share of agriculture that includes livestock has fallen from 41 percent in the 1950s to as low as 12 percent in 2013 while forestry sector has declined from 12 percent in the 1950s to only 1.4 percent in 2013. Fishery sector was contributing around 1 percent to GDP which now have fallen to 0.7 percent. Overall agriculture and allied activities contribute less than 14 percent to GDP which is likely to fall further. However the big concern is high share of this sector in employment which still contributes more than 45 percent and unless this comes down through occupation diversification towards agro processing manufacturing and services sector, the overall productivity of this sector shall remain low.

Table 1.2: Percentage share of agriculture and allied activities in Agriculture GDP

Period	Agriculture, including livestock	Forestry & logging	Fishing	Agriculture, forestry & fishing
1950s	41.3	12.0	1.1	50.4
1960s	35.1	10.1	1.1	42.9
1970s	31.4	8.6	1.2	38.4
1980s	27.7	5.1	1.1	33.0
1990s	22.5	3.2	1.2	26.7
2000s	15.8	2.0	0.9	18.7
2012-13	11.8	1.3	0.8	13.9

SUB SECTORAL PERFORMANCE OF AGRICULTURE

In order to see the prospects of future growth in agriculture it is essential to see the growth performance at the disaggregated level. Figure 1.3 depicts percentage share of different sub sectors in the value of total output of agriculture and allied activities. We can divide these activities into crop, animal husbandry, fishery and forestry. The crop sector contributes around

2/3rd in the total value of output while livestock sector contribution is around 1/4th and rest of around 13 percent of total output comes through fishery and forestry. It is interesting to note that while crop and forestry sector contribution is going down that of livestock and fishery sectors' contribution is increasing rapidly. Therefore, the growth of these two sub sectors shall play a bigger role in the overall growth in agriculture in the coming future. Nevertheless, crop sector remains very important and still occupies principal position in agriculture and allied activities.

Crop sector consists of traditional foodgrains (wheat, rice and other cereals), pulse crops, oilseeds, sugar, fibres, fruits and vegetables, drugs and narcotics, condiments and spices and various other crops. Among all agricultural crops, cereals constitute highest share although their share is rapidly declining. Fruits and vegetables share is almost close to cereals and it is rapidly increasing and expected to surpass cereals sooner than later. Oilseeds followed by sugar, fibres and pulses contribute in that order. Looking at the percentage share of various crops in total value of output from agriculture and allied activities, cereals contribute around 18 percent, fruits and vegetables around 17 percent, oilseeds around 6 percent and sugar, fibre, and pulses altogether account for around 10 percent and similarly an equal share of 10 percent is contributed by condiments, spices and other crops in the total value of output of agriculture and allied activities.

Figure 1.3: Percentage share in the total value of output from agriculture and allied sector

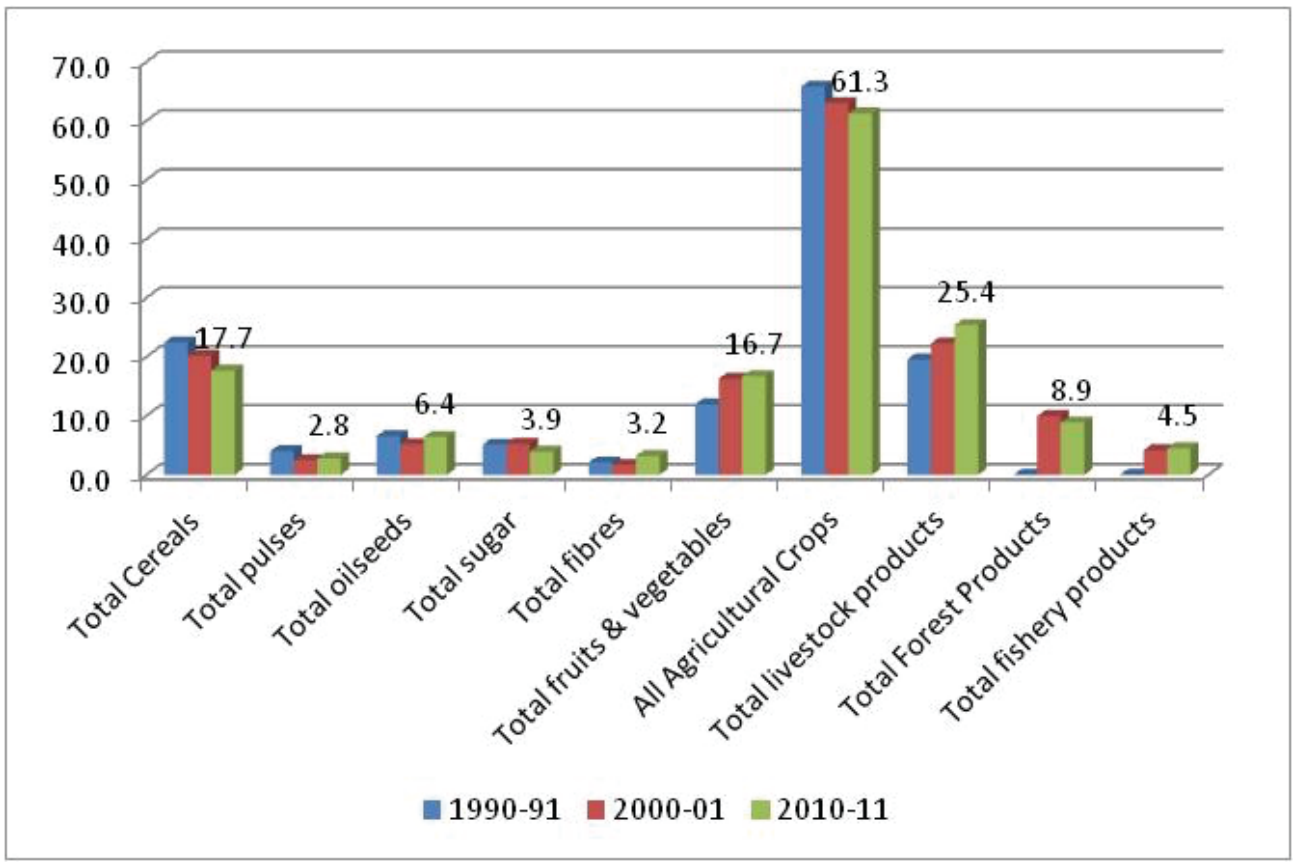


Table 1.3: Growth Rate in Sub Sectors of Agriculture and Allied Activities
(Exponential % per annum)

Sub Sector	1990s	2000s	Aggregate
Total cereals	1.99	2.00	1.28
Total pulses	0.02	2.20	0.67
Total oilseeds	1.09	4.48	1.73
Total sugar	2.94	1.13	0.97
Total fibres	1.28	10.83	4.14
Total drugs & narcotics	4.06	3.10	3.75
Total condiments & spices	4.71	4.53	4.19
Total fruits & vegetables	6.03	4.12	4.25
All agricultural crops	2.66	2.91	2.08
Total livestock products	3.77	4.34	3.90
Total forest products	-	1.75	1.75
Total fishery products	-	3.68	3.68
Total value of agricultural and allied activities	2.94	3.15	2.49

It is interesting to see how different sub sectors have performed in the last two decades that also provides some signals on what should be the focus for future plans. The emerging sectors which performed above 3 percent per annum growth rate during the period of last two decades, i.e., from 1990-91 to 2010-11 were fruits and vegetables, condiments and spices, fibres mainly cotton because of 'bt' technology, livestock, fishery and drugs and narcotics (Table 1.3). In other words high performing sub sectors in agriculture were mainly horticulture, dairy sector and fisheries including marine products. The traditional crop sectors, viz., cereals, pulses, sugarcane and to some extent oilseeds as well as forestry realized less than 2 percent per annum growth during this period that was much less than the aggregate average of 2.5 percent per annum for total agriculture and allied activities.

Comparing growth in the two decades, fibres realized a kind of transformation from less than 1.3 percent growth in the 1990s to around 11 percent growth in the 2000s which highlights the importance of technology for achieving high growth (introduction of bt in cotton). Similarly, high growth was maintained by horticulture and dairy sectors. The only exception in traditional crops was increase in growth in the oilseed sector which realized around 4.5 percent growth in the 2000s as compared to 1 percent per annum growth in the 1990s. Cereals and pulses could not exceed above 2 percent growth in their value of output during both the decades despite so much emphasis on increasing pulse production. The

broader trends indicate huge potential for future growth in high value commodities, like fruits and vegetables, milk and meat products which come under livestock sector and that of fishery sector. The scope for growth of foodgrains production including sugar and oilseeds to some extent, in future shall depend on increase in their yield rate as diversification of area from foodgrains and other traditional crops to high value commodities like horticulture and dairy sector has already become a known factor.

PERFORMANCE AT STATE LEVEL

For analysing state level performance in agriculture, growth rate in GSDP agriculture and allied activities was calculated for the most recent decade of 2004-05 to 2014-15 using exponential trend growth rate. Figure 1.4 shows that growth rates varied across states quite extensively. There were at least eight states which experienced more than 4 percent growth rate and out of these three states namely Madhya Pradesh, Jharkhand and Chhattisgarh surpassed 6 percent per annum growth rate in agriculture and allied activities. Rajasthan, Andhra Pradesh, Bihar, Gujarat and Karnataka experienced above 4 percent growth rate. Among the states which had lower growth in agriculture and allied activities, e.g., Assam, Haryana, Maharashtra, Tamil Nadu, Uttar Pradesh, Uttarakhand and Himachal Pradesh grew by above 3 percent per annum. Odisha, West Bengal, Punjab and Jammu and Kashmir observed low but positive growth rate while Kerala experienced negative growth rate in agriculture and allied activities. It is to be noted that this was the decade of revival of agriculture after having low growth in the past decade of mid 1990s as mentioned elsewhere. This revival was made possible by the combined efforts of the Union and state governments which saw a renewed focus on agriculture in terms of increased budget on agriculture, huge increase in public and private investment in agriculture and beginning of many Central and Centrally Sponsored programmes on agriculture, e.g., Rashtriya Krishi Vikas Yojana, National Food Security Mission, National Horticulture Mission and also irrigation, soil conservation, horticulture, dairy and fishery projects started by many state governments like Gujarat, Madhya Pradesh, Rajasthan, Karnataka and so on.

Figure 1.4: Growth rate in GSDP agriculture and allied sector during 2005-06 to 2014-15 (Exponential % per annum)

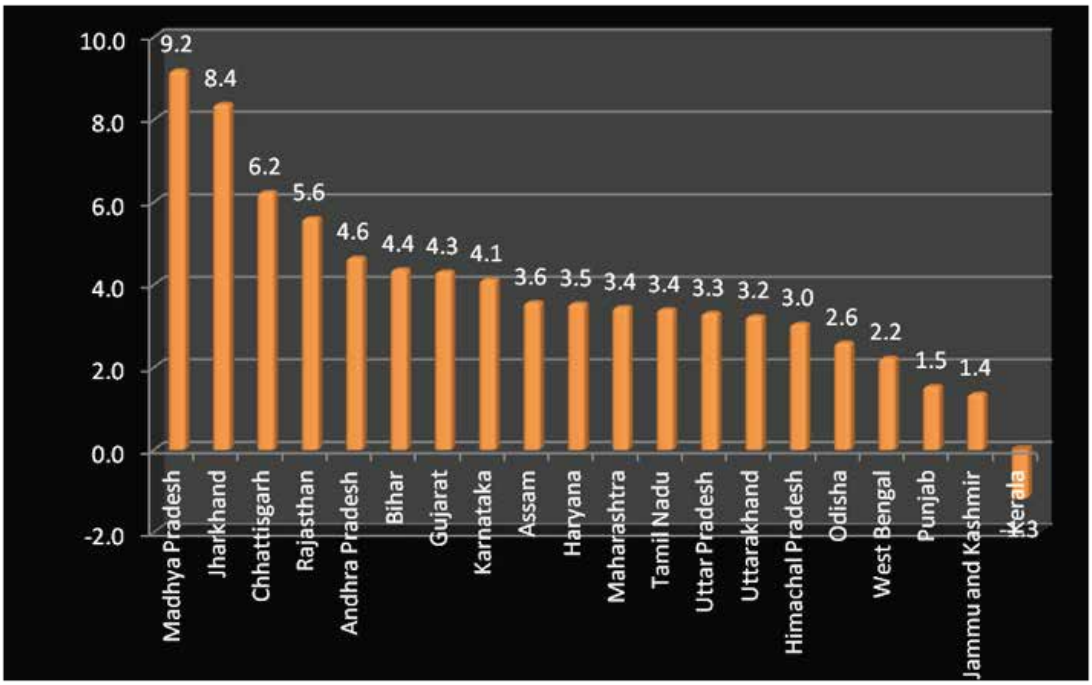


Table 1.4: Growth rate in total value of output from agriculture and allied sectors during 2012-13 to 2014-15 (Annual average % per annum)

State	Crops	Livestock	Forestry and Logging	Fishing and Aquaculture	Agriculture Forestry and Fishing
Andhra Pradesh	14.09	15.89	9.20	24.14	15.74
Madhya Pradesh	10.20	18.75	-0.95	13.11	10.11
Odisha	9.11	2.67	0.87	7.95	6.88
Chhattisgarh	7.75	3.01	0.02	7.90	6.18
Jharkhand	4.86	0.44	0.85	5.14	3.23
Assam	3.95	-0.01	-3.08	4.81	3.38
Gujarat	3.94	6.64	2.47	9.64	3.79
Karnataka	2.33	4.08	-2.35	4.66	2.29
Tamil Nadu	1.28	13.30	-3.15	3.33	4.89
Rajasthan	0.01	10.14	-0.44	15.92	2.68
Uttar Pradesh	-0.04	4.79	-1.95	4.78	1.08
Punjab	-0.87	3.97	-1.94	5.61	0.37
Telangana	-0.89	6.17	-0.56	11.11	1.88
Uttarakhand	-1.98	5.11	1.32	1.61	0.28
Maharashtra	-2.49	2.98	-3.77	3.32	-1.73
Haryana	-2.76	6.38	-2.79	1.74	0.13
Bihar	-2.99	8.06	1.60	11.73	0.36
Kerala	-5.21	4.05	-0.62	4.01	-1.79

The sub sectoral performance of agriculture and allied activities during the recent past has not been as spectacular as it looks at the aggregate especially the performance of crop sector. During 2011-12 to 2014-15,crop sector saw double digit growth in Andhra Pradesh and Madhya Pradesh and above 4 percent growth in Odisha, Chhattisgarh and Jharkhand (Table 1.4). However, a number of states experienced negative growth in crop sector which included Uttar Pradesh, Punjab, Telangana, Uttarakhand, Maharashtra, Haryana, Bihar and Kerala. Similarly, in forestry Andhra Pradesh observed 9 percent and Gujarat observed above 2 percent while Bihar and Uttrakhand had more than 1 percent growth while rest of the states had either nil or negative growth rate during the above mentioned period. All states observed positive growth rate in fishing while in livestock all but Assam observed positive growth rate. At the aggregate, the tempo of growth was positive except, Maharashtra and Kerala states.

Table 1.5: Percentage share in the total value of output from agriculture and allied sector (TE 2014-15)

State	Crops	Livestock	Forestry and Logging	Fishing and Aquaculture	Agriculture Forestry and Fishing
Madhya Pradesh	81.3	10.9	7.0	0.7	100.0
Assam	72.6	5.7	5.7	16.1	100.0
Gujarat	71.3	19.4	6.0	3.4	100.0
Karnataka	70.1	18.9	7.3	3.7	100.0
Odisha	68.7	13.1	11.2	7.1	100.0
Chhattisgarh	68.4	8.2	14.5	8.9	100.0
Maharashtra	67.5	20.7	9.7		100.0
Uttar Pradesh	67.1	25.0	6.3	1.6	100.0
Bihar	65.0	21.7	6.8	6.5	100.0
Punjab	62.9	27.6	8.6	0.8	100.0
Jharkhand	62.7	19.4	15.3	2.6	100.0
Rajasthan	60.2	28.5	11.0	0.3	100.0
Haryana	59.8	33.1	5.7	1.4	100.0
Telangana	57.8	35.9	3.2	3.1	100.0
Kerala	56.7	25.9	9.0	8.3	100.0
Uttarakhand	54.8	24.1	20.8	0.3	100.0
Tamil Nadu	54.2	37.1	3.8	4.9	100.0
Andhra Pradesh	53.9	28.9	2.9	14.3	100.0
All India	62.0	26.1	7.6	4.3	100.0

The states like Andhra Pradesh, Madhya Pradesh, Odisha, Chhattisgarh, Jharkhand, Assam and Gujarat which observed high growth rate in total agriculture sector also had high contribution in growth from both crop sector as well as either livestock or fishery sectors. The other states that had moderate growth in agriculture like Karnataka, Tamil Nadu and Rajasthan had low growth from crop sector but high growth from livestock and fishery sectors. Among the states that observed negative growth in crop sector, Bihar, Haryana, Uttarakhand, Telangana, Punjab and Uttar Pradesh observed very high growth either in livestock or fishery or both these sub sectors. However, despite high growth in other sub sectors the aggregate agriculture sector growth in these states mostly remained either negligible or negative. This explains high weight of crop sector in the contribution of agriculture in most of these states and thereby high importance of crop productivity for realising high growth in future in agriculture sector remains indispensable.

GROWTH TRENDS IN AREA, PRODUCTION AND PRODUCTIVITY

Indian agriculture has made great strides in providing food security for its people. The foodgrains production has increased from 130 million tonnes in 1980–81 to 272 million tonnes during 2016–17 (2nd revised estimates). However, production of foodgrains still remains subject of wide fluctuations. Good monsoon for almost a decade with few exceptions ensured that the country touched a new peak in foodgrains production in 2013-14 of 265 million tonnes. Abnormal monsoon in 2014-15 and 2015-16 once again led to some down fall in foodgrains production while riding on above normal monsoon during 2016-17 enabled the country to achieve above 270 million tonnes during the current year. Among different crops, the most inspiring increase appeared in the case of coarse cereals whose production increased from around 30 million tonnes in the mid-1990s to 40 million tonnes in 2007–08 and further to 44 million tonnes during the current year 2016-17. Among coarse cereals the stimulating increase occurred in the case of maize whose production increased from less than 10 million tonnes in the mid 1990s to more than 25 million tonnes at present. Production of pulses remained stagnant to around 14 to 15 million tonnes, the level India had achieved around the late 1980s or early 1990s. The stagnation in production forced the country to import huge amount of pulses. Special pulse programmes enabled the country to reach a new peak of 22 million tonnes during the current year. In the case of oilseeds, the new peak achieved in 2016-17 is 33.6 million tonnes, the previous being 24 million tonnes achieved in the mid 1990s as a result of Oilseeds Mission Programme.

Table 1.6 presents the trend growth rates in area, production, and yield of major crops for the country as a whole. It is evident from the statistics that foodgrains production increased at a rate of 3.2 percent in the 1980s, which decelerated to 1.6 percent in the 1990s but recuperated at 2.4 percent in the 2000s. Whereas growth in production was partly contributed by increase in area in the 1980s the growth in area under foodgrains was negative in the 1990s and almost negligible in the 2000s. Looking at yield, during all the

three and a half decades period growth in yield was above 2 percent per annum although yearly fluctuations were observed. The growth trends in individual cereals reveal that production growth rate came down from 3.6 percent in the 1980s to 2 percent in the 1990s and further to 1.9 percent in the 2000s in the case of rice and this was a result of decline in growth rate of yield in rice as area growth was only around half a percent throughout. In the case of wheat, growth in production remained around 3.5 percent in the 1980s and 1990s and it came down slightly to 2.5 percent per annum in the 2000s. Growth in production of wheat was contributed by rise in yield rate in the 1980s while area growth was the main contributor in the 1990s and 2000s. For kharif coarse cereals, area growth remained negative throughout the period while yield growth contributed 1.8 percent to the growth in production in the 2000s. Rabi coarse cereals on the other hand realized rapid growth of 3.8 percent in the 1990s and above 5.5 percent in 2000s owning to growth in yield rate by 3.4 and 6.2 percent, during the same period, respectively. Thus, among cereals, rabi coarse cereals contributed highest in the recuperation of production growth in foodgrains.

Table 1.6: Growth rate in area, yield and production of major crops at all India (exponential growth rate % per annum)

Name of the crop	Description	1980 to 1984	1995 to 2014	1980 to 1989	1990 to 1999	2000 to 2014
Paddy	Area	0.52	-0.02	0.41	0.68	0.05
	Yield	2.96	1.56	3.20	1.32	1.88
	Production	3.50	1.54	3.62	2.00	1.93
Wheat	Area	0.68	0.95	0.46	1.72	1.45
	Yield	3.02	0.96	3.11	1.82	1.10
	Production	3.72	1.91	3.57	3.57	2.57
Kharif Coarse Cereals	Area	-2.03	-1.16	-1.38	-2.75	-1.43
	Yield	2.47	2.72	1.96	1.93	3.3
	Production	0.39	1.53	0.55	-0.87	1.82
Rabi Coarse Cereals	Area	-1.30	-0.73	-1.14	0.43	-0.59
	Yield	2.14	4.66	0.43	3.37	6.1
	Production	0.81	3.89	-0.72	3.81	5.52
Kharif Pulses	Area	5.27	-0.57	8.08	-8.26	-0.25
	Yield	0.38	1.41	0.55	1.87	2.30
	Production	5.67	0.82	8.67	-6.55	2.05
Rabi Pulses	Area	2.53	0.57	4.32	-4.75	2.32
	Yield	1.38	1.31	1.13	1.68	1.86
	Production	3.95	1.90	5.50	-3.15	4.22

Name of the crop	Description	1980 to 1984	1995 to 2014	1980 to 1989	1990 to 1999	2000 to 2014
Total Foodgrains	Area	0.57	-0.04	1.08	-1.42	0.28
	Yield	2.50	1.80	2.11	3.07	2.08
	Production	3.08	1.75	3.21	1.60	2.37
Kharif Oilseeds	Area	3.4	1.3	2.9	0.7	1.8
	Yield	2.7	1.7	2.6	3.7	2.9
	Production	6.2	3.0	5.6	4.4	4.8
Rabi Oilseeds	Area	3.00	-1.00	1.74	-0.69	0.12
	Yield	2.91	2.18	3.43	-0.12	2.14
	Production	5.99	1.17	5.23	-0.81	2.27
Cotton	Area	-0.23	1.92	-1.26	2.71	3.51
	Yield	4.07	5.63	4.10	-0.40	7.54
	Production	3.82	7.66	2.79	2.30	11.31
Sugarcane	Area	1.91	1.22	1.46	1.67	1.46
	Yield	1.49	0.16	1.21	1.05	0.69
	Production	3.43	1.38	2.69	2.74	2.16
Jute & Mesta	Area	-1.98	-1.28	-2.87	0.67	-1.57
	Yield	1.06	0.56	0.11	1.45	0.17
	Production	3.10	1.86	3.07	0.78	1.77

Among pulses, kharif pulses saw a complete U turn in area from positive 8 percent growth rate in the 1980s to negative 8 percent growth rate in the 1990s and almost negligible growth in the 2000s. Led by area, production growth of kharif pulses also turned from positive 8.7 percent in the 1980s to negative 6.6 percent in the 1990s while there was some retrieval in the 2000s due to increase in yield rate. Rabi pulses also had similar experience of 5.5 percent growth in production in the 1980s to -3.2 percent growth in the 1990s and retrieval of 4.2 percent growth in 2000s which was contributed partly by increase in area and increase in yield rate possibly due to programmes like ISOPOM, NFSM pulses and so on. In the case of oilseeds, there was continuous above 4 percent increase in production of kharif oilseeds due to both rise in area as well yield rate while yield growth rate contributed increase in production of rabi oilseeds in the 1980s and 2000s whereas in the 1990s production growth was almost negligible. In the case of cotton, introduction of BT cotton led to double digit growth in production in the 2000s compared to less than 3 percent growth in production in the 1980s and 1990s. On the opposite without any such breakthrough in technology sugarcane experienced around 2 percent growth in the production in the entire decades of 1980s, 1990s and 2000s.

To comprehend state level picture in this section we explore the trends in production in

the major states for cereals, pulses, oilseeds, and other commercial crops. As already seen in the case of all India, mostly production trends were either declining or negative in the entire decade of 1990s and then there was resurgence in the post 2000s. We compare trends in production of various crops for 15 years beginning with 1980s and 2000s, i.e., the trend growth rates presented in the first column in Appendix Table 1.1A, viz., 1980-81 to 1994-95 with that of 2000-01 to 2014-15, the last column in the table. In other words we compare the growth trends in production in a decade and half when agriculture performance was at the peak with the decade and a half when the agriculture started recuperating. This comparison will reveal how picture of agriculture is changing in different states during the last 30-35 years.

Crop wise looking first at paddy, high growth (above 3 percent) was observed in Haryana, Punjab, West Bengal, Uttar Pradesh, Odisha, Madhya Pradesh and Tamil Nadu in the 1980s. The growth in production was above 3 percent only in Kerala, Madhya Pradesh and Haryana in the 2000s. On the overall growth in paddy production slowed down from 3.5 percent per annum in 1980-1994 to only 1.9 percent per annum during 2000-2014. In the case of wheat, above 3 percent growth was observed in Bihar, Haryana, Madhya Pradesh, Punjab, Rajasthan and Uttar Pradesh in the 1980s. In the 2000s, growth in wheat production moved to double digit in Gujarat, above 7 percent in Madhya Pradesh and above 3 percent in Maharashtra and Rajasthan. Overall growth in production declined from 3.7 percent in 1980-1994 to 2.6 percent in 2000-2014. In kharif coarse cereals, above 2 percent growth in production was observed only in Maharashtra and Rajasthan in the 1980s. Compared to this Tamil Nadu observed 7.8 percent growth in production, followed by Rajasthan, Karnataka and Bihar with growth performance above 3 percent during the 2000s. Consequently the overall growth in kharif coarse cereals increased from 0.4 percent during 1980-1994 to 1.8 percent in 2000-2014. Similar trends were observed for rabi coarse cereals whereby growth in production moved from Karnataka state in the 1980s to double digit growth in Gujarat, Tamil Nadu and Andhra Pradesh, above 7 percent growth in Rajasthan and above 3 percent growth in Haryana along with Karnataka in the 2000s. The overall growth rate in production was less than 1 percent in 1980-1994 that increased to 5.5 percent in 2000-2014. Thus, coarse cereals have provided a silver lining to agriculture growth during the last one and a half decade.

In the case of pulses, while there was some decline in growth rate of production of kharif pulses that was compensated by an increase in production growth in rabi pulses. Among states, Rajasthan, Maharashtra, Tamil Nadu, Gujarat and Andhra Pradesh observed above 5 percent growth in production in kharif pulses in the 1980s that could be maintained only in Rajasthan, Bihar and Madhya Pradesh in the 2000s. Similarly, in the case of rabi pulses high growth in production was observed in Andhra Pradesh, Maharashtra, Bihar, Madhya Pradesh and Uttar Pradesh in the 1980s which was maintained in the 2000s by high growth in Karnataka, Maharashtra, Odisha, Rajasthan and Madhya Praddsh. In oilseeds, the growth

momentum in production was led by Rajasthan, Maharashtra, Gujarat, Madhya Pradesh and Uttar Pradesh in the case of kharif oilseeds and Bihar, Madhya Pradesh, Rajasthan, Odisha and West Bengal in the case of rabi oilseeds. For cotton the emerging states were Gujarat, Madhya Pradesh, Andhra Pradesh, Karnataka and Maharashtra all with double digit growth in the period of 2000-2014, led by both increase in area as well as productivity due to the contribution of BT technology. In the case of sugarcane, only Bihar, Maharashtra and Karnataka observed high growth in the 2000s while in jute & mesta only Bihar observed above 4 percent growth in the production during the period of 2000-2014.

The points emerging from discussion in Chapter 1

1. The longer term growth in agriculture has been sustained while short term fluctuations are palpable.
2. Among sub sectors, animal husbandry and fishery given their past performance have comparatively high growth potential compared to crop husbandry and forestry, albeit renewed emphasis on agri-pastoral-farm forestry systems, i.e., fruit trees, shrubs, perennial grasses and small ruminants have the potential to revive the contribution of forestry sub sector.
3. The growth potential within crop sector lies more in horticulture and other high value commodities compared to traditional food grains sector.
4. Transformation of fibres highlights the importance of technology in crop sector for achieving high growth. The technology, especially the bio technology needs adoption in other possible crops like maize, canola, brinjal, mustard and so on, and new form of precision farming need adoption at a larger scale.
5. Huge potential for future growth in high value commodities, like fruits and vegetables, milk and meat products and fishery sector.
6. For achieving self-sufficiency in pulses and oilseeds, rabi pulses and kharif oilseeds have more potential in area and yield expansion and need to be fully utilised.

Policy Suggestions

- To balance labour productivity in agriculture (where almost 50 percent of the population is contributing less than 15 percent of output), there is dire need to strengthen linkages between agriculture and allied activities and rest of the economy through the development of rural non-agricultural enterprises, particularly agro processing sector and SMEs in peri-urban areas. This has to be top priority of the reform agenda for the future.

- Maintaining productivity growth to sustain the growth of food crops and other food products that form the main staples of the population is essential for more balanced growth. Policies should focus on measures that provide incentives for efficient utilisation of both capital investments as well as natural resources. Increasing productivity calls for

investments in technology, extension, research and logistics to raise output through efficient usage of natural resources and also minimising wastage. Technology needs to be brought in to the centre stage.

- Shift in consumer preferences and increasing numbers of the middle income class have altered the domestic demand for agricultural commodities and globalisation has connected Indian farmer as well as consumer to international markets. As a result, the demand for dairy products, meat and meat products, fruits and vegetables and their processed products is growing fast and will continue to do so in the future. To meet this growing demand and maintain competitiveness, more investments in the entire food chain that involves collection, grading, storage, packaging, and transport to help take produce from farms to markets and factories is the key to the future growth of the agricultural and allied sectors.

- The fragmentation of land holdings means that to achieve economies of scale, bulk-buying and sale of produce have become extremely important to generate more incomes. Therefore, large-scale retail and supermarket operations can lead to the development of necessary infrastructure that improves supply logistics and also help in dealing with price volatility through risk pooling. For the desired changes to take place there is a need to look beyond production and pay due attention to post-harvest supply chain which facilitates especially the small holders.

CHAPTER II

CHAPTER II

AGRICULTURE INPUT USAGE

Planning for food security is an important task that covers many subsectors of agriculture, faces many challenges and has many inspiring opportunities of success. Demand predictions relating to future requirements for human consumption have been detailed in Chapter 3. The existing agricultural development schemes and programmes are based on demand supply projections for crop husbandry and agricultural inputs made by the erstwhile Planning Commission under the 12th Five Year Plan. These projections are available only up to the terminal year of 12th Plan i.e., 2016-17. Now it has been decided to do away with 5 years plan. NITI Aayog has undertaken to develop a 15 year vision document for all important sectors of the economy. The agricultural developmental plans especially those oriented towards production of food commodities and related infrastructure are based on the demand and supply projections for the growing population and other uses. To impart proper planning for the future, it is important to have reliable projections, made by experts for demand and supply of agriculture including the critical inputs such as fertilizers, seeds, credit, and feed and fodder and others. It would be prudent to make projections for 2019-20, 2023-24 and 2032-33 which coincides the 3 years action plan, 7 years strategy and 15 year vision document being prepared by NITI Aayog. Apart from that, the prices of agricultural commodities such as pulses have fluctuated significantly in recent years causing much concern. Any intervention to moderate such fluctuation would critically depend on the estimates of demand, production and associated shortfall, if any, that has to be met through imports. Hence, for a sustainable planning for the commodities which are important for food and nutritional security, there is an urgent need to assess the projected/estimated demand and supply in short, medium term and long term.

This chapter presents demand-supply projections for major inputs, i.e., seed, fertilizer, credit and feed & fodder and other related inputs. The projections are based on the requirements of inputs as worked out by the concerned departments in the Ministry of Agriculture and Farmers' Welfare, Government of India. The forecasts are based on recommendations of the third sub-group on inputs headed by the Agriculture Commissioner Dr. S.K. Malhotra. In the following paragraphs, status of various inputs and future demand projections are discussed in details.

INVESTMENT

Investment grossly defined as capital formation is one of the basic requirement for the growth of any sector. Gross Capital Formation (GCF) in agriculture as a percentage of agriculture GDP is the true measure of growing capital formation in comparison to growth of output in agriculture sector. GCF in agriculture and allied sector as a percentage of agri-GDP averaged around 7 percent during the early 1950s that augmented to around 10 percent in the mid 1970s after which it followed a declining trend until the end of 1990s when it came down to around 8

percent. During this period not only public investment declined it set a waning path for the private investment as well. However, a reversal in the declining trend was achieved from early 2000s through the efforts of government schemes and programmes resulting in higher GCF contributed by both public as well as private investment. The percentage of GCF increased to 13.9 percent of agri-GDP during the 10th Plan (2002-07). It further increased to 18.5 percent of agri-GDP during the Eleventh Plan (2007-12). There has been some decline in GCF in the initial years of Twelfth Plan. Thus, as a percentage of agri-GDP, the GCF in agriculture has more than doubled during the last decade (Figure 2.1). The consequence of increase in agriculture investment has been the revival of agriculture growth from less than 3 percent in the Ninth and Tenth Plan to above 4 percent growth during the Eleventh Plan. However, recent decline is once again a cause of concern as it might slow down the growth process of agriculture sector.

While the GCF as a percentage of agri-GDP has improved substantially, there has not been a commensurate improvement in the rate of growth of the agriculture sector, although direct relationship between capital formation and growth has clearly been established. It has been discussed in literature that the expenditure on subsidies crowds out public investment in agriculture research, irrigation, rural roads and power. There is always a trade-off between allocating money through subsidies or by increasing investments. The investment option is much better than subsidies for sustaining long-term growth in agricultural production and also to reduce poverty faster (Chand and Kumar, 2004). The fertilizer subsidy has clearly distorted its consumption pattern, as there are clear indications that it has led to an imbalanced use of N, P and K in states like Punjab and Haryana and has also contributed to deteriorating soil conditions. Lower public investment due to more emphasis on provision of subsidy will only further deteriorate the quality of public services like uninterrupted power supply, in some cases involving macroeconomic inefficiencies such as private investment in diesel generating sets. This leads to under-utilization of power capacity due to poor distribution and maintenance.

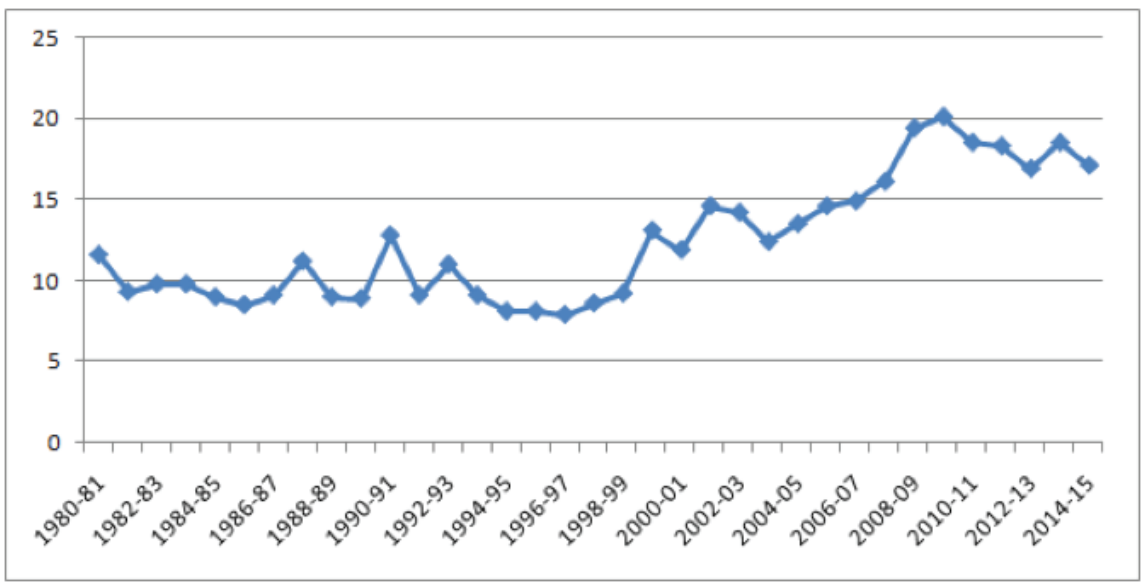


Figure 2.1: Gross Capital Formation Agriculture as a (%) of GDP Agriculture

Note: Figures up to 2010-11 are at 2004-05 prices and 2011-12 onwards at 2011-12 prices

Source: CSO.

It is interesting to note that while public investment in agriculture is critical and important, in actual terms, it forms less than 15 percent of the total investment in agriculture while more than 85 percent comes from the private sector (Table 2.1). In the early 1980s, the share of the public sector and private sector (including household sector) in gross capital formation in agriculture was roughly equal, but by the early 2000s, the share of the private sector was four times larger than the share of the public sector. Moreover, the private sector responds much better and faster to the incentive structures in agriculture. Hence, along with bringing in greater public investment in agriculture, there is a need for bringing in reforms in the incentive structure as well.

As two-thirds of capital formation in the private sector is through bank credit, the role of banks is important in meeting the private sector's long-term investment credit demand. However, the current estimates suggest that long-term credit is not just declining but also it constitutes less than a quarter of total agricultural credit. The policy thrust, therefore, has to be on incentivizing banks through adequate budgetary support. Similarly, reviving public sector investment is critical due to its multiplier effect on the overall GCF in the sector. Thus, there is a need to formulate a long-term perspective plan for rural infrastructure that focuses on infrastructural projects that have the highest total impact and strongest linkages. The convergence of resources of centre and state governments is also important, as it would avoid duplication or concentration of activities in particular areas.

Table 2.1: Public and Private Investment in Agriculture and Allied Sectors (Rs. Crore)

	Public	Private	Total	Public (YoY%)	Private (YoY%)	Total (YoY%)
2004 -05 prices						
2004 -05	16187 (21.3)	59909 (78.7)	76096 (100.0)	-	-	-
2005 -06	19940 (23.0)	66664 (77.0)	86604 (100.0)	23.2	11.3	13.8
2006 -07	22987 (25.0)	69070 (75.0)	92057 (100.0)	15.3	3.6	6.3
2007 -08	23257 (22.0)	82484 (78.0)	105741 (100.0)	1.2	19.4	14.9
2008 -09	20572 (16.2)	106555 (83.8)	127127 (100.0)	-11.5	29.2	20.2
2009 -10	22693 (17.0)	110469 (83.0)	133162 (100.0)	10.3	3.7	4.7
2010 -11	19854 (15.0)	112880 (85.0)	132734 (100.0)	-12.5	2.2	-0.3
2011 -12 prices						
2011 -12*	35715 (13.0)	238716 (87.0)	274431 (100.0)	-	-	-
2012 -13*	36078 (14.2)	217229 (85.8)	253307 (100.0)	1.0	-9.0	-7.7
2013 -14*	32472 (11.7)	244692 (88.3)	277164 (100.0)	-10.0	12.6	9.4
2014 -15#	36061 (14.1)	220434 (85.9)	256495 (100.0)	11.1	-9.9	-7.5

Source: Central Statistics Office (CSO).

#: 1st Revised Estimates (New Series). *: 2nd Revised Estimates (New Series).

Note: Figures in parentheses are percentage of total investment.

There is an emerging view that capital formation needs to be seen from two separate viewpoints, i.e., point of capital formation in agriculture and point of capital formation for agriculture. The estimates for capital formation as compiled by the CSO include only the capital formation in the agriculture sector by the public and private sectors. However, in order to have a comprehensive measure of capital formation in the sector, there is a need for a broader data series that includes capital formation in activities such as production of fertilizers and pesticides, development of agricultural markets, rural roads and communications, agricultural education, research and development of agricultural technology, rural electrification, etc., which form part of capital formation for agriculture as opposed to capital formation in agriculture (NABARD, 2014). Policies will need to take into account the complementarities between capital formation in agriculture and for agriculture to provide proper direction to investment in the sector.

SEEDS

For raising agricultural productivity, seed is the most critical input. Use of good quality seeds can enhance 15 to 20 percent productivity. Therefore, raising yield rate in agriculture largely depends on higher replacement rate of quality seeds of high yielding varieties/hybrids. Hence, increasing demand for food with rising population would demand much faster growth of seed sector, especially to meet the demand of hybrid seeds and to replace old with new high yielding varieties. The Indian Seed Programme occupies a pivotal place in Indian agriculture and is well poised for continued growth in the years to come.

India's Seed Programme has a strong seed production base in terms of diverse and ideal agro-climates spread throughout the country for producing high quality seeds of several tropical, temperate and sub-tropical plant varieties in enough quantities at competitive prices. Over the years, several seed crop zones have evolved with extreme levels of specialization. Similarly, for post harvest handling, the Indian seed processing/conditioning industry has perfected the techniques of quality up-gradation and maintenance to ensure high standards of physical condition and quality. By virtue of the diverse agro-climates several geographical zones in the country have emerged as ideal seed storage locations under ambient conditions. In terms of seed marketing and distribution, more than about 20,000 seed dealers and distributors are in the business. As the private sector has not been enthusiastic about entering into seed production of high volume low margin crops of wheat, paddy, other cereals, oilseeds and pulses, the public sector seed corporations will continue to remain dominant in cereals, pulses and oilseeds for many more years to come.

Thus, Indian Seed Improvement Programme is backed up by a strong crop improvement programme in both the public and private sectors. The private sector has started to play a significant role in the seed industry over the last few years. However, the main focus of

private seed companies has been on the high value low volume seeds. Private sector companies have a significant place mainly in the case of maize, sunflower and cotton. In the case of vegetable seeds and planting materials of horticultural crops, the private sector is the dominant player. The private sector has also started to play an important role in the supply of quality seeds of vegetables and crops like hybrid maize, sorghum, bajra, cotton, castor, sunflower, paddy etc. The progress of production and distribution of certified seeds, requirement and availability of quality seeds and share of public and private sectors during the recent decades is briefed in Tables 2.2 to 2.4.

Table 2.2: Production and Distribution of Certified Seeds in India

Year	Production of Breeder Seed (000 tonnes)	Production of Foundation Seed (000 tonnes)	Distribution of Certified/Quality Seed (000 tonnes)
1991 - 92	3.5	37.5	575
2001 - 02	4.6	54.4	918
2011 - 12	12.3	222.7	3536
2012 - 13	11.0	161.7	3286
2013 - 14	8.2	174.3	3473
2014 - 15	8.6	157.6	3518
2015 - 16	8.6	149.5	3435
2016 - 17	11.2	220.9	3803
CAGR			
1991 - 2004	1.05	1.04	1.05
2005 - 2016	1.02	1.10	1.09
1991 - 2016	1.06	1.07	1.09

Source: Ministry of Agriculture and Farmers Welfare, Govt. of India

Table 2.3: Year-wise requirement and availability of quality seeds (in lakh quintals)

Year	Requirement	Availability
2004-05	110.83	132.27
2005-06	107.08	140.51
2006-07	128.76	148.18
2007-08	180.74	194.31
2008-09	207.28	250.35
2009-10	249.12	279.72
2010-11	290.76	321.36
2011-12	330.41	353.62

Source: Directorate of Economics & Statistics, Ministry of Agriculture, GOI
(http://dacnet.nic.in/eands)

Table 2.4: Total seed production by the public and private sectors

Public	Total Seed Production (lakh qtls)	Share of private sector (%)	Quantity of seed produced by private sector (lakh qtls)	Quantity of seed produced by public sector (lakh qtls)
2003 - 04	132.27	47.48	62.8 0	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: Singh, Harbir and Ramesh Chand (2011) Seeds Division, Department of Agriculture & Cooperation, Ministry of Agriculture.

Seed Replacement Rate (SRR) or Seed Replacement Ratio is a measure of how much of the total cropped area was sown with certified seeds in comparison to farm saved seeds. Since certified seeds are better in productivity, the SRR is directly proportional to productivity. However, the replacement rate in most of the field crops in India is much below the optimum level (Singh and Chand, 2011). Due to huge demand supply gap, India suffers from a dismal seed replacement ratio. Currently, only around 15 percent of India's total cropped area is planted with freshly obtained quality seeds every year. A huge 85 percent area is sown with farm saved seeds. This ratio varies from crop to crop between 7 percent in staple crops to maximum 70 percent in some vegetables and fruits. For wheat and rice, it is between 9 to 18 percent. Seeds are available for fruits, vegetables, flowers and high value / costly seed crops but not enough seeds are supplied in the case of low value and high volume crops such as rice and wheat. For oilseeds and pulses; this ratio lies between 20-100 percent and for some crops such as hybrid cotton, the ratio might be 100 percent. Without achieving the optimal seed replacement ration, any efforts to get expected yields will be futile.

For achieving the desired levels of SRR, adequate seeds of good variety need to be produced first. Each state needs to prepare a State Seed Plan to meet the region specific requirements. The list of recommended varieties must be revisited and finalized in consultation with the scientists of the State Agriculture University, ICAR Institutes in that region, Crop-Coordinators, State Agriculture Department officials and the seed producing agencies. In last two decades the ICAR institutes and SAUs have made significant progress in meeting fully the breeder seed (BS) requirement. In less than a decade, even the breeder seed production has been doubled from 62231 quintals (2005-06) to 122633 quintals (2010-11). However, production of certified seed by following an efficient chain is still a major concern. States must ensure production, multiplication and replacement of seed to increase the SRR progressively, especially in respect of regionally important varieties.

Table 2.5: Seed replacement rate in India (%)

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	CAGR
Wheat	13.04	13.00	13.00	16.48	17.64	21.76	25.23	26.84	31.86	32.63	32.55	1.12
Paddy	19.22	19.31	19.16	16.27	21.33	22.41	25.87	30.05	33.6	37.47	40.42	1.09
Maize	20.98	21.35	24.41	31.5	35.39	43.78	44.24	48.48	46.85	54.09	56.58	1.12
Jowar	18.36	18.78	26.71	19.28	19.03	19.37	19.87	26.16	26.34	25.86	23.85	1.03
Bajra	45.92	48.47	51.02	44.9	55.36	55.1	48.47	62.92	48.85	61.43	60.4	1.03
Gram	4.17	4.23	7.09	9.87	9.41	9.04	11.90	14.38	21.97	18.38	19.35	1.20
Urd	16.55	17.06	20.48	17.24	15.70	13.65	23.89	26.31	30.91	29.19	34.41	1.08
Moong	13.47	13.8	19.48	12.34	12.50	19.97	21.75	21.94	23.01	26.68	30.29	1.09
Arhar	8.71	8.84	13.6	9.80	10.48	11.56	16.05	16.02	27.79	17.51	22.16	1.11
G.Nut	5.20	5.50	11.00	7.11	6.89	9.79	14.29	17.04	22.95	24.50	22.51	1.20
R/M	38.39	44.64	66.96	58.48	55.36	60.71	58.62	52.67	74.8	63.64	78.88	1.05
Soyabean	12.44	12.45	15.58	27.00	28.88	28.4	33.39	35.12	38.95	35.85	52.75	1.15
Sunflower	13.73	15.69	19.61	60.15	67.67	66.92	62.88	43.64	51.46	61.2	32.47	1.12
Cotton	21.21	21.86	19.84	20.73	21.78	19.84	15.3	12.07	11.65	10.43	33/100	0.96
Jute	28.77	30.14	27.4	26.03	26.03	35.62	32.88	35.4	33.29	35.94	42.41	1.04

Source: http://seednet.gov.in/Material/IndianSeedSector.htm; Downloaded on 27th July 2017.

Also, as a social commitment, the seed producing companies have to come forward to include some low-profit crops in their baskets in the interest of small/resource poor farmers. In this context, an effective partnership between public and private seed organizations will be highly desirable. Even emerging concept of contract farming through Public-Private-Partnership will be highly beneficial. The state departments may consider procuring quality seeds of improved crop varieties through a Contract Seed Production system by allotting the same, as per their requirements, to the public or private sector companies. This will ensure timely availability of sufficient quantities of seed of the desired (new improved) varieties. A fair competition will keep the rates reasonable, whereas by participating in such activities the private sector can contribute towards their social responsibilities. A joint committee comprising representatives from the ICAR institutes, SAUs from the region, seed sector representatives and farmers' groups may prefer varieties at least 2-3 years in advance. The State Governments may also consider an option of Contract Seed Production by advance indenting of the seed of desired improved varieties/hybrids to both public/private sector seed companies. Current practice of procurement of seed on tender basis has to be discouraged. Out-scaling innovation and adoption of cutting edge technologies, such as biotechnology and nano-technology, would be critical for desired impact on livelihood of resource poor small holder farmers. For this role of seed sector is indeed important and must be appreciated. The seed sector could also consider joining hands with other players in the agri-input sector not only for improved efficiency but also for serving better the farmers' interests. Partnership between the public research institutions and private sectors are also desired in establishing Technology Parks in different regions to out-scale innovation and disseminate technologies for the benefit of farmers. It will go a long way if government also extends the benefit of subsidy to truthfully

labelled seed of promising hybrids produced by the private sector. Sharing of germplasm is imperative for crop improvement. However, while the national repository makes available the germplasm to the researchers and national seed companies, the private sector must also come forward and share their valuable germplasm with the public sector institutions for research purpose. Also these need to be stored in the Gene Bank for posterity. The partnership between the Public institutions and the Private sector needs to go beyond mere commercialization of varieties, such as evaluation of germplasm and development of varieties with biotic and abiotic stress tolerance and desired quality traits. The Indian seed sector today is well established with tremendous potential to grow beyond boundaries of domestic market. We must be proactive to explore export potential and create enabling environment. This can be achieved through a well planned strategy and targeted implementation plan.

A new dimension for seed industry has been added for organic production of crops. While there is a need for breeding suitable cultivars and planting materials for organic farming, there is also a need for suitable package of practices for seed and planting material production. Considerable value-addition to varieties of seeds is possible through maintenance breeding, seed priming, seed invigoration, seed coating and seed pelleting. The whole range of production and availability of quality seed and planting material require a vibrant Public-Private-Partnership, nurtured and supported through suitable agreements, contracts and sharing of resources. Such alliances should come into existence in the very near future. The seed production and availability of different crops must be governed through appropriate quality standards and certification practices so that stakeholders along the value-chain are benefited.

SEED DEMAND PROJECTIONS

There are some major changes in inputs markets for agriculture especially rising share of purchased inputs in the cost of cultivation. Seeds, fertilizers, pesticides, farm machinery form larger share of the total cost. Traditionally 12.5 percent of total production of grain meant for seeds. Over a period of time seeds demand have increased. In particular, there is tremendous growth in the use of quality seed since the mid 2000s. A lot of focus on multiple plantations is coming with a view to double the farmers' income. It is important to note that seed is a main factor behind the growth in food production during green revolution. The high yielding variety area has grown very rapidly at 6.33 percent per year since the green revolution, rising from 6.05 million hectares in 1967/68 to 76 million hectares in 1999/2000. This growth has however slowed down to 2.4 percent per year in the last decade. The data on production of different categories of seed during the period 2005-06 to 2015-16 indicated negative trend for breeder and foundation seed production (Table 2.2). While breeder seed production has declined sharply since 2011-12 by 80 percent, the decline in

foundation seed has been much sharper at 87 percent and the certified seed production at -60 percent. However, Distribution of certified seed has seen an impressive growth during last decade. The growth in distribution of certified seed was 10 percent in wheat, 11 percent in maize, 9 percent in oilseeds and 13 percent per annum in pulses. This is obvious from the data that positive growth in productivity could be achieved due to better growth in seed availability and its distribution. However, the flip side of this is decline in the breeder seed production which indicates that the availability of new variety seeds in near future will be restricted that can also affect the growth in productivity. Following strategy is needed in seed sector (i) Enhancing the yield, bringing more area under high yielding new varieties and hybrids would be helpful (ii) Substantial increases in the yield potential of different food crops need to be achieved through intensive research in terms of using the latest bio-technology iii) There is some restrictions on biotechnological application which should be relaxed iv) Development of seed infrastructure need to be given importance. Given the increasing requirement for seed, the working group proposed to increase the traditional 12.5 percent of total production of grain meant for seeds to 20 percent especially for self pollinated crops in the country. The remaining requirement of seed to sow the 80 percent area is met through the farmers' saved seeds, which often is degenerated and poor in vigor. This is adversely affecting crop productivity as the potential of a crop variety is not being exploited. Though the situation is likely to improve gradually, a large area of crops continues to be sown with farmers' saved seeds.

Table 2.6a: Breeder Seed Requirement as per actual SRR and in 5% & 10% increment from actual SRR

Crops	Area (mha)	Seed rate (kg/ha)	SMR	Actual SRR (%)	Breeder Seed Requirement (q)			
					Actual SRR	Scenario 2023-24 (5% increment from actual SRR)	Scenario 2032-33 (10% increment from actual SRR)	Ideal SRR
Crops with SRR data available @ national level								
Paddy	44.08	30.00	80.00	40.40	834.77	938.08	1041.39	723.19
Wheat	32.52	100.00	20.00	32.60	26503.80	30568.80	34633.80	28455.00
Maize	9.08	20.00	80.00	56.60	160.60	174.79	188.98	141.88
Pearlmillet	9.55	5.00	200.00	60.40	7.21	7.81	8.40	5.97
Sorghum	8.30	12.00	100.00	30.16	30.04	35.02	40.00	49.80
Chickpea	9.60	58.00	15.00	19.40	4800.85	6038.19	7275.52	8661.33
Pigeonpea	3.73	10.00	100.00	22.20	8.28	10.15	12.01	13.06
Mung	3.73	15.00	40.00	30.30	105.96	123.44	140.92	122.39
Urd	3.19	12.50	40.00	34.40	85.73	98.19	110.65	87.23
Soybean	12.00	62.50	16.00	52.80	15468.75	16933.59	18398.44	10253.91
Sunflower	1.91	20.00	50.00	43.64	66.68	74.32	81.96	76.40
Groundnut	6.29	100.00	8.00	22.50	22113.28	27027.34	31941.41	34398.44
R& Mustard	2.21	5.00	100.00	78.90	8.72	9.27	9.82	5.53
Total					70194.67	82038.99	93883.31	82994.11

Area: Indiastat- Avg. of recent three years (mha) and Internet sources
Seed Rate & SMR: Seednet database
Actual SRR: Seednet database (Avg. of recent three years- 2009,-10, 2010-11 and 2011-12)
Ideal SRR is 35% in Self pollinated crops and 50% in cross pollinated crops
Assumption:
Area will remain same or otherwise the assessed requirements should be considered with upper and lower tail (+/-) of 10 %.
BS-FS-CS conversion @ 100%

Table 2.6b: Breeder Seed Requirement as per ideal SRR and in 5% & 10% increment from ideal SRR

Crops	Area (mha)	Seed rate (kg/ha)	SMR	Ideal SRR (%)	Breeder Seed Requirement (q)		
					ideal SRR	5% increment from ideal SRR	10% increment from ideal SRR
Cereal Crops							
Paddy	44.08	30.00	80.00	35.00	723.19	826.50	929.81
Wheat	31.98	100.00	20.00	35.00	28455.00	32520.00	36585.00
Maize	9.08	20.00	80.00	50.00	141.88	156.06	170.25
Barley	0.60	100.00	15.00	35.00	933.33	1066.67	1200.00
Pearl millet	9.55	5.00	200.00	50.00	5.97	6.57	7.16
Sorghum	8.30	12.00	100.00	50.00	49.80	54.78	59.76
Pulse Crops							
Chickpea	9.60	58.00	15.00	35.00	8661.33	9898.67	11136.00
Pigeon pea	3.73	10.00	100.00	35.00	13.06	14.92	16.79
Mung	3.73	15.00	40.00	35.00	122.39	139.88	157.36
Urd	3.19	12.50	40.00	35.00	87.23	99.69	112.15
Field Pea	0.72	100.00	10.00	35.00	2520.00	2880.00	3240.00
Lentil	1.31	25.00	10.00	35.00	1146.25	1310.00	1473.75
Cowpea	0.15	12.50	40.00	35.00	4.10	4.69	5.27
Oilseed Crops							
Soybean	12.00	62.50	16.00	35.00	10253.91	11718.75	13183.59
Sunflower	1.91	20.00	50.00	50.00	76.40	84.04	91.68
Groundnut	6.29	100.00	8.00	35.00	34398.44	39312.50	44226.56
R& Mustard	2.21	5.00	100.00	50.00	5.53	6.08	6.63
Safflower	0.32	12.00	60.00	50.00	5.33	5.87	6.40
Sesame	1.80	5.00	250.00	35.00	0.50	0.58	0.65
Niger	0.41	5.00	50.00	50.00	4.10	4.51	4.92
Castor	0.79	5.00	60.00	50.00	5.49	6.03	6.58
Fibre Crops							
Cotton	14.00	12.50	50.00	35.00	245.53	280.60	315.68
Jute	0.81	5.00	100.00	35.00	1.42	1.62	1.82
Sun hemp	0.03	15.00	30.00	35.00	1.75	2.00	2.25
Mesta	0.15	12.50	40.00	35.00	4.10	4.69	5.27
Forage Crops							
Fodder Maize	0.36	25.00	80.00	50.00	7.03	7.73	8.44
Fodder Sorghum	0.18	20.00	100.00	50.00	1.80	1.98	2.16
Fodder Pearl millet	1.01	5.00	200.00	50.00	0.63	0.69	0.76
Total					87875.47	100416.08	112956.69

Area: Indiastat- Avg. of recent three years (mha) and Internet sources, Seed Rate & SMR: Seednet database, Actual SRR: Seednet database (Avg. of recent three years- 2009-10, 2010-11 and 2011-12), Ideal SRR is 35% in Self pollinated crops and 50% in cross pollinated crops

Assumption: Area will remain same or otherwise assessed requirements should be considered with upper & lower tail (+/-) of 10 %.BS-FS-CS conversion@100%

Table 2.6c: Breeder Seed Requirement (q) based on growth trends in cultivated area (mha) at all India

A. Exponential growth rate of past 10 years																
	Rice				Wheat				Cotton				Jute & Mesta			
	Area	BS requirement			Area	BS requirement			Area	BS requirement			Area	BS requirement		
		ideal SRR	5% increment from ideal SRR	10% increment from ideal SRR		ideal SRR	5% increment from ideal SRR	10% increment from ideal SRR		ideal SRR	5% increment from ideal SRR	10% increment from ideal SRR		ideal SRR	5% increment from ideal SRR	10% increment from ideal SRR
2015	44.08	723.19	826.50	929.81	31.99	27991.25	31990.00	35988.75	13.41	234.68	268.20	301.73	0.80	1.40	1.60	1.80
2016	44.08	722.86	826.13	929.39	32.52	28455.00	32520.00	36585.00	14.03	245.53	280.60	315.68	0.79	1.38	1.58	1.78
2017	44.04	722.53	825.75	928.97	33.06	28927.50	33060.00	37192.50	14.68	256.90	293.60	330.30	0.78	1.37	1.56	1.76
2020	43.98	721.55	824.63	927.70	34.74	30397.50	34740.00	39082.50	16.82	294.35	336.40	378.45	0.75	1.31	1.50	1.69
2021	43.96	721.22	824.25	927.28	35.32	30905.00	35320.00	39735.00	17.60	308.00	352.00	396.00	0.74	1.30	1.48	1.67
2028	43.83	719.09	821.81	924.54	39.65	34693.75	39650.00	44606.25	24.17	422.98	483.40	543.83	0.67	1.17	1.34	1.51
2029	43.81	718.76	821.44	924.12	40.31	35271.25	40310.00	45348.75	25.29	442.58	505.80	569.03	0.66	1.16	1.32	1.49
2032	43.75	717.77	820.31	922.85	42.36	37065.00	42360.00	47655.00	28.97	506.98	579.40	651.83	0.63	1.10	1.26	1.42
B. Exponential growth rate of past 15 years																
	Rice				Wheat				Cotton				Jute & Mesta			
	Area	BS requirement			Area	BS requirement			Area	BS requirement			Area	BS requirement		
		ideal SRR	5% increment from ideal SRR	10% increment from ideal SRR		ideal SRR	5% increment from ideal SRR	10% increment from ideal SRR		ideal SRR	5% increment from ideal SRR	10% increment from ideal SRR		ideal SRR	5% increment from ideal SRR	10% increment from ideal SRR
2015	44.13	724.01	827.44	930.87	31.92	27930.00	31920.00	673312.50	13.27	232.23	265.40	298.58	0.80	1.40	1.60	1.80
2016	44.16	724.50	828.00	931.50	32.39	28341.25	32390.00	683226.56	13.73	240.28	274.60	308.93	0.78	1.37	1.56	1.76
2017	44.19	724.99	828.56	932.13	32.86	28752.50	32860.00	693140.63	14.22	248.85	284.40	319.95	0.77	1.35	1.54	1.73
2020	44.29	726.63	830.44	934.24	34.32	30030.00	34320.00	723937.50	15.77	275.98	315.40	354.83	0.74	1.30	1.48	1.67
2021	44.32	727.13	831.00	934.88	34.81	30458.75	34810.00	734273.44	16.32	285.60	326.40	367.20	0.72	1.26	1.44	1.62
2028	44.54	730.73	835.13	939.52	38.52	33705.00	38520.00	812531.25	20.78	363.65	415.60	467.55	0.65	1.14	1.30	1.46
2029	44.57	731.23	835.69	940.15	39.08	34195.00	39080.00	824343.75	21.51	376.43	430.20	483.98	0.64	1.12	1.28	1.44
2032	44.67	732.87	837.56	942.26	40.81	35708.75	40810.00	860835.94	23.85	417.38	477.00	536.63	0.61	1.07	1.22	1.37

Ideal SRR is 35% in Self-pollinated crops and 50% in cross pollinated crops
Assumption: Area will remain same or otherwise the assessed requirements should be considered with upper and lower tail (+/-) of 10 %.

FERTILIZER

To meet the growing demand for agricultural products, it is necessary to increase productivity of available land through proper planning and optimum utilization of resources such as fertilizers, seeds, water, etc. Balanced fertilizer use is essential for raising agricultural productivity. Though there has been substantial increase in production and consumption of fertilizer over the years, nutrient response ratio is not so encouraging in our country mainly due to imbalanced use of fertilizer and lack of use of micro and secondary nutrients. Although India has diverse types of soil but most of them are deficient in nitrogen and phosphorus. Over the years, the increased usage of chemical fertilizers has played a significant role in increasing the farm productivity. However, the current trends show that the marginal productivity of soil in relation to the application of fertilizers is declining. The key reason to this is a comparatively higher usage of the straight fertilizers (Urea, DAP & MOP) in comparison to complex fertilizers (NPKs); and either low or non usage of secondary and micro nutrients.

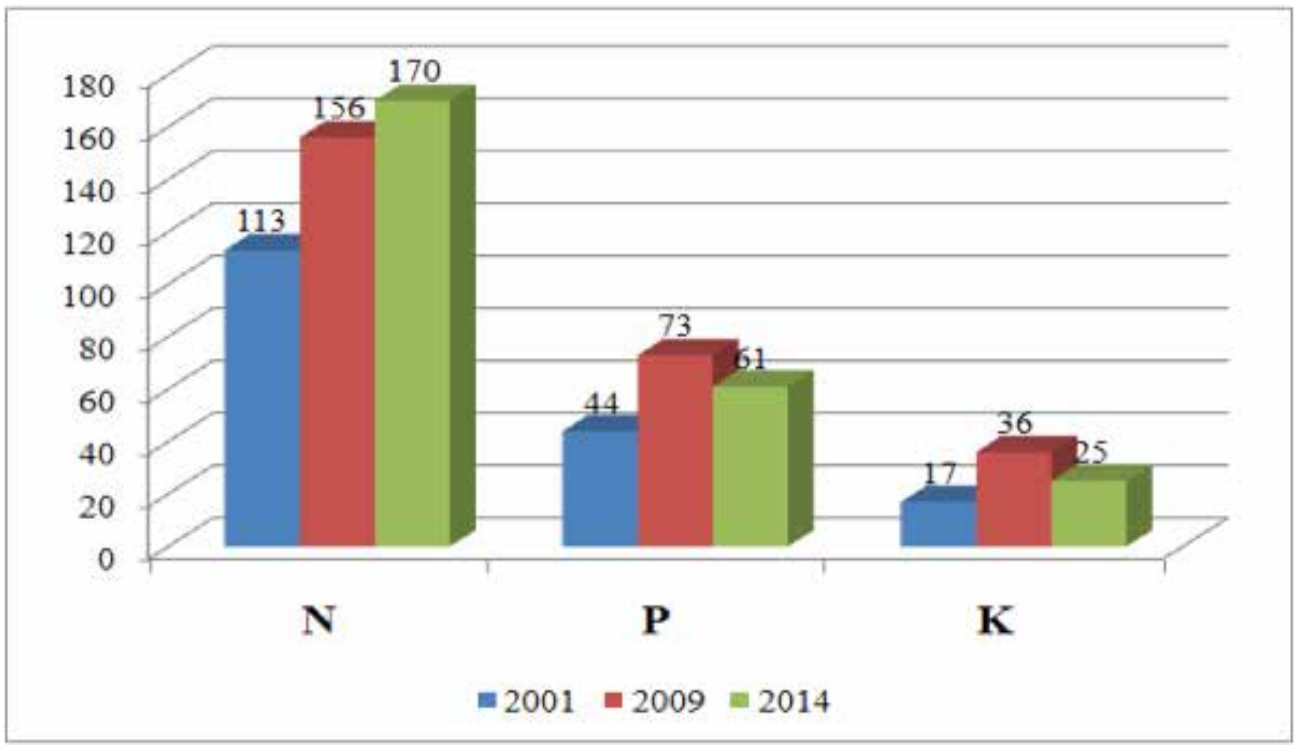
The average consumption of fertilizers increased from 69.84 kg per ha in 1991-92 to 128.08 kg per ha in 2014-15. There is, however, wide inter-state variability in consumption of fertilizers, with states like Punjab, Haryana and Andhra Pradesh having per hectare consumption of over 200 kg and other states, like Odisha, Kerala, Madhya Pradesh, Jharkhand, Chhattisgarh and Rajasthan, reporting less than 100 kg per hectare consumption. The average consumption per hectare of arable land in India (151 kg in 2012) is far less in comparison to some of the other high consumption countries such as Egypt (369 kg), Chile (272 kg), China (439 kg), South Korea (275 kg), Japan (231 kg), Malaysia (293 kg), Vietnam (244 kg), Belarus (266 kg), Netherlands (235 kg) and UK (234 kg). The main reason of low per hectare consumption of chemical fertilizers is absence of assured water supply. Assured water supply is precondition for the usage of chemical fertilizers. Since most of the cultivated areas in India are rainfed; they consume only 20 percent of the total fertilizers. India is deficient in primary sources of fertilizer inputs (such as natural gas, rock phosphate, potash), it has sizeable import dependence for the intermediates like phosphoric acid and ammonia.

Table 2.7: Consumption of Fertilizers (NPK Nutrients, lakh tonnes)

Details	1991-92	2000-01	2012-13	2013-14	2014-15
Nitrogenous (N)	80.46	109.2	168.21	167.5	169.46
Phosphate (P)	33.21	42.15	66.53	56.33	60.98
Potash (K)	13.61	15.67	20.62	20.99	25.32
Total (N+P+K)	127.28	167.02	255.36	244.82	255.76
Consumption of Fertilizer (Kg per ha)	69.84	89.63	131.36	118.55	128.08

The nitrification process is necessary for making nitrogen available to plants. However, if the process of nitrification is too rapid; nitrogen will escape to atmosphere and plants will not be able to recover it from Urea efficiently. Generally, the plants are able to recover a fraction of all Urea N and this fraction is known as Nitrogen Use Efficiency (NUE). The NUE stands between 30 to 50 percent. Thus, almost two third of Urea Nitrogen escapes from the soil and is not used by the plants. Further, faster conversion of nitrate into Urea also results in accumulation of nitrates in soil/underground water. Once nitrate reaches underground water, it is most difficult to remove; and causes diseases such as blue baby syndrome. This implies that there is a need to regulate the urea hydrolysis and nitrification. This is done by some chemical/natural agents called Nitrification inhibitors. However, most of the nitrification inhibitors are costly chemicals (examples nitrapyrin, dicyandiamide and ammonium thiosulphate) beyond reach of Indian farmers. Coating Urea with Neem oil or Neem cake has been proved to be an effective natural alternative to these chemicals. It has been scientifically established that Neem oil serves as an effective inhibitor if coated on Urea. There are many benefits of this process such as: Neem coating leads to more gradual release of urea, helping plants gain more nutrient and resulting in higher yields; Lower underground water contamination due to leaching of urea; Neem serves as a natural insecticide; Neem-coating helps to check heavily subsidized urea's pilferage to chemical industry and other uses such as making of adulterated milk. Given these advantages, Government has mandated all indigenous producers of Urea to produce 100 percent of urea as Neem coated urea only.

The ideal NPK (nitrogen, phosphorous, potassium) proportion for the Indian soil is 4:2:1. Though this proportions vary from place to place and region to region depending upon the rainfall and temperature. The green revolution featured use of chemical fertilizer as a prerequisite of increasing the yield of the production. The beneficiary state including Punjab, Haryana, Uttar Pradesh and others saw a rise in fertilizer use. Mindless use of disproportionate fertilizer ratio in the soil, rendering soil in many areas unfit for cultivation. The ratio of NPK in Punjab and Haryana was 19.2:5.5:1 and 20.6:6:1, respectively in 2011. After the introduction of the NBS Policy, there has been a large increase in the prices of P and K fertilizers due to an increase in the international prices of these products and raw materials, but the price of urea has remained stagnant at Rs 5,360 per metric tonne. This disparity in the prices of urea and P and K fertilizers led to a distortion in the consumption pattern of NPK fertilizers. Between 2001-02 and 2009-10, consumption of N had increased by 38 percent, that of P by 66 percent and K by 118 percent. After the Nutrient Based Subsidy (NBS) Policy came into effect, between 2009-10 and 2014-15 of N increased by just 9 percent, consumption of P and K fell by 16 percent and 30 percent, respectively (Figure 2.2). Thus, while the NBS Policy may have reduced injudicious use, it has actually worsened the nutrient balance, as farmers have reduced the use of P and K, which are essential to soil and plant health.



Source: Department of Agriculture, Cooperation and Farmers Welfare

Figure 2.2: Consumption of Fertilizers (lakh tonnes)

In order to address the issue of price disparity, improvement in fertilizer policy is a must. Balanced use of organic and inorganic fertilizers has a direct impact on soil fertility. Present policy may be revisited to promote both inorganic and organic fertilizers. Efforts may be made to move towards direct cash transfer on unit area basis so that farmers are free to choose between chemical fertilizers and organic fertilizers on their own as per soil health status/fertility. Gradual and reasonable increase in price of urea along with its inclusion under Nutrient Based Subsidy (NBS) scheme is a desirable policy option. Nutrient use efficiency varies from fertilizer to fertilizer even nutrient use efficiency of a similar kind of fertilizer may vary depending upon its composition/coating and form (granulated/ powdered). At present subsidy is given on fertilizers depending upon the content of nutrients in the fertilizer. The present subsidy regime does not take in to account the nutrient use efficiency of the fertilizer due to which, there seems to be no initiative on part of industry on research and development of new efficient/better products. The ambit of NBS scheme may be made broader to consider nutrient use efficiency of fertilizers so that the focus is on efficient uptake of nutrients by the plants. Water-soluble fertilizers need to be promoted by bringing them under subsidy regime.

FERTILIZER DEMAND PROJECTIONS

Fertilizers have contributed enormously to the growth of food production and its use has increased from a mere 1.5 million tons in 1967/68 to 17.38 million tons in 2001/02. This amounts to a growth rate of 7.6 percent per year which has reduced to 5.5 percent during

the period 2001/02 to 2010/11. The situation became alarming in subsequent years with growth in fertilizer use turning to negative in all the major nutrients except nitrogen. Even in nitrogen also the growth is less than 1 percent per year. The paradox is that even with reducing fertilizer use, the production has been rising. However, this may be a temporary phenomenon and needs serious relook in view of the average fertilizer application rates for many crops are still substantially lower than those seen in many Asian and other developing countries as mentioned above. The increase in food production will certainly require substantial increase in the fertilizer use. However, managing soil fertility for raising yields has become more complex because of the emergence of various deficiencies and other soil issues. Increased use of fertilizer will need to be accompanied by more balanced and efficient fertilizer use, the use of organic manure, and other measures to optimize the soil environment. On the basis of information supplied to a parliament question, the demand projections of Fertilizers are given below:

Table 2.8: All India Demand Projections of Fertilizer 2015-16 to 2019-20 (Lakh ton)

Year	Urea	DAP	NP/NPKs	MOP*
2015-16	328.58	122.12	111.42	46.43
2016-17	336.77	124.13	114.20	47.93
2017-18	337.54	127.64	118.41	49.34
2018-19	345.36	129.50	123.18	50.48
2019-20	353.07	130.14	127.99	50.86

The gap between demand and indigenous production is fulfilled through import. The cost of imported fertilizers is nearly same as that of domestic production. The available information on fertilizer consumption as given in Table 2.7 is reproduced with their decadal growth rates in Table 2.9 below:

Table 2.9: Fertilizer consumption[1] (in nutrients '000 tons)

Year	N	P_2O_5	K_2O	Total	Kg/ha
2001/02	11310.2	4382.4	1667.1	17359.7	96.0
2010/11	16558.2	8049.7	3514.3	28122.2	142.3
2013/14	16945.4	6098.4	2532.30	25576.1	128.08
Annual Growth Rates					
2001/02-2010/11	4.33	6.99	8.64	5.51	4.47
2010/11-2014/15	0.77	-8.84	-10.35	-3.11	-3.45

[1] Data extracted from different issues of Agricultural Statistics at a Glance and Fertilizer Association of India Issues.

The increase in food production cannot be achieved without providing for and maintaining soil fertility. It is envisaged that given the scarcity of organic materials, this will need to be achieved mainly through a substantial increase in the fertilizer use levels. The food grain production target of 318 million tons will require an addition of 66 million tons. Assuming a response ratio of 7[2] which is optimistic for the future and that 75 percent of the fertilizer is used in food grain production, it is estimated that the fertilizer (N,P&K) use will need to increase from 25.58 million tons in 2013/14 to about 35 million tons in 2031/32. Per hectare (cropped area) fertilizer use will need to increase from 128.1 kg/ha to 175 kg/ha at a growth of 2.25 percent per year. It is extremely important that the fertilizer use is balanced. Following strategies should be imparted:

- Need to educate and guide the farmers in intensive soil fertility management, soil health cards, application of organic materials to the maximum extent possible, application of micro-nutrients.
- Enforcing greater efficiency in both production and distribution of fertilizer
- The use of bio-pesticides needs to be encouraged.

CREDIT

In order to transform agriculture more effectively, credit plays a pivotal role especially among small and marginal farmers. Apparently, public investment, price support, trade and credit policy will have major effect on the agricultural productivity. The existing policy of low input and low output prices will continue due to food security reasons followed by increasing focus on enhancing availability of institutional credit. Providing relief to drought affected farmers as part of welfare measures needs attention. The growth in credit has been significant during last 7-8 years. It is an urgent need to assess the projected/estimated demand for credit in view of changing scenario of agriculture and more paid out costs for inputs, farm implements and other critical activities. The long term credit requirement needs to be spell out keeping in view the changing dynamics of agriculture and allied activities.

The Government has taken many policy initiatives for strengthening of farm credit delivery system for providing credit at lower rates of interest to support the resource requirements of the agricultural sector. The emphasis of these policies has been on providing timely and adequate credit support to farmers with particular focus on small and marginal farmers and weaker sections of society to enable them to adopt modern technology and improved agricultural practices for increasing agricultural production and productivity. The policy essentially lays emphasis on augmenting credit flow at the ground level through credit planning, adoption of region specific strategies and rationalization of lending policies and procedures and bringing down the rate of interest on farm loan. The targets have been suitably increased every year to ensure that farmers get adequate and timely credit for their crop production and agri-allied activities. These targets have been surpassed by banks for

[2] Sarma and Gandhi, 1990, IFPRI

over the years. Government announces annual target for agriculture credit in the budget every year. Agricultural credit flow has shown consistent progress every year. Agriculture Credit of Rs. 711,621 crore was provided to the farmers against target of Rs. 7,00,000 crore in 2013-14. In the year 2014-15, agriculture credit flow was Rs. 845,328.23 crore against the target of Rs. 8,00,000 crore. Target for the year 2015-16 was fixed at Rs. 850,000 crore and achievement is Rs. 877,224 crore. The Target for the year 2016-17 has been fixed at Rs. 9,00,000 crore and a sum of Rs. 755,995.17 crore has been disbursed as agriculture credit during April-September, 2016. Details of disbursement of Ground Level credit (GLC) and Short Term Crop Loan from 2006-07 onwards and targets set for the future are given in Table 2.10.

Table 2.10: Future requirements for Ground Level Credit (GLC) and Short Term Crop Loan

(Amount in Rs. Crore)

Year	Ground Level Credit (GLC)		Short Term Crop Loan	
	Target	Achievement	Target	Achievement
2006 -07	175000	229400	NA	138455
2007 -08	225000	254657	140000	181393
2008 -09	280000	301908	160000	210461
2009 -10	325000	384514	200000	276656
2010 -11	375000	468291	220000	335550
2011 -12	475000	511029	280000	396158
2012 -13	575000	607376	345000	473500
2013 -14	700000	730123	500000	548435
2014 -15	800000	845328	575000	635412
2015 -16*	850000	915510	595000	665313
2016 -17*	900000	1065756	615000	622685
2017 -18	1000000	--	680000	--
2019 -20	1200000	--	822800	--
2023 -24	1640000	--	1180000	--
2032 -33	3820000		2800000	--

*Provisional data. 2017-18 onwards calculated @ apporx 10% annual growth

The Government has been implementing Interest Subvention Scheme since 2006-07. Under the Scheme, interest subvention of 2 percent per annum is provided to Public Sector Banks, Private Sector Scheduled Commercial Banks, Cooperative Banks and Regional Rural Banks on their own funds used for short term crop loans upto Rs. 3.00 lakh per farmer provided the lending institutions make available short term credit at the ground level at 7 percent per annum to farmers. Farmers are provided with 3 percent additional interest subvention for the short term crop loan of upto Rs. 3.00 lakh for a maximum period of one year for prompt repayment on or before the due date. Thus, farmers, who promptly repay their crop loans as per the repayment schedule fixed by the banks, are extended loans at an effective interest rate of 4 percent per annum. Government has extended the scheme to crop loans borrowed from private sector scheduled commercial banks in respect of loans given within the service area of the branch concerned.

Further, in order to discourage distress sale by farmers and to encourage them to store their produce in warehouses against warehouse receipts, the benefit of interest subvention scheme has been extended to small and marginal farmers having Kisan Credit Card for a further period upto six months post harvest on the same rate as available to crop loan against negotiable warehouse receipt for keeping their produce in warehouses.

To provide relief to farmers affected by natural calamities, the interest subvention of two percent continues to be available to banks for the first year on the restructured amount. Such restructured loans may attract normal rate of interest from the second year onwards as per the policy laid down by the RBI.

LIVESTOCK-FEED AND FODDER

FEED AND FODDER AND OTHER INPUTS

Agriculture in India is associated with crop husbandry and livestock production to strengthen economic growth. Cattle are the only tangible asset and mainstay for the economic security for small holders. The dairying, fisheries and poultry are the dominant sub sectors which contribute significantly towards the agricultural GDP. The animal and fishery sector together contribute about 34 percent of the agri-GDP in 2013-14. The milk production has almost tripled since 1990-91 with a growth of over 4 percent annually which has increased to almost 5 percent in recent years. The egg production has also noticed progressive increase over the years with 5.7 percent annual growth in recent times. The production of fish has shown mixed trends. While it grew more than 4 percent between 1990/91 to 1999/2000, the growth slowed down to 3.6 percent during 2000/01 to 2009/10 but again picked up recently. Meat production while recorded impressive growth of 10.8 percent per annum during 2000/01 to 2009/10 has slipped to close to 7 percent in recent times. The bovine population in the country is about 299.9 million. The positive growth in bovine population has contributed towards the significant increase in the milk production in the country. The livestock sector is exposed to a number of constraints. The pre-dominant are low productivity, chronic shortages of feed & fodder, large population of unproductive cattle, absence of effective extension system, low health care, immunization and hygienic programme, lack of Cold chain logistics, unorganized marketing, etc.

The demand for feed will also increase from other subsectors of livestock like poultry and fisheries. The production of eggs has increased to 82 billion in 2014-15 over 30.1 billion in 1999-2000. However, one of the major constraints in the poultry sector is poor quality feeds / unavailability of balanced diets with seasonal fluctuations in demand and supply. The fisheries sector also contributes about 4 percent to the Agri-GDP and provides employment to nine million people. There is still a wide scope for realizing the full production potentials.

While the availability of the fodder and feed has increased significantly in recent years, the increase in green forages has been negligible. In spite of impressive increase, a current deficit of 10, 33 and 35 percent is estimated for dry fodder, concentrates and green fodder, respectively. This deficit is likely to widen to 11 percent, 35 percent and 45 percent, respectively by 2020-21. This is likely to happen in view of crop diversification from cereals to commercial crops affecting the availability of crop residues. The most critical issue is stagnation in the availability of green fodder. The reason for this is inadequate fodder seed production, market linkages, and very low seed replacement rate. According to an estimate, only 25 percent of requisite forage seeds are available, that too of 15- 20 years old varieties. Seeds of better and newer varieties are not available to the farmers for cultivation. Production and early replacement of quality seeds of newer varieties need to be optimized. Over the years, considerable technological advancement has taken place in the feed and fodders focusing on enhancement of nutritional quality and productivity enhancement. The key driving forces for feed and fodder development in the coming years would be on productivity enhancement, shift to commercial production systems and convergence with other flagship schemes of the government like MGNREGA, RKVY and Watershed programme. Keeping in view, it is very important to assess the projected/estimated demand for Feed and Fodder and other inputs for the year 2019-20, 2023-24 and 2032-33.

STATUS AND AREAS OF CONCERN

The country is largest producer of milk and targeted to produce 300 million ton by 2022. However, country is having experiences of droughts and floods which have a lot of consequences particularly to livestock farmers. The milching animals' productivity reduces drastically due to lack of fodder, feed and drinking water. The contribution of feed and fodder is 50 percent towards livestock productivity & production. The cereals crop residues i.e., wheat, rice and coarse cereals straws/hay contribute about 71 percent of overall feed resources used for animal feeding, followed by green fodder 23 percent while concentrated feeds account for 6 percent, only. At present, there is no Feed and Fodder Security for more than 500 million animals in the country. In the recent times, livestock production is changing from sustenance to agri-business in the form of enterprises and industries based on milk, meat, eggs and other livestock products.

The other area of concern is the management of the major feeding sources for livestock. They include pasturelands, crop residues, edible weeds, grasses, cultivated fodder, tree leaves and agro-industrial by-products. Fodder crops are cultivated only on about 4.9 percent of the gross cropped area of the country and this area has been static for last 25 years. There exist wide variations in the different estimates of feed and fodder requirements, but all such estimates project significant deficit of green and dry fodder and the concentrates.

NITI Aayog in their three Year Action Agenda on shift into High Value Commodities, inter-alia, indicated an important challenge in the development of animal husbandry concerns fodder. Rapidly growing numbers of unproductive male cattle and weak fodder base due to problems in pasture management and shrinking of common properties make this problem doubly serious. We need innovation in institutional aspects of pasture protection and management. Also necessary is greater co-ordination between agencies responsible for livestock and those for crops that produce fodder.

The small and marginal farmers own only 44 percent of the agricultural land while they own over 80 percent livestock assets. Besides, over the years, landholdings in India have become smaller & fragmented. According to 2010-11 Agriculture Census, 47 percent of land holdings have become less than half a hectare in size. These holdings are too small to support a family of five thereby many farmers are now seeking alternative sources of income. But stringent tenancy laws in most of the States have meant that these farmers hesitate to lease the land they leave behind. As a result, an increasing amount of farmland is left fallow. The introduction of a modern land leasing law that balances and protects the right of tenant and landowner would be potential solution. In these leased farm lands, the Fodder along with milk production activities would be a substitute for an additional fodder area and also to earn more income.

The Gazette notification of Ministry of Environment Forest and Climate Change on 23rd May, 2017 on prevention of cruelty to Animals (Regulatory of Live Stock Markets) put restriction on sale of cattle for slaughter. The cattle are defined as bovine animals including bulls, cows, buffalos, steers, heifers, calves and camels. The purpose of the Rule is to ensure welfare of the animal market and ensure adequate facilities for housing, feeding, feed storage areas, water supply, water troughs, ramps, veterinary care, shelter for old, young, sick and unproductive cattle which are serious issues that need to be addressed particularly with reference to fodder and feed.

CURRENT SCENARIO AND ESTIMATES OF DEMAND AND SUPPLY OF FODDER & FEED

The overall productivity of livestock has been low, because of inadequate nutrition from green fodder, along with dry residue and protein concentrate. The reason for this is the shortage of upto 40 percent of Green fodder and upto 35 percent of dry fodder. The green fodder shortage is due to encroachment of over 10 million hectares of pasture land with poor replacement by agriculture land. This problem is compounded by lack of focus on scientific growth of fodder species in over 105 arid and drought prone districts even while there is burning of available crop residue in fodder surplus States like Punjab and Haryana year after year. Further, the cost of fodder is increasing at a much faster rate than price of milk thereby reducing profitability. The overall productivity of Dairy sector is low because of inadequate nutrition from green fodder, along with dry residue and protein concentrate.

The 34th report of Parliamentary Standing Committee on Agriculture has also indicated shortage of 122 million ton dry fodder, 284 million ton of green fodder and 35 million ton of constraint by 2020. The detail of supply and demand of Fodder and Feed is as under:

Table 2.11: Requirement and availability of Fodder and Feed (Dry matter in million tonnes)

Type of Fodder	Parameters	2015	2020	2025
Dry Fodder	Requirement	491	530	550
	Availability	387	408	433
	Deficit	**104**	**122**	**117**
Green Fodder	Requirement	840	880	1000
	Availability	619	596	600
	Deficit	**221**	**284**	**400**
Concentrate	Requirement	87	96	105
	Availability	58	61	65
	Deficit	**29**	**35**	**40**

Besides above estimate, the IGFRI, Jhansi in its Vision- 2050 has indicated supply and demand on the basis of livestock population as under:-

Table 2.12: Projected livestock population estimates*

(Million adult cattle unit, ACU#)

Year	Cattle	Buffalo	Sheep	Goat	Equine	Camel	Total
2010	127.31	88.88	4.66	9.03	0.75	0.49	231.10
2020	129.16	95.31	5.03	10.32	0.63	0.43	240.86
2030	133.66	106.87	5.39	11.18	0.54	0.29	257.93
2040	136.69	115.08	5.76	11.99	0.40	0.20	270.14
2050	139.63	127.16	6.13	13.19	0.29	0.12	286.52

* Estimates based on past Livestock censuses published by the Directorate of Economic & Statistics and Department of Animal Husbandry & Dairying;

Category-wise population data was multiplied with standard body weight to get total weight while conversion to ACU (1 ACU = 350 kg);

Table 2.13: Demand and supply estimates* of dry and green forages (million tonnes)

Year	Demand		Supply		Deficit		Deficit as %	
	Dry	Green	Dry	Green	Dry	Green	Dry	Green
2010	508.99	816.83	453.28	525.51	55.72	291.32	10.95	35.66
2020	530.50	851.34	467.65	590.42	62.85	260.92	11.85	30.65
2030	568.10	911.67	500.03	687.46	68.07	224.21	11.98	24.59
2040	594.97	954.81	524.40	761.76	70.57	193.05	11.86	20.22
2050	631.05	1012.70	547.78	826.05	83.27	186.65	13.20	18.43

*Assumptions: For calculation of demand of dry and green forages, concentrate feed's data were adopted from article;- Dikshit, A.K., and P.S. Birthal, (2010); 'India's livestock feed demand: Estimates and projections'; Agricultural Economics Research Review, 23(1): 15-28.

Green forage, dry forage and concentrate feed were converted into dry matter (DM) applying a factor of 0.25, 0.90 and 0.90, respectively.

Area under fodder crop and pastures were extrapolated.

Supply of green fodder was calculated using a factor of 60 to 70 t/ha for cultivated areas;

For pasture sources, a factor of 1.2 to 1.5 t/ha was used for green forage supply;

These estimates of feed demand are built upon the actual feed consumption rates obtained from a nationally representative household survey; hence are more credible.

REGIONAL IMBALANCES IN FODDER AVAILABILITY

The pattern of deficit varies in different parts of the country. For instance, the green fodder availability in Western Himalayan, Upper Gangetic Plains and Eastern Plateau and Hilly Zones is more than 60 percent of the actual requirement. In Trans Gangetic Plains, the feed availability is between 40 and 60 percent of the requirement and in the remaining zones, the figure is below 40 percent. In the case of dry fodder, availability is over 60 percent in the Eastern Himalayan, Middle Gangetic Plains, Upper Gangetic Plains, East Coast Plains and Hilly Zones. In Trans Gangetic Plains, Eastern Plateau and Hills and Central Plateau and Hills, the availability is in the range of 40-60 percent, while in the remaining zones of the country the availability is below 40 percent.

AREA UNDER FODDER PRODUCTION

Fodder crops are the plant species that are cultivated and harvested for feeding the animals in the form of forage (cut green and fed fresh), silage (preserved under anaerobic condition) and hay (dehydrated green fodder). The total area under cultivated fodders is around 9.18 million ha on individual crop basis. Sorghum amongst the kharif crops (2.6 million ha) and berseem (Egyptian clover) amongst the rabi crops (1.9 millionha) occupy about 54 percent of the total cultivated fodder cropped area. The area under permanent pastures has been declining over the years and the trend could well continue in the future. Due to over-grazing, the productivity of the pastures has been declining too. The area under fodder crops has almost remained static for the last 3-4 decades.

Table 2.14: Area under different fodder crops

S. N.	Fodder crops	Areas in '000'ha
1	Berseem (Egyptian clover)	1,900
2	Lucerne (Alfalfa)	1,000
3	Senji (Sweet clover)	5
4	Shaftal (Persian clover)	5
5	Metha (Fenugreek)	5
6	Lobia (Cowpea)	300
7	Guar (Clusterbean)	200
8	Rice bean	20
9	Jai (Oat)	100
10	Jau (Barley)	10
11	Jowar / Chari(Sorghum)	2,600
12	Bajra (Pearl millet)	900
13	Makka (Maize)	900
14	Makchari (Teosinte)	10
15	Chara sarson (Chinese cabbage)	10

Sizeable amount of fodder demand is fulfilled through vast grasslands and rangelands. Any positive or negative change in its position will have impact on several environmental issues. Similarly, the increase in livestock population will also affect the availability of organic wastes which in turn can boost the agricultural production. Table 2.15 depicts the total area uncultivated under various categories.

Table 2.15: Area under various categories other than crop husbandry (2012-13)

S. N.	Resources	Areas in million ha
1	Forests	69.41
2	Permanent pastures/grazing lands	10.24
3	Cultivable wastelands	13.66
4	Fallow lands	24.99
5	Fallow land other than current fallows	10.19
6	Barren uncultivable wastelands	19.26
7	Total common property resources other than forests	54.01

India has an area of 10.24 million ha land under permanent pasture and other grazing lands categories during 2012-13. Rajasthan state with 1.69 m ha land under permanent pasture and other grazing lands is the largest area (16.54 percent) (Agriculture Statistics at a Glance, 2015). In addition to that Himachal Pradesh, Chhattisgarh, Gujarat, Karnataka, Madhya Pradesh, Odisha, Andhra Pradesh and Maharashtra states have significant area under this category. The state wise details are provided in Table 2.16.

Table 2.16: State wise area under permanent pasture and other grazing land (2012-13)
(in thousand ha)

S.N.	States	Areas	Percent	Ranking
1	Andhra Pradesh	515	5.03	IX
2	Chhattisgarh	861	8.41	VI
3	Gujarat	851	8.31	VII
4	Karnataka	908	8.87	V
5	Madhya Pradesh	1286	12.56	III
6	Maharashtra	1245	12.16	IV
7	Rajasthan	1694	16.54	I
8	Himachal Pradesh	1508	14.73	II
9	Jammu & Kashmir	114	1.11	X
10	Odisha	536	5.23	VIII
	Sub Total	9518	92.95	
	Other States	722	7.05	
	Total	10240	100	

The pasturelands available in different states are overgrazed and not properly managed which lead to lower productivity. In different states, grazing pressure on this land is very high compared to carrying capacity. About 70 percent of grazing land comes under poor to very poor conditions in Rajasthan having productivity below 500 kg / ha with carrying capacity of 0.13 ACU / ha.

ONGOING PROGAMME OF ANIMAL HUSBANDRY, DAIRYING AND FISHERIES (DAHD&F)

The Department of Animal Husbandry, Dairying and Fisheries Government of India is implementing Centrally Sponsored National Livestock Mission with a Sub Mission on Feed and Fodder Development since 2014-15. Under the Sub Mission financial assistance is provided to the Animal Husbandry Departments of the States/UTs for feed and fodder development under the following components:

Table 2.17: Various fodder development programmes of DAHD&F

	Name of the Components
1.	Fodder Production from Non-forest wasteland/rangeland/grassland/non-arable land
2.	Fodder production from Forest land
3.	Fodder Seed Procurement/ Production & Distribution
4.	Introduction of Hand Driven Chaff-Cutter
5.	Introduction of Power Driven Chaff-Cutter
6.	Distribution of low capacity, tractor mountable Fodder Block Making units, hay baling machines/reapers/forage harvesters
7.	Establishment of silage making Units
8.	Establishment of by pass protein production units
9.	Establishment of Area Specific Mineral Mixture / Feed Pelleting/Feed Manufacturing Unit.
10.	Establishment/modernization of Feed Testing Laboratories

Table 2.18: State wise release of funds under Sub Mission Feed and Fodder of National Livestock Mission

(Rs in Lakhs)

Name of the State & UTs	**2014-15**	**2015-16**	**2016-17**
Andaman & Nicobar			2.25
Andhra Pradesh			558.00
Bihar	343.00	0	
Chhattisgarh	0	212.61	41.57
Gujarat	1,500.00	0	1095.83
Haryana	490.00	0	
Himachal Pradesh	74.99	0	
Jharkhand	500.00	0	200.00
Karnataka	0	422.00	1.04255
Maharashtra	157.14	500.00	1338.205
Nagaland	39.94	23.25	
Odisha	178.50	72.60	131.40
Rajasthan	0	338.817	177.45
Sikkim	7.65	15.11	
Tamil Nadu	600.00	0	
Tripura	5.70	0	
Uttarakhand	0	101.55	
Uttar Pradesh	321.00	0	
West Bengal	550.35	0	27.72
Total	**4768.27**	**1685.937**	**3573.4675**

PROPOSED POLICY AND INTERVENTION FOR FODDER AND FEED SECURITY

The Fodder & Feed Security programmes will try to address these problems in the form of a mission mode programme considering all the stakeholder's benefit and problem solving so that a push can be given to the livestock sector making it a competitive enterprise for India, and also to harness its export potential. The sub-mission will specially focus on increasing production, productivity and availability through adoption of improved and appropriate technologies and intervention best suited to specific agro-climatic region in both arable and non-arable land.

OBJECTIVES: The Sub mission fodder and feed Security aimed to achieve following objectives:

a. Increasing production of Green Fodder through area expansion & productivity enhancement;
b. Establishing effective seed production chain with the involvement of famers, dairy cooperatives, Seed Corporations and entrepreneurs.
c. Collection and management of crops residues to fulfil the requirement of dry fodder;
d. Facilitate procurement of inferior quality of foodgrains by providing ***"Price Deficiency Payment"*** to strengthen feed industries to meet the requirement of concentrates /feed for bovine, poultry and inlands fisheries.
e. Commercialization of Fodder & Feed for rural job creation & employment ; and
f. Enhancing farm level economy to restore confidence amongst the Dairy farmers.

TARGETS

1. Additional Production of Green Fodder of 250 million tonnes by bringing 10 million ha gross fodder cropped areas;
2. Collection & management of additional 150 million tonnes of dry fodder;
3. Fortification & enrichment of 150 million tonnes of dry fodder;
4. Enhance additional availability of 35 million tonnes of concentrates;
5. Bringing 2 million ha area under perennial grasses
6. Bringing 5 million ha as catch crops & intercropping of fodder crops in horticultural/ Plantation areas.

STRATEGIES: To achieve the above objectives and targets, the Mission would adopt following strategies;

1. Focus on assured irrigated & residual moisture areas and high potential of productive bovine districts with assured supply of fodder seed and incentivise irrigation for fodder as a catch crop between wheat – rice cropping system, rice fallow and intercrop in orchard areas.

2. Focus on rainfed areas for cultivation of Australian perennial grasses.
3. Facilitate land leasing and contract farming on cluster basis to commercialise fodder cultivation, silage making and enrichment of dry fodder & storage.
4. Rehabilitation of degraded land and forest fringe areas with perennial fodder grasses including moringa (sahajan) & hedge lusarn etc., for small ruminants.
5. Agro climatic zone wise planning & incentivise for collection of paddy, wheat and course-cereals stubble for dry fodder and its transportation to deficits destination.
6. Focus on procurement of inferior quality of foodgrains or non-existent of MSP procurement areas in eastern States by incentivise *"Price Deficiency Payment"* to the farmers for providing raw material to feed industries to meet the requirement of concentrate for bovine, poultry and inlands fisheries.
7. Setting up of fodder depots for making availability of dry fodder, forages & concentrates in high density milch animals' localities especially for SC/ST, marginal & small and landless dairy farmers engaged in livestock rearing.
8. Integration of various proposed interventions and targets with district plan of each identified district.
9. Close monitoring of flow of funds to ensure timely reach of interventions to the targeted beneficiaries.
10. Constant monitoring and concurrent evaluation by the implementing agencies for assessing the impact of the interventions for a result oriented approach.

COVERAGE OF FODDER AND FEED SECURITY PROGRAMME

The fodder and feed Security programme will be operated in all States and Union territories to promote holistic growth in fodder resource availability covering fodder production, conservation and marketing; fodder seed production and marketing; grassland development including horti-pasture and silvi-pasture development; intensive fodder management on individually and community owned lands; and, post-harvest management of green fodder & crop residues and their utilization for round the year feeding of livestock for increased productivity.

APPROACH

A. PRODUCTION OF GREEN FODDER

Total area under fodder cultivation is about 9 million ha on individual crop basis, out of which an area of 2 million ha under **berseem** cultivation during Rabi and 2.6 million ha **sorghum** amongst Kharif as well as summer/lean period crops. Seeds are one of the important inputs affecting 20-25 percent of fodder production. Department of DAC&FW is assessing seed requirement of all crops and making rolling plan for production,

procurement and distribution through NSC, SSC and Private companies except **fodder seed crops.** There are also 100 percent Foreign Direct Investment (FDI) under development of seeds. However, there is no involvement of FDI under fodder seeds production.

The Regional Fodder Stations of DADF are producing foundation seeds of desired variety and States are supposed to uplift their foundations for its further multiplication and distribution as certified/ quality seeds in the form of minikits. Earlier the regional stations produced seeds which were directly sold / distributed as a minikits to farmers and to the States. Regional fodder stations are having an area of 600 hectares and 29 percent area is under irrigation. These stations are producing seeds of seasonal crops like oats, maize, sorghum, bajra, cowpea and perennial grasses. The seeds production is around 500-600 tons annually as a foundation seed and truthfully labelled seeds. Analysis of the data of fodder Stations indicate only a few States have uplifted the regional fodder station's foundation seeds, namely Chhattisgarh, Karnataka, Maharashtra, Rajasthan, Tamil Nadu & Uttarakhand from 2015-2017. The regional fodder stations namely Bangalore & Kalyani reported that they are unable to dispose off their foundation / truthful level seeds because States are demanding seeds in a minikits which can be directly distributed to farmers. **There are restrictions for involvement of private sector for seed procurement, multiplication & distribution.**

Berseem (Egyptian clover) mostly cultivated as Rabi fodder crop in the states of Punjab, Haryana, Uttar Pradesh, Maharashtra whereby 200 sq mt., is sufficient for small and marginal livestock owner. Market value of seed is around Rs. 300-400 per kg. Seed requirement per ha is around 20- 25 kg only. However, the seed of Berseem is imported from Egypt since long ago. This seed is not under production chain of DAC&FW. The Export Import (EXIM) Committee of Seed Division of DAC&FW permitted the import of berseem seeds variety, i.e., **Mescavi.** The import amount during the recent past is provided in Table 2.19 below.

Table 2.19: Imported quantity of Barseem Seed - Mescavi

Sl.No.	Year	Import (MT)
1.	2004-05	2062
2.	2005-06	2930
3.	2006-07	7912
4.	2007-08	7622
5.	2014-15	13204
6.	2016-17	10474

The imports are being carried out by private companies mostly from Egypt and some quantity from Spain and Italy. It clearly indicates non availability of berseem seeds to cover 2 million ha. The regional fodder stations of DAHD&F are also not producing berseem seeds.

The **Sorghum and African Tall Maize crops** used for grain and fodder both have no problem of seed availability especially during Kharif season. However, the normal kharif

sorghum seed when sown during summer crop under Rabi fallow lands excrete HCN (Hydrocyanic acid), which is a poisonous acid dangerous for animals. During summer season fodder seed of sorghum i.e., MP Chari variety & African tall Maize can be sown on rabi harvested areas as a **catch fodder crop** in assured irrigated areas to ensure green fodder for productive animals. However, there are problems of non- availability of **MP Chari** variety of sorghum & African tall maize seeds for cultivation during summer season. There are no rolling fodder seed production plan under seed production, procurement and distribution to farmers for fodder cultivation.

Timely availability of quality forage seeds is one of the important limiting factors. The seed chain from breeder to certified seeds does not exist at NSC and SSC level and also the institutional mechanism in most of the states. Our approach should be ensuring timely seed availability for 9 million ha. Besides, for increasing 5 million ha additional gross fodder area under catch fodder crop (April to June) in rice – wheat crops rotation area where assured irrigation exists as well as in Rice fallow land in Eastern India.

PROPOSED INTERVENTION/COMPONENTS

1) **Assistance for Fodder seeds production:** Fodder seeds are to be provided among dairy farmers at subsidies rate for its cultivation. The seed production & availability programme should be modified as per ongoing National Food Scrutiny Mission under which NSC, NAFED, IFFDC, KRIBHCO and HIL has been assigned to ensure the supply & availability of certified / quality seed, wherein, assistance for production of certified seed is being provided to seed growing agencies. About 75 percent of the subsidy is meant for farmers and 25 percent for seed producing agencies to meet expenditure including certification cost. The Seed Producing Agencies shall be eligible for the incentive only when they purchase the seed production from the farmers and issue a certificate to this effect. The subsidy will be given to central seed agencies like NSC, KRIBHCO, IFFCO etc., directly and to State Seed Corporations and Private Seeds companies through State governments. The central seed agencies will submit action plan for approval to DADF.
2) **Assistance to Fodder Seed distribution in the form of Minikits:** Seed producing agencies (NSC/SSCs/SAUs/Private Companies) authorized by the State will distribute seed to selected districts. The District Milk Federation, Milk Producer Cooperative Societies/District Fodder Security Executive Committee will finalize the list of beneficiaries in consultation with Village Milk Federation/Panchayat. Assistance for purchase of seeds will be available to selected Dairy farmers for the area not exceeding 2 ha each.

In the case of supply of seeds by Central Seed Agencies like NSC reimbursement of subsidy for distribution will be made directly by the DADF to such agency, within 20 percent of

State's Seed distribution target in identified Fodder Security Mission districts on the basis of verification by Districts/States and adjusted from the State's overall allocation under seed distribution component. Sapling of grasses may also be assigned and assistance to be provided on its transplantation potential grass cultivation field.

3) **Fodder production from Forest and Non-forest wasteland / Gauchar/ rangeland / grassland /non-arable land/rivers basin, watershed catchments area/canal embankments (ha):** The activities are proposed under this component are: distribution of seed / planting material of improved varieties of suitable crops and grasses, ancillary planting, hortipastoral/ silvipastoral plantations tending, protection and maintenance works up to 5th year of planting / sowing, Rangeland improvement and Harvesting and densification of fodder.

4) **Fodder Demonstrations for Livestock based farming system approach:** The livestock rears are to be focused on cluster basis wherein improved cultivation practices of fodder, legumes & grasses production for high value farm livestock rearing including small ruminants will be targeted and encouraged to ensure round the year green fodder availability with buy back arrangements. Thereby, green fodder made available locally in plenty which lead to not just healthy cattle but also increase their productivity even during drought situation. A system of diversified farming will be encouraged where diversification to fodder crops and livestock rearing could be accepted by farmers as an alternative cash crop. It involved encouraging farmers to undertake fodder cultivation through a buy back arrangement with the dairy farmers, thereby land owners, as well as small & marginal, landless livestock rearers could permanently earn and increase their income.

   A cafeteria of fodder crops, grasses, shrubs/trees, intercropping specific intervention (seeds, sapling, nutrients, irrigation etc) would be provided to enable the States to pick up the critical inputs relevant to a particular Agro-Climatic Zone for dissemination through large scale demonstration. It is expected that these demonstrations on large scale will have a positive impact to change the mindset of the farmers to diversify for high value product under Animal Husbandry sector. These demonstrations also visualize commercialization of fodder will create rural job & employment and enhance farm level economy to restore confidence amongst the dairy farmers.

5) **Strengthening & Development of Infrastructure:** The National Accounts Statistics 2017 indicates that between 2011-12 and 2015-16, the total value of the cereals and pulses produced in the country went down by 3 percent, for Oilseeds by over 13 percent and Sugar by 1 percent but value of grass which is mainly used as cheap forage for milch animals **increased by 1 percent.** In this scenario the department may focus the State/Milk Federation/State Agricultural/Horticultural/Forestry/Veterinary Universities Farms for fodder seeds & fodder production, training & demonstrations needs to be strengthen. There are more than two hundred farms in the States/UTs which is to be focused for improved fodder, fodder grasses, seeds production for increasing livestock

productivity in their domain. These investments are likely to increase value of output of grasses in agriculture and allied sector.

B. Dry Fodder management through post harvest operations & technologies

1) The cereals crop residues namely, wheat, coarse cereals and rice straws have contributed about 71 percent of overall feed resources used for animal feeding while green fodder accounted for 23 percent and concentrated feeds for 6 percent only. Poorer livestock owners, dependent mainly on common and agricultural residue, end up underfeeding the animals. The 34th report of Parliamentary Standing Committee on Agriculture has indicated shortage of 122 million ton dry fodder by 2020. The Group of Secretary (GOS) on Department of Animal Husbandry, Dairying and Fisheries has reported **35 percent shortages of dry fodder.** In such scenario the Dry fodder such as wheat, rice, coarse cereals straw/ stubble would be collected, stored, enriched and transported at deficit areas /region for consistent supply for animal feeding.
2) The production of cereals estimated at 251 million tonnes comprises of wheat- 97.44 million tonnes, paddy – 109.15 million tonnes and coarse cereals -44.39 million tonnes during 2016-17. The ratio of grain and stalk/ stubble production is 1:1.5 & worked out about 370 million tonnes. An estimate of Ministry of New & Renewable has indicated that the generation of crops residues of 501 million tonnes, surplus 140 million tones and burned 92.81 tonnes.
3) The small and marginal farmers own only 44 percent of the agricultural land while they own over 80 percent livestock assets. The small & marginal farmers by and large collect and manage harvested crops residues for livestock feeding. But large size cultivators due to shortage of agricultural labours and use of mechanized harvesting dispose of straw, stubble & stalks in field and burn or re-plough, ultimately lead to shortage of dry fodder in the rural side.
4) Department of Agriculture, Cooperation and Farmer Welfare's programme viz. National Food Security Mission (NFSM), National Mission on Oil Seed (NMOP), National Mission on Sustainable Agriculture (NMSA), and Mission for Integrated development of Horticulture (MIDH) encompass of interventions/activities, defined from field preparation to the stage of crop maturity with inputs and also being supported by Minimum Support Price (MSP) for foodgrains. The Pradhan Mantri Fasal Bima Yojana (PMFBY) covers only foodgrain production from seed sowing to crops harvests & threshing. Beside, reliefs are also extended to farmers under NDRF/SDRF by using criteria on productivity of foodgrains. These interventions have a missing link with respect to crop residues/ straw collection & management at harvesting stage, while the crop residue is an impartment input for Animal Husbandry productivity & production.
5) At present the price of dry fodder/straw of livestock are several times more than the existing prices of foodgrains under Food Security Act. In lean period & cyclone/ droughts, floods situations there are acute shortages of straws/ dry fodder and normally

available @ Rs. 6 to 12 per kg (Rs. 600-1200/qt). Besides, small scale dairy owners are being forced to buy the commodity at a very high, hitting their businesses and margins. In normal course, about 70 percent expenditure is incurred by the farmers on dry fodder including green forage & feed.

6) Both, human and animal population depends on cereals, pulses, oil seeds and horticulture crops. Animal population, in return add nutritional security to human beings in the form of milk & its products, i.e., paneer, butter oil and meat etc. The prevailing situation calls for crops residues collection, storage & management to ensure dry fodder security for livestock rears in normal as well as in deficit areas by undertaking two weeks' intervention at harvesting time of wheat, paddy & coarse cereals.

PROPOSED INTERVENTIONS / COMPONENTS

1) **Assistance to crops residue producers:** It is proposed to collect straw/ stubbles covering 10 million ha by 2019-20. An incentive amounting Rs.1000/ ha is proposed to be extended to those farmers who have left crops residue for permitting its collection by Marginal & Small, SC/ST, Women and Landless Dairy farmers.
2) **Assistance to crop residues collection, storage, and transportation:** The collection of crops residue works to be assigned to marginal & small, SC/ST, women and landless Dairy farmers with active facilitation of line department/agencies. For this purpose an amount of Rs. 1000/tonne incentive to be provided for straw collection limited to 1000 ha for one group of straw collector. Small & marginal and landless may form Self Help Groups (SHGs), Farmers Interest Groups (FIGs), End Implementing Agencies (EDIs) with facilitation of Primary Milk Produces Cooperative/Federation. The members may access collected straw as per their livestock needs. The surpluses may be stored for further commercial marketing. This group may also be supported with bailing machines & feed Block Making units and further enrichment for commercialization to deficit locations.

Straw/dry fodder collector/Straw business entrepreneur covering 1000 ha may be able to collect straw of Rs. 1.8 crore per cropping season (straw production @ 30 qt /ha x Rs.600/qt = Rs.18,000/ha) . The proposed incentive may be extended only for one time and further the dairy farmers/straw entrepreneurs may evolve self-reliant on straw by striking a deal to buy stubble per ha with cultivators for the next cropping season. **The proposed intervention is economically viable in assured irrigated – wheat, paddy crop rotation area.**

PROJECTED BENEFITS

- The proposed two weeks interventions ultimately lead to Dry Fodder Security of milching Cattles and Buffalos round the year for milk and meat production also create an employment opportunities to laborers, farmers & traders.
- The proposed Interventions will definitely be a step to lead doubling of dairy farmer's income by 2022.
- Collection and managing of stubble /straw will also mitigate problems of fogging /smog up to some extent.

3) **Distribution of Hand and Power Driven Chaff Cutters**
Financial support for post harvest operations, like providing chaff cutters (hand/power driven) to the farmers, establishment of fodder densification units, feed enrichment units, and area-specific mineral mixture units, etc.

4) **Fodder Machinery for Value Addition.** These activities include Infrastructure development for Fodder block, Silage/Hay Making/enrichment at individual/ Panchayat/block/Primary Milk Cooperative level and establishment of Fodder banks.

C. FEED MANAGEMENT

1) **Facilitation for Procurement and Supply of raw feed material to Feed Industries:** Parliamentary Standing Committee has estimated that there is shortage of **35 million** tonnes of concentrates. While Group of Secretary (GOS) on Department of Animal Husbandry, Dairying and Fisheries has **reported 45 percent shortages of concentrates.** The Feed industries generally use Maize, Soybean, wheat/rice bran etc. It calls for focus on procurement of inferior quality of foodgrains, or non-existent of MSP procurement areas in Eastern States by incentivise ***"Price Deficiency Payment"*** to the farmers cultivating maize, soyabean etc for providing raw material of feed industries to meet the requirement of concentrate for bovine, poultry, pigs and inlands fisheries. The facilitation of procurement to be provided to those who have setup feed industries in procured areas.

2) **Establishment of Bypass protein making, area specific mineral mixture/feed manufacturin/feed pelleting units.** Commercial units shall be supported for production of bypass protein, areas specific mineral mixture to bridge the gap of feed availability and ensure supply to high yielding livestock.

3) **Establishment/modernisation of Feed testing laboratories.** To ensure the supply of quality manufactured feed, the feed testing laboratory to be strengthened and opening of new testing laboratories under State Animal Husbandry, Milk Union/Federation, Agriculture, Veterinary/Fisheries Universities & Collages is also proposed.

EXPECTED OUTCOME;

1) Bridging the gap between demand and supply of green fodder, dry fodder and feed of livestock.
2) Increase production and productivity of livestock.
3) Diversification of agriculture to livestock based farming system.
4) Creation of employment generation with commercialization of fodder.
5) Increase opportunity for setting up of Agro-based feed industries in rural areas.
6) Enhance farm level economy and restore confidence amongst the livestock rears.

CHAPTER III

CHAPTER III

DEMAND AND SUPPLY FORECASTS

Planning for food security and management of grain supply in the immediate future depends on the empirical prediction of demand and supply of foodgrains. The demand of agricultural commodities is linked to their requirement as final human consumption and intermediate consumption in the supply chain in addition to their requirement as seed and feed for animal consumption. The supply for the consumption requirement during the reference period gets sourced either from the domestic production, its net inventory from the carry-over stocks or through imports, depending upon the capacity of domestic supply resources. Demand projections relate to future requirements arising out of growth in population, increased per capita income and changes in income distribution if any. Demand predictions for household consumption can be worked out following three different approaches. (i) The simplistic approach to project the demand for the future is by using projection of population and the base year consumption parameters. This approach assumes short term static behaviour of consumption. (ii) The Normative Approach to estimate the demand is based on the normative requirement as recommended by National Institute of Nutrition, Hyderabad (iii) The third approach for assessing demand projections is the Behaviouristic Approach which is based on the growth of population and changing behaviour of consumption on account of changing per capita income in a growing economy, measured in terms of consumption/expenditure elasticities.

The actual population and its share for urban and rural sectors are available only for 2011 Census. The future projections post 2011 Census have not been brought out by the Registrar General of India (RGI) as was done during the 2001 Census. Therefore, future population projections are carried out by the Working Group using the decennial growth rates of past Census and the growth rate in urban and rural population ratios. The projected population is provided in Table 3.1. The total population is expected to increase from 1.22 billion in 2011 to 1.38 billion by the next Census of 2021 and 1.55 billion by the Census 2031. The urban population ratio is expected to increase from the present level of 31 percent to 40 percent by 2033-34. Population projections for India made by the UNO are presented in the last column for the sake of comparison.

Demand estimates are worked out using the above mentioned three approaches. For projection of household consumption based on static behavior, we need to consider base year consumption which is multiplied by the projected population to get the estimates of demand for household (human) consumption. The estimates of indirect demand for seed, feed and wastage and its intermediate usage for industry are then added to human

consumption to get the estimates of aggregate demand for a particular period. The latest National Sample Survey data for consumption for quinquinnial round are available for 68th Round for the year 2011. As this was also a normal year for the economy the same has been used for the estimation of consumption. Given the actual population estimates based on Census 2011 also available for the same year, we get the actual consumption for 2011. Subsequently, the projected consumption estimates are obtained by multiplying the projected population with the actual consumption for 2011. The NSS data pertaining to consumption of foodgrains in the 68th Round is given in the Table 3.2 below:

Table 3.1: Projected Population - All India (Million)

Year	Total	Urban	Rural	% Urban	UN Projections #
2011 -12	1214.8	379.4	835.4	31.23	1247.2
2012 -13	1230.9	388.8	842.0	31.59	1263.1
2013 -14	1247.1	398.4	848.7	31.95	1278.6
2014 -15	1263.5	408.3	855.2	32.31	1293.9
2015 -16	1280.2	418.3	861.8	32.68	1309.1
2016 -17	1297.0	428.7	868.3	33.05	1324.2
2017 -18	1314.1	439.3	874.8	33.43	1339.2
2018 -19	1331.4	450.1	881.3	33.81	1354.1
2019 -20	1349.0	461.3	887.7	34.19	1368.7
2020 -21	1366.8	472.7	894.1	34.58	1383.2
2021 -22	1384.1	484.1	900.0	34.97	1397.4
2022 -23	1399.8	495.2	904.6	35.37	1411.4
2023 -24	1415.6	506.5	909.2	35.78	1425.2
2024 -25	1431.7	518.0	913.6	36.18	1438.6
2025 -26	1447.9	529.8	918.0	36.59	1451.8
2026 -27	1464.2	541.9	922.3	37.01	1464.7
2027 -28	1480.8	554.3	926.5	37.43	1477.3
2028 -29	1497.6	567.0	930.6	37.86	1489.6
2029 -30	1514.5	579.9	934.6	38.29	1501.5
2030 -31	1531.7	593.1	938.5	38.72	1513.0
2031 -32	1549.0	606.7	942.3	39.17	1524.1
2032 -33	1566.5	620.5	946.0	39.61	1534.9
2033 -34	1584.3	634.7	949.6	40.06	1545.2

Note: The population estimates are converted from calendar to financial year

UN Population Division, Dept of Economics and Social Affairs, - Medium variant;

https://esa.un.org/unpd/wpp/Download/Standard/Population/: Accessed on 25th July 2017.

Table 3.2: Per capita per month consumption during 2011-12

Commodity	Rural	Urban
Rice and its products (kg)	6.13	4.66
Wheat and its products (kg)	4.43	4.32
Coarse cereals (kg)	0.69	0.33
All cereals (kg)	11.25	9.31
All pulses and products (kg)	0.79	0.90
All edible oils (kg)	0.68	0.85
Sugar (kg)	0.78	0.86
Liquid milk (litre)	4.33	5.42
Milk and products (kg)	4.38	5.55
Eggs, meat and fish (kg)	0.64	0.80
Vegetables (kg)	6.96	7.12
Fruits (kg)	1.53	2.36
Dry nuts (kg)	0.09	0.16

Source: National Sample Survey, Report No. 558 (68th Round).

In addition to direct demand for household consumption, there is demand of foodgrains for seed, feed and industrial uses (for agro processing) and also some wastage in the process of harvesting, collection etc. The ratio of Seed, Feed, Wastage and Industrial uses (SFWI) is used for translating consumption requirement to domestic production requirements and for converting the latter into net available for consumption. For the official estimates of the 10th and 11th Five Year Plan, the SFWI requirement was retained at 12.5 percent of the gross output for all the foodgrain crops except for rice for which this requirement was taken as 7.6 percent. However, with the changing tastes and diversifying basket of consumption there is an increased demand for animal products including meat products as well as milk products. This increased thrust to animal husbandry has led to higher demand for feed. Similarly, with the changing life style and increasing numbers of both spouse working especially in the urban areas the habit of eating outside home (in hotels and restaurants) is increasing. A doubt is expressed in some quarters whether eating food outside home is properly included in the household consumption in the National Sample Survey. There is no unanimity on what amount of total production is being used for the seed, feed, industrial uses and other indirect consumption.

In this exercise, estimates for SFWI have been worked out that includes not only seed, feed, wastage but also foodgrains used for industrial purposes as well as eating out side home. The Working Group calculated the aggregate indirect demand for major foodgrains as residuals using the trend analysis of gap between aggregate food supply and demand after adjusting for net imports (imports and exports) and changes in the government stocks[3]. The gap between supply and demand during our analysis (1990-91 to 2011-12) period observed an increase of 1.3 percent in rice, 2.7 percent in wheat, 3.6 percent in coarse cereals while pulses observed an increase of 1.6 percent. At the overall, gap between demand and supply of

[3]Reliable data on private stock are not maintained and therefore such estimates were not available.

foodgrains observed a trend growth rate of 3.3 percent per annum. We used above trend growth rates on the TE 2014-15 to simulate the difference for the future years for the major foodgrains. In the case of edible oils, a norm of 28 percent of gross output was used for oil recovery rate from oilseeds as was done by the Working Group for 10th Plan on the suggestion of Ministry of Consumer Affairs, Food and Public Distribution. In the case of oilseeds, their use for seed, feed & wastage and their consumption in secondary/ supplementary sectors taken together was increasing at a whopping 7.4 percent per annum. However, this included the indirect use of huge amount of imported palm oil, a significant part of which would be used for industrial purposes and not purely for direct or indirect consumption purpose. This issue was discussed thoroughly in the Working Group Meeting. To overcome this problem, it was unanimously decided that to work out gap in demand and supply of oilseed (edible oils) in the historical data, only the residual imports, i.e., total edible imports – palm oil imports, will be added to the domestic production to get the total availability of edible oils. The edible oil term is used in the report as synonym to vegetable oil.

It may be mentioned here that the requirement towards seed and wastage varies widely from crop to crop and state to state. With increase in productivity and greater awareness amongst farmers to control post harvest losses, the wastage ratio is expected to decline over time. Similarly, with the increase in high yielding variety seeds use of home seeds tend to decline over time. Therefore, any increase in SFWI would essentially be caused by higher use of grains as animal feed. The estimated average quantity of SFWI and other uses for different foodgrains based on gap between demand and supply is given in Table 3.3. Among foodgrains, the use of coarse grains for indirect demand is expected to increase at a rapid pace, e.g. increasing use of maize for poultry feed. The overall foodgrains use as SFWI is estimated to increase from 34 million tonnes in the early 1990s to around 76 million tonnes up to 2015-16. It is expected to cross 95 million tones by the end of 2025-26 and cross 120 million tones by 2032-33. The ratio of SFW to total foodgrains' demand would increase from less than 25 percent in TE 2012-13 to around 40 percent by 2032-33.

Table 3.3: Average demand for SFW and other uses (million tones)

Period	Rice	Wheat	CC	Pulses	Foodgrains	Oilseeds (excluding oil palm)
1990-95	5.16	10.54	13.65	4.68	34.03	3.04
1996-00	5.70	15.62	17.66	4.54	43.52	2.68
2001-05	4.89	15.28	18.91	4.55	43.63	3.46
2006-10	6.62	17.53	23.14	7.52	54.82	2.79
2011-15	15.12	22.45	29.06	9.36	75.99	3.32
2016-20	16.88	23.85	33.21	10.00	83.94	6.14
2021-25	18.01	27.24	39.59	10.81	95.65	8.78
2026-30	19.21	31.11	47.20	11.70	109.21	12.54
2031-34	20.22	34.58	54.28	12.45	121.54	16.63

DEMAND FOR FOODGRAINS, ANIMAL AND HORTICULTURAL PRODUCTS BASED ON HOUSEHOLD CONSUMPTION APPROACH

The medium and long term demand for foodgrains, dairy and horticultural commodities based on household consumption behaviour is presented in Tables 3.4 and 3.5. The demand estimates for household consumption are calculated separately for rural and urban using the base year consumption as given in Table 3.2 and the projected population estimates as presented in Table 3.1. Total demand is calculated by adding indirect demand (Table 3.3) to the household consumption demand. As mentioned earlier, the household consumption approach is static in nature as it assumes household tastes and preferences remain constant with the rise in income thereby household consumption pattern does not change over time. As per this approach, the household demand for rice would increase from 83 million tonnes in the base year to 93 million tonnes in 2021-22 and 105 million tonnes by 2033-34. Similarly, wheat demand for household consumption will increase from 64 million tonnes in the base year to 73 million tonnes in 2021-22 and further to 83 million tonnes by 2033-34.

Total foodgrains demand would increase from 167 million tonnes in the base year to 189 million tonnes in 2021-22 and 215 million tonnes by 2033-34. Adding the indirect demand, the total demand for foodgrains that was 242 million tonnes during the base year is expected to increase to 258-260 million tonnes during the forgoing financial year (2016-17), 280-285 million tonnes by 2021-22 and 340-355 million tonnes by 2033-34. The edible (vegetable) oils demand (excluding palm oil) would increase from around 10 million tonnes at the base year to 14-15 million tonnes in 2021-22 and 19-21 million tonnes by 2033-34. Demand for dairy and horticultural products is presented in Table 3.5. Demand for liquid milk for household consumption is expected to increase from 68 million kilolitres in the base year to 78 million kilolitres in 2021-22 and reach 90 million kilolitres by 2032-33. Sugar demand will increase from 12 million tonnes in the base year to 15 million tonnes by 2032-33 while meat and meat products demand will increase from 10 million tonnes to 13 million tonnes during the same time period. Demand for fruits and vegetables will increase from 129 million tonnes in 2011-12 to 147 million tonnes in 2021-22 and 167 million tonnes in 2032-33 as per static household consumption behaviour. The aggregate demand for milk will touch 220 million kilolitres in 2032-33, sugar will be 46 million tonnes, eggs, fish and meat will be 25 million tonnes and fruits and vegetables demand will exceed 420 million tonnes during the forecast period.

Table 3.4: Demand for Foodgrains based on Actual Consumption in 2011 NSS Family Budget Survey (million tonnes)

Year	Total Demand						
	Rice	**Wheat**	**CCs**	**Cereal**	**Pulses**	**Food grains**	**Edible Oil**
2011-12	94	90	38	222	20	**242**	10
2012-13	93	78	35	206	22	**228**	11
2016-17	**104**	**91**	**40-41**	**235-237**	**23**	**258-260**	**13**
2020-21	110	97-98	45-48	252-255	24-25	**275-280**	14
2021-22	111	99	46-50	256-260	24-25	**280-285**	14-15
2028-29	119-120	110-111	57-64	286-295	27-29	**313-324**	17-18
2032-33	125	117-118	65-74	306-318	28-31	**334-349**	19-20
2033-34	126	119-120	67-77	311-324	28-31	**340-355**	19-21
	Household Demand						
2011-12	83	64	8	155	12	**167**	10.66
2012-13	84	65	9	157	12	**169**	10.81
2016-17	**88**	**68**	**9**	**165**	**13**	**178**	**11.43**
2020-21	92	72	9	174	14	**187**	12.09
2021-22	93	73	9	176	14	**189**	12.25
2028-29	100	79	10	189	15	**204**	13.35
2032-33	104	82	10	197	16	**213**	14.02
2033-34	105	83	10	199	16	**215**	14.20

Table 3.5: Demand for dairy and horticultural commodities based on actual consumption in 2011 NSS Family Budget Survey

Item	**2011-12**	**2012-13**	**2016-17**	**2020-21**	**2021-22**	**2028-29**	**2032-33**
Total demand including indirect uses							
Liquid milk (Million kilolitre)	118.34	121.06	136.85	153.40	157.89	193.75	219.02
Milk and Products (Million tonnes)	119.38	122.12	137.99	154.62	159.13	195.13	220.49
Sugar (Million tonnes)	34.74	35.48	36.53	39.66	40.26	44.25	46.37
Eggs (Million no)	70.56	72.89	84.95	99.45	103.54	138.39	164.81
Eggs, Fish & Meat (Million tonnes)	11.64	11.89	13.00	14.75	15.28	20.33	25.01
Vegetables (Million tonnes)	152.14	154.10	167.22	183.60	188.01	222.05	245.45
Fruits (Million tonnes)	88.13	80.39	97.87	113.88	118.01	151.80	175.91
Dry nuts (Million tonnes)	1.64	1.67	1.77	1.88	1.91	2.10	2.22
HouseholdDemand							
Liquid milk (Million kilo litre)	68.13	69.08	73.04	77.24	78.30	85.28	89.56
Milk and Products (Million tonnes)	69.17	70.14	74.18	78.46	79.54	86.66	91.04
Sugar (Million tonnes)	11.72	11.88	12.54	13.24	13.41	14.56	15.25
Eggs (Million no)	33.90	34.41	36.54	38.82	39.39	43.27	45.67
Fish & Prawn (Million tonnes)	3.81	3.86	4.07	4.28	4.34	4.69	4.90
Eggs, Fish & Meat (Million tonnes)	10.11	10.25	10.84	11.46	11.62	12.65	13.28
Vegetables (Million tonnes)	102.20	103.56	109.16	115.07	116.54	126.18	132.04
Fruits (Million tonnes)	26.05	26.44	28.05	29.76	30.19	33.10	34.90
Dry nuts (Million tonnes)	1.64	1.67	1.77	1.88	1.91	2.10	2.22

FOODGRAINS DEMAND BASED ON 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 29 kg for those involved in moderate activities. Assuming that the norm for sedentary activity represents the requirement of total population, demand for foodgrain at the end of 2020-21is projected to be 201 million tonnes for household consumption and 289-294 million tonnes for total consumption. By the end of 2032-33 household consumption demand would rise to 231 million tonnes and total demand would range 356-372 million tonnes (Table 3.6). If ICMR recommendation for moderate activity is taken to represent average requirement of the whole population the level of foodgrain demand would increase to 239 million tonnes for household consumption and 328-332 million tonnes for total consumption by 2020-21. By the end of 2032-33 household consumption demand would increase to 277 million tonnes and total demand would exceed four hundred million tonnes as the estimates stand at 402-418 million tonnes.

Table 3.6 a: Demand for Foodgrains as per Normative Approach based on Calorie Requirement (ICMR)

Period	Usage type	Commodity	Sedentary*	Moderate$
2032-33	Household Consumption	Cereals	192	231
		Pulses	40	46
		Foodgrains	231	277
	Total Consumption	Cereals	304-317	343-356
		Pulses	52-55	59-61
		Foodgrains	**356-372**	**402-418**
2020-21	Household Consumption	Cereals	167	200
		Pulses	34	40
		Foodgrains	201	239
	Total Consumption	Cereals	245-248	278-281
		Pulses	44-45	50-51
		Foodgrains	**289-294**	**328-332**

Note:

* Cereals=122 kg per person per annum; Pulses = 25 kg per person per annum

$ Cereals=146 kg per person per annum; Pulses = 29 kg per person per annum

Table 3.6 b: Demand for Fruits, Vegetables and other products for household consumption based on Calorie Requirement (ICMR) as per Normative Approach

Items	per capita per day consumption (in gms)	per capita per annum consumption (in kg)	Consumption in 2020-21 (million tonnes)	Consumption in 2032-33 (million tonnes)
Green leafy	50	18.3	25	29
Other vegetables	150	54.8	75	87
Roots & Tubers	100	36.5	50	58
Total vegetables	300	109.5	150	173
Fruits	100	36.5	50	58
Nuts & oil seeds	25	9.1	12	14
Fats & Oils	30	11.0	15	17
Sugar/Jaggery	40	14.6	20	23
Milk and products	250	91.3	125	145
Animal foods	60	21.9	30	35

In the case of animal products and fruits and vegetables, demand for milk and products for household consumption would go up to 145 million tonnes by 2032-33; fruits and vegetable demand would increase to 231 million tonnes and sugar demand for household consumption would increase to 23 million tonnes at the end of forecast period.

BEHAVIOURAL APPROACH

The third approach for assessing demand projections is the Behaviouristic Approach which is based on the growth of population and changing behaviour of consumption on account of changing per capita income in a growing economy, measured in terms of consumption expenditure elasticities. The demand projections are obtained using the following model:

$$Q_{ijt} = q_{ij0} * P_{jt} * (1+g_{jt} * e_{ij})^t$$

Where Q_{ijt} is household demand for i^{th} commodity for the j^{th} sub group (rural or urban) during the t^{th} time period; q_{ij0} is the annual per capita quantity consumed of i^{th} commodity by the j^{th} sub group during the base year (2011-12); P_{jt} is the projected population of j^{th} sub group in the year t; g_{jt} is annual growth rate in per capita income for the j^{th} sub group during the t^{th} time period; and e_{ij} is the expenditure elasticity of the i^{th} commodity for the j^{th} sub group. The demand projections are done for rural and urban households in the baseline and high growth scenarios. Finally by adding rural and urban sectors predicted demand, we arrive at the national demand for various foodgrains, edible oils, animal and horticultural products.

Table 3.7: Projected Growth Rate in GDP and Per Capita in Different Scenarios

	Baseline Scenario (6%)			High growth Scenario - I 8%			High growth Scenario - II 10%		
	Total	**Rural**	**Urban**	**Total**	**Rural**	**Urban**	**Total**	**Rural**	**Urban**
GDP (% per annum)									
2011-12*	6.69	6.45	6.90	6.69	6.45	6.90	6.69	6.45	6.90
2012-13*	4.47	3.69	5.18	4.47	3.69	5.18	4.47	3.69	5.18
2016-17	6.00	5.21	6.68	8.00	7.19	8.69	10.00	9.18	10.70
2020-21	6.00	5.21	6.64	8.00	7.19	8.65	10.00	9.18	10.66
2021-22	6.00	5.21	6.63	8.00	7.19	8.64	10.00	9.18	10.66
2028-29	6.00	5.21	6.58	8.00	7.19	8.59	10.00	9.18	10.60
2032-33	6.00	5.21	6.55	8.00	7.19	8.56	10.00	9.18	10.57
2033-34	6.00	5.21	6.54	8.00	7.19	8.55	10.00	9.18	10.56
GDP Per Capita (% per annum)									
2011-12*	5.13	5.38	4.19	5.13	5.38	4.19	5.13	5.38	4.19
2012-13*	3.15	2.89	2.70	3.15	2.89	2.70	3.15	2.89	2.70
2016-17	4.68	4.45	4.21	6.68	6.43	6.22	8.68	8.42	8.23
2020-21	4.68	4.49	4.17	6.68	6.47	6.18	8.68	8.46	8.19
2021-22	4.73	4.54	4.21	6.73	6.53	6.22	8.73	8.51	8.23
2028-29	4.87	4.76	4.29	6.87	6.75	6.30	8.87	8.73	8.31
2032-33	4.87	4.82	4.26	6.87	6.80	6.27	8.87	8.79	8.28
2033-34	4.87	4.83	4.26	6.87	6.81	6.27	8.87	8.80	8.28

Note: * For 2011-12 and 2012-13 the growth rates are actual.

The baseline assumes GDP growth rate of 6 percent per annum for the forecast period, i.e., 2012-13 to 2032-33. The high growth scenario is worked out for more ambitious growth rate of 8 percent per annum and also for very high growth rate of 10 percent per annum for the forecast period. However, given the past achievements of Indian economy and given the forecast period of almost two decades, persistent 8 percent per annum growth in GDP appears to be more realistic whereas two digit growth for two decades might be inaccessible. Therefore the working group decided to stick with the baseline and high growth scenario of 8 percent and renounce 10 percent growth scenario. The rural and urban share of GDP growth was calculated using the historical data available from the National Accounts Statistics for the quinquennial rounds of NSS. Contribution of rural sector in total GDP is expected to come down from 47.4 percent in 2011 to 44 percent in 2020-21 and 40 percent in 2032-33.

For estimating expenditure elasticities, Almost Ideal Demand System (AIDS) was estimated using NSS unit level household budget data from 47th up to 68th Round for household expenditure shares. For corresponding prices data, Wholesale Price Indices collected by the Office of Economic Adviser, Ministry of Commerce, Government of India was used to obtain the estimates of expenditure elasticities. The elasticity estimates are presented in Table 3.8.

Table 3.8: Expenditure Elasticities based on AIDS Model

Commodity	Rural	Urban
Cereals	- 0.13	- 0.04
Pulses	0.55	0.36
Edible oils	0.88	0.37
Fruits and Vegetables	0.85	0.42
Milk	0.82	0.40
Meat	0.82	0.40

HOUSEHOLD DEMAND FOR FOODGRAINS, EDIBLE OILS, ANIMAL AND HORTICULTURAL PRODUCTS

The projected demand for foodgrains and edible oils for the above mentioned two scenarios is presented in Table 3.9 and the total demand including the indirect demand for seed, feed, wastage and other industrial uses is presented in Table 3.10. In the baseline scenario, the foodgrains demand for household consumption is expected to increase from 167 million tonnes in 2011-12 to 183 million tonnes by 2020-21 and 205 million tonnes by 2032-33. This increase in demand of foodgrains would be on account of increase in demand for rice and wheat while demand for other inferior cereals following the past trends will continue to decline on account of rising income. Demand for pulses for household consumption will increase from around 12 million tonnes in 2011-12 to 16 million tonnes by 2020-21 and will touch 25 million tonnes during the projection period up to 2032-33. Oilseed demand (excluding palm oil) will increase at a rapid rate from present level of 38 million tones to above 56 million tones by the end 2020-21 and touch 100 million tones by 2032-33.

Expenditure elasticity of cereals in the rural as well as urban sector was estimated as negative. With growth and rising income in the economy, people tend to diversify their consumption basket towards more nutritious but more expensive commodities like fruits, vegetables and meat. With the increase in population there would be higher demand for cereals and pulses but with higher income shift will take place towards high value crops. The net demand of cereals would depend on the net effect of rising population and rising income. If the future income grows at a rate of 8 percent per annum, there will be positive effect on demand for cereals on account of higher population but negative effect due to higher income. In the high growth scenario, foodgrains demand will increase up to 183 million tonnes by the end of 2021-22 and will further increase to 203 million tonnes by the end of 2032-33. In this scenario, the breakup of foodgrains demand by 2032-33 would be 95 million tonnes of rice, 73 million tonnes of wheat, 6 million tonnes of coarse-grains and 30 million tonnes of pulses. This decline in demand with high growth will not only be in coarse cereals but also in superior cereals like wheat and rice. Demand for pulses will however increase in high growth rate scenario. It is interesting to note that in both the scenarios, growth rate in demand of cereals including the demand of individual cereals, e.g., rice,

wheat or coarse grains would be less than that of population growth rate. On the other hand, the growth in demand of pulses for human consumption will far exceed that of population growth rate in all the three scenarios and thereby may have adverse effect on the food security of future.

Table 3.9: Demand for Foodgrains based on Behavioural Approach – Household Consumption (million tonnes)

	Rice	Wheat	Other cer	Total cer	Pulses	Foodgrain	Edible oil	Oilseeds (28%)
Baseline (growth rate of GDP at 6% per annum)								
2011-12 Actual	82.71	64.04	8.44	155.20	11.98	167.17	10.66	38.1
2012-13	83.56	64.70	8.42	156.65	12.31	168.99	11.02	39.4
2016-17	86.57	66.90	8.06	161.26	14.23	175.76	13.27	47.4
2020-21	89.76	69.31	7.77	166.31	16.32	183.17	15.82	56.5
2021-22	90.51	69.87	7.68	167.44	16.92	184.99	16.57	59.2
2028-29	94.98	73.29	7.07	174.08	21.53	196.87	22.73	81.2
2032-33	97.67	75.43	6.77	178.19	24.62	204.49	27.13	96.9
2033-34	98.35	75.98	6.71	179.24	25.46	206.49	28.36	101.3
High growth (growth rate of GDP at 8% per annum)								
2012-13	83.56	64.70	8.42	156.65	12.31	168.99	11.02	39.4
2016-17	85.97	66.27	7.70	159.54	14.90	174.85	14.18	50.7
2020-21	88.67	68.15	7.18	163.18	17.75	181.75	17.85	63.8
2021-22	89.28	68.58	7.04	163.96	18.58	183.47	18.96	67.7
2028-29	92.83	71.09	6.14	168.15	25.21	195.27	28.66	102.4
2032-33	94.96	72.71	5.73	170.87	29.90	203.31	36.21	129.3
2033-34	95.50	73.14	5.64	171.58	31.21	205.48	38.40	137.2

The expenditure elasticity for edible (vegetable) oils was positive and its magnitude was higher than foodgrains, both in rural as well as urban sectors. Accordingly, with the increase in population, demand for edible oils is expected to increase. Positive elasticity indicates that growth in income would work as an accelerator for future demand not only for edible oils but also for the other high value commodities. The edible oils demand for household consumption is expected to increase from 11 million tonnes in the base year (2011-12) to 15 million tonnes by the end of 2020-21 and up to 27 million tonnes by 2032-33 with the baseline growth rate of 6 percent per annum. However, if the future economy grows at a higher growth rate of 8 percent per annum, the demand for edible oils for household consumption would be up to 18 million tonnes by the end of 2020-21 and 36 million tonnes by the end of 2032-33. The growth rate in demand of edible oils would exceed 3 percent per annum in the baseline scenario and 5 percent in the high growth scenario. Thus, demand for edible oils is expected to increase at a much faster rate as compared to demand for foodgrains for household consumption in both the three scenarios.

Table 3.10: Demand for Foodgrains based on Behavioural Approach – Total Consumption

(million tonnes)

	Rice	Wheat	Other cer	Total cer	Pulses	Foodgrain	Edible oil	Oilseeds (28 %)
Baseline (growth rate of GDP at 6% per annum)								
2011-12 Actual	93.99	90.01	38.00	221.99	20.31	242.30	9.55	34.11
2012-13	92.45	78.11	34.58	205.14	22.17	227.31	11.52	41.13
2016-17	103.02	89.51	38.98	231.50	23.91	255.41	14.75	52.67
2020-21	107.08	94.45	43.36	244.89	26.64	271.53	17.79	63.54
2021-22	108.05	95.68	44.54	248.28	27.40	275.68	18.69	66.76
2028-29	114.19	104.38	54.21	272.77	33.22	306.00	26.22	93.65
2032-33	117.89	110.00	61.04	288.93	37.07	326.00	31.78	113.49
2033-34	118.83	111.48	62.91	293.22	38.11	331.33	33.36	119.13
High growth (growth rate of GDP at 8% per annum)								
2012-13	92.45	78.11	34.58	205.14	22.17	227.31	11.52	41.13
2016-17	102.54	89.09	40.05	231.67	25.05	256.72	15.67	55.95
2020-21	106.20	93.72	45.70	245.61	28.96	274.58	19.83	70.80
2021-22	107.07	94.88	47.27	249.21	30.07	279.28	21.08	75.30
2028-29	112.48	103.14	60.40	276.02	38.90	314.91	32.16	114.85
2032-33	115.76	108.58	69.87	294.21	45.03	339.23	40.86	145.93
2033-34	116.60	110.02	72.48	299.10	46.71	345.81	43.40	154.99

The aggregate demand for foodgrains is projected to increase in the baseline scenario from 242 million tonnes in 2011-12 to 271 million tonnes by the end of 2020-21 and 326 million tonnes by the end of 2032-33 if the economy grows at 6 percent per annum growth rate. If future economic growth catches up with 8 percent per annum, aggregate demand for foodgrains would approach 275 million tonnes by 2020-21 and will touch 340 million tonnes by the end of 2032-33. In the case of superior cereals, aggregate demand of wheat would come closer to that of rice because of increased demand of wheat as feed for animal use. The aggregate demand for these two cereals is expected to exceed 100 million tonnes each by the end of 2032-33. In the case of coarse cereals, aggregate demand is expected to increase whereas for household consumption their demand was expected to either remain constant or decline by 2032-33. The aggregate demand of coarse cereals can increase from 38 million tonnes in 2011-12 to around 61-70 million tonnes in 2032-33 in different growth scenarios. Similarly, aggregate demand for pulses is expected to increase from 20 million tonnes in the baseline scenario and would go up to 37 to 45 million tonnes depending upon various growth scenarios. Lastly, the oilseeds demand (excluding palm oil) would increase at a much faster rate as compared to foodgrains demand and could increase from 34 million tonnes of baseline scenario to up to 113 to 145 million tonnes by 2032-33 among different growth scenarios. Against the case of foodgrains in which case human demand is expected to decline if the economy grows at a faster rate, the demand for edible oils as well as pulses will increase at a higher rate in consonance with the higher growth rate of per capita income.

Using expenditure elasticities of milk, meat and fruits and vegetables as given in Table 3.8 and base year per capita expenditure for 2011-12 as given in Table 3.2 above, the forecasts have been

worked out for milk and meat products and fruits and vegetables for household consumption. The forecasts are presented in Table 3.11. The demand for milk and meat products as well as horticultural products is expected to increase at much faster rate as compared to demand for foodgrains. The expenditure elasticity for all these commodities is positive and its volume is close to unity in rural areas while it is around half of that in urban areas indicating diversification of consumption basket happening in rural areas whereas urban consumer advanced to this process much earlier. The demand for milk products for household consumption is expected to increase from 69 million tonnes in 2011-12 to cross 100 million tonnes by 2020-21 to touch around 170 million tonnes in 2032-33 if the economy grows at 6 percent per annum. In the high growth scenario, the demand will expand upto 225 million tonnes by 2032-33. Similarly, meat including fish demand will increase from 10 million tonnes from the base year of 2011-12 to 26 million tonnes by 2032-33 in the baseline scenario and 33 million tonnes in the high growth scenario.

Demand for horticultural products including fruits and vegetables will increase from 128 million tonnes in the base year of 2011-12 to around 190 million tonnes by 2020-21 and further to 327 million tonnes by 2032-33 in the baseline scenario. In the high growth scenario, demand will increase up to 215 million tonnes in 2020-21 and cross 430 million tonnes by 2032-33. The growth in demand for these high value commodities for household consumption will be slightly less than 5 percent per annum in the baseline scenario that would exceed 6 percent per annum in the high growth scenario. The aggregate demand for milk and milk products can touch 300-355 million tonnes in 2032-33 while meat and meat products can rise up to 37-45 million tonnes. The aggregate demand for fruits and vegetables could be as high as 580 to 690 million tonnes depending on various growth scenarios.

Table 3.11: Demand for dairy and horticulture based on Behavioural Approach – Household Consumption (million tonnes)

Year	Milk and products	Eggs, fish and meat	Vegetables	Fruits	Nuts	Fruitsand vegetables
Actual demand						
2011-12	69.17	10.11	102.20	26.05	1.64	128.25
Baseline (growth rate of GDP at 6.0 percent per annum)						
2012-13	71.48	10.45	105.67	26.94	1.70	132.61
2016-17	85.66	12.52	127.33	32.41	2.04	159.74
2020-21	101.66	14.86	151.89	38.61	2.43	190.5
2021-22	106.39	15.56	159.19	40.44	2.55	199.63
2028-29	144.49	21.13	218.46	55.28	3.48	273.74
2032-33	171.43	25.07	260.74	65.82	4.14	326.56
2033-34	178.96	26.17	272.60	68.77	4.33	341.37
High growth (growth rate of GDP at 8% per annum)						
2012-13	71.48	10.45	105.67	26.94	1.70	132.61
2016-17	91.35	13.36	136.37	34.58	2.18	170.95
2020-21	114.19	16.70	171.91	43.41	2.73	215.32
2021-22	121.07	17.71	182.69	46.07	2.90	228.76
2028-29	180.28	26.38	276.52	69.13	4.34	345.65
2032-33	225.61	33.02	349.29	86.89	5.45	436.18
2033-34	238.69	34.93	370.42	92.03	5.77	462.45

Table 3.12: Demand for dairy and horticulture based on Behavioural Approach – Total Consumption (million tonnes)

Year	Milk and products	Eggs, fish and meat	Vegetables	Fruits	Nuts	Fruits and vegetables
Actual demand						
2011-12	119.38	11.64	152.14	88.13	1.64	240.27
Baseline (growth rate of GDP at 6.0 percent per annum)						
2012-13	123.46	12.08	156.21	80.90	1.70	237.11
2016-17	149.47	14.68	185.39	102.24	2.04	287.63
2020-21	177.82	18.15	220.41	122.73	2.43	343.14
2021-22	185.99	19.21	230.65	128.26	2.55	358.91
2028-29	252.96	28.80	314.33	173.97	3.48	488.3
2032-33	300.89	36.80	374.15	206.84	4.14	580.99
High growth (growth rate of GDP at 8% per annum)						
2012-13	123.46	12.08	156.21	80.90	1.70	237.11
2016-17	155.16	15.51	194.43	104.41	2.18	298.84
2020-21	190.35	19.99	240.44	127.53	2.73	367.97
2021-22	200.67	21.37	254.16	133.89	2.90	388.05
2028-29	288.74	34.05	372.39	187.82	4.34	560.22
2032-33	355.06	44.74	462.70	227.90	5.45	690.61

SUPPLY PROJECTIONS

For supply projections of foodgrains and oilseeds, a simultaneous equation model has been used for the historical data period from 1980–81 to 2015–16. The set of equations include four simultaneous equations to estimate the parameters for the dependent variables. These four determined variables were area, yield, farm harvest price (in real terms), and quantity of exports. For horticultural crops like fruits and vegetables and other commercial crops, like cotton and sugarcane only area and yield equations were estimated. The specification of equations estimated are given below:

i) Area = f (P_i, P_j, Rain, Irrg, Fert/Fertp, Trend, Lagged)

ii) Yield = f (P_i, Rain, Irrg, Fert/Fertp, Trend, Lagged)

iii) Real dom price = f (MSP, WP, Prod, WI, PD, Trend, Lagged)

iv) Exports = f (P_i, WP, Prod, Open, PD, WT, WI, REER, Trend, Lagged)

Where

P_i is real domestic (farm harvest) price;

P_j is real competing crop price;

Rain is rainfall – annual, monsoon or winter months as applicable in different cases;

Irrg is percentage of area under irrigation

Fert is fertilizer use in kgs per hectare;

Fertp is real fertilizer price;

MSP is real minimum support price;

WP is real world price or real unit value of exports;

WI is real world income;

PD is policy dummy;

Open is openness in terms of share of Indian exports in the world exports commodity wise; WT is volume of world trade in a particular commodity. REER is real effective exchange rate

The estimated elasticities are then used to forecast area and yield for the forecast period. The key relationships captured in the model are the following. Production is estimated using crop area and yield equations. The factors influencing area and yield were both price and non price factors like the lagged yield and area under the crop, lagged price of the crop relative to the price of other commodities competing with it for land and other inputs, irrigated area, and prices of fertilisers relative to crop price. Net exports are modelled as a function of world income, export prices, domestic production, domestic prices and the exchange rate. Domestic price is estimated as a function of domestic production, MSP, export price and own lagged value.

Based on a set of assumptions relating to exogenous variables, the estimated set of equations have been used to project the area and yield in the case of rice, wheat, coarse cereals, pulses, oilseeds, cotton, sugarcane and fruits and vegetables. Two sets of projections are done based on growth of exogenous variables. The supply projections based on the econometric model are presented in Table 3.16 and 3.17. Before discussing the supply projection based on econometric model, Tables 3.13 to 3.15 present supply projections based on exponential growth rates in the historical data for area and yield at all India and major growing states, respectively. The projections are worked out assuming area under the respective crop and its yield continues growing at the rate of past trends. If the trend growth follows the pattern of past 10 years at all India, the production of foodgrains will grow up to 312 million tonnes by the end of 2020-21 and 415 million tonnes by 2032-33. On the other hand if growth follows the pattern of past 15 years, production will be 303 million tones in 2020-21 and 405 million tones in 2032-33.

Table 3.13: Supply - Production Estimates Based on Growth Trends at All India
(All in million tonnes except cotton and jute & mesta in million bales)

	Rice	Wheat	CC	Cereals	Pulses	Foodgrains	Oilseeds	Cotton	S cane	J&M
Exponential Growth Rate of Past 10 Years										
2015	104.41	92.29	38.52	235.22	16.35	251.57	25.25	30.01	348.45	10.52
2016	110.15	98.38	44.19	252.72	22.95	275.67	32.10	33.09	306.72	10.60
2017	112.08	101.45	45.33	258.85	23.80	282.65	32.70	35.59	312.31	10.63
2020	118.06	111.23	48.97	278.25	26.55	304.81	34.68	44.27	329.71	10.74
2021	120.12	114.69	50.26	285.07	27.55	312.62	35.40	47.61	335.72	10.78
2028	135.62	142.17	60.50	338.29	35.73	374.02	41.29	79.23	380.99	11.03
2029	138.00	146.60	62.15	346.75	37.10	383.85	42.27	85.21	387.94	11.06
2032	145.36	160.74	67.46	373.56	41.55	415.11	45.44	105.99	409.55	11.17

Exponential Growth Rate of Past 15 Years										
2015	104.41	92.29	38.52	235.22	16.35	251.57	25.25	30.01	348.45	10.52
2016	110.15	98.38	44.19	252.72	22.95	275.67	32.10	33.09	306.72	10.60
2017	112.19	100.91	45.45	258.54	23.71	282.25	33.38	36.85	313.35	10.62
2020	118.52	108.88	49.50	276.91	26.17	303.08	37.59	50.90	334.11	10.67
2021	120.71	111.68	50.96	283.35	27.05	310.40	39.11	56.68	341.34	10.69
2028	137.23	133.36	62.89	333.48	34.21	367.69	51.84	120.41	396.46	10.82
2029	139.76	136.79	64.88	341.43	35.39	376.82	53.99	134.09	405.03	10.84
2032	147.66	147.60	71.35	366.60	39.21	405.81	61.03	185.19	431.87	10.90

Similarly oilseeds production will range 45-61 million tonnes in these two scenarios, cotton production would grow up to 106-185 million bales and sugarcane production rise up to 410-439 million tones by the end of 2032-33. We also used exponential growth trends in the major states growing these commodities. For generating state scenario, instead we used longer period growth as fluctuations were much higher at the state level especially in the yield. If we consider the growth trends in the major growing states, our range of projection was more or less closer to the all India estimates. The foodgrains production would touch 378 to 397 million tones by 2032-33 as per area and yield trends at the state level with past 25 and 35 years of trend growth pattern. Oilseeds would grow in the range of 60 to 79 million tonnes and cotton and sugarcane would be 82-105 million bales and 395-437 million tones, respectively.

Table 3.14: Supply - Production Estimates Based on Growth Trends at State Level
(All in million tonnes except cotton and jute & mesta in million bales)

	Rice	Wheat	CC	Cereals	Pulses	Foodgrains	Oilseeds	Cotton	S cane	J&M
Exponential Growth Rate from 1990-91 to 2014-15										
2015	104.41	92.29	38.52	235.22	16.35	251.57	25.25	30.01	348.45	10.52
2016	110.15	98.38	44.19	252.73	22.95	275.68	32.10	33.09	306.72	10.60
2017	111.94	100.46	45.09	257.49	23.08	280.57	33.21	35.41	311.31	10.74
2020	117.52	107.00	48.15	272.68	23.53	296.21	36.95	43.59	325.75	11.18
2021	119.46	109.30	49.30	278.06	23.71	301.77	38.34	46.77	330.81	11.33
2028	134.14	127.15	59.79	321.08	25.44	346.52	50.59	77.93	370.01	12.51
2029	136.41	129.98	61.72	328.11	25.75	353.87	52.76	84.00	376.20	12.70
2032	143.50	138.95	68.35	350.80	26.83	377.63	60.03	105.53	395.79	13.27

Exponential Growth Rate from 1980-81 to 2014-15										
2015	104.41	92.29	38.52	235.22	16.35	251.57	25.25	30.01	348.45	10.52
2016	110.15	98.38	44.19	252.73	22.95	275.68	32.10	33.09	306.72	10.60
2017	112.49	100.99	44.88	258.36	23.25	281.61	33.78	34.95	313.40	10.78
2020	119.86	109.27	47.17	276.30	24.21	300.52	39.56	41.26	334.47	11.36
2021	122.44	112.19	48.03	282.65	24.57	307.22	41.76	43.63	341.87	11.57
2028	142.36	135.10	55.47	332.93	27.57	360.50	62.14	64.97	399.27	13.17
2029	145.49	138.76	56.79	341.04	28.09	369.13	65.92	68.84	408.35	13.43
2032	155.36	150.40	61.22	366.97	29.77	396.74	78.96	81.97	437.04	14.23

Similar to food grains and oilseeds, we also used area and yield trends for last 10 and 15 years at all India level to predict area and production of horticultural commodities, i.e., fruits and vegetables. As growth trends are much higher in the case of horticultural commodities, our projections for these commodities are also more striving. With the growth trends of last one decade in area and yield, India will increase horticultural production from the present level of around 300 million tonnes to jump to above 635 million tonnes in 2032-33 in which fruits will grow from present level of 94 million tonnes to around 195 million tonnes and vegetable will grow from around 176 million tonnes of present level to above 365 million tonnes in 2032-33. On the other hand, if we consider 15 years growth period for area and yield, the fruits production will increase up to 227 million tonnes, vegetable production will touch above 390 million tonnes and aggregate horticultural production will advance to above 680 million tonnes in 2032-33.

In the case of livestock products, growth trends in production were used for last 10 and 15 years as unlike foodgrains and horticultural commodities the data for these commodities is available for production alone. The milk production at present lies around 155 million tonnes which is expected to grow up to 326 to 333 million tonnes by 2032-33. Eggs prodution would grow from 83 billion in 2015-16 to around 215 billion by 2032-33. However, wool production may rise only marginally from 49 million kg to 56 million kg. Meat that includes, beef/buffalo meat, mutton, goat, pig and poultry meat is expected to increase from present level of 7 million tonnes to around 40 to 45 million tonnes while fish production will increase from 11 million tonnes to around 25 million tonnes.

Table 3.15a: Area and Production Estimates Based on Growth Trends at All India

Year	Fruit	Vegetables	Horticulture	Fruit	Vegetables	Horticulture
Production estimates - million tones						
Exponential Growth Rate of Past 10 Years				**Exponential Growth Rate of Past 15 Years**		
2015	90.18	169.06	286.19	90.18	169.06	286.19
2016	93.71	176.18	299.85	93.71	176.18	299.85
2017	98.11	184.40	314.31	99.04	185.26	315.65
2020	112.59	211.43	361.99	116.95	215.39	368.22
2021	117.87	221.29	379.44	123.61	226.49	387.62
2028	162.52	304.50	527.55	182.15	321.96	555.28
2029	170.15	318.71	552.98	192.53	338.55	584.54
2032	195.27	365.43	636.87	227.33	393.63	681.89
Area estimates - million hectares						
2015	6.30	10.11	24.47	6.30	10.11	24.47
2016	6.46	10.30	25.11	6.46	10.30	25.11
2017	6.58	10.64	25.81	6.72	10.67	25.82
2020	6.96	11.76	28.02	7.57	11.86	28.09
2021	7.09	12.16	28.80	7.88	12.29	28.88
2028	8.07	15.36	34.88	10.41	15.76	35.14
2029	8.22	15.88	35.85	10.83	16.32	36.14
2032	8.70	17.54	38.92	12.20	18.16	39.31

Table 3.15b: Production Estimates Based on Growth Trends at All India

Year	Milk (million tonnes)	Eggs (billion numbers)	Wool (million kgs)	Meat (million tonnes)	Fish (million tonnes)
Exponential Growth Rate of Past 10 Years					
2015	155.5	82.9	48.5	7.0	11.0
2016	162.6	87.8	48.9	7.8	11.5
2017	170.1	92.9	49.4	8.7	12.1
2020	194.6	110.0	50.6	12.1	14.0
2021	203.5	116.4	51.1	13.5	14.7
2028	278.5	173.0	54.2	29.0	20.7
2029	291.3	183.1	54.7	32.4	21.8
2032	333.2	217.0	56.1	45.0	25.2
Exponential Growth Rate of Past 15 Years					
2015	155.5	82.9	47.9	7.0	10.9
2016	162.4	87.7	47.7	7.8	11.3
2017	169.7	92.8	47.5	8.6	11.8
2020	193.4	109.7	46.8	11.7	13.4
2021	202.0	116.0	46.6	12.9	13.9
2028	274.1	171.7	45.1	26.4	18.6
2029	286.3	181.6	44.9	29.2	19.3
2032	326.3	214.9	44.3	39.7	21.9

However, projections using econometric model are more scientific and have better probability of projection of future as compared to projection based on linear/exponential trend growth rates. The econometric model indicates that production of foodgrains is likely to increase in the coming years from the present level of above 275 million tonnes to 289-298 million tonnes by the end of 2020-21 and 343-379 million tones by the end of 2032-33. The major increase is likely to come from wheat and rice and slight increase in coarse grains and pulses. Similarly, oilseeds production will also increase in the short and medium term, contributed both by area expansion and yield increase. The oilseeds production will increase from the present level of 32 million tonnes to achieve 48-65 million tonnes by 2032-33. On the overall, growth in production for the predicted period in the case of foodgrains could be slightly less or more than the historical period but not very different than what has been achieved during the last one decade. On the other hand, given the price and other incentives for oilseeds (programme like ISOPOM, Palm oil and so on) the predicted growth in production of oilseeds will significantly be higher than the observed growth in the historical period. Similarly, cotton would continue on high growth path if supported by 2nd and 3rd generation of technology. It would achieve much higher level of production and may cross 100 million bales by 2032-33. Sugarcane in the wake of no technology break through would achieve slight increase in production. The major change may appear in horticulture sector where fruits and vegetables production is expected to increase at much faster rate from present level of above 90 and 170 million tonnes, respectively to achieve, above 200 and 350 million tonnes by 2032-33. The growth rates estimated from the econometric model are based on the projected pattern of the prices of crops and other exogenous variables including advancement of technology and irrigated area in the future, which is supposed to carry on its past behaviour.

Table 3.16: Supply - Production Estimates Based on Three Stage Least Square Estimates
All India (All in million tonnes except cotton in million bales)

	Rice	Wheat	CC	Cereals	Pulses	Foodgrains	Oilseeds	Cotton	S cane
Exponential Growth Rate Pre Liberalisation									
2015	101.7	89.9	36.8	228.4	17.3	245.7	29.6	29.3	338
2016	109.4	97.9	40.0	247.2	18.6	265.8	34.2	36.1	365
2017	112.5	101.2	41.3	255.0	19.2	274.1	35.0	38.2	381
2020	120.9	105.0	42.3	268.2	20.7	288.9	38.0	45.4	407
2021	123.6	105.8	42.4	271.7	21.3	293.1	38.8	48.1	415
2028	142.4	110.2	43.3	295.9	27.2	323.1	44.6	71.9	463
2029	145.2	110.8	43.6	299.6	28.2	327.8	45.5	76.1	468
2032	154.1	112.6	44.3	311.0	32.0	343.0	48.5	90.5	482

Exponential Growth Rate Post Liberalisation									
2015	102.1	89.5	37.4	228.9	17.3	246.2	29.9	29.7	335
2016	110.2	93.9	40.6	244.7	18.8	263.5	35.0	36.7	360
2017	113.8	96.3	42.5	252.5	19.5	272.1	36.1	39.4	372
2020	123.7	101.7	45.7	271.1	21.2	292.3	40.1	48.8	391
2021	126.8	103.3	46.6	276.8	21.9	298.7	41.7	52.4	396
2028	149.7	115.3	53.6	318.6	28.6	347.2	55.5	86.2	434
2029	153.2	117.1	54.7	325.0	29.9	354.9	57.9	92.5	440
2032	164.2	122.6	58.0	344.9	34.3	379.2	65.8	114.5	458

Table 3.17: Area and Production Estimates Based on Regression Analysis All India

	Fruit	Vegetables	Fruit	Vegetables
Production estimates - Million tones				
Exponential Growth Rate (1991 to 2004)			**Exponential Growth Rate (2005 to 2015)**	
2015	87.82	168.71	85.40	167.90
2016	98.45	177.37	93.70	177.06
2017	105.16	184.69	98.31	184.16
2020	120.44	210.19	111.05	208.16
2021	126.01	219.45	115.65	216.83
2028	172.93	296.75	153.69	288.57
2029	180.93	309.83	160.07	300.60
2032	207.23	352.61	180.81	339.76
Area estimates - Million hectares				
2015	6.89	9.61	6.73	9.54
2016	7.62	9.95	7.30	9.86
2017	8.08	10.22	7.59	10.10
2020	9.06	11.19	8.33	10.94
2021	9.41	11.54	8.60	11.24
2028	12.28	14.28	10.70	13.53
2029	12.76	14.72	11.04	13.90
2032	14.30	16.12	12.13	15.05

It is pertinent to see whether production growth would be contributed more by increase in area or by yield rate. The forecasts also present crop wise expected area by 2032-33 (see Appendix Tables 3.1A to 3.3A). It is seen from both trend and econometric model forecasts that there would be hardly any increase in area under foodgrains. Only some increase in area is indicated in the case of pulses whereas area under coarse cereals is expected to further go down. Hence, the entire increase in production in foodgrains is expected to be contributed by expansion in yield that might come either in terms of increase in factor use or shall be contributed by total factor productivity. All other crops including oilseeds, commercial crops and horticultural crops will have some contribution by increased area which would essentially come from diversification away from foodgrains and the large contribution will be by increase in yield rate. Therefore, the projection will come true only if yield expansion takes place for which the role of better use of inputs, new technology and extension and marketing activities would play a very vital role.

THE WORKING GROUP RECOMMENDATIONS ON FINAL PROJECTIONS

Thus, both demand and supply estimates were worked out using three different methods that provide us all the possible ranges for the forecast period. Whereas the static approach demand estimates arrive at 334-350 million tonnes of foodgrains demand during 2032-33, the behaviouristic approach provide us the range of 326-340 million tonnes. Similarly, the supply estimates based on all India and state trends work out around 378-415 million tonnes of foodgrains production while three stage least square model provide the range of 343 to 380 million tonnes in the terminal year of 2032-33. In order to arrive at final estimates for the forecast period, the working group calculated averages of the above sets of estimates and after having a wider discussion with the concerned departments and the experts and policy makers the final figures were worked out for the aggregate demand and supply. Table 3.18 provides the final estimates for demand and Table 3.19 provides final estimates for supply forecasts.

Table 3.18: Demand estimates - million tonnes

Commodity	2011-12	2012-13	2016-17	2020-18	2021-22	2028-29	2029-30	2032-33
Rice	93.99	92.54	103.59	108.16	109.28	116.49	117.56	120.84
Wheat	90.01	78.20	90.18	95.71	97.12	107.08	108.62	113.46
C· Cereals	38.00	34.64	40.02	45.44	46.92	58.98	60.99	67.48
Cereals	221.99	205.37	233.79	249.31	253.31	282.55	287.18	301.78
Pulses	20.31	22.09	23.61	26.05	26.72	31.83	32.64	35.23
Foodgrains	**242.30**	**227.46**	**257.39**	**275.36**	**280.03**	**314.37**	**319.81**	**337.01**
Edible oil (without palmoil)	9.55	11.41	14.08	16.50	17.21	23.24	24.31	27.88
Oilseeds	34.11	40.75	50.30	58.92	61.45	83.02	86.80	99.59
Milk and products	119.38	123.01	147.54	174.26	181.93	245.61	256.43	292.15
Eggs, meat and fish	11.64	12.02	14.40	17.63	18.62	27.73	29.45	35.52
Vegetables	152.14	155.51	182.35	214.82	224.27	302.93	316.33	360.77
Fruits	88.13	80.73	101.51	121.38	126.72	171.20	178.74	203.55
Nuts	1.64	1.69	2.00	2.35	2.45	3.31	3.45	3.94
Sugar	34.74	35.48	36.53	39.66	40.26	44.25	44.77	46.37

Table 3.19: Supply estimates: million tonnes

Commodity	2015-16	2016-17	2017-18	2020-21	2021-22	2028-29	2029-30	2032-33
Rice	104.41	110.15	112.50	119.76	122.19	140.25	143.02	151.69
Wheat	92.29	98.38	100.21	107.18	109.50	127.21	130.00	138.82
C. Cereals	38.52	44.19	44.09	46.96	47.93	55.93	57.29	61.79
Cereals	235.22	252.72	256.79	273.90	279.62	323.38	330.31	352.30
Pulses	16.35	22.95	22.09	23.73	24.35	29.79	30.75	33.95
Foodgrains	**251.57**	**275.67**	**278.88**	**297.63**	**303.97**	**353.17**	**361.06**	**386.25**
Oilseeds	25.25	32.10	34.03	37.81	39.19	51.00	53.07	59.96
Sugarcane	348.45	306.72	333.76	353.67	360.10	407.25	414.16	435.69
Sugar	35.54	31.29	34.04	36.07	36.73	41.54	42.24	44.44
Cotton	30.01	33.09	36.75	45.71	49.20	83.43	90.13	113.94
Jute & mesta	10.52	10.60	10.69	10.99	11.09	11.88	12.01	12.39
Fruit	90.18	93.71	100.15	115.25	120.79	167.83	175.92	202.66
Vegetables	169.06	176.18	184.63	211.29	221.02	302.95	316.92	362.86
Total horticulture	286.19	299.85	314.98	365.10	383.53	541.42	568.76	659.38
Milk	155.50	162.53	169.88	193.97	202.74	276.28	288.77	329.73
Eggs	82.93	87.73	92.81	109.88	116.24	172.38	182.36	215.91
Wool	48.20	48.30	48.40	48.72	48.84	49.69	49.82	50.23
Meat	7.00	7.78	8.65	11.88	13.21	27.71	30.81	42.33
Fish	10.91	11.42	11.94	13.68	14.31	19.64	20.55	23.55

The balance sheet as shown by these two tables looks quite affirmative for foodgrains except the case of pulses and oilseeds in which case India is already in acute deficit. India is poised for some surplus in rice and wheat while coarse grains will be sufficient to meet the domestic demand whereas pulses will have deficit of around 5 to 7 million tonnes. The overall foodgrains will have quite comfortable position as far as food security is concerned. However, the biggest worry would remain that of oilseeds in which case a massive deficit of more than 50 million tonnes will appear which was worked out without including the imported palm oil whose import already exceeded 9 million tonnes in 2014-15. Unless India succeeds in achieving nothing less than second **Yellow Revolution** either through technological breakthrough somewhat similar to BT Cotton, or there is massive expansion in area under oilseeds along with transformation achieved in the yield rate. There is huge possibility of expanding area under oil palm which has much better yield rate compared to oilseed field crops. It is to be noted that the forecasts have been based on two assumptions. On the one hand, oilseeds supply has been estimated based on data for nine major oilseeds as available with the MoA, GoI. On the other hand, all imported edible oils except palm oil

has been considered as demand for edible oils even though some part of these might have been used for other industrial purposes. Therefore interpreting balance sheet in edible oils need more caution. In other commodities including milk, meat, fruits and vegetables and sugar there appears to be fine balance between demand and supply given the assumptions on supply side turns true.

POLICY IMPLICATIONS FOR FOOD SECURITY

The fluctuations in foodgrain balances could be the result of change in either demand or supply. Although, in the long run, production and consumption of foodgrains both move on a stable path, however in the short run foodgrain production is subject to higher fluctuations given the agriculture's dependence on weather and rainfall, as compared to their household consumption. The short run fluctuations in production cause ripples in food security as have been experienced widely by many countries during the recent past. In India, although long run food balances appear to remain in surplus, however, short run fluctuations in production (and in export) can be a major cause of worry. As has been experienced during the recent past, higher exports of foodgrains may turn food balances negative. The appropriate policy to deal with such a situation should not be imposing restrictions on exports that might turn counter-productive in the long run. We need to enhance productivity of food crops to raise the overall level of foodgrain production to turn our agriculture merely self-sufficient into net exporter. We need to lay emphasis on productivity improvement, public investment in irrigation, infrastructure development, and efficient use of water and plant nutrition. We also need to put in resources for research and development.

Advances in crop production techniques in the post-green revolution period significantly helped in expanding food output and stocks of major cereals in India. Long-term food security demands that we need to upgrade our growth in input expansion in agriculture, e.g., irrigation, fertilizer usage, high yielding variety seeds etc., to the same extent as was observed in the 1970s and 1980s. Research in production technology of non-cereal food through technology access, especially to the poor small producers, should also be promoted in order to meet the growing demand of non cereal crops. Improvement in the quality of food items and reduction in transaction costs associated with their market access need a policy priority. The scope of area expansion is limited and also some area has to shift from foodgrains to non-foodgrains to meet their increasing demand. If cereal pricing is left to the market forces playing the facilitating role, land will be released from rice and wheat cultivation to meet the growing demand for non-cereal crops such as oilseeds, fruits and vegetables in accordance with diet diversification. This policy would facilitate agricultural diversification in tune with the emerging demand patterns. Higher value of future demand for these crops may justify extra research spending on crops whose demand will not respond strongly to rising urban incomes. The growing demand for livestock products gives an opportunity to increase incomes and

employment and to reduce poverty in rural areas. If flexibility on the supply side is facilitated, production will adjust to the market forces and generate higher incomes in the rural areas and help to meet the target of doubling farmers' income.

The future increases in the production of foodgrains have to be essentially achieved through the increase in productivity given the insignificant or even negative trends in the area expansion under foodgrains observed in most of the states during both pre as well as post liberalization periods. Productivity of almost all food crops as well as that of oilseeds has declined during the post liberalization period (post 1990s) as compared to the pre liberalization period (1980s). If we wish to reverse the trend in productivity to achieve the positive food balances indicated above, we need to recapture the growth in input use as achieved during the 1980s. Some reversal has already taken place in the negative trends of public investment in agriculture observed during the post 2004. We further need to accelerate public investment in agriculture as there are strong complementarities between public and private investment. There is also dire need to strengthen investment in irrigation, both in medium and minor irrigation projects. These policy changes will help in maintaining yield growth that will enable the country not only to maintain a balance between domestic production and demand but may also generate surplus to turn India into a net exporter of foodgrains.

To achieve higher growth in yield, our input use like irrigation, fertilizer use etc., will have to increase at a much faster rate. However, due to fertilizer policy followed by the government in the past, use of nitrogen fertilizers have increased over other nutrients as indicated in Chapter 2. Phosphorus deficiency is now the most widespread soil fertility problem in both irrigated and un-irrigated plots in the country. Correcting the distortion in relative prices of primary fertilizers by removing the remaining subsidies could help correct the imbalances in the use of the primary plant nutrients: nitrogen, phosphorus, and potash. The most disquieting feature in Indian agriculture today is the decline in real investment in irrigation, which can be traced to a paucity of financial resources caused largely by the rise in subsidies. The irrigation expansion has to be much higher than what we have been able to achieve during the post liberalization period. It is essential to explore the options for cost-effective expansion of irrigated area. Scaling down the input subsidies provided for water, electricity, and fertilizer would augment the resources available for investment in irrigation, rural roads, and prevention of land degradation. It would also promote more efficient allocation of resources and provide incentives for development of cost-reducing innovations.

Further, to provide appropriate incentives to the farmers, there is also need to continue with enhancement in their farm harvest prices by means of increasing minimum support prices in the future or by providing them other incentives. However, the scope for influencing long-run productivity growth through manipulation of crop prices is limited. Reforms of

trade and macroeconomic policies are needed to encourage long-term investment and technological change in the agriculture sector. The increasing complexity of production environments demands efficient information dissemination and training in the use of modern technologies. For this, an appropriate extension services need to be created to stimulate and encourage both top-down and bottom-up flows of information between farmers, extension workers and research scientists to promote generation, adoption and evaluation of location-specific farm technologies. Resource productivity can be further enhanced by creating infrastructure in less developed areas by managing infrastructure better and by introducing new technologies.

CHAPTER IV

CHAPTER IV

PAST AND PRESENT SCENARIO OF FARM MECHANISATION AND STRATEGIES FOR ITS PROMOTION

In spite of its top ranking in production of a number of crops including rice, wheat, sugarcane, fruits and vegetables, the stagnancy in productivity and shortage of agricultural labour are two major bottlenecks of Indian agriculture. Several studies suggest a direct correlation between farm mechanisation and crop productivity. Use of improved implements has potential to increase productivity up to 30 percent and reduce the cost of cultivation up to 20 percent. At present, Indian farmers are adapting farm mechanisation at a faster rate in comparison to recent past. Although, the sale of tractors in India cannot be taken as the only measure of farm mechanisation but to a great extent it reflects the level of mechanisation. Indian tractor industries have emerged as largest in the world and account for about 1/3rd of the total global tractor production. According to the World Bank estimates, half of the Indian population would be urban by the year 2050. It is estimated that percentage of agricultural workers of total work force would from 54.6 percent in 2011 to 25.7 percent by 2050. Thus, there is a need to enhance the level of farm mechanisation in the country.

STATUS OF FARM MECHANISATION IN INDIA

Mechanisation has been identified as a key tool to increase the agricultural production globally. Table 4.1 presents the share of agriculture in GDP and level of farm mechanisation in different countries. As Indian market too is considerably growing in demand for food which requires increasing agriculture produce, further promotion of farm mechanisation is essential. It is estimated that global demand of agricultural implements will be about US$ 200 billion by 2018 and Asian countries will contribute more than 60 percent to the total demand.

Table 4.1 Agriculture share in GDP vis-à-vis level of farm mechanisation in different countries

Country	Agricultural GDP (%)	Level of mechanisation (%)
USA	1	95
Western Europe	<5	95
Russia	4	80
Brazil	5	75
China	10	48
India	14	40

Source: World Bank indicators, CIA fact book, Mechanisation and Farm Technology Division of Department of Agriculture and Cooperation, Trading Economics, FAO Year book 2013.

The agriculture sector in India has witnessed a considerable decline in use of animal and human power (animate power) in agriculture related activities. The role of tractors in India reflects the growing trend of tractorisation in the country (Table 4.2). Custom hiring of farm equipments is a prevalent practice in India, especially among small land owners for whom ownership of large farm machines is expensive and uneconomical. Given the labour scarcity and the launch of several government programs, the adoption of farm mechanisation is set to increase.

Table 4.2 Aspects of Indian agriculture (1960-2010)

Item	1960	1970	1980	1990	2000	2010
Agricultural land (Mha)	133	140	140	143	143	142
Irrigation pumps (million)	0.4	3.3	6.2	12.9	19.5	25
Irrigated area (%)	19	22	28	33	34	35
Cropping intensity	1.15	1.18	1.23	1.30	1.33	1.39
Fertilizer use (kg/ha)	2	15	39	88	125	150
Grain yield (kg/ha)	700	860	1000	1300	1600	1900
Tractors (thousands)	37	146	531	1200	2600	4000
Area per tractor (ha)	3600	960	260	120	55	36
Power tillers (thousand)	0	9.5	16	31	100	155
Draft animals (million)	80.4	82.6	73.4	70.9	60.3	50

Source: Singh (2013)

Different sources of power available on the Indian farms for performing various mobile and stationary operations are mobile power, viz., human, draught animals, tractors, power tillers and self-propelled machines, and stationary power, i.e., diesel/petrol/kerosene engines and electric motors. While the population of agricultural workers as percentage of rural population has gone down from about 69 percent in 1951 to about 55 percent in 2014-15 but in absolute terms, due to increase in overall population, the number of agricultural workers available in rural areas increased from 131 million in 1960-61 to 263 million in 2010-11 and corresponding power increased from 6.55 million kW to 13.15 million kW during the same time period. It is estimated that number of agricultural workers will increase to about 336 million and power available from agricultural workers will be 16.84 million kW in 2032-33 (Tables 4.3 & 4.4).

Table 4.3 Farm power sources in India

Year	Population of farm power sources, million					
	Agricultural Workers	Draft animal power	Tractors	Power tillers	Diesel engines	Electric motors
1960-61	131	80.4	0.037	0	0.23	0.20
1970-71	126	82.6	0.168	0.0096	1.70	1.60
1980-81	148	73.4	0.531	0.0162	2.88	3.35
1990-91	185	70.9	1.192	0.0323	4.80	8.07
2000-01	234	60.3	2.546	0.1147	6.226	13.25
2010-11	263	51.3	4.427	0.2943	8.134	17.488
2011-12*	266	50.4	4.843	0.3442	8.212	17.873
2012-13*	269	49.5	5.211	0.3801	8.290	18.245
2013-14*	272	48.6	5.653	0.4240	8.368	18.606
2019-20*	291	43.8	8.370	0.7000	8.860	21.07
2023-24*	304	40.9	11.000	1.0400	9.190	22.89
2032-33*	336	34.8	20.360	2.5300	10.030	27.57
**CAGR, %	1.13	-1.79	8.49	10.34	0.95	2.09

* Estimated figures; ** Expected Source: Singh (2015a); Singh et al. (2015); Anonymous (2015)

Over the years the annual use of draught animals has been declining. While earlier a pair of animals was being used for about 1200-1800 hours annually, their average annual use has now come down to about 300-500 hours only, that too for tillage, sowing, weeding and rural transport. The population of draught animals during 1960-61 to 2032-33 is given in Table 4.3. The declining trend of draught animal power has been more visible in those states where the demand of tractors and power tillers has been high. It is observed that on average a tractor is replacing about 5 pairs of animals and power tiller about 2 pairs of animals. Draught animal power availability in India decreased from 0.22 kW/ha in 1960-61 to 0.09 kW/ha by 2032-33 (Figure4.1).

Table 4.4 Farm power available from different sources in India

Year	Power available from different power sources, million kW*						Total Power Million kW
	Agricultural Workers	Draft Animal Power	Tractors	Power Tillers	Diesel Engines	Electric Motors	
1960-61	6.55	30.552	0.966	0	1.288	0.74	40.126
1970-71	6.30	31.388	4.385	0.054	9.520	5.92	57.567
1980-81	7.40	27.892	13.859	0.091	16.128	12.395	77.765
1990-91	9.25	26.942	31.111	0.181	26.880	29.859	124.223
2000-01	11.70	22.914	66.451	0.642	34.866	49.025	185.598
2010-11	13.15	19.494	115.545	1.648	45.550	64.706	260.093
2011-12**	13.30	19.152	126.402	1.928	45.987	66.130	272.903
2012-13**	13.46	18.81	136.007	2.129	46.424	67.507	284.336
2013-14**	13.60	18.468	147.543	2.374	46.861	68.842	297.689
2019-20**	14.55	16.644	218.457	3.920	49.616	77.959	381.146
2023-24**	15.22	15.542	287.100	5.824	51.464	84.693	459.842
2032-33**	16.84	13.224	531.396	14.168	56.168	102.009	733.803

* Power per unit area is total power available in million kW divided by total cultivated area (142 million ha)
Source: Singh (2015a); Singh et al. (2014); Singh et al. (2015)
** Estimated figures
Note: 1 Human= 0.05 kW; draught animal = 0.38 kW; tractor = 26.1 kW; Power tiller = 5.6 kW; Electric motor = 3.7 kW; Diesel Engine = 5.6 kW.

Due to too much involvement of labour in different farm operations, the cost of production of many crops in our country is quite high as compared to developed countries. Human power availability for agriculture was about 0.046 kW/ha in 1960-61 which is estimated to be about 0.12 kW/ha in 2032-33 (Fig. 4.1).

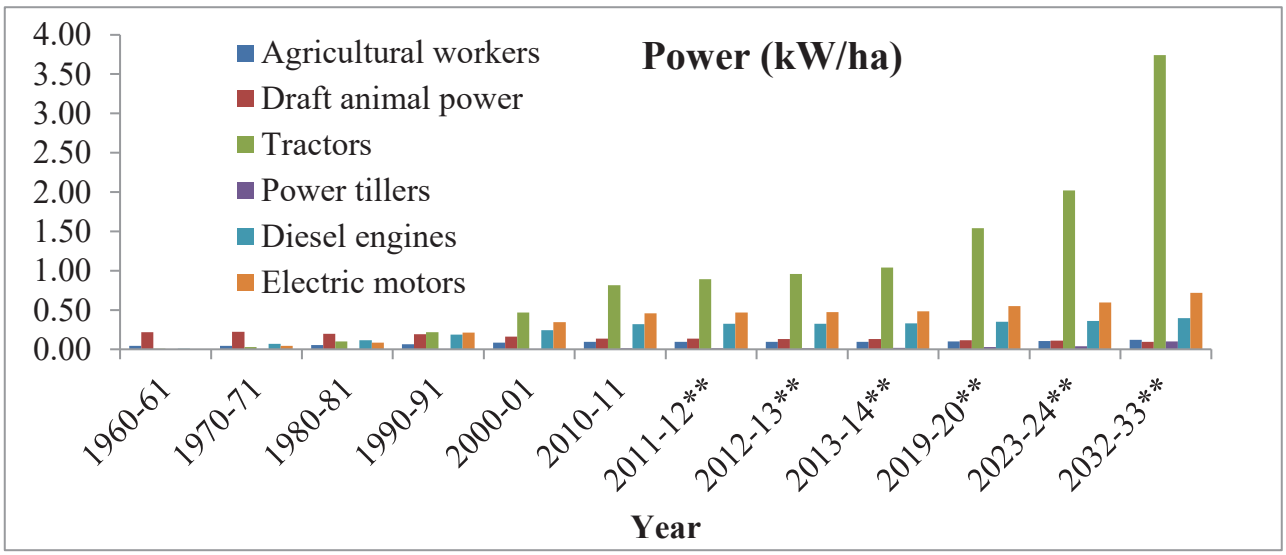


Figure 4.1: Power available from different power sources on Indian farms

[Source: Singh (2016)]

The share of agricultural workers in total power availability in 1960-61 was about 16.3 percent, which has reduced to 2.3 percent in 2032-33. Compound annual growth rate (CAGR) of different power sources on Indian farms has been given in Table 4.5.

Table 4.5 Compound Annual Growth Rate (CAGR) of different power sources on Indian farms

	CAGR (%)					
	Agricultural Workers	**Draft Animal Power**	**Tractors**	**Power Tillers**	**Diesel Engines**	**Electric Motors**
1960 -61 to 1990 -91	1.16	-0.42	12.27	6.25	10.66	13.12
1991 -92 to 2013 -14	1.54	-1.33	6.65	12.03	2.5	3.29
1960 -61 to 2013 -14	1.38	-0.82	9.79	9.3	7.04	8.74
2010 -11 to 2032 -33	1.13	-1.79	8.49	10.34	0.95	2.09

Source: Singh (2013); Singh et al. (2010); Singh et al. (2009); Live Stock Census, 2012, 2007, 2002, Tractor Manufacturers' Association (TMA); Power Tiller Manufacturers' Association (PTMA)

For meeting the increased demand of mobile power for timely farm operations and increased cropping intensity, additional power is available mainly from tractors and power tillers. Self-propelled reapers and combines also provide mobile power specially for harvesting operations. Number of tractors in India has grown from 0.037 million in 1960-61 to 5.946 million units in the year 2014-15. It is estimated that number of tractors will be increased to 20.36 million

in 2032-33 (Table 4.3). Farm power availability from tractor has consequently increased from 0.007 kW/ha in 1960 to 1.03 kW/ha in 2013-14 at an overall growth rate of 10 percent per annum during the last 54 years. It is estimated that power availability from tractor will reach 3.74 kW/ha in 2032-33 (Figure 4.1).

Over the years the shift has been towards the use of mechanical and electrical sources of power. In 1960-61 about 93 percent farm power was coming from animate sources, which has reduced to about 12.6 percent in 2010-11 (Figure 4.2). On the other hand, mechanical and electrical sources of power have increased from 7 percent to about 87.4 percent during the same time period. It is estimated that by 2032-33 the share of animate source will be reduced to 4.1 percent in total farm power.

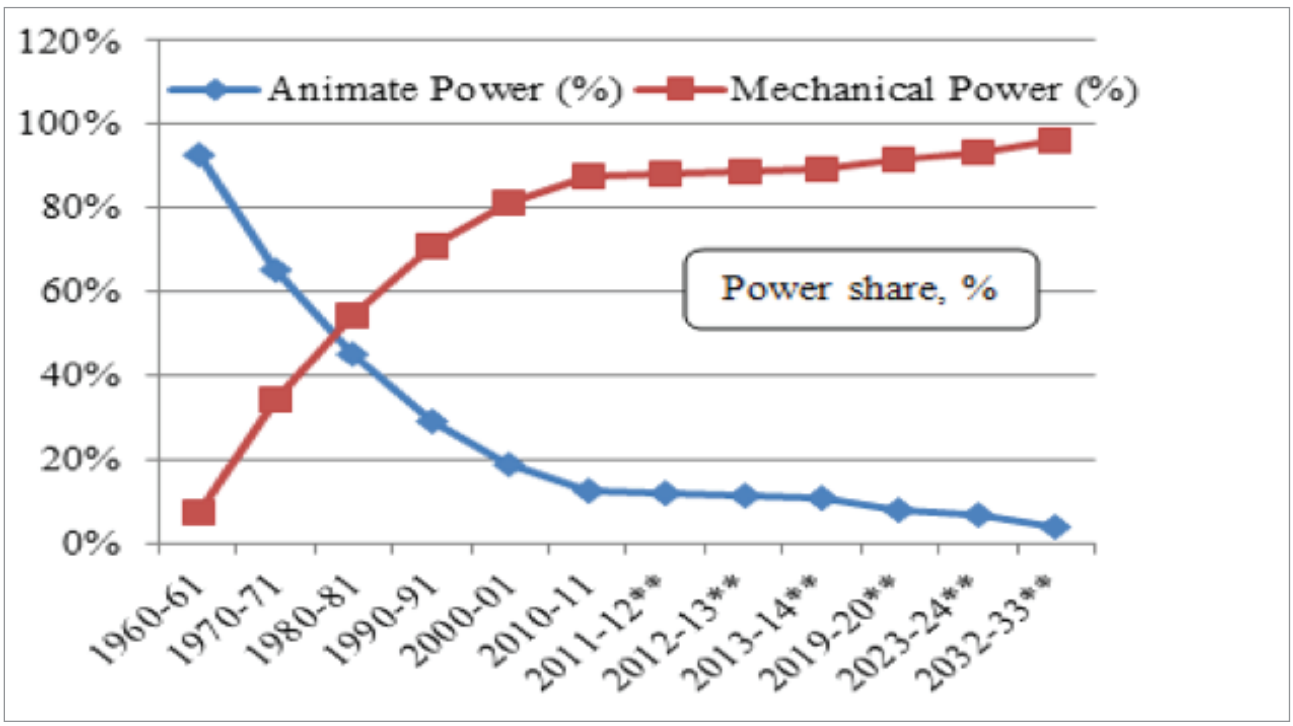


Figure 4.2: Animate and mechanical power scenario in Indian agriculture
[Source: Singh (2016)]

The operation-wise farm mechanisation in the country is about 40 percent for tillage and seedbed preparation, 30 percent for seeding/Planting, 35-45 percent for Plant protection, 60-70 percent for harvesting and threshing for rice and wheat and less than 15 percent for other crops (Table 4.6). The level of mechanisation varies greatly by region. States in the north (Punjab, Haryana and western Uttar Pradesh) have high level of mechanisation (70-80 percent overall; 80-90 percent for rice and wheat) due to high productive land as well as declining labour force and also full support by state governments. The eastern and southern states have lower level of mechanisation (35-45 percent) due to smaller and more scattered land holdings. In the north-eastern states, the level of farm mechanisation is extremely low mainly due to hilly topography, high transportation cost of farm equipments, and socio-economic conditions of the farmers.

Table 4.6: Extent of farm mechanisation in different agricultural operations

Operation	Level of mechanisation (%)
Tillage and seed bed preparation	40
Seeding and Planting	29
Plant protection	35-45
Irrigation	37
Harvesting and threshing (rice and wheat)	60-70

Source: Agricultural Engineering Division, Nepal Agricultural Research Council, UNESCAP CSAM website

Farm mechanisation has been known to provide a number of economic and social benefits to the farmers. It saves inputs like seeds and fertilizers up to 15-20 percent and labour requirement and operational time by 20-30 percent. On the other hand, it increases cropping intensity by 5-20 percent and crop productivity by 10-15 percent. It helps in encouraging the youth to join farming and attract more people to work.

The agricultural sector in India, for a long time, has depended on cheap and surplus labour. Now, the situation is changing with more opportunities available in factories and services as well as the Government's rural employment creation programs. Labour shortage is being experienced during peak seasons due to enactment of the National Rural Employment Guarantee Act (NREGA) and huge demand from the construction sector in cities. The overall work force in agriculture and allied activities has been declining indicating a rise in secondary and tertiary sectors. Labour is available at a higher cost per hectare and this would increase the demand for mechanisation. It has been observed that the percentage of agricultural workers to total workers in India has been gradually declining from 59.1 percent in 1991 to 54.6 percent in 2011 (Table 4.7). It is expected to further decline to 49.9 percent in 2033 and 25.7 percent by 2050 leading to severe farm labour shortage.

Within the Asian region, China dominates in terms of production and sales of agricultural equipments. In 2011, China overtook the European countries and US to become the largest producer of farm equipment in the world. Countries such as the United States and other European countries are completely mechanised. Countries such as China and Japan have also seen higher percentage of farm machineries. Indian agriculture sector requires an increase in farm equipments. Countries with higher level of farm mechanisation are able to increase their productivity and therefore are better equipped to meet their demand factors. India's demand factors are likely to rise dramatically. Thus, there is a need to enhance the level of farm mechanisation in the country.

Table 4.7: Population dynamics of Indian agricultural workers

Population Dynamics of Indian Agricultural Workers (No in Million)						
Particulars	**1991**	**2001**	**2011**	**2020***	**2024***	**2033***
Country's population	846.4	1,028.7	1,210.7	1,347.3	1411.5	1570.9
Total number of workers	313.7	402.2	481.7	553.2	587.6	674.9
Workers as percentage of population, %	37.1	39.1	39.8	41.06	41.63	42.96
Number of agricultural workers including cultivators and agricultural labourers	185.3	234.1	263	290.99	304.37	336.76
Agricultural workers' as percentage of total number of workers, %	59.1	58.2	54.6	52.6	51.8	49.9
Women workers as percentage of agricultural workers, %	35.1	39.0	37.2	38.2	38.6	39.6

*Projected figures

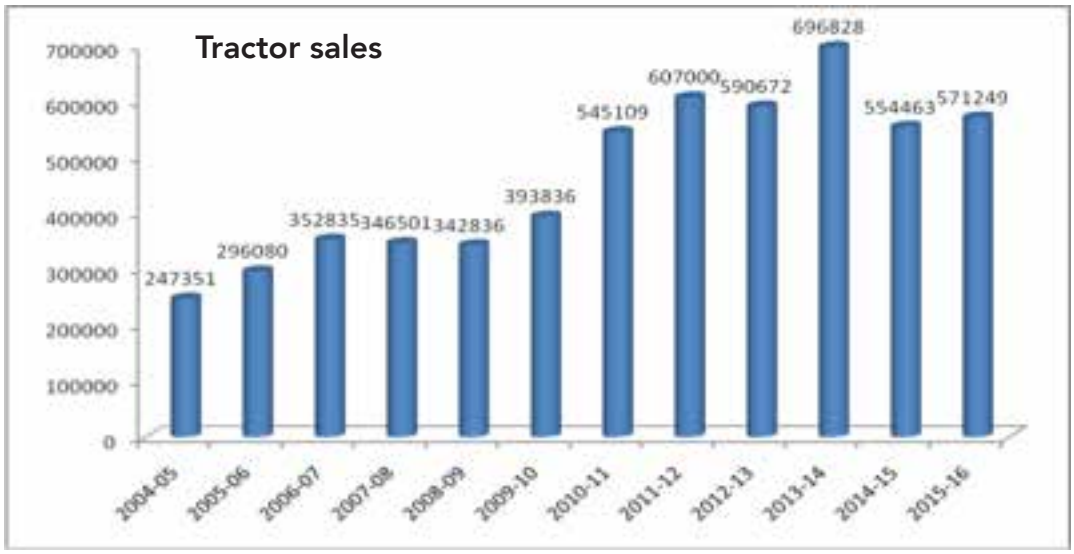
Source: Vision 2050 Document of ICAR-Central Institute of Agricultural Engineering, Bhopal, 2015.

Farm mechanisation in India stands at about 40-45 percent and it is low in comparison to US (95 percent), Brazil (75 percent) and China (57 percent). The farm power availability has grown from 0.28 kW/ha in 1960-61 to 1.83 kW/ha in 2010-11 and expected to be increased to 5.17 kW/ha in 2032-33. Level of mechanisation for major crops in different operations has been given in Table 4.8.

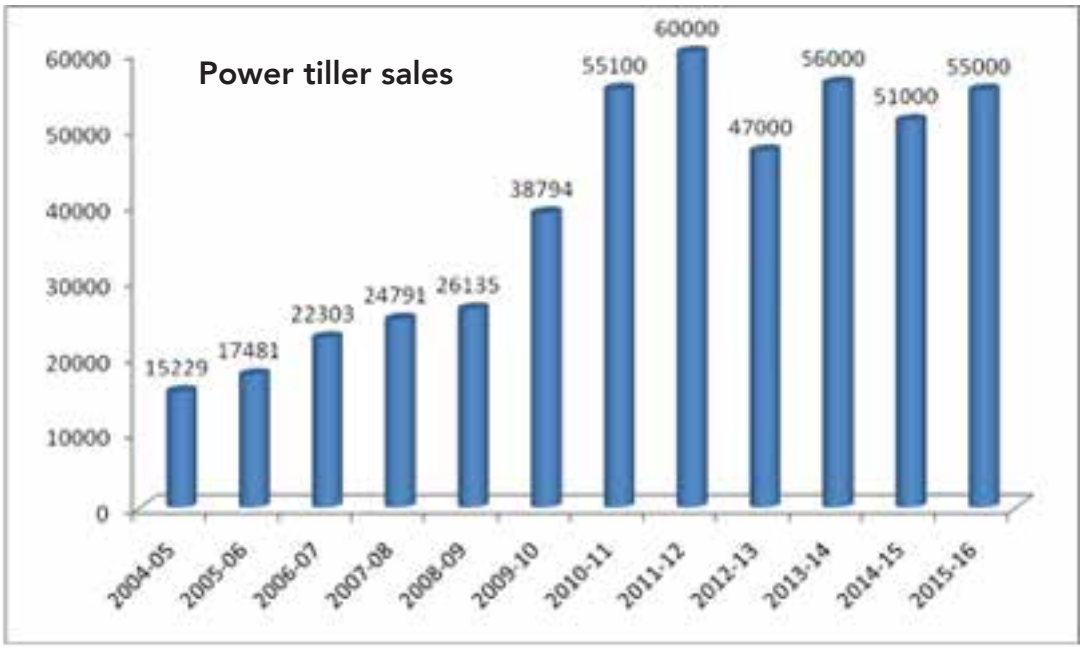
Table 4.8.Level of mechanisation by crop and value-chain process

	Seed bed preparation	**Sowing/Planting/transPlanting**	**Weed and pest control**	**Harvesting and threshing**
Paddy	85-90	5-10	80-90	70-80
Wheat	90-95	80-90	70-80	80-90
Potato	90-95	80-90	80-90	70-80
Cotton	90-95	50-60	50-60	0
Maize	90-95	80-90	70-80	50-60
Gram	90-95	50-60	60-70	30-40
Sorghum	80-90	30-50	60-70	20-30
Millets	80-90	30-40	60-70	20-30
Oilseeds	80-90	30-40	60-80	20-30
Sunflower	80-90	40-50	80-90	60-70
Fodder crop	80-90	20-40	80-90	10-20
Vegetable crop	70-80	5-10	80-90	<1
Horticultural crops	60-70	30-40	40-50	<1

Source: Country Presentation Paper, Agricultural Machinery Manufacturers Association (AMMA) India, 2014.



(a)



(b)

Figure 4.3: Sales of (a) Tractors and (b) Power tillers [Source: Singh et al. (2014); Singh (2015a); Kale (2015); Tractor Manufacturers' Association (TMA); Power Tiller Manufacturers' Association (PTMA)]

The two major segments of equipments, tractor and power tillers have shown steady growth over the years (Figure 4.3). India is considered the largest tractor market in the world.

Amidst growing concerns about labour availability and shrinking profitability of agriculture as an enterprise the need has been felt for appropriate, affordable and energy efficient equipment and technology for cost effective production and processing of crops focused at increased yield, reduced cost of cultivation, prevention of losses and value addition through location specific management practices. The farmers have realised these advantages and mechanisation is on increasing trend in many parts of the country. However, the type of equipment suitable for cultivation and the rate of introduction of new equipment are to be

considered with multi-disciplinary approach specific to the site-specific needs. During the past four decades a large number of farm tools, implements and machines have been developed for different farm operations and are being used by the Indian farmers (Table 4.9).The scenario of farm mechanisation has certainly changed as the Indian agricultural equipment market has experienced a rapid growth with expected strong potential for future growth as well (Table 4.10). Availability of power operated and animal operated implements with respect to the net cultivated area are shown in Tables 4.11 and 4.12.

India's small farms usually do not present an economic condition to permit the extensive use of agricultural machinery. Given the constraint of limited days' usage of machinery, the operational and capital costs may be optimized for the farmers by making the machinery available to the farmers on custom hiring. Thus, even small farmers may be able to get the benefit of agricultural mechanisation.

Table 4.9: Number of farm machines in India

Farm Machinery	Number of farm machines available ('000)							
	1992-93	2003-04	% Increase over 1992-93	2013-14	% Increase over 2003-04	2031-32*	% Increase over 2013-14	**CAGR, %
Manually Operated Machinery								
Sprayers	1827	2046	12.0	2214	8.2	2611.27	17.9	0.92
Animal Operated Machinery								
Wooden ploughs	43464	44267	1.8	44997	1.6	46440.72	3.2	0.17
Steel ploughs	12649	19622	55.0	25972	32.4	48205.13	85.6	3.49
Seed drills/ Seed-cum-fertilizer drills	472	963	104.0	1474	53.1	3908.61	165.2	5.57
Wet land puddlers	5151	8550	39.7	11640	36.1	23424.81	101.2	3.96
Animal carts	15220	16577	8.9	17663	6.5	20056.07	13.5	0.71
Tractor/power operated machinery								
Power operated sprayers/dusters	303	561	85.1	796	41.9	1823.82	129.1	4.71
MB Ploughs	408	852	108.8	1328	55.9	3650.89	174.9	5.78
Cultivators	706	949	34.4	1170	23.3	1800.80	53.9	2.43
Disc harrows	531	913	71.9	1260	38.0	2642.02	109.7	4.20
Seed-cum-fertilizer drills	390	1011	159.2	2852	182.1	15708.63	450.8	9.94
Planters	54	75	38.9	92	22.7	145.27	57.9	2.57
Levelers	1057	1827	72.8	2343	28.2	4629.77	97.6	3.86
Threshers/Multi crop threshers	2597	5309	104.4	7775	46.4	19898.79	155.9	5.36
Combines (Tractor-drawn & self-propelled)	8.5	20	135.3	59	195.0	311.06	427.2	9.67

* Estimated figures; ** Expected

Source: Livestock Census (2003); Tyagi et al. (2010)

Table 4.10: Annual market of major farm machines used in India

Items	Numbers	Items	Numbers
Tractors	450000 - 500000	Power tillers	50000 - 60000
MB plow	45000 - 50000	Rotavator	100000 - 120000
Cultivators	150000 - 200000	Harrows	120000 - 150000
Seed∱erti drills	60000 - 75000	Planters	15000 - 25000
Rice transPlanters	2000 - 3000	Power weeders	35000 - 40000
Reapers	10000 - 15000	Threshers	60000 - 75000
Combine harvesters	3500 - 4000	Trailers	150000 - 175000
Sprayers (TD)	10000 - 15000	Laser land levelers	2500 - 3500
Potato diggers	25000 - 30000	Rotary hoes/Power weeders	20000 - 25000

Source: Singh et al., 2015.

Table 4.11: Availability of power operated implements with respect to the net cultivated area

Year	Sprayers & dusters (no/1000ha)	Harrows (no/1000ha)	Threshers (no/1000ha)	Tillers (no/1000ha)	Ploughs (no/1000ha)	Planters (no/1000ha)	Levellers (no/1000ha)
1972-73	0.249	0.398	1.4631	0.582	0.405	0.064	0.348
1982-83	0.884	1.347	7.3058	2.245	1.019	0.221	2.951
1992-93	2.131	3.734	18.2630	4.965	2.869	0.380	7.433
2002-03	3.810	6.218	35.8569	6.565	5.708	0.517	12.472
2012-13	5.459	8.651	53.1709	8.107	9.040	0.636	16.292
2022-23*	7.134	11.125	70.7360	9.689	12.343	0.750	17.261
2023-24*	7.302	11.381	72.5283	9.851	12.663	0.765	17.132
2024-25*	7.472	11.622	74.2776	10.007	12.967	0.772	16.941
2032-33*	8.990	13.850	90.2800	11.390	15.800	0.870	15.720
CAGR, %	2.34	2.21	2.47	1.63	2.50	1.46	-0.93

Source: Tyagi et al. (2010) & Agricultural Statistics at a Glance 2011-2013. * Estimated values

Table 4.12: Availability of animal operated implements with respect to the net cultivated area

Year	Wooden ploughs (no/1000 ha)	Steel ploughs (no/1000 ha)	Puddlers (no/1000 ha)	Seed drills & Planters (no/1000 ha)	Carts (no/1000 ha)	Cane Crushers (no/1000 ha)
1972-73	0	0	0	0	0	0
1982-83	294.783	50.770	17.954	41.247	98.418	4.939
1992-93	305.654	88.952	36.224	54.191	107.032	5.345
2002-03	312.989	134.469	58.364	69.306	116.579	6.027
2012-13	317.260	178.934	80.021	83.771	124.011	6.716
2022-23*	323.100	224.253	102.059	98.033	131.288	7.438
2023-24*	323.846	228.909	104.320	99.462	132.047	7.514
2024-25*	324.363	233.407	106.508	100.822	132.705	7.585
2032-33*	330.67	273.90	126.06	112.77	138.55	8.230
CAGR, %	0.23	2.02	2.16	1.41	0.54	0.98

Source: Tyagi et al. (2010) & Agricultural Statistics at a Glance. * Estimated values

Table 4.13: Status of farm machinery industry in India

Farm machinery	Number of manufacturing units
Agricultural tractors	22
Power Tillers	5
Irrigation Pumps	600
Plant Protection Equipment	300
Combine Harvesters	48
Reapers	60
Threshers	6,000
Seed Drills and Planters	2,500
Diesel Oil Engines	200
Plough, Cultivators, Harrows	5,000
Chaff Cutters	50
Rural Artisans	>1 Mn

Source: Singh, Kanchan K., 2014. Presentation during 2nd Regional Forum on Sustainable Agricultural Mechanisation at Serpong, Indonesia 9-11, September 2014.

The medium scale and large scale industries manufacture diesel engines, electric motors, irrigation pumps, sprayers and dusters, land development machinery, tractors, power tillers, post-harvest and processing machinery and dairy equipment (Table 4.13). The marketing of agricultural machinery by these industries is through their network of dealerships and, therefore, these manufacturers are able to provide effective after-sales service. These industries upgrade their product and process technologies through their own R&D efforts, in addition to technological support from external agencies.

There are about 250 medium to large scale units, 2,500 small scale industries, 15,000 tiny industries and 1,00,000 village level artisans in India. Most of them are under un-organized sector except the tractor and power tiller industries. There were no ways to pass on Government benefit schemes to these industries. The All-India Agricultural Machinery Manufacturers' Association (AMMA-India) was established in the year 2010 on January 17 at the behest of Department of Agriculture and Cooperation (Mechanisation and Technology Division), Ministry of Allied Sectors. The main objectives of association are: i) augmenting and intensifying agricultural mechanisation related activities in different agro-climatic zones; ii) promoting scientific development and technological up-gradation of need based agricultural machines and power sources; iii) providing technological coordination, management and advisory back-up to the members of AMMA-India; and iv) providing effective liaison with Government organizations, NGOs and agencies sponsoring national and international fairs/meets and to establish institutional relations for implementation of appropriate policies and initiatives to promote growth of agricultural mechanisation. Presently 448 agricultural machinery manufacturers including tractor industries are the members of this association. Association is working very closely with central as well as state governments for implementations of various Government schemes for the benefit of users/farmers and manufacturers.

The timeliness of operations has assumed greater significant in obtaining optimal yields from different crops, which has been possible by way of mechanisation. It is apparent from Table 4.14 that the cropping intensity increases with increase in per unit power availability. The adoption and application of package of farm machinery and technology for agricultural mechanisation has significantly contributed to improve the cropping intensity and farm produce during the last 40 years and its positive relationship with availability and growth of farm power is depicted in the Figure 4.4.

Food grain productivity in India has increased from 0.636 t/ha in 1965-66 to 2.20 t/ha in 2013-14, while farm power availability has increased from 0.32 kW/ha to 2.11 kW/ha during the same time period. It is estimated that food grain productivity and farm power availability will increase to 3.96 t/ha and 4.81 kW/ha by 2032-33(Figure 4.5). The relationship between food grain productivity and unit farm power availability for the period 1960-61 to 2032-33 have shown a linear function, with highly significant value of coefficient of determination (R2 = 0.99). It is also evident that farm power input has to be increased further to achieve higher food grain production, the composition of farm power from different sources to be properly balanced to meet its timely requirement for various farm operations.

Table 4.14: Cropping intensity and power availability on Indian farms

Year	Cropping intensity (%)	Food grain productivity (t/ha)	Power available (kW/ha)	Power per unit production (kW/t)	Net sown area per Tractor (ha)
1965-66	114.00	0.636	0.32	0.50	2162
1975-76	120.30	0.944	0.48	0.51	487
1985-86	126.80	1.184	0.73	0.62	174
1995-96	130.80	1.499	1.05	0.70	82
2005-06	136.54	1.715	1.49	0.87	45
2010-11	139.56	1.930	1.85	0.96	34
2011-12	138.77	2.079	1.93	0.93	31
2012-13	138.92	2.129	2.02	0.95	29
2013-14	139.29	2.200	2.11	0.96	27.24
2019-20*	141.40	2.650	2.74	1.03	18.7
2023-24*	142.82	3.000	3.26	1.09	14.55
2032-33*	146.06	3.960	4.81	1.21	8.27
**CAGR,%	0.25	3.14	4.44	1.41	-6.08

** Expected

Source: Singh (2015); Agricultural Statistics at a glance 2015

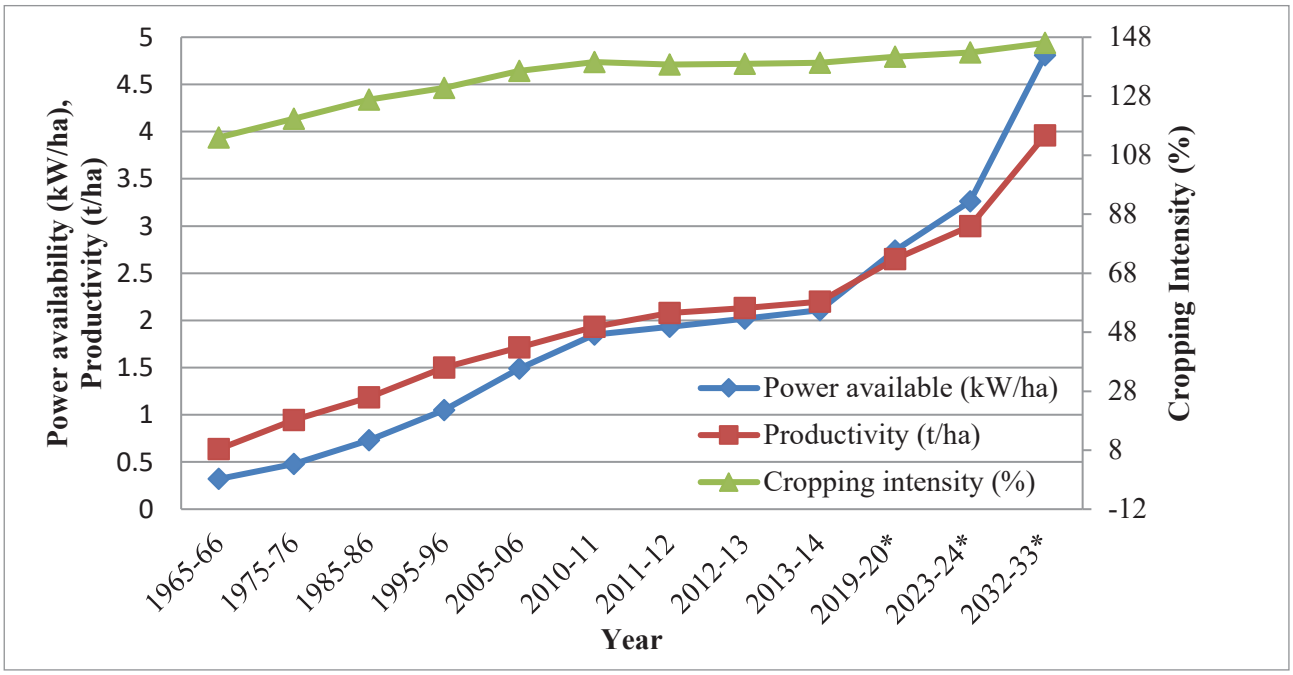


Figure 4.4: Farm power availability and average yield of food grains and cropping intensity in India during 1965- 2033 (Source: Kale et al., 2016)

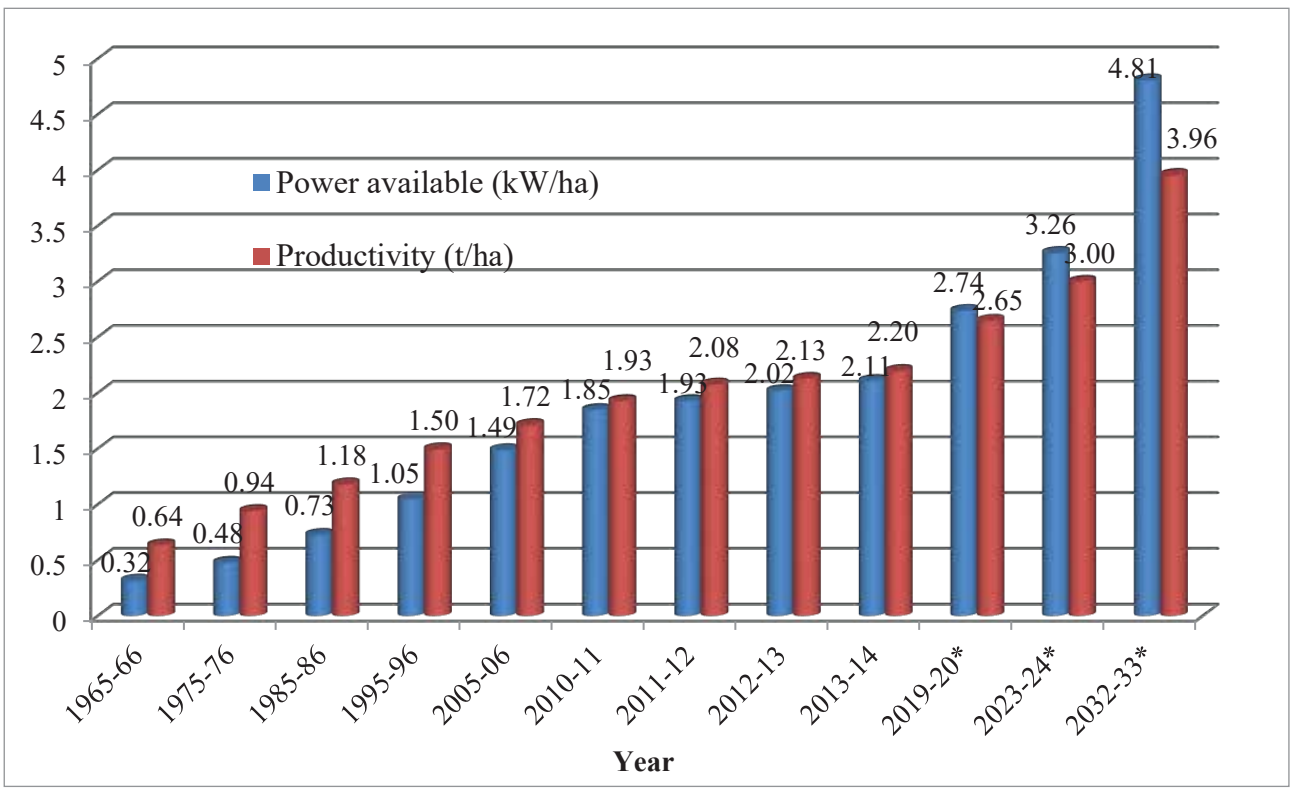


Figure 4.5: Power availability and food grain productivity over the years

(Source: Singh et al., 2014; Singh, 2015a)

The overall mechanisation level in India is only 40-45 percent even though 90 percent of the total farm power is contributed by mechanical and electrical power sources. The average farm power availability needs to be increased to a minimum of 2.5 kW/ha by 2020 to assure timeliness and quality in field operations, to undertake heavy field operations like sub-soiling, chiseling, deep ploughing and summer ploughing. The concerted efforts have resulted in the mechanisation of critical farm operations of major crops in different states. The economic benefit due to adoption of improved implements is of the order of Rs 833.75 thousand crore per annum, which is only a small fraction of the existing potential for improvement (Singh, 2015). This has also resulted in generating employment to rural youths and artisans for the production, operation and maintenance of these machines. Due to significant and continuous reduction of the workforce in agriculture, higher levels of farm mechanisation are necessary for sustainable productivity and profitability.

Major thrust towards farm mechanisation during 12th Plan

As such there is no Agricultural Mechanisation Policy in India. In order to lay special emphasis on farm mechanisation and to bring more inclusiveness, a dedicated Sub-Mission on Agricultural Mechanisation (SMAM) for the XII Plan (2012-17) was launched by the Government of India (Kale, 2015; Anonymous, 2014). SMAM puts 'Small and Marginal Farmers' at the core of the interventions with a special emphasis on 'reaching the unreached', i.e. bringing farm mechanisation to those villages where the technologies deployed are decades old. Besides, the mission is also catering to 'adverse economies of scale' by promoting 'Custom Hiring Services' through 'the rural entrepreneurship' model. Custom Hiring Centres (CHCs) are a unit comprising a set of farm machinery, implements and equipment for hiring. These centres provide farm machines on rental basis to farmers who cannot afford to purchase machines. States such as Punjab, Haryana, Uttar Pradesh, Madhya Pradesh, Uttarakhand, Gujarat, Maharashtra, Karnataka and Tamil Nadu have maximum number of registered and unregistered CHCs catering to the machinery and equipment requirement of the farmers. The government also recognizes the value of these centres and the role they can play in mechanisation of farm operations. As a result, establishment of farm machinery banks for custom hiring is one of the core components of the Sub-Mission on Agricultural Mechanisation (SMAM).

The Mission is catalyzing an accelerated but inclusive growth of agricultural mechanisation and providing assistance for promotion and strengthening of agricultural mechanisation through training, testing and demonstration; post-harvest technology and management; procurement of selected agricultural machinery and equipment; establishment of farm machinery banks for custom hiring; establishing hi-tech productive equipment centres to target low productive agricultural regions and assistance for increasing farm mechanisation. To make the cost of machinery affordable and to make them available to all farmers, the

government has launched a credit-linked subsidy scheme for establishment of farm machinery banks and hi-tech high productive equipment hubs for custom hiring for increasing the reach of farm mechanisation to small and marginal farmers and to the regions where availability of farm power is low.

Farm Machinery Banks are promoting mechanisation in districts with low farm power availability, facilitating hiring services of various agricultural machinery/implements used for different farm operations, expanding mechanised activities during cropping seasons in large areas especially in small and marginal holdings, and introducing improved/newly developed agricultural implements and machines in crop production. Hi-Tech, high productive equipment hubs are promoting utilization of hi-tech, high value machines for higher productivity, providing hiring services for various high value crop specific machines applied for different operations, expanding mechanised activities during cropping seasons to cover large areas, and involving manufacturers for setting up of such centres.

GOVERNMENT'S ROLE IN FARM EQUIPMENT SECTOR

The Government has implemented various farm mechanisation programs in the country through schemes such as Rashtriya Krishi Vikas Yojna (RKVY), Mission for Integrated Development of Horticulture (MIDH), National Mission on Oilseeds and Oil Palm (NMOOP) and National Food Security Mission (NFSM) and lately Sub-Mission on Agricultural Mechanisation (SMAM). In addition to development of such schemes, the government has also implemented the National Mission on Agricultural Extension and Technology (NMAET) to strengthen the extension machinery and utilise the same for synergizing the interventions under these schemes.

FUTURE PROSPECTS FOR MECHANISATION AND SUGGESTED STRATEGIES FOR ITS PROMOTION

Small and scattered land holdings, high initial cost of equipment, non-availability of high-tech precision equipment, poor quality of equipment available in the market and poor after sales services are some of the major challenges for mechanisation of Indian agriculture, which hinders faster growth of farm mechanisation. The efforts so far have been mainly towards tractorization rather than mechanisation of Indian agriculture. Although, farmers have a number of options for financing, a number of challenges continue to hinder credit flow within the beneficiaries. These include high collaterals, especially for loans of more than 1.0 lakh, high interest rates and relatively low repayment periods (5-7 years). Small and marginal farmers are still far away from the benefits of farm mechanisation. Even after a large number of custom hiring centres are in operation small and marginal farmers struggle to perform the farm operations timely. Since,

about 85 percent of farm holdings are under small and marginal category this group of farmers needs to be targeted with appropriate farm machines and technologies.

The future investment in agricultural mechanisation will be guided by a number of factors. Sales data gathered over the past years indicate growing preference for tractors in the 41 to 50 hp or higher hp range. High capacity machines including rotary tiller, harrows, laser levelers, high clearance sprayers, Planters, high capacity threshers and self-propelled and tractors drawn combines will also be preferred in future. The custom hiring of mechanical power for tillage, irrigation, harvesting and threshing will be preferred by those farmers who cannot afford to own machines. The present trend in agricultural mechanisation is for the high capacity machines to be used for custom hiring and for contractual field operations. Hand operated tools and implements will only grow very slowly as the number of agricultural workers increase. Animal operated implements will decrease due to the continued decrease in the number of draft animals. In contrast, the use of power operated farm equipment will increase rapidly. Horticulture mechanisation and mechanisation of hill agriculture are areas where mechanisation has to go in a long way to increase the farmer's income by reducing labour requirement.

Business and enterprise friendly policies, laws, and regulations as well as physical and institutional infrastructures, which encourage commercial activities and entrepreneurship in farming, input supply, produce handling, processing and marketing as well as in manufacturing will be key factors to the success of agricultural mechanisation in the different states of India. Following strategies may be considered for promoting farm mechanisation in the country.

I. Reduce or eliminate subsidies and use these funds to reduce interest rates on loans and taxes for purchase of equipment and machinery for agricultural operations and food processing.
II. Promote on-farm storage, processing and marketing facilities in catchment areas.
III. Number of custom hiring centres, especially in areas of small and marginal land holdings should be increased substantially.
IV. Quality of farm machines must be assured at as it brings more confidence among farmers for adoption of farm mechanisation.
V. Strengthen support services for research and development; testing and standardization; as well as for human resource development in support of agricultural mechanisation.
VI. Manufacturing facilities should be developed especially in areas with low level of farm mechanisation by providing incentives to manufacturers establishing such facilities in these areas.

VII. Since percentage of women workers in agriculture is increasing day by day development of gender friendly equipment should be taken up.

VIII. In order to provide economical mechanisation solutions to the farmers, cooperative farming should be promoted in areas of small sizes of holdings.

IX. More research and development efforts should be diverted towards development of machines for mechanisation of horticulture and hill agriculture.

X. In order to reduce the input cost the use efficiency of various farm inputs needs to be improved through high-tech interventions such as site-specific nutrient management, mechatronics and opto-electronics.

XI. Skill development in the area of operation, repair and maintenance of farm machines should be taken up.

CHAPTER V

CHAPTER - V

PERFORMANCE OF CENTRALLY SPONSORED AND CENTRAL SECTOR SCHEMES

BACKGROUND

The Subgroup V on Centrally Sponsored and Central Sector Schemes and investment in agriculture worked under the chairmanship of Dr, Ashok Dalwai, Additional Secretary, Department of Agriculture, Cooperation and Farmers Welfare (DACFW). The constitution of the subgroup-V is given in Annexure 5.1A.

TERMS OF REFERENCE (TOR)

(i) To review the performance of centrally sponsored and central sector schemes implemented by the Ministry of Agriculture & Farmers Welfare during 12th Plan with reference to their targets of production and suggest modifications to improve the schemes, if to be continued; and

(ii) to analyse the priority in the expenditure on agriculture and allied sectors by the States and the Central Government to suggest ways to augment it.

The subgroup held two meetings and reviewed the performance of centrally sponsored and central sector schemes implemented by the Ministry of Agriculture & Farmers' Welfare during 12th Plan to analyse the priorities in the expenditure on agriculture and allied sectors so as to suggest way forward to augment the investment in agriculture and to achieve the projected demand of foodgrains and other commodities by 2032-33.

AN OVERVIEW

Agriculture is the principal source of livelihood for 48.9 percent of the workers as per the 68th Round of NSSO data 2011-12. Hence, any strategy must necessarily address the issues faced Agriculture and rural India comprising close to 70 percent of the population of India (Census 2011). Agricultural sector growth rate had improved appreciably to over 4 percent in the 11th Plan and production of food grains by nearly 30 percent. India has transformed from a food deficit country to a major exporter of agricultural commodities. Various schemes and programmes launched during the previous Plan periods have contributed to this growth, though much more remains to be accomplished. During the XI Plan (2007-11), a series of new programmes and initiatives were put in place such as the National Horticulture Mission, National Food Security Mission, Rashtriya Krishi Vikas Yojana (RKVY), etc., which were revamped during XII Plan with increased spread and scope for number of reasons and following the response of the States, recommendations of erstwhile Planning Commission and Department of Expenditure strongly

backed up by the Evaluation Studies conducted by independent agencies. During XII Plan some of the umbrella schemes were initiated with multidisciplinary and multi-functionary nature to infuse convergence and optimize the use of available resources. *Pradhan Mantri Krishi Sinchai Yojana* is one such scheme under centrally sponsored category. The Government has also introduced two innovative programmes under central sector schemes e-NAM and Soil Health Card. While one addresses the farmer's price realization, another about the soil productivity and economizing the fertilizer use. The Pradhan Mantri Fasal Bima Yojana (PMFBY) is an initiative introduced since 2016-17 to minimize the risk associated with cropping.

Economic Survey 2014-15 had expressed concern that a deeper shift in the agricultural sector may be underway calling for greater attention towards this sector. The Survey highlighted other major concerns in the agriculture sector, which include risk of high level of food inflation, seasonal and short-term price spikes in some commodities like onions, tomatoes, and potatoes which have become more severe, long lasting; thereby causing economic instability in the system. It has indicated that the strategy of price-led growth in agriculture is not sustainable; also there is little room for increasing production through expansion in cropped area. Hence, there is a need to rely more on non-price factors that contributes towards higher productivity. The survey has recommended bringing a new paradigm in the approach towards agriculture for getting "more from less" especially in relation to water via micro irrigation; prioritising the cultivation of less water-intensive crops, especially pulses and oil-seeds, supported by a favourable Minimum Support Price regime backed by a strengthened procurement system; and re-invigorating agricultural research and extension in these crops.

Hon'ble Prime Minister set up a Task Force on Agriculture Development chaired by Vice Chairman, NITI Aayog. The States also set up similar Task Forces. The Task Force was set up to recommend strategies for re-invigorating agriculture, strategies for reforms, innovation and technology diffusion and identify successful experiments for replication. In 2016-17 Union Budget significant emphasis on agriculture through reorientation of Government interventions in the farm and non-farm sectors was laid so as to double the income of the farmers by 2022. The major emphasis has been on optimal utilization of our water resources; creation of new infrastructure for irrigation; conservation of soil fertility with balanced use of fertilizers; and provide value addition and connectivity from farm to markets.

The key growth drivers identified for agriculture and allied sector during 2012-2017 period included (a) improving viability of farming and returns on investment that depend on scale, market access, prices and risk; (b) development and dissemination of appropriate technologies that depend on quality of research and level of skill development; (c) Plan expenditure on agriculture and infrastructure which together with policy must aim to improve productivity, functioning of markets and more efficient use of natural resources; and (d) governance in terms of institutions that make possible better delivery of services like

credit, insurance, animal health and of quality inputs like seeds, fertilizers, pesticides and farm machinery. Correcting regional imbalances by extending green revolution to low productivity areas such as the eastern region was also a prime focus. Agriculture and allied sector face major challenges in low and uneven productivity, stress of natural resources, uneconomic size of farm holdings, huge gap between price paid by consumers and received by farmers, price volatility, inadequate marketing infrastructure, natural hazards and limited risk coverage as well as low credit support and climate change. These would need to be addressed through appropriate policy reorientation, investment and incentivization of innovations, technologies, inputs and institutional reforms.

The average annual agricultural growth rate at 4.1 percent was achieved in 11th Plan. A target of 4 percent growth of Agri-GDP was retained in the 12th Plan. The Agri-GDP growth was 1.2 percent in 2012-13, which improved significantly to 4.3 percent during 2013-14 due to record production of food grains, oilseeds, fruits and vegetables, other crops, livestock products and forestry and fisheries. During 2014-15, low rainfall and stressed weather during winters affected the crop output and consequently the Agri-GDP growth declined sharply to 0.2 percent but again recovered to rise to 1.1 percent in 2015-16. The impressive turn around could happen in 2016-17 with growth touching to 5 percent and all time record production of almost all the commodities of agriculture and allied sector. While this is a noticeable achievement with all tall claims of technology innovations, infrastructure for irrigation and water resources, it strongly demonstrates that the monsoon and weather are still the deciding factors for agrarian economy growth.

On average, the total investment in agriculture & allied sector increased at a rate of 11.6 percent during 11th Plan primarily on account of private investment growing at 15 percent (NAS release). Public investment in agriculture increased from 2.8 percent of GDP in 10th Plan to 3.1 percent in 11th Plan and remained at the same level in 2012-13. The private investment increased from 15.9 percent of agricultural GDP in 11th Plan to 18.1 percent in 2012-13. In order to attain 4 percent agricultural growth, higher investment in agriculture has been required both from public and private sector. The Gross Budgetary Support (GBS) for 12th Plan for Ministry of Agriculture including Rashtriya Krishi Vikas Yojana (RKVY) stood at Rs. 1,74,478 crore. The total allocation for 2012-13 to 2016-17 to the Ministry of Agriculture was close to Rs. 150000 crore. A comparison within the Departments of the Ministry indicated lower fund availability to research which needs to be improved in view of thrust on developing new technologies, for productivity enhancement and risk adaptation & mitigation against climate change, etc. The public investment in Agriculture and allied sector is routed through the centrally sponsored schemes and few central sector schemes, the important ones are discussed subsequently.

CENTRALLY SPONSORED AND CENTRAL SECTOR SCHEMES

Following the implementation of recommendations of the 14th Finance Commission, the

fund sharing pattern between centre and state for many schemes for agriculture have changed. The funding pattern of major schemes of Ministry of Agriculture like Rashtriya Krishi Vikas Yojana, National Food Security Mission, Mission for Integrated Development of Horticulture, National Mission for Sustainable Agriculture, National Mission for Agriculture Extension and Technology and National Livestock Mission has changed from earlier 100 percent or 90:10 (centre: state) funding pattern to 60:40 for mainstream states and 90:10 for hilly and NE States. This has affected the performance of the CSSs and CSs in some States. The analysis of the centrally sponsored schemes is presented in following paragraphs:

NATIONAL FOOD SECURITY MISSION (NFSM)

The National Food Security Mission (NFSM) launched in 2007-08 with a target of additional 20 million tons (mt) of target crops (rice, wheat and pulses) compared to pre-NFSM year. The NFSM has reportedly given tangible outcomes with 35 million tons increase during 2007-2012. The target growth for food grain production was 2-2.5 percent for 12th Plan. Accordingly, NFSM was revamped and broadened in its scope and design in XII Plan by bringing all the states under its ambit and targeting all foodgrains. This was a major deviation from the NFSM philosophy to target the disadvantaged and low hanging fruits in 11th Plan. Favourable South West Monsoons in 2013 resulted in 266 million tons of food grain production. Subsequently, the production declined in 2014-15 on account of drought and unseasonal rains/hail storms. Satisfactorily, the food grain production all the years of the 12th Plan has been much higher than the average production of the 11th Plan and has surpassed the projected demand of 257 million tons in the year 2016-17. The scheme envisaged 25 million tons of additional food grains production (10 mt rice, 8 mt wheat, 4 mt pulses and 3 mt coarse cereals) by the terminal year of 12th Plan. Given the annual production estimates of 276 million tons in 2016-17, it seems to be achieved on a macro scale but real success of NFSM could be measured in terms of its direct impact in the districts targeted for clusters of demonstrations running into millions of ha in the last 5 years. The focus on higher production of pulses was much significant with the achievement of over 22 million tons of pulses production but that too require rigorous analysis of how much has been achieved due to rise in productivity and how much due to area expansion. Higher incentives were given to States under NFSM to enhance pulses production. Rs.500 crore has been allocated in 2016-17 to the same.

The NFSM impact on productivity in many districts has been lower than expectations. During 12th Plan larger focus was given to pulses and coarse cereals. These crops are predominantly grown in rainfed ecologies under starving water and nutrition conditions. Hence, impact of NFSM on scaling up the reach of the technology especially seeds has to be vigorously analysed. While NFSM is said to have contributed towards achieving the food security, it would be prudent to mention that package demonstrations of established

technologies and known practices has been the critical area of funding under NFSM that raises very serious issues with the NFSM impacting the promotion of newer technologies. In future, NFSM need to align its activities with new but few technologies related to new variety seeds, conservation and water positive agriculture, and constant backup of research for new and promising technology. Integration of small and marginal farmers with value chain and group formation through FPOs could be another area for sustaining the pulses and oilseeds production. The food fortification has been much sharper after India's commitment for sustainable development goals SDG-2 related to hunger and nutrition. NFSM could play a vital role along with food security to nutritional security without artificial fortification once it brings the nutri-grains under strategic research and promotional component of NFSM The high protein maize, and micronutrient rich rice and wheat, etc., could be promoted in appropriate ecologies to popularize these. The learning of the first pilot on nutri-cereals initiated in 100 high malnutrition ridden districts in 2012-13 on bio-fortified food crops and its procurement arrangement through Small Farmers Agri-business Consortium (SFAC), for supply to Mid-Day Meal Programme could be scaled up under NFSM.

RASHTRIYA KRISHI VIKAS YOJANA (RKVY)

The Rashtriya Krishi Vikas Yojana (RKVY) was launched in 2007 to operationalize the "resolution of the 53rd meeting of the National Development Council (NDC) held on 29th May, 2007 that a special Additional Central Assistance (ACA) Scheme is initiated." The twin purpose of the RKVY as conceived was to encourage States to draw up District and State Agricultural Plans and also increase their own spending on the sector so as to reorient agricultural development strategies for rejuvenating Indian agriculture during the Eleventh Plan. The maximum flexibility in selecting interventions and setting state specific targets was inbuilt in RKVY and hence was preferred by the states.

One objective of RKVY was to incentivise states to increase expenditure on agriculture and allied sectors. State Plan expenditures (excluding RKVY receipts) as percentage of GDP in agricultural and allied increased from 1.0 percent in 10th Plan to 1.4 percent in the 11th Plan. State Plan expenditures on Agriculture and Allied Sectors (excluding RKVY) have also increased as percentage total Plan spending by States, from about 5 percent during 10th Plan to over 6 percent during 11th Plan. RKVY was therefore successful in motivating States to pay greater attention to agriculture, besides providing increased Central assistance for the sector. RKVY as assistance was particularly useful for the fund starved Animal Husbandry, Dairying and Fisheries sectors. Projects amounting to over Rs. 5000 crore were sanctioned under RKVY for these sectors during 11th Plan, about 20 percent of the total sanctioned RKVY projects, and more than spending on DAHD's schemes. This has provided a substantial push to these sectors which accounts for a significant contribution to the Agricultural Gross Domestic Product (GDP).

The RKVY Guidelines recognize and build on the need for convergence and integration of the various programmes implemented at District/State level into District Agriculture Plans (DAPs) and State Agriculture Plan (SAP). Each district is required to formulate a District Agriculture Plan by including the resources available from other existing schemes, District, State or Central Schemes and tied and untied grants from the Central and State Finance Commissions etc. The DAP should include animal husbandry and fishery, minor irrigation projects, rural development works, agricultural marketing schemes and schemes for water harvesting and conservation, keeping in view the natural resources and technological possibilities in each district. Each State is further required to prepare a comprehensive State Agricultural Plan (SAP) by integrating the DAPs. The State will have to indicate resources that can flow from the State to the district.

RKVY is not limited to any sector or intervention within the farming sphere. States have flexibility to choose the projects which are likely to generate growth in agriculture and allied sectors. The projects of the State Governments are approved by the State Level Sanctioning Committees (SLSCs) under the Chairmanship of Chief Secretary of the respective States. States have taken up numerous projects across the entire spectrum of agriculture and allied sectors. These cover areas such as crops, horticulture, organic farming, agriculture/farm mechanisation, micro/minor irrigation, watershed development, agriculture marketing and storage, seed farms and soil/fertilizer testing laboratories, animal husbandry, dairy development, fisheries, extension and research etc.

Besides crop-production-related activities, RKVY has provided necessary boost to the development of livestock and fisheries sectors by ensuring flow of additional funds over and above the funds available from other resources. National Mission on Protein Supplements (NMPS) was launched in the year 2011-12 as a part of RKVY with objective to increase production of animal protein like milk, meat and fish etc., in order to meet rising demand for these products. Similarly Accelerated Fodder Development Programme (AFDP) was also launched to increase availability of fodder. Many Agriculture programmes of National important were launched as sub-schemes of RKVY since 2010-11. Over the years, RKVY has also facilitated in addressing national priorities, without affecting the autonomy and flexibility of States, through special sub-schemes. Sub-schemes namely Bringing Green Revolution to Eastern India (BGREI), Saffron Mission, Vidharbha Intensive Irrigation Development Progarmme (VIIDP), Crop Diversification in Original Green Revolution areas and Additional Fodder Development Programme (AFDP) are important to name. These sub-schemes implemented under RKVY since its inception are as under:

(i) Bringing Green Revolution to Eastern India
(ii) Integrated Development of 60,000 pulses villages in rainfed areas
(iii) Promotion of Oil Palm
(iv) Vegetable Initiative for Urban Clusters
(v) Nutri-cereals

(vi) Nutri-Farm
(vii) National Mission for Protein Supplements
(viii) Accelerated Fodder Development Programme
(ix) Saffron Mission (implemented in J&K)
(x) Vidarbha Intensive Irrigation Development Programme
(xi) Crop Diversification in original green revolution States

Table 5.1: Financial Progress of RKVY during 2007-08 to 2012-13 (in Rs. Crore)

Year	BE	RE	Expenditure
2007-08	*0.00	1263.00	1246.89
2008-09	3165.67	2891.70	2886.80
2009-10	4067.07	3707.07	3760.93
2010-11	6722.00	6722.00	6720.06
2011-12	7810.87	7810.87	7794.09
XI Plan	**21765.61**	**22394.64**	**22408.77**
2012-13	9217.00	8400.00	8400.00
2013-14	9954.02	8400.00	6921.52
2014-15	9954.02	9864.02	8363.89
2015-16	4500.00	4454.65	3914.94
2016-17	5364.00	3876.15	NA
XII Plan	38989.04	34994.82	27600.35
2017-18	45136.23	1530.74	NA

In the eleventh Plan, Rs. 22,408.77 crore were released to states and UTs for implementation of the projects under RKVY. The feedback from States indicated the utilization of Rs. 22330.83 crore for various sub-sectors such as crops, horticulture, agricultural mechanisation, natural resource management, marketing & post-harvest management, animal husbandry, dairy development, fisheries, extension etc. During XII Plan a provision of Rs. 63246 crore has been kept under RKVY of which 33625.04 crore allocated during 2012-15. Since 2014-15 the funding pattern and nature of RKVY has been modified i.e., from 100 percent ACA to States to 60:40 fund sharing between Centre and State as CSS. The financial progress of RKVY is given in Table 5.1.

Nonetheless, several less funded sub-sectors of agriculture particularly Animal Husbandry, Dairying and Fisheries got benefitted to different degree in different states. Over 30 percent of the total sanctioned RKVY projects worth over Rs. 5000 crore were sanctioned under RKVY for these sectors during 11th Plan which has been more than

spending on DAHD's schemes. This trend is likely to be sustained during XII Plan. The data available in public domain indicated that total projects sanctioned under these sectors during last three years of the Plan period were 25.8 percent worth Rs. 5248.93 crore. This could provide a substantial push to these sectors which account for a significant contribution to the Agri-GDP.

While RKVY has been one of the most performing centrally sponsored schemes with complete flexibility to States, it severely failed to infuse the critical analytical pathways of problem identification and project formulations. Though the preparation of Comprehensive District Agriculture Plans (C-DAPs) and State Agricultural Plans have been mandatory it remained the weakest area in majority of the States, especially during XII Plan, mainly due to lack of capacity at district level and commitment. During 12th Plan the progress on DAPs and SAPs were dismal as majority of the States did not prepared the DAPs and SAPs.

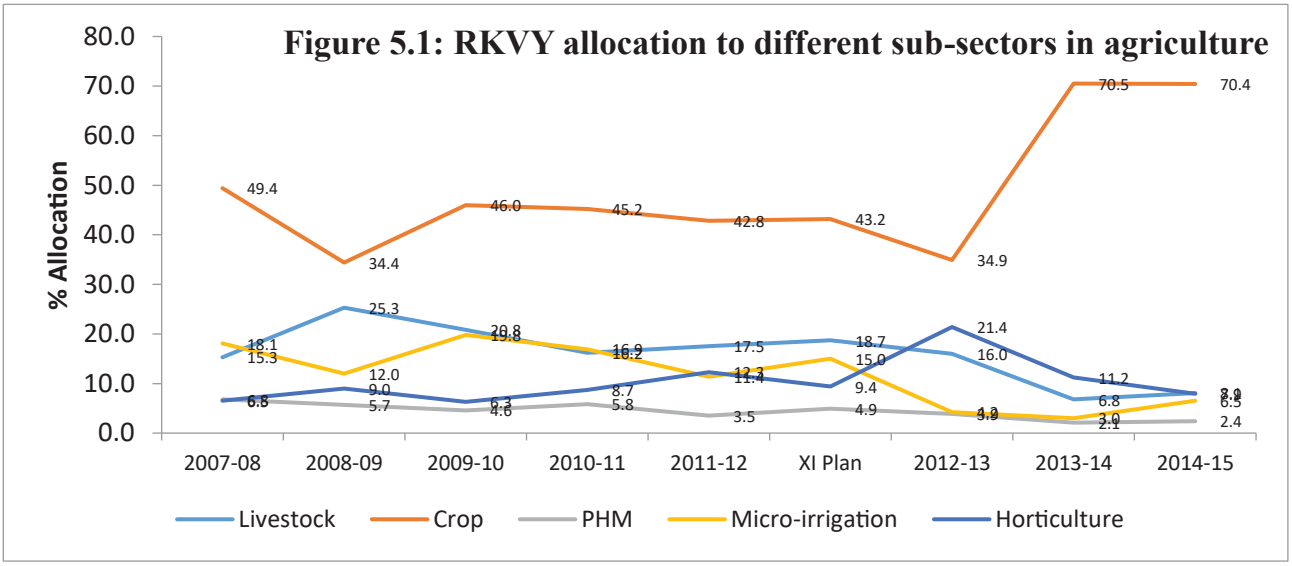
While there is very strong anecdotal evidence of the success of RKVY, a detailed impact assessment of the scheme is needed for further experience and learning especially the processes and pathways that were followed for the project identification, their feasibility and the outcomes in relation to intended benefits. Many States have requested changes in the allocation criteria of RKVY and some have objected to opening of new windows within the RKVY in the form of special schemes. Understanding these, the special schemes were limited to a ceiling of 20 percent of RKVY funding and at least 40 percent of RKVY spending on hard infrastructure. The allocation criterion was also made more inclusive in the 12th Plan.

The evaluation of RKVY to find out the processes of formulations and more importantly sanctioning of projects was emphasized by PMO. Given the emphasis to analyse the process of project conceptualizations and its approvals, NITI Aayog sought information from Department of Agriculture & Cooperation and the States. The response from States was very low as only Madhya Pradesh, Chhattisgarh, Jharkhand, Goa, Karnataka, Odisha and Puducherry provided the information. Based on the data of the select states, a presentation was done in the National Level Meeting held at Gangatok, Sikkim in which Agriculture Minister and other senior functionaries of DACFW were present.

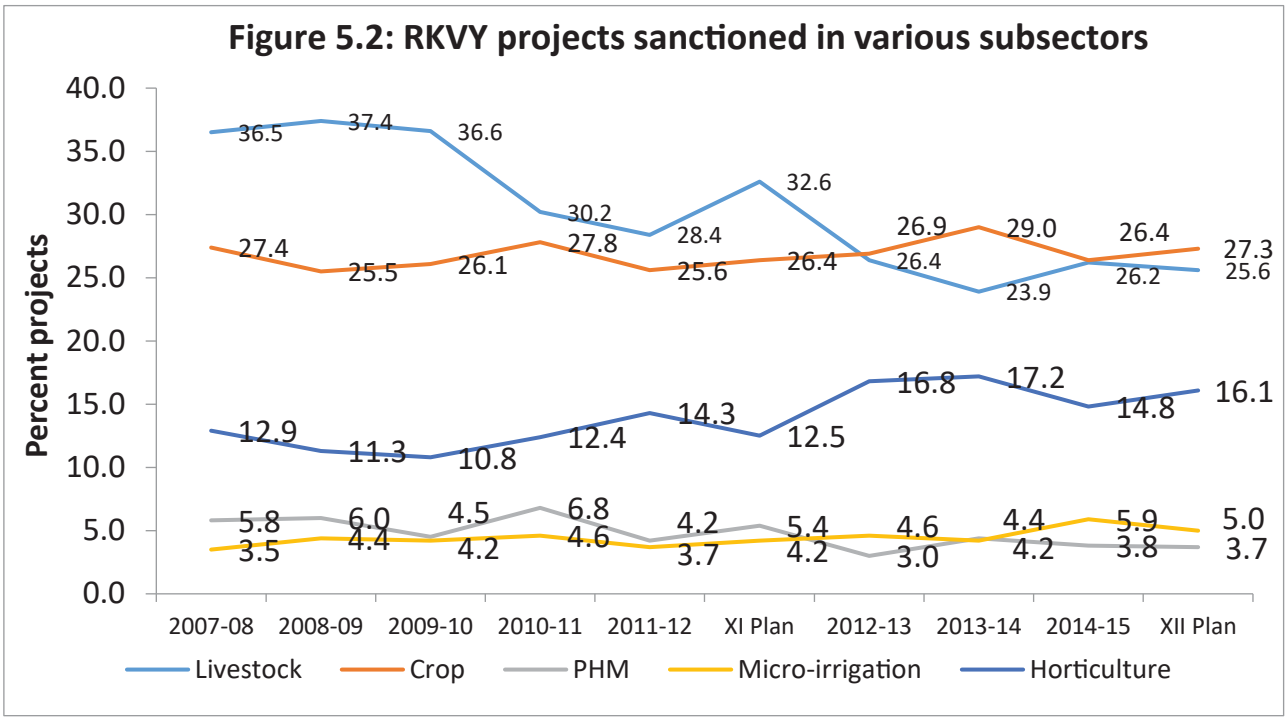
Skewed allocations amongst different sub-sectors: Figure 5.1 below presents the allocations to different subsectors in agriculture. This indicates that the allocations were more to crop and related activities compared to other important sectors. This requires critical analysis in view of the growth potential in other subsectors.

Inadequate focus on identified problems The inter-State fund allocation criteria of RKVY do identify the critical and priority areas for investment. For instance, RKVY provided exclusive

weightage of 30 percent in XI Plan and 20 percent in XII Plan to rainfed areas in its allocation; but the States have not been able to address this specific problem. Given the data in public domain on micro-irrigation, the total allocation for this very crucial water-positive intervention has been only 15 percent during XI Plan which was sharply reduced to 6.5 percent cumulatively during first three years of the XII Plan. This indicates that RKVY is not responding well to the identified problems seriously while huge amount is getting allocated for rainfed area but with very little investment for and in water-scarce ecosystems. Similar is the case with horticulture which has been very promising growth potential in agriculture. The post- harvest management has been another area of concern along with research support.



Strategic Planning is missing: Figure 5.2 presents the projects sanctioned for different subsectors of agriculture critical to boost its growth. While it started with a positive note in the initial years to sanction larger number of projects for livestock sector compared to crops, the deceleration started after some years and continued. The number of projects in other critical sectors other than crops was remained very low. This is a serious challenge for all the States for strategic Planning of resources of RKVY. While crop sector is adequately funded by other programmes like NFSM, MIDH, NMSA, Organic Farming, etc, the livestock, fisheries, infrastructure of agricultural marketing, storage, PHM, etc., were very thinly funded which would have been augmented through RKVY along with micro-irrigation to realize *per drop more crop*. In majority of the States, NFSM and MIDH interventions are replicated through RKVY funds in non-NFSM and non-MIDH districts without considering the objective criteria adopted in these programmes which excluded some of the districts.



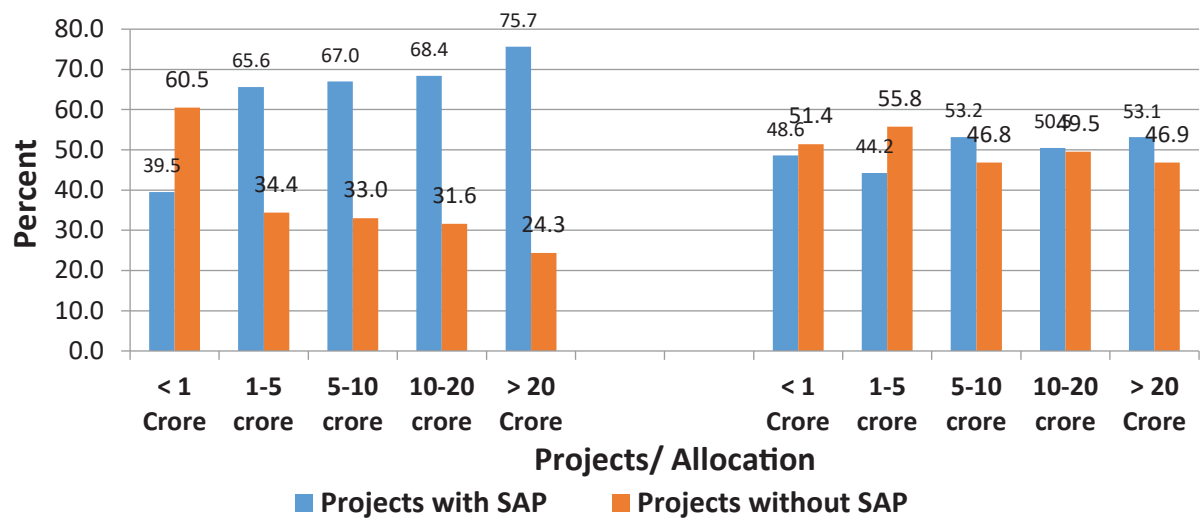
Missing analytical pathways of project identification: States welcomed wholeheartedly to the flexibility provided under RKVY for project formulations and approvals. However, the project formulations and approvals following **critical analytical pathways** for setting the priority based on the potential of an intervention in a given area has neither been institutionalized nor adopted in majority of the States. The preparation of Comprehensive District Agriculture Plans (C-DAPs) has been a weak area in many states, partly due to lack of capacity at district level. Although there are reservations regarding quality and effective capability of district level Planning and project design, the guiding principle for RKVY was that a sizeable quantum of projects sanctioned by SLSCs need to originate from the district level, preferably approved by District Planning Committees. The suitable units will have to be formed at district level. It is also necessary to see decentralized Planning as an iterative Planning-doing-learning-Planning cycle rather than simply a onetime activity. The challenge is to institutionalize this process and ensure that the agency facilitating Planning is also accountable for the outcome. Based on the information provided by the States of **Chhattisgarh, Goa, Jharkhand, Karnataka, MP, Odisha and Puducherry** and ISEC evaluation report on RKVY, the analysis was done in NITI Aayog for both production growth projects and Infrastructure. The salient points are as under:

(a) Production growth projects

- Over 60 percent projects in less than Rs 1 crore categories emanated without SAP. However, more than 75 percent projects in >20 crore category emanated from SAP. Non-SAP/DAP projects prevailed over SAP-DAP projects in terms of allocation. Close to 24 percent projects that were approved through non-SAP route under >20 crore category were allocated about 47 percent of the allocation in these States while 76 percent projects in the same category identified and approved through SAP route were given only 53 percent of the allocation.

- Smaller sized projects were largely emanated from non-SAP route which somehow indicate a democratic distribution of public funds on the choices of individuals (Figure 5.3).

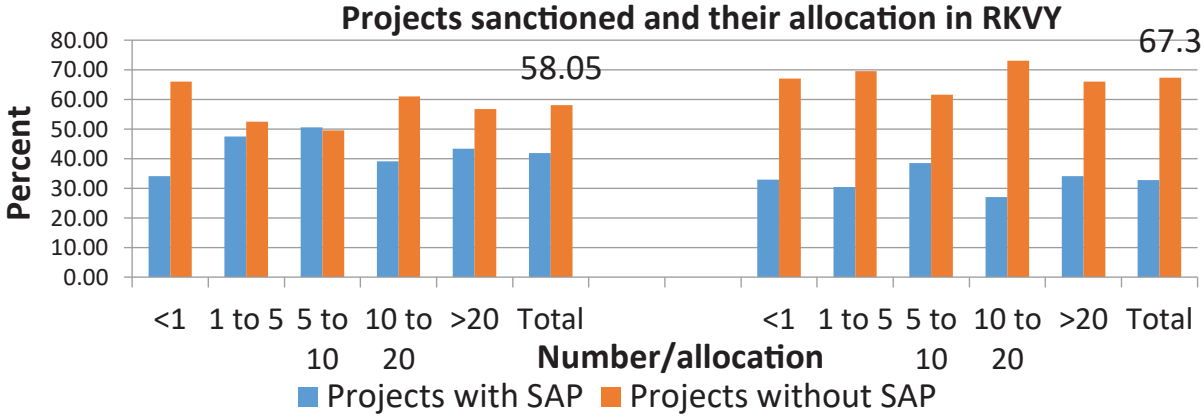
Figure 5.3: Number of projects and their allocation under SAP and Non-SAP



(b) Infrastructure projects

- Over 65 percent projects in <Rs 1 crore category emanated without SAP and only 35 percent projects were identified based on SAP. Under this group the larger pie was shared by non-SAP route projects in number as well as allocation under large project category also. More than 56 percent projects and 65 percent allocation in >20 crore category emanated from non-SAP route.
- Non-SAP/DAP projects prevailed over SAP-DAP projects in terms of allocation (Figure 5.4)

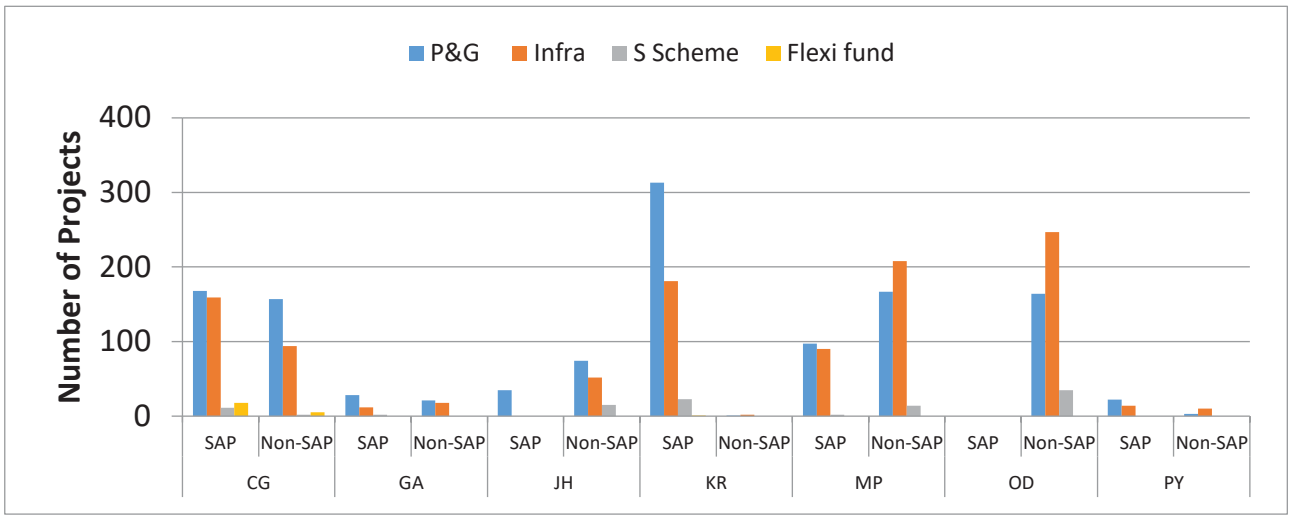
Figure 5.4: Infarstructure Projects sanctioned and their allocation in RKVY



State-specific Insights

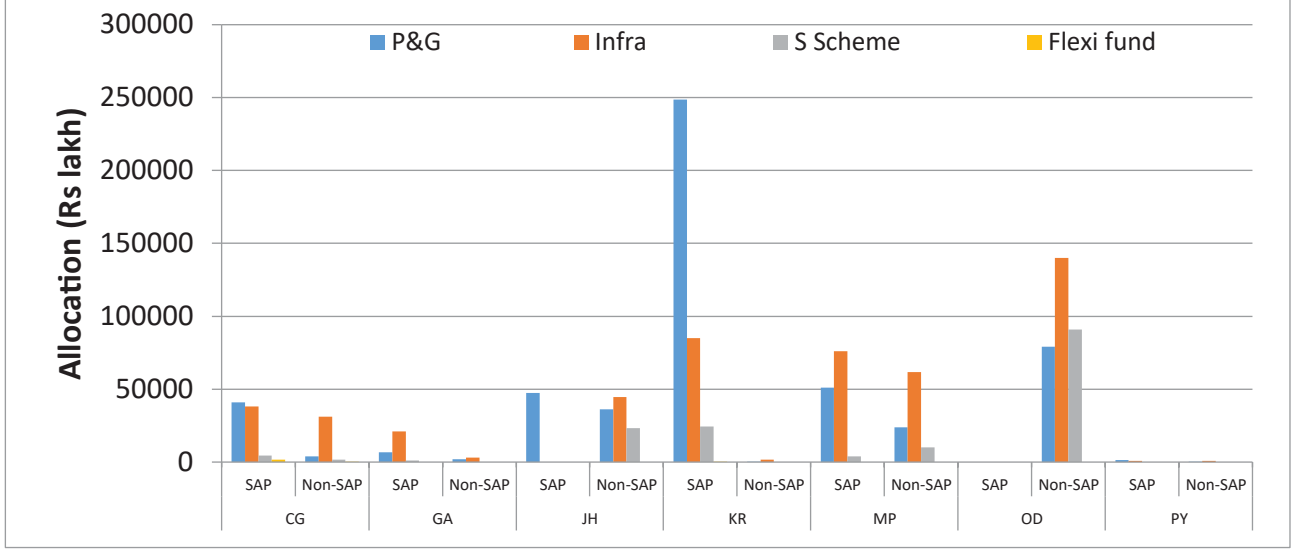
- Differential trends in different states have been observed while approving the projects. While Chhattisgarh and Goa maintained balance between SAP and Non-SAP route of project identification, Jharkhand, Madhya Pradesh and Odisha were highly skewed towards non-SAP route. Surprisingly, in Odisha all the projects in all the streams emanated from non-SAP route. Contrary to this, in Karnataka maximum projects emanated from SAP route (Figure- 5.5).

Figure 5.5: State-wise number of SAP and non SAP projects



- The allocation of the funds for SAP and non-SAP projects followed the same trends as in the case of numbers (Figure 5.6). Based on the data available from limited States, it may be concluded that non-SAP route of project identification prevailed over SAP route both in number and their allocation.

Figure-5.6: Allocation of funds to projects identified through SAP and non-SAP route



RKVY design needs to be seen in the context of many pending key reforms. Despite efforts by the Central Government, progress in agricultural marketing, extension and cooperative reforms continue to be sluggish. Delivery of services has not been efficient due to lack of staff at various levels. State Agricultural Universities (SAUs) need greater funding support from the State Governments. Inadequacy of agricultural infrastructure hampers achievement of growth potential of the agriculture sector.

The RKVY must be re-oriented to facilitate market reforms, higher expenditure on SAUs and for infrastructure development. Both processes and products that lead to reforms in the sector should be identified and indexed to rank the States. The States must institutionalize the critical analytical pathway for project formulations and approval of the RKVY. Atleast 75 percent of the projects of RKVY must emanate from SAPs for which formulation and implementation of District Agriculture Plans should be made mandatory.

The RKVY must continue to incentivize those states who invest more from their own resources in agriculture as has happened in the XI Plan but somehow diluted in XII Plan. The eligibility criteria of higher investment over previous year must be strictly adhered. The current eligibility conditions and allocation formula for RKVY should be changed. The eligibility criteria must also include formulation and implementation of District Agriculture Plans

A mismatch has been observed in problem identification and response to the problems. The inter-state allocation criteria should capture this paradox. The State investing equal or more than that the eligibility for a given criteria should be incentivized. Those which are making 75 percent or more under infrastructure should also be incentivized.

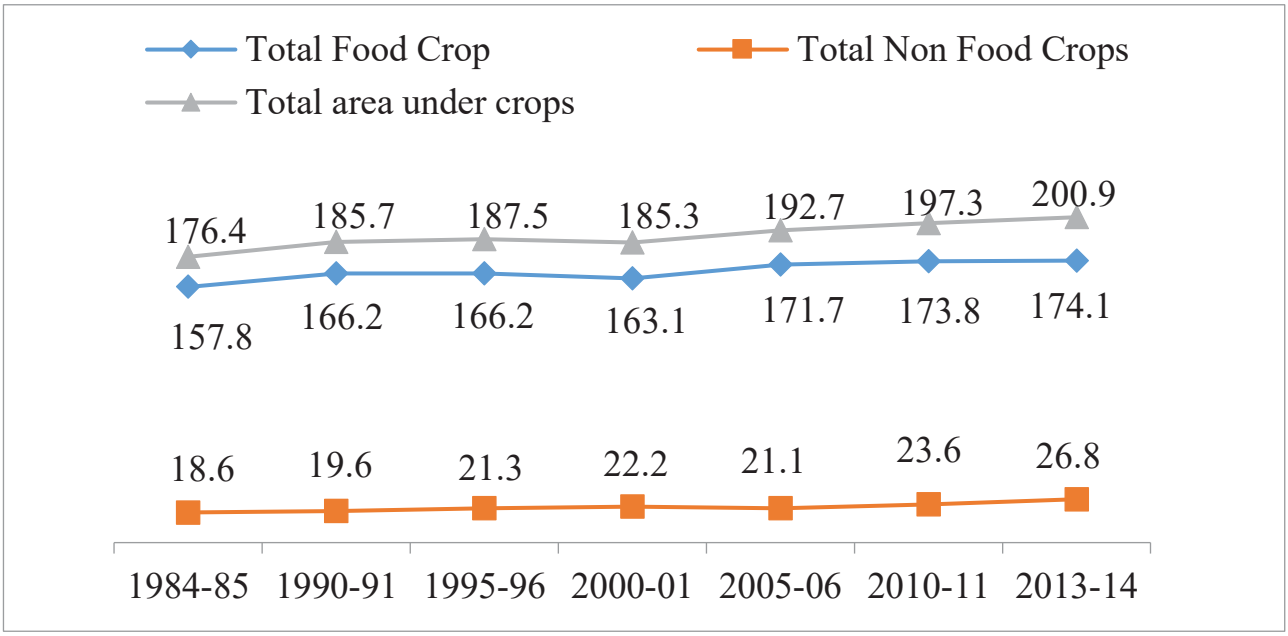
The weakest link in the RKVY is very low monitoring and lack of ownership. This needs to be strengthened by the use of technology. All the infrastructure projects should be geo-tagged and monitored by linking with *Bhuvan portal*. The DPCs should be made accountable for C-DAPs and also the outcomes. The monitoring of project by many state also need to be improved. Many states have not entered details of approved projects in the RDMIS for monitoring the progress during 2015-16.

CROP DIVERSIFICATION

Significant thinking has gone into diversification of agriculture since 1990s, especially in green revolution areas. Farmers have shifted areas away from food grains to more remunerative commercial and horticulture crops. Present increase in the cultivated land has been on account of cropping intensity, while net sown area has declined slightly. Overall, the cropped area increased by about 24.5 million ha during 1984-85 to 2013-14, with definite impact of seasonality depending

upon the rainfall and consequent impact on the irrigation water availability. The variability which was much sharper in the 1990s has narrowed down in the recent years. This has happened due to two reasons. Firstly, the rainfall deficiency in previous years was much more pronounced in rainfed regions which changed its pattern to relatively well watered areas of north-west and eastern areas and farmers resorted to save their crops on irrigated water although with additional cost to cultivation. The significant growth in cropped area has culminated into close to 200 million ha area under cropping for the first time in the country in 2013-14.

Figure 5.7: Cropped area in million ha



Secondly, the post reforms policies have brought out significant changes in the cropping area due to better price signals through minimum support prices. The expansion of irrigation in some of the major rainfed ecologies like Madhya Pradesh, Gujarat and Uttar Pradesh coupled with better application tools, farm mechanisation and introduction of water stress resilient varieties that increased the coverage under cropping. The value of output from crops has shown similar response but more significant in the later part of the liberalization due to better market prices and global trends.

Foodgrains, fruits, vegetables, condiments and spices, sugar, pulses and oilseeds are the food crops as they are the integral part of our dietary intake. In our farming systems, food crops occupy the lion's share in the total cropped area, dominated by cereals (58.2 percent) followed by oilseeds and pulses. Oilseeds and pulses include over 20 crops as groups and compete each other for acreage in a year both at macro and micro level depending upon the price signals, market behaviours, global trends and the climatic conditions. The area of oilseeds and pulses keeps on swinging in the favour of one or the other depending upon these factors. Government promotional programmes also bring in changes in the area of particular crop. Post TMO, the area of oilseeds got a boost while post NFSM the area under wheat, pulses have shown an increase. It is interesting to learn that the increase in area under food crops since 1984-85 was 16.29 million

ha against 8.15 million ha under non-food crops. The increase in non-food crops was 44 percent compared to only about 10 percent increase in food crops. This is a classic case of technology led diversification towards non-food crops at the cost of some of the coarse cereals and also the oilseeds like groundnut and other minor kharif oilseed in favour of cotton after Bt cotton hybrids introduction in 2002. The technology (Bt cotton) was appropriately supported by the market (large export to China) and assured procurement (CCI procuring cotton in all the cotton producing States).

Though such sporadic incidences are available in many commodities and regions in India, the structured programme for diversification has been missing. With adequate reserves of rice and wheat and focus shifting from food security to income security, a designed diversification from crop centric farming to low water demanding activities including crops, livestock/fish/forestry and allied activities is the appropriate way to deal with the situation. A special Plan on crop diversification was initiated under RKVY during 2013-14 in Punjab (20 districts), Haryana (10 districts) and Western U.P. (15 districts) to shift area from paddy to alternate crops to arrest the depletion of ground water and restoration of soil fertility; the learning of this may provide a base for further expansion of the diversification Plans. Pooling of resources and synergy amongst programmes of rural development (land and water issues), agriculture (production, marketing and input support), post-harvest industries (processing, abattoirs), water resources, etc., will be the prerequisite for significant success in this endeavour. The immediate need is to improve the marketing and storage facilities for alternative crops in these States. Reforms in marketing, land leasing, tenancy laws and risk management are crucial to change the mindset of farmers to make more investments in alternative crops/ enterprises (oilseeds, pulses, horticulture and livestock), especially in rainfed regions.

BRINGING GREEN REVOLUTION TO EASTERN INDIA (BGREI)

The special efforts to enhance productivity of rice based cropping systems in eastern States (Assam, Bihar, Chhattisgarh, Jharkhand, Odisha, Eastern Uttar Pradesh and West Bengal) was launched in 2010-11 with an allocation of Rs. 500 crore which was enhanced to Rs. 1000 crores in later years. A record production of 58.55 million tonnes of rice in the implementing States during 2012-13 was achieved. This programme needs to continue. However, these States should focus more on creating assets especially water storage and lifting devices, for higher surface water retention and utilization to sustain growth in productivity. Interventions should be for utilization of surface water potential, well integrated with recently launched Pradhan Mantri Krishi Sinchai Yojana (PMKSY) rather than merely on demonstration of well adopted technologies. The procurement system of rice and alternative crops like oilseeds and pulses should also be strengthened in the region to provide remunerative returns to farmers.

NATIONAL MISSION FOR OILSEEDS AND OIL PALM (NMOOP)

The envisaged growth in oilseeds during the 12th Plan was 5 percent. The restructured National Mission for Oilseeds and Oil Palm (NMOOP) was launched to achieve 35.51 million tonnes of oilseeds by 2016-17, with flexibilities for introducing innovative measures; and by involving private sector. A major issue in oilseeds sector, besides low productivity, is low recovery of oil from oilseeds. NMOOP, besides focusing on critical inputs for productivity gains, should also promote efficient tools/techniques for oil extraction, as being done for tree borne oilseeds (TBOs). The oil palm and other TBOs should be promoted with higher investments. These crops are also very helpful in utilization of waste lands, as well to fetch higher yield for edible oil. The oilseed programme needs to be funded more to enhance domestic production to meet burgeoning needs and reduce imports.

MISSION FOR INTEGRATED DEVELOPMENT OF HORTICULTURE (MIDH)

Several ongoing schemes on horticultural development have been subsumed under Mission for Integrated Development of Horticulture (MIDH), with greater flexibility to States for achieving envisaged growth of 5 percent in horticulture during Twelfth Plan. The availability of fruits and vegetables has increased from 158 g to 190 g and 309 g to 349 g, respectively during 2007 to 2013. The vegetable clusters programme started as a sub-scheme of RKVY has proved effective in linking small farmers to value chain and should be made a major initiative under MIDH. The specific areas like accreditation of nurseries and quality Planting material, higher productivity along with quality enhancement should get priority beside creation of infrastructure for reducing post-harvest losses. The National Horticulture Mission (NHM) has been co-terminus with the 12th Plan, hence institutional strengthening should be the core agenda to carry forward the horticultural development by the States. The Schemes of National Horticulture Board (NHB) and Coconut Development Board (CDB) which are part of MIDH need to be continued beyond 12th Plan to achieve their full mandate and goals.

NATIONAL MISSION FOR SUSTAINABLE AGRICULTURE

The ultimate irrigation potential is 139.91 million ha while the gross cropped area (GCA) was 195.25 m ha in 2011-12. This indicates that even with full utilization of the Irrigation potential about 28 percent of gross cropped area would remain rainfed if GCA stagnates at 2011-12 level. The National Mission for Sustainable Agriculture (NMSA) launched during the Twelfth Plan, aims at mainstreaming rainfed technologies including agro-forestry through location specific integrated/composite farming systems. It seeks to transform Indian agriculture into a climate resilient production system through suitable adaptation and mitigation measures. NMSA has a strong component of on-farm water management for efficient water application tools and other practices to enhance the on-farm water use efficiency and micro-irrigation

which has been extended to non-horticultural crops also. A target of 3.64 million ha under micro-irrigation has been kept under NMSA for the Twelfth Plan. However, major investment in research and development that enhances water use efficiency is required. A pilot on management and sharing of resources of commons through stronger involvement of communities, civil society groups and reputed NGOs is envisaged in 29 blocks (one in each State) along with leveraging of funds from other schemes like MGNREGS, IWMP etc. A strong mechanism for research backup in NMSA needs to be built up to assess the impact of climate change and respond appropriately. Specific focus on improving the productivity of problem soils and suitability to farming, preferably under PPP model as successfully implemented in some States, needs to be mainstreamed.

Agroforestry integrates trees and shrubs on farmlands and rural landscapes to enhance productivity, profitability, diversity and ecosystem sustainability. National Agroforestry Policy, 2014 will help in developing policies related to harvesting and marketing of farm forestry produce, which have been important factors in promotion of farm forestry and restoring ecological services (carbon sequestration) and improving the income and livelihoods of rural households, especially the small farmers.

PRICE SUPPORT FOR AGRICULTURAL COMMODITIES

The Minimum Support Prices (MSPs) of various rabi and kharif crops have risen sharply during the period 2007-2017. These have helped farmers to get remunerative returns for their investments. Over and above, many State Governments announced additional bonus on procurement of wheat and rice. However, MSP has never been inclusive in terms of geographies and commodities. It would be pertinent that there is careful calibration of MSPs to balance the interests of farmers and consumers. The emphasis should be such that open market prices are higher than the MSPs so that dependence on Government procurement is limited. Besides, in many States, it has been observed that procurement by central agencies is limited or non-existent while market prices of many commodities often fall below MSP. For such regions, it is imperative that price support system be diversified to introduce an alternative to physical procurement of the produce.

NITI Aayog in its 3 years Action Agenda presented to Government strongly recommended to introduce Price Deficiency Payment mechanism in which all the farmers willing to receive the benefits of the PDP have to register themselves with local APMC and make sale of their produce through APMC system. Based on MSP for those commodities which have MSP and threshold price for non-MSP commodities the farmers may be provided a deficiency payment up to some ceiling (say 10 percent) of the MSP/threshold price if the sale price rules below the MSP or threshold price. The ceiling for the produce an individual may also be fixed based on his land holding, crop grown and the optimum productivity in a given

season. Interestingly Maharashtra has already implemented a pilot on PDP for soybean and onion and Madhya Pradesh has introduced it for few crops this year. The learning of these states will help in further strengthening of this important and strong alternative to physical procurement. However, the States have to strengthen their APMC for data management of farmers, price discovery and intelligence and linking the farmers data with digitised land records.

INTEGRATION OF SMALL FARMERS WITH VALUE CHAIN

During 12th Plan renewed emphasis was laid on encouraging formation of Farmers' Producers Organization (FPOs) to create enabling environment to successfully deal with a range of challenges that small and marginal farmers confront today. Small Farmers' Agribusiness Consortium (SFAC) was mandated to lead a national pilot project, to promote FPOs as a demonstration of the benefits of building institutions of producers and their integration in agri-value chains. Since inception in 2011, the FPO project has helped to mobilize approximately 8.98 lakh farmers in about 927 FPOs by September, 2015. Farmers have responded enthusiastically to the message of aggregation and in implementing the pilot project. The vital ecosystem put together to support FPOs includes equity grants, credit guarantee fund for facilitating loans to FPCs, inclusion of dairy and poultry as eligible activities, nomination of SFAC as procurement agency to buy pulses and oilseeds under price support operations, inclusion of FPOs under Gramin Bhandaran Yojana and making them eligible for grants under RKVY for building critical infrastructure. The FPOs have also roped in the implementation of price stabilization of onion and procurement of pulses in select states. These initiatives need to be continued and scaled in the next 15 years also.

AGRICULTURE R&D

The future growth in agriculture will primarily be knowledge and technology driven. This demands more investment in agricultural R&D, innovations and institutions to bring about significant change in technologies for resource conservations and productivity enhancement. During 11th Plan, the investment on Agri-R&D was about 0.7 percent of agri-GDP which needs to be enhanced to minimum of 1 percent of agriculture GDP by 2022-23 and 2 percent by 2032-33. However, there has been slow progress in finalizing the new and existing projects for research during the 12th Plan which needs a serious review. Besides, reforms in Agri-R&D should be the major agenda for years to come. Despite low participation in agriculture R&D, private sector has come out with some impressive technologies like Bt cotton and hybrids in maize and vegetables. Private sector need to be facilitated and encouraged to invest more in R&D in the country. The multiplicity of institutions with overlapping activities in agriculture research and structural reorientation in Krishi Vigyan Kendras (KVKs), etc., are some of the core issues that require immediate

attention. KVKs should promote village level knowledge and entrepreneurship models through shared investment to empower the farmers not only as users of technology but also as producers of knowledge. In order to improve the efficiency and performance of KVKs, a national level competition has been proposed in Union Budget 2016-17 to be held among 674 KVKs, with a total prize money of Rs.50 lakh. A large number of new varieties are developed each year through public funding every year but often not adopted by the farmers due to lack of confidence in the variety, poor dissemination, issues in varietal identification, breeder seed production and further multiplication and distribution.

Transformation in agricultural education to make it more inclusive for rural entrepreneurship and having strong organic linkages with Higher Education Programmes of Ministry of Human Resources is also required. Several ambitious programmes and institutions of upstream research have been commissioned during 12th Plan, but are yet to take off due to limited resources available. These programmes along with other initiatives such as Agriculture Technology Forecast Centre (ATFC), Agri-Innovate India etc., need to be implemented on priority. The proliferation of SAUs and disintegration into Veterinary and Horticultural universities need a thorough review by the States, under the guiding principle of integrated farming practices adopted by the farmers. The focus also needs to shift from incremental research to transformational research. One of the problems of slow progress of agriculture in eastern region has been low outreach of the institutions and technologies leading to lower productivity in spite of abundant natural resources. The establishment of Institutions of excellence on the pattern of IARI in Assam and Jharkhand for spearheading research in Agriculture is an important move. The State Agricultural Universities are also proposed to be established in Andhra Pradesh and Rajasthan; and Horticulture Universities in Telangana and Haryana for better outreach but their linkages with industry and other stakeholders to conduct user centric research need to be prioritised.

NATIONAL MISSION FOR AGRICULTURE EXTENSION AND TECHNOLOGY

The NMAET is an overarching arrangement for support to states extension programmes, agricultural technology management agency (ATMA), inputs such as seed, mechanisation and pesticides and capacity building for farmers, extension personnel and trainers along with initiatives for print and electronic extension activities. While progress on physical and financial terms for the NMAET and its constituent submission were satisfactory, the infusion of technology in agricultural extension in programme administration, technology diffusion and the feedback has been limited. Serious concerns have also been raised in NSSO surveys about the reach out of the extension services and level of technology adoption. The extension eco-system has changed over the years and multiple players including private agencies and service providers, NGOs, Civil Society Organizations, etc., are also involved actively in this activity though at limited scale but with greater acceptability and visibility. The

public extension system needs to be reformed to integrate the best learning of these players. Agriculture extension in the States needs overhauling to appreciate the technological development and its dissemination amongst farmers, with a proper feedback to research system on adoption of the technologies. National Mission for Agriculture Extension & Technology (NMAET) needs to catalyze focus on technology in agri-extension.

PRADHAN MANTRI KRISHI SINCHAI YOJANA (PMKSY)

Currently 66 million ha i.e., 47 percent of net cropped area is irrigated in the country. An irrigation potential of 85.03 lakh ha is estimated to have been created by States from major/medium/minor irrigation projects under the AIBP till March 2013. Multiple programmes are operating for development of surface, groundwater resources and also enhancing the application use efficiency of the irrigation water but without any convergence for resource sharing and bringing synergy. A strong case exists to develop a matrix for convergence amongst different programmes and departments based on comprehensive information of all water bodies and reservoirs. In this context, Union Budget 2016-17 has also proposed fast tracking of 89 irrigation projects under AIBP which will help to irrigate 80.6 lakh hectares. Of these 23 projects are proposed to be completed before 31st March, 2017.

Pradhan Mantri Krishi Sinchai Yojana (PMKSY) has been announced in 2015-16. The PMKSY aims to ensure access to protective irrigation to all agricultural farms through water harvesting and recycling with increased water application efficiency to achieve maximum water productivity i.e., *per drop more crop.*. The focus of PMKSY is on end-to-end solution in irrigation supply chain, viz. water sources and distribution network and farm level applications. The PMKSY will provide an overarching management and governance for convergence amongst the programmes of agriculture, water resources, land resources and other departments dealing with water and energy. An allocation of Rs. 5,300 crore was provided in 2015-16 to support micro-irrigation, watershed development and PMKSY-AIBP. The States have been urged to contribute on this further. A total of 28.5 lakh ha is expected to be brought under irrigation under this scheme. Besides, a dedicated Long Term Irrigation Fund in NABARD with an initial corpus of about Rs.20,000 crore has also been established. A major programme for sustainable management of ground water resources has been prepared with an estimated cost of Rs. 6,000 crore and proposed for multilateral funding. In addition, at least 5 lakh farm ponds and dug wells in rain fed areas and 10 lakh compost pits for production of organic manure are proposed to be taken up by making productive use of the allocations under MGNREGA.

Per drop more crop is the core activity under PMKSY. About 94 percent area of the total coverage under micro irrigation is accounted by only 9 States (Rajasthan, Maharashtra, Andhra Pradesh, Karnataka, Gujarat, Haryana, Madhya Pradesh, Tamil Nadu, and

Chhattisgarh). Interestingly these are the States which have maximum water scarcity but largely diversified. The most disturbing element is the progressive negative performance in terms of growth in micro-irrigation programme. While the performance was much promising during initial years of the programme with over 20 percent annual growth in area under micro-irrigation that has abruptly declined to close to 1 percent in drip and turned highly negative for sprinklers (11 percent) during last five years.

The Micro-Irrigation necessitates new strategy turning it from from subsidy driven system distribution to PPP mode of installation, repair and maintenance along with providing quality but affordable energy to run the pressure devices. Another approach could be installation and maintenance by private player in command catchments with service charged from the users. Such pilots may be tried in select states. Some States have also experimented with customised services of rain gun backed by water source on hire basis in pulses. The results such pilots need to be analysed and sale out if found positive.

Table 5.2: Micro Irrigation Programme: Past Performance

Year	**Area (ha)**		
	Drip	Sprinkler	Total
2005 - 06	11685	132	11817
2010 - 11	331803	359216	691019
2015/16	357516	217484	575000
CAGR (%)			
2005/06 - 2015/16	21.01	37.28	20.51
2005/06 - 2010/11	20.61	17.67	19.02
2011/12 - 2015-16	1.09	-10.97	-4.04

SOIL HEALTH CARDS

Indian Agriculture is marked with skewed application of fertilizers. An appropriate soil health card helps farmers know the fertility status his farm land and get crop-specific prescription for the right mix of fertilizers and manure needed to achieve the higher productivity. With this aim, GOI launched the scheme on 19th February 2015. The scheme aims to provide soil card to all the farmers in the country and crop-wise recommendations of nutrients and fertilizers required for the individual farms to help farmers to improve productivity through judicious fertilizer and manure uses. A target of 14 crore soil health cards to as many farmers across the country was set in a phased manner. An outlay of Rs. 568.54 crore for a period of three years (later revised to two years) was provided. The scheme is implemented on 50:50 sharing pattern.

Soil Health card (SHC) has to be issued once in three years for 12 parameters - N,P,K,S, Zn, Fe, Cu, Mn, Bo, pH, EC, Organic carbon. It should also contain fertiliser recommendations for kharif, rabi and summer crops. Nationally agreed norms of soil sample collection in a grid of 2.5 ha in irrigated area and 10 ha in rainfed area with the help of GPS tools and revenue maps was followed. A total of about 2.54 crore samples was to be collected and tested to generate 14 crore soil health cards to individual farm land holding. SMS service to inform farmers to collect the cards after they were prepared was also started. The soil health card is made available online also to the farmers.

Out of the total 141 million hectare of net cropped area, 7.3 million grid samples was to be collected to cover 73 million ha area (one grid of 10 ha) under rainfed situations. Similarly, 27 million grid samples were to be collected to cover 68 million ha irrigated land (one grid of 2.5 ha). Hence, 34.6 million grid samples were targeted in two years. This translates, on average, to 25000 grid samples per district/year. In Cycle I, 2.87 crore samples were collected, 2.44 crore samples tested, and 11.98 crore soil health cards printed. However, only 9.3 crore soil health cards distributed. It indicates that only 78 percent farmers received the SHCs while about 86 percent of 14 crore soil health cards printed.

Himachal Pradesh is the leading State which had issued SHC under the scheme with coverage of 100 percent followed by Chhattisgarh. Punjab (16.27 percent), Assam (10.15 percent), Arunachal Pradesh (8.52 percent) and Manipur (4.67 percent) were among the states which had issued lowest SHCs under the scheme. Though the results on physical and financial performance of the scheme is very encouraging, the users feedback and the ground level truths do reveal several shortcomings in the execution of the scheme, capacity of the technical personnel and also the infrastructure available for the analysis of such a huge sample size with the available manpower, infrastructure and other logistics and support services.

NITI Aayog conducted a study in **Varanasi, and Sitapur** districts in Uttar Pradesh, the salient observations are as under:

- In both the districts the cultivated area is irrigated, so the soil sample were collected at 2.5 ha grid with the help of revenue maps. During the initial stages GPS was not available with the departments and soil samples were collected without GPS from farmers' fields. **Shortage of technical personnel for soil testing laboratories in Varanasi and Sitapur districts was observed.** A drive for recruitment of qualified personnel must be initiated for successful management of soil testing programme. During the peak period, laboratory has been running in two shift to analyse 200 samples in a day and overcome the inadequacy of manpower. However, inadequate training remains an area of concern. **Soil sample storage seems to be the major problem.** No proper space in the laboratories available to store the huge quantity of samples drawn. This has raised a serious doubt on the quality of the analysis.

- **The analysis of micro-nutrients is highly skill intensive activity** and needs adequate training for handling of Atomic Absorption Spectrophotometer (AAS) in quality labs of reputed research institutions. It was observed that soil testing lab (STL) staff has got only one training for the duration of 5 days in Lucknow for handling the Soil sample testing equipments for micronutrient analysis which seems to be highly inadequate. Further, the STL staff needs to be provided training for up-gradation of their knowledge and skills at regular intervals for STL staff. Lack of Inadequate infrastructure, erratic supply of electricity and water, lack of adequate maintainance of equipment's, supply of spare parts of equipment/machine and poor maintenance services and almost non-existence AMC for equipments is the major concern.
- Major concern about the method of collecting the soil samples was expressed. As per scheme Guidelines, one soil sample for every 2.5 hectares in irrigated area is collected based on the grids. Samples have to be collected from all the 4 corners and 1 from the centre of the field then mixed and final sample is drawn as per the guidelines. However, mostly the farmers' collected sample themselves from centre of their field. This means it was only one individual farmer's field sample rather than a grid sample. The farmers from whose field the soil samples were not collected had reservations to use the soil health cards.
- In the focus group discussion and individual interactions with beneficiaries of the SHCs, the farmers informed that the cards were written in English which is difficult to read and understand for majority of them.
- The concern about the genuineness of the recommendations was also raised. FYM, Compost recommended for per ha in SHCs to the tune of **53 tons to 67 tons/ha** against a normal recommendation of 10-15 tons/ha for rice. The availability of such quantity of FYM/compost was also questioned.
- During the data entry of sample registration, server of web portal was down (four to five times a day). Internet connectivity is another major problem because interruption in power/electricity supply. About 25 samples registered in day in a portal because of interruption in electricity supply and server of web portal is down.

In view of the observations in the previous para, redesigning the scheme both in terms of targets and also the sampling procedures is needed.

- The scheme at present is department owned and driven which needs to be made participatory. One or two farmers in each village should be selected and trained for soil sample collection, GPS use and sample dispatch. They may also be trained to educate the fellow farmers about use of the SHC recommendations. Farmer to farmer extension is the most effective way of knowledge exchange even today. Providing these farm scouts some honorarium may also be thought of rather than paying Rs. 15 to 40 per sample collected to the extension officers.

- Soil fertility though dynamic but does not change severely within a span of 5 years. Hence, 3 year cycle may be extended to 5 year cycle. Simultaneously, the optimum capacity of a soil testing labs must be reworked in view of the electricity and water supply to a district, subdivision and block level lab, availability of manpower and above all the chemicals and lamps (required for micro-nutrient analysis). It is highly exaggerated at present and leading to incorrect reporting. The targets given at present are impossible to achieve with current state of equipments, even if they run optimally. These must be rationalized to avoid the fake reporting.
- Severe shortage of trained/skilled manpower in labs and the equipments' in the soil testing laboratories are old and non-functional and need immediate replacement. A drive for strengthening of existing soil testing laboratories (STL) needs to be started along with establishment of new static or mobile soil testing laboratories (STLs) and mini soil testing laboratories. However, their optimum utilization must be ensured. At subdivision and block level, major problem is water and electricity (interruption in power) supply.
- Farmers may bring soil samples directly to the laboratory. Most of the samples are, however, sent to the laboratories through the field extension staff. An organized assembly-processing dispatch system is required to ensure prompt delivery of samples to the laboratory.

ORGANIC FARMING

Organic farming attempts to reduce or eliminate external agricultural inputs, especially synthetic ones and relies on ecosystem management. The intensive uses of inorganic fertilizers, pesticides and other inputs for maximizing agri-production were necessitated to meet the consumption requirement of growing population. However, indiscriminate use of chemical inputs has become serious hazard to human life. Growing concern about sustainable production with eco-friendly inputs use, has brought organic farming in sharp focus which offers an attractive opportunity to small farms, also in view of the premium price tag, provided the marketing and quality organic input supply are ensured. The Organic Farming has been identified a priority area for the North Eastern Region where large agricultural produce are luckily organic by default. To sustain organic farming, higher investment for secondary processing and capacity building with input support is required. Towards this end, the Government has launched two important schemes. First, the 'Parmparagat Krishi Vikas Yojana' which will bring 5 lakh acres under organic farming over a three year period. Second, a value chain based organic farming scheme called "Organic Value Chain Development in North East Region" has been launched. These schemes need to implemented with greater precision and focus on export promotion through branding and GIs.

NATIONAL INNOVATIONS ON CLIMATE RESILIENT AGRICULTURE (NICRA)

Studies conducted at Indian Agricultural Research Institute (IARI) indicated the possibility of loss of 4-5 million tonnes in wheat production with every rise of 1°C temperature throughout the

growing period. Increase in temperature in future is likely to reduce fertilizer use efficiency, aggravate the heat stress in dairy animals adversely affecting their productive and reproductive performance, and limit effective area where high yielding dairy cattle can be economically reared. Increasing sea and river water temperature is likely to adversely affect fish breeding, migration, and harvests. National Innovations on Climate Resilient Agriculture (NICRA) was launched in February 2011 to undertake strategic research and demonstration of proven climate resilient technology. It has made achievements, like collection of real time data on crop and weather and district level contingency Plans and agro-advisory mechanism and pilot testing of block level agro advisory system, linked to real time weather monitoring in Belgaum district of Karnataka. Weather indices for wheat, cotton and groundnut have also been developed for improving the weather insurance products. First ever district-level vulnerability atlas, presenting relative vulnerability of 572 rural districts of India in terms of sensitivity, exposure and adaptive capacity to prioritize investments and Plan for research on adaptation interventions, has also been developed. NICRA and NMSA are two important programmes in Research & Development for implementing the national adaptation Plans in agriculture and need to be continued. In addition, the Earth System Science Organization (ESSO) issues agro-meteorological advisories in 12 languages to 600 districts and is subscribed to by over 4.8 million farmers, while Gramin Krishi Mausam Sewa is providing these advisory services at block level. The newly launched Kisan TV channel should provide a platform to disseminate these advisories countrywide. However, the response to climate change induced calamities, available in terms of relief measures are largely confined to input subsidy and to a limited extent in the form of crop insurance. These are perceived to be grossly inadequate and require some long term Planning with multi-pronged approach. Accordingly, transparent relief measures need to be put in place as a social service. The farmers' database needs to be linked with Aadhaar seeded bank accounts and a minimum specified sum of cash needs to be transferred into these accounts in the event of natural calamity.

INTEREST SUBVENTION AND AGRICULTURAL CREDIT

The target of doubling of the flow of agricultural credit in three years with base year as 2004-05 was achieved in two years. Agricultural credit flow further increased consistently to reach Rs.711,621 crore in 2013-14. The target for 2014-15 was set at Rs. 800,000 crore and for 2015-16, it has been further up scaled to Rs. 850,000 crore, against which actual credit is expected at over Rs. 9 lakh crore. During 2017-18, the target of 10 lakh crore was envisaged. A number of other initiatives for enhancing flow of credit to agricultural sector have been put in place. The Kisan Credit Card Scheme has been made broad-based to include term credit and consumption needs, besides some risk cover against accidental death. The interest subvention scheme for short-term crop loans up to Rs. 3 lakh, has been continued and a farmer who repays the loan on time, becomes eligible to get crop loan at 4 percent rate of interest. Post-harvest loans are also being granted against Negotiable Warehouse Receipts (NWRs) with benefit of interest subvention. In the Union Budget 2015-16, Rs. 25,000 crore has been allocated towards Rural

Infrastructure Development Fund (RIDF); Rs. 15,000 crore for Long Term Rural Credit Fund; Rs. 45,000 crore for Short Term Co-operative Rural Credit Refinance Fund; and Rs. 15,000 crore for Short Term RRB Refinance Fund.

While total credit targets and availability has been raised substantially, the equitable distribution of credit amongst different strata of farmers and geographies has been a major challenge. This has resulted into dominance of private money lenders in many of the regions particularly to small and marginal farmers. This needs a serious review and reach of institutional credit to those who need it the most must be ensured. For modernizing the interest subvention scheme, the recommendations of the Sarangi Committee needs to be implemented at the earliest.

PRADHAN MANTRI FASAL BIMA YOJANA (PMFBY)

The multiplicity of insurance schemes (National Agricultural Insurance Scheme, Modified National Agricultural Insurance Scheme, Weather Based Crop Insurance Scheme and Coconut Insurance Scheme) has been revamped into National Crop Insurance Programme. While it will add value and address problems more effectively, still this instrument available for risk management needs to be made more extensive, efficient and effective to cover the risk of individual farmers, more so of non-loanee farmers in the vulnerable areas. States are reluctant to notify a smaller unit area (such as a village) because of increased requirements of the minimum number of crop cutting experiments that have to be undertaken, which is both costly and time consuming. In order to address the problems faced by the farmers especially regarding insurance, a new Pradhan Mantri Fasal Bima Yojana (PMFBY) has been launched in January 2016. The scheme requires only 1.5 to 5 percent of the premium to be paid by the farmers and remaining to be shared in a ratio of 50:50 by Centre and the State. The progress of the scheme has been very encouraging with 24 States and 3 UTs participating in the scheme.

Table 5.3: Coverage details of PMFBY during the year 2016-17

Coverage Details During 2016-2017	**Kharif 2016**	**Rabi 2016-17 (Prov)**	**Total**
Loanee Applications (in lakh)	299.05	139.92	438.97
Non-Loanee Applications (in lakh)	102.48	32.8	135.28
Total Farmer Applications (in lakh)	401.53	172.78	574.25
Area Insured (in lakh ha.)	385.34	195.82	581.16
Sum Insured (Rs. in crore)	134582	66837	201420
Gross premium (Rs. in crore)	17381.86	5524.56	22906.42
Claims Reported (Rs. in crore)	8057.48	1952.21	10009.62
Claims Paid (Rs. crore)	6233.69	1493.38	7727.07
Farmers Benefited (in lakh)	84.9	5.89	90.79

Though technologies like remote sensing, drones, smart phones etc. are being used for conducting the filed level assessments of area insured and the losses, yet it is still at a nascent stage. The major challenge in PMFBY is precise record of area insured and the extent and intensity of damage if any. The crop cutting experiments (CCE) is the only accepted method by the States to arrive at any decisions in this regard. The number of CCEs runs into millions and hence conducting adequate number of CCEs is the most significant challenge. Timely release of premium subsidy by States, real time flow of information from Cooperatives and speedy computerization of PACS is another challenge. The area discrepancies have been another issue which require immediate address. The Central and State governments have to resolve these issues at the earliest.

NATIONAL AGRICULTURE MARKET (NAM)

Reforms in agricultural marketing were initiated to ease restrictive and monopolistic approval of State Governments to agricultural markets, reduce intermediaries in supply chain and enhance private sector investment. Recently Government suggested a new Model Agricultural Produce and Livestock Marketing Committee (APLMC) Act, 2017 which is an improved version of Agricultural Produce Marketing Committee (APMC) Act suggested by the Central Government in 2003. Much needed provision for permitting the out-of-mandi transactions and the matter of exemption of market fee on horticultural perishables along with the electronic marketing etc., have been explicitly dealt in the new Act. Few States have already adopted this model.

The scheme namely National Agriculture Market portal e-NAM was launched on April 15th, 2016 to connect e-mandis in several States with a budget allocation of Rs. 200 crore from 2015-16 to 2017-18. e-National Agriculture Market (NAM) is a pan-India electronic trading platform which networks the existing APMC mandis to create a unified national market for agricultural commodities. This includes provision for supplying software free of cost to the States/UTs and for cost of related hardware/infrastructure to be subsidized by the Government of India up to Rs. 30 Lakh per mandi (Other than for private mandis). e-NAM is an online inter-connectivity of e-mandis, aimed at ushering in much needed agriculture marketing reforms to enable farmers to get better price of their produce. It provides a single window service for all APMC related information and services. This includes commodity arrivals & prices, buy & sell trade offers, provision to respond to trade offers, among other services. Farmers can showcase their produce online from their nearest market and traders can quote price from anywhere. It will result in increased numbers of traders and greater competition. It will also ensure open price discovery and better returns to farmers. To integrate wholesale mandis across the country with the online platform, the state governments have to amend their Agriculture Produce Market Committee (APMC) Act. Only those States/UTs that have completed these three pre-requisites will be eligible for assistance under the scheme. These include:

i) a single license to be valid across the state;
ii) single point levy of market fee; and
iii) provision for electronic auction as a mode for price discovery

Small Farmers Agribusiness Consortium (SFAC) was entrusted with the responsibility to implement the national e-platform. 585 regulated wholesale markets in States/UTs across the country were targeted to join with the common e-market platform by March 2018. M/s. Nagarjuna Fertilizers and Chemicals Ltd. is the Strategic Partner (SP) who is responsible for development, operation and maintenance of the platform. The State-wise progress of the integration of APMC mandis under e-NAM is given in following Table 5.4 and their performance in Table 5.5 below:

Table 5.4 a: Numbers of markets integrated with e-NAM state wise

Name of State	No. of markets integrated to e - NAM portal		
	Up to Sept, 2016	As on 31st March 2017	As on 18th Aug 2017
Andhra Pradesh	12	22	22
Chhattisgarh	05	14	14
Gujarat	40	40	40
Haryana	37	54	54
Himachal Pradesh	07	17	19
Jharkhand	08	19	19
Madhya Pradesh	20	58	58
Maharashtra	--	44	45
Orissa	--	9	10
Rajasthan	11	25	25
Telangana	44	44	44
Uttar Pradesh	66	66	100
Uttarakhand	--	05	05
Total	**250**	**417**	**455**

Source: http://www.enam.gov.in/NAM/home/dashboard3.html#

Table 5.4 b: e-NAM – Performance Summary

In India APMC Market 1. No. of States - 29 2. Regulated Market Yard by APMC - 2477 3. Sub Market Yard by APMC - 4843	**e-NAM joined** A. No. of States -13 B. No. of APMC Mandi joined - 455 C. Types of Commodity - 69
e-NAM Registered a) Farmers 5 Million (5006881) b) Trader – 95286 c) Commission Agent – 50358	**e-NAM Business** 1) Quantity Trade - 10647451.15Ton 2) Quantum of business has touched Rs 24,536.74 crore.

CONSTRAINT/ISSUES OF E-NAM

- Infrastructure Issues:
  - Mandis not entirely on virtual market
  - Software failure - data entry during peak period
- Quality Verification of Agri-Produce:
  - No assaying (Quality testing) is done, Lab is present with equipment, and no Technical staff is present
  - Manual examination by traders
- Pricing System:
  - Trader is a price giver and farmer is the price taker.
  - Degree of Price Variation would continue
- Lack of Awareness among the farmers
- Lack of Financial Inclusion:
  - Not well defined system for making the payments in the farmer's account.
  - Cash Payments done by middlemen to farmers
- APMC mandi provide space for market never ensure the sale of produce of farmers
- Risk coinsurance - who will bear a cost of transportation loss of produce during transportation
- Inter portability issues: In many states, e-platform other than APMCs are operating successfully like ReMS in Karnataka and NIMMs in Rajasthan. However, these are not given access to e-NAM due to inter-operatibility issues. This is affecting the transaction of the millions of the farmers.

ANIMAL HUSBANDRY, DAIRYING AND FISHERIES

Livestock contributes 25 percent of Gross Value Added in the agriculture sector and provides self-employment to about 21 million people. The average growth of livestock output was 4.8 percent per annum during the Eleventh Plan. The Twelfth Plan envisaged a growth of 5-6 percent in this sector, comprising of 5 percent in milk production, 2-3 percent in rural poultry, 11 percent in commercial broilers, 7 percent in layers and 6 percent in fisheries. To achieve such growth rates, some of the major initiatives like enhancing the artificial insemination from 25 to 50 percent, 100 percent high genetic merit bull replacement, enhancing the inland fisheries productivity from present level of 1 mt/ha to 3-4 mt/ha through judicious use of inputs, etc. are required.

Major issues in livestock sector are access to feed, fodder and all the more drinking water which is becoming increasingly scarce in rain-fed areas that support about 75 percent of the livestock population. The ongoing programmes of Department of Animal Husbandry, Dairying and Fisheries have been revamped under three Centrally Sponsored Schemes-National Livestock Mission, National Programme for Bovine Breeding and Dairy

Development (NPBBDD) and Livestock Health and Disease Control and a Central Sector Scheme-National Fisheries Development Board (NFDB), with more flexibility to States through cafeteria of interventions. These programmes have started delivering good results and need to be continued in the remaining period of Twelfth Plan with more balanced state-wise distribution of assistance, instead of going entirely by demand driven approach. While enhancing the allocation to this sector will be a strong case to be considered, there is a need to strengthen institutions and marketing, processing (abattoirs), quality and sanitary standards for the sector. The conservation of indigenous breeds, processing and value addition in milk and milk products and strengthening of milk cooperatives require utmost priority. Rashtriya Gokul Mission launched in 2014-15 is an important initiative for conservation of indigenous breeds. Timely availability and reliability of data is an important concern. The data released with some delay serves limited purpose for appropriate policy decisions. It is, therefore, pertinent that immediate action for streamlining the procedures of data collection are taken by the concerned departments, with suitable blending of remote sensing and satellite information to synchronize the estimates for crops, fruits and vegetables, etc.

However, in the course of review of various centrally sponsored schemes implemented by various ministries during the 12th Five Year Plan period, it was felt that, those schemes fell short of expectations. Moreover, there was an overwhelming emphasis on a process centric approach and lack of flexibility in designing and implementing the CSSs that has diffused the focus on their outcomes. To assess the situations, NITI Aayog constituted a Sub-Group during March, 2015 under the convenorship of Chief Minister, Madhya Pradesh to review the issues concerning the Centrally Sponsored Schemes (CSSs), rationalization/ re-structuring of CSSs and recommend measures for ensuring that, its implementation is stream-lined with the provisions of adequate flexibility. To this backdrop, the Sub-Group finalised that, the details of schemes presently implementing by the Department of Animal Husbandry, Dairying and Fisheries (DAH,D&F), Ministry of Agriculture and Farmers' Welfare (MoA&FW) will be merged under an umbrella programme of White Revolution-Rashtriya Pasudhan Vikas Yojana (WR-RPVY) as a core initiative.

White Revolution is an umbrella of Centrally Sponsored/ Central Sector Schemes with the following Sub-schemes :-

(i). National Programme for Dairy Development (NPDD).
(ii). National Dairy Plan-I (NDP-I).
(iii). Dairy Entrepreneurship Development Scheme (DEDS).
(iv). Supporting State Cooperative Dairy Federation (SSCDF).
(v). Rashtriya Gokul Mission (RGM) with the sub-schemes namely National Programme for Bovine Breeding (NPBB), National Mission on Bovine Productivity (NMBP) and Indigenous Breed.

(vi). Breed Improvement Institutes (BIIs).
(vii). Livestock Health and Disease Control (LH&DC).
(viii). Assistance to Animal Health Institute (AAHI).
(ix). National Livestock Mission (NLM) including Small Livestock Institutes (SLIs)
(x). Livestock Census (LC)
(xi). Integrated Sample Survey (ISS)

These schemes are being normally implemented on a cost sharing ratio of 60:40 between centre and state government except NE & Special Category States where the ratio is 90:10. Some Sub-Schemes are even on different sharing pattern as in case of NDP, NPDD (for capital item 50:50) which are as per already approved concerned sub-scheme. The DEDS is a beneficiary oriented scheme wherein the entire subsidy portion (25% for general and 331/3% for SC&ST beneficiary) to eligible beneficiary is provided by Central Government through NABARD. DEDS is thus a credit subsidy scheme and no State share is involved. The summary of activities under the WR-RPVY are as follows :

National Programme for Dairy Development (NPDD) - The sub-scheme aims to create and strengthen infrastructure of production of quality milk including cold chain infrastructure linking the farmer to the consumer and infrastructure for procurement, processing in marketing of milk, for training of Dairy farmers. Also to increase milk production by providing technical inputs services like cattle feed and mineral mixture and to assist in rehabilitation of potentially viable milk federations/unions.

National Dairy Plan-I (Externally Aided Programme) - The sub-scheme (NDP-I) has been setup to increase productivity of milch animals and thereby increase milk production to meet the rapidly growing demand for milk and to provide rural milk produces with greater access to the organize milk processing sector.

Dairy Entrepreneurship Development Scheme (DEDS) - The scheme aims to generate self-employment and provide infrastructure for dairy sector and to set up modern dairy farms and infrastructure for production of clean milk to encourage heifer calf rearing for conservation and development of good breeding stock and to bring structural changes in the unorganized sector, so that initial processing of milk can be taken up at the village level and to upgrade traditional technology to handle milk on a commercial scale.

Supporting State Cooperative Dairy Federation (SSCDF) - The scheme aims to assist the State Dairy Cooperative Federation by providing subsidy in the form of working capital, the tide over the present crisis on account of the global dairy scenario by providing stable market access to the dairy farmers. It will enable State Cooperative Dairy Federations to continue to make timely payments to the farmers and cooperatives to procure milk at a remunerative price from the farmers, even during the flush season and Milk Federation/ Unions to maintain quality supply of

milk and products for the consumers in the domestic market at a reasonable price.

Rashtriya Gokul Mission (RGM) - The scheme has been initiated with the aim of development and conservation of indigenous breeds. Scheme is crucial for development and conservation indigenous breeds and upliftment of rural poor as more than 80% low producing indigenous breeds are with small and marginal farmers and landless labour. The aim of the scheme is genetic up-gradation of bovine population through delivery of quality breeding inputs at the farmers' doorstep. Implementation of scheme crucial to enhance milk production and productivity of bovines, thereby making dairying more remunerative to poor farmers of the country. The scheme will lead to multiplication of elite animals in an exponential manner and play important role in checking spread of animal diseases and enhancing trade of milk.

Breed Improvement Institutes (BIIs) - The sub-scheme "Breed Improvement Institutes" includes seven Central Cattle Breeding Farms (CCBFs), one Central Frozen Semen Production & Training Institute (CFSP&TI) and four centres of Central Herd Registration sub-scheme (CHRS) and being implemented as Central Sector Scheme of Ministry of Agriculture & Farmers Welfare, Government of India. These organizations had been established during 60s & 70s. Since these centres are catering the demand of high genetic germplasm in the country and also playing vital role in implementation of various other sub-schemes of this Department, therefore this sub-scheme is likely to continue over proposed period of Fourteenth Finance Commission i.e. 2017-18 to 2019-20. The measures being introduced will require long-term support. However, the projected budget is limited to activities proposed within the period of Fourteenth Finance Commission. The sub-scheme "Breed Improvement Institutes" is 100% Central Sector sub-scheme.

Livestock Health and Disease Control (LH&DC) - The overall aim and objective of the scheme is to improve the animal health situation in the country by way of implementation of prophylactic vaccination programs against various animal diseases, strengthening of laboratory network, biological production units, capacity building, disease surveillance and prompt reporting of animal diseases and veterinary infrastructure and continuous veterinary education. Thus the implementation of the scheme will ultimately lead to prevention & control, subsequently eradicating the diseases, easy access to veterinary services, higher productivity from animals, boosting up the trade and improving socio-economic status of masses.

Assistance to Animal Health Institutes (AAHIs) - The Department has been implementing a Central Sector Scheme namely "Directorate of Animal Health" since 8th five year Plan and continued during 9th, 10th and modified in 11th Plan for strengthening of Animal Quarantine and Certification Services (AQCS). The Scheme (2017-18 to 2019-20) continued without any modification during 12th Plan. The Scheme comprises mainly of three components namely (a) Animal Quarantine and Certification Services (AQCS), (b) Central / Regional Disease

Diagnostic Laboratory (CDDL/RDDL) and (c) National Veterinary Biological Products Quality Control Laboratory (presently it is known as Chaudhary Charan Singh National Institute of Animal Health). However, during the year 2015-16, the nomenclature of the Scheme was changed into Animal Health Institutes remaining all the three components unchanged.

National Livestock Mission (NLM) - The scheme aim to sustainable and continuous growth of livestock sector by emulating the success achieved in Dairy and poultry sectors, across species and regions. It broadly covers all the activities required to ensure quantitative and qualitative improvement in livestock production systems and capacity building of all stakeholders. The major outcomes of the mission is to reduce the gap in demand and availability of fodder, conservation and improvement of indigenous breeds, higher productivity and production in a sustainable and environment friendly manner, enhanced livelihood opportunities, especially in rain-fed areas and for landless, small and marginal farmers, increased awareness, improved risk coverage and better availability of quality animal products to consumers overall socio-economic upliftment of livestock rearers.

Livestock Census (LC) - The main objective of Livestock Census is to provide information on livestock population, species wise and breed-wise along with age, sex-composition etc. up to household level in rural and urban areas. Livestock rearing is one of the most important economic activities in the rural areas of the country providing supplementary income for most of the families dependent on agriculture. Apart from providing a subsidiary income to the families, rearing of livestock such as cattle, buffaloes, sheep, goats, pigs, poultry etc. is a source of protein in the form of milk, eggs and meat. Animal Husbandry and Dairying programs have attained considerable importance in various five year Plans and various schemes/projects have been taken up by the States and the Centre for the development of this sector. In order to make an objective assessment of these projects and evaluate their impact, the need for reliable and correct data is utmost essential. Timely availability of reliable and current data relating to various indicators is essential for monitoring, evaluating and evolving policies for various developmental activities in this sector. The scheme is implemented throughout the country to bring out estimates of major livestock products such as milk, wool, meat and eggs. Under the proposed scheme the estimates are to be brought out annually which is used for policy and Planning purposes especially deriving the per capita availability of day to day essential food items such as milk and eggs. The estimates for other components viz. meat and wool are also widely used for similar purposes. Since the proposed scheme is implemented on sample basis the huge cost and manpower involved in collecting information through complete enumeration is also saved.

Integrated Sample Survey (ISS) - The scheme (2017-18 to 2019-20) is implemented throughout the country to bring out estimates of major livestock products such as milk, wool, meat and eggs. Under the proposed scheme the estimates are to be brought out annually which is used for policy and Planning purposes especially deriving the per-capita availability of day to day essential food items such as milk and eggs. The estimates for other

component viz. meat and wool are also widely used for similar purposes. Since the proposed scheme is implemented on sample basis the huge cost and manpower involved in collecting information through complete enumeration is also saved.

BLUE REVOLUTION

Recognizing the potential and possibilities, Government of India has envisaged a program to unlock the country's fisheries sector through an integrated approach at a scale necessary to make a difference. The **Blue Revolution,** in its scope and reach, **focuses on creating an enabling environment for an integrated and holistic development and management of fisheries for the socio economic development of the fishers and fish farmers keeping in view the sustainability, bio-security and environmental concerns.** Accordingly, thrust areas have been identified for enhancing fisheries production and productivity from aquaculture and fisheries resources, both inland and marine, during ensuing years through the active participation of all stakeholders.

The Blue Revolution/Neel Kranti, will have multi-dimensional approach to all activities related with the development of the fisheries sector to make it a vibrant industry in India. It will focus on tapping the potential from aquaculture and fisheries resources, subsequently increasing the contribution of Indian fisheries in the export earning of the country. It will ensure increase in the income of the fishers and fish farmers' sustainability with environment safeguards and bio security. The Blue Revolution Integrated Development and Management of Fisheries has been conceptualised with the envisioned impact related to (i) 69% increase in inland fish production from 64.5 MT (2014-15) to 108.9 MT in (2020-21); (ii) 24% increase in productivity by enhanced usage of technology in freshwater pond culture; (iii) enhanced focus on creation of infrastructure for sustainable growth; (iv) connecting 15 million fishers for livelihood opportunities; (v) post-harvest facilities for reduction in waste up-to 10%; (vi) increased market accessibility for consumers and (vii) expected increase in exports will be >30%.

The National Fisheries Development Board (NFDB) has been set up as a special purpose vehicle for the development of fisheries sector in the country. However, the programmes and broader contours of the NFDB need to be balanced. There is also a need to focus on specific areas of fisheries information system including reliable data base, comprehensive fisher-folk safety net, infrastructure in the domestic wholesale and retail fish markets, setting up of modern fish processing Plants, re-engineering of the value chain and value addition for higher income and investment in infrastructure through Public Private Partnership (PPP) mode. With marine fisheries facing serious constraints, the main source of future growth in fisheries sector has to be inland fisheries.

Objectives : The main objectives of the Scheme are :-

(i) To increase the overall fish production in a responsible and sustainable manner for economic prosperity;

(ii) To modernize fisheries with special focus on new technologies;
(iii) To ensure food and nutritional security;
(iv) To generate employment and export earnings;
(v) To ensure inclusive development and empower fishers and aquaculture farmers.

Proposal : Blue Revolution is an umbrella scheme, implemented as a re-structured Central Sector Scheme for "Integrated Development and Management of Fisheries" covering following six broad areas –

(i) National Fisheries Development Board (NFDB) and its activities,
(ii) Development of Inland Fisheries and Aquaculture,
(iii) Development of Marine Fisheries, Infrastructure and Post-Harvest Operations,
(iv) Strengthening of Database & Geographical Information System of the Fisheries Sector,
(v) Institutional Arrangement for Fisheries Sector
(vi) Monitoring, Control and Surveillance (MCS) and other need-based Interventions.

Implementation: The new proposals/activities under the (i) National Fisheries Development Board (NFDB) and its activities, (ii) Development of Inland Fisheries and Aquaculture, (iii) Development of Marine Fisheries, Infrastructure and Post-Harvest Operations would be implemented through the National Fisheries Development Board on the Detailed Project Reports (DPR) based model, restricting the central financial assistance as below :

(i) 50% of the project/unit cost for general States, leaving the rest to State agencies/organisations, corporations, federations, boards, fisheries co-operatives, private entrepreneurs, individual beneficiaries.
(ii) 75% of the project/unit cost for North-Eastern/Hilly States leaving the rest to State agencies/Organizations, Cooperatives, individual beneficiaries etc.
(iii) 100% for projects directly implemented by the Government of India through its institutes/organisations and Union Territories.

The other three components of the scheme viz. (a) Strengthening of Database & Geographical Information System of the Fisheries Sector, (b) Institutional Arrangement for the Fisheries Sector and (c) Monitoring, Control and Surveillance (MCS) and other need-based interventions would be implemented departmentally (DAH,D&F) with 100% central funding. As regard to the National Scheme of Welfare of Fishermen, it is proposed to merge (a) the Housing component with the "Pradhan Mantri Awas Yojana (PMAY) - Housing for All by 2022", (b) Insurance component with the Umbrella Insurance Scheme of the Department of Financial Services, Ministry of Finance and (c) the Savings-cum-Relief component will be part of both marine and inland components to cover the marine and inland fishers. *The Department (DAH,D&F), wherever possible, will consider to extend financial assistance under beneficiary -oriented schemes and such assistance may be*

capped at a certain level and directly transferred to the bank account of beneficiary under Direct Benefit Transfer (DBT) platform.

Anticipated Outputs : The anticipated outputs from the proposed scheme are :

(i) Increased fish production at a projected growth rate of 6% per annum;
(ii) Enhanced livelihoods of fishers and aquaculture fish farmers;
(iii) Step forward towards food and nutritional security, providing high energy proteins for tackling protein malnutrition.
(iv) Better quality and safe products for consumers
(v) Creation of rural employment through ancillary industries such as packaging, transportation, ice manufacturing, processing etc.
(vi) Increased foreign exchange earnings through exports.
(vii) Skill development and capacity building in fisheries and allied activities; creation of post-harvest and cold chain infrastructure facilities.
(viii) Wide reach of the welfare oriented schemes.
(ix) Increased private investment, entrepreneurship development, more Public Private Partnership (PPP), better leveraging of institutional finance, use of space applications and tools etc.

POLICY LEVEL INTERVENTIONS

Areas which require policy level interventions for enhancing fish production and productivity are convergence with related schemes such as Mahatma Gandhi National Rural Employment Guarantee Act (MNREGA), Rashtriya Krishi Vikas Yojana (RKVY) and Sagarmala etc.

i). Fisheries and Aquaculture are included in the State List however, the Union Government supplements the efforts of the States/Union Territories (UTs) for development of the sector. Inland sector is by and large, fully in the domain of State Governments while marine fisheries is a shared responsibility between the Central and coastal State Governments. Coastal State Governments & UTs are responsible for development and management/regulation of fisheries in the sea waters inside the 12 nautical miles (22 km) territorial limit. The development and regulation of fisheries in the EEZ waters between 12 and 200 nautical miles (370 km).

ii). Blue Revolution is to be implemented with active cooperation of State Governments. To make it an implementable Plan, State Governments were involved from the initial stage, as a measure of building confidence among the implementing agencies. Plan formulation was started with the assessment of current status of fisheries activities in all states. In depth discussions were held to arrive at some workable mechanisms and to streamline the quantum of targets to ensure smooth operations at time of execution.

iii). The Ministry of Agriculture and Farmers Welfare, Department of Animal Husbandry, Dairying & Fisheries has restructured the activities by merging all the ongoing schemes under an umbrella of Blue Revolution. The restructured schemes provide focused approach for the development and management of fisheries, covering inland, brackish water and marine fisheries and also of the activities undertaken by the National Fisheries Development Board (NFDB).

WAY FORWARD :

Though the share of agriculture in GDP has declined over the years, yet without the growth of this sector, it would be extremely difficult to achieve the overall growth targets for the economy. Hence, strategies for faster, more inclusive and sustainable growth must necessarily address the issues faced by the millions of people living in the rural areas. People and Produce in agriculture sector are subjected often to number of serious stresses related to untimely monsoon or other calamities like floods, hailstorms, etc. The Pradhan Mantri Fasal Bima Yojana is a right step which needs to be continued. Also similar initiatives are required for addressing the risks in livestock sector.

The farmers must get a larger share of the price ultimately paid by the consumers. While MSP related interventions need to be continued, the alternatives to physical procurement like Price Deficiency Payment must be piloted by the States for some commodities and select districts.

The economy of scale of land holding is the major issue and land is the important input or any agricultural activity. Rising absentee landlordism in many States has put large tracts of land out of productive use, as the landowners do not lease it due to fear of losing ownership to tenants. Further, small and marginal farm holders are looking for opportunities to raise their operational holdings by leasing-in land. The net result is that some land is not used optimally and many smaller holdings are suffering from scale disadvantages. This requires substantive reforms in the land policy particularly at the States' level, to achieve the economies of scale in agriculture. Promotion of contract farming, legislation on land leasing and encouraging the land sharing for both farmers and landowners. The model land leasing act suggested by NITI Aayog needs to be adopted by the States to enact their leasing laws.

The enhancement of investments in agriculture is the core area to enhance productivity, infuse profitable commercialization and competitiveness. The large scale dependence on rainfall and low level of investments both on-farm and off-farm are the major reason for low average productivity which is dismally less as compared to any global standards. The enhanced investment, both public and private is required to develop these regions. The Centre and States while invest more through the CSSs, they need to evolve policies to channelize greater private investments in farm inputs, irrigation, marketing, post-harvest management, risk management, land development and capacity of institutions.

Much of the future growth in agriculture will come from non-crop sector, the investment in horticulture, dairy, livestock, fisheries, etc., must be provided necessary impetus so as to meet the future requirements and also enhance and double the farmers' income.

The National Agricultural Market has got initial issues which need to be settled early and one comprehensive e-platform which can speak and transact with both public and public-private platforms needs to be developed on priority. The opportunities for livelihood of rural people outside the agriculture sector and linking them to the value chain must also be created simultaneously.

Climate change remains the major challenge impacting yields of crops, livestock, dairy and fisheries; and further impacting price behaviours often locally and sometimes globally. Government introduced two major responses to climate change-National Mission for Sustainable Agriculture for development and National Innovations on Climate Resilient Agriculture (NICRA) for research. These key initiatives aimed at transforming agriculture into a climate resilient production system through adaptation and mitigation measures. While initial learnings are promising, a greater convergence of these initiatives with Pradhan Mantri Krishi Sinchai Yojana (PMKSY), MGNREGA, etc., is a must to scale up the initial learning.

While public R&D system in agriculture is inevitable in view of the diversity of the sector and its clientele, the reforms in the public R&D should be the core agenda for next 15 years for greater autonomy, larger participation of private sector and accountability for the public investment made. In India, it must be viewed as an essential service to nation as millions of the farmers with low purchasing capacity still resort to public evolved technologies and support as the private sector evolved technologies, many a times, are beyond the normal capacity of small & marginal farmers. Private investments and engagements are often limited to select commodities and geographies.

Optimal resource utilization for sustainable intensification of the overall fish production requires certain novel and critical interventions. In addition, the scheme encompasses inclusive development by providing special care to fishermen societies, co-operative bodies, women, scheduled castes and scheduled tribes, under developed regions etc. by extending adequate financial assistance. However, emphasis will be on promoting private investment & entrepreneurship particularly for big projects, arrangements for institutional finance, facilitating backward and forward linkages, training and capacity building etc.

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ANNEXURES

File No. Q-11018/02/2016-Agri.
Government of India
NITI (National Institution for Transforming India) Aayog
(Agriculture Vertical)

NITI Aayog, Sansad Marg, New Delhi – 110001
Date: 22nd August, 2016

OFFICE MEMORANDUM

Subject: Constitution of Working Group on Crop Husbandry, Agricultural Inputs, Demand and Supply Projections– reg.

In partial modification to earlier notification issued on 29th July, 2016 on the subject cited above, the composition of the Working Group has been revised as under:

2. The composition of the Working Group:

(i)	Dr. Pramod Kumar, Professor & Head, ADRTC, ISEC, Bangalore – 560072	Chairman
(ii)	Dr Vijay Pal Sharma, Chairman, CACP, Krishi Bhawan, New Delhi	Member
(iii)	Dr Ganesh Kumar, Professor, IGIDR (email agk@igidr.ac.in)	Member
(iv)	Dr C. Ravi, Professor, CESS Hyderabad(email cravi@cess.ac.in)	Member
(v)	Director, Central Institute of Agricultural, Engineering	Member
(vi)	Joint Secretary (Crops), DACFW, Krishi Bhawan, New Delhi	Member
(vii)	Joint Secretary (MIDH), DACFW, Krishi Bhawan, New Delhi	Member
(viii)	ADG (Seeds), ICAR, Krishi Bhawan, New Delhi	Member
(ix)	Animal Husbandry Commissioner AHD&F, Krishi Bhawan, New Delhi	Member
(x)	Joint Secretary, Deptt. of Fertilizers, Shastri Bhawan, New Delhi	Member
(xi)	Pr. Secretary (Agri.) Government of Madhya Pradesh	Member
(xii)	Pr. Secretary(Agri.), Government of Bihar	Member
(xiii)	Pr. Secretary (Agri.) Government of Telangana	Member
(xiv)	Pr. Secretary (Agri.) Government of Rajasthan	Member
(xv)	Shri Satish Chander, Director General, Fertilizer Association of India	Member
(xvi)	Sh. Surinder Singh, Ex Adviser (Agri.), NITI Aayog	Member
(xvii)	Sr E&SA, DES, D/o Agriculture, Cooperation & Farmers Welfare	Member
(xviii)	Representative of DG, CSO, Sardar Patel Bhawan, New Delhi	Member
(xix)	Dr J P Mishra, Adviser (Agri.), NITI Aayog, New Delhi	Member Secretary

3. The term 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' and 'for' agriculture and farmers' income and suggest policy initiatives and other interventions required to increase these;
ii) to examine the changing preference and consumption habit of consumers for food and related items;
iii) to assess the demand and supply of fertilizers, seeds, credit, feed & fodder and other inputs for 2019-20, 2023-24 and 2032-33 and suggest measures to meet the demand and judicious management of inputs to achieve higher use efficiency;
iv) to assess the extent of farm mechanization and suggest strategies for its promotion, also covering all farm implements and machines / equipment.
v) to review the performance of centrally sponsored and central sector schemes implemented by the Ministry of Agriculture & Farmers Welfare during 12th Plan with reference to their targets of production and suggest modifications to improve the schemes, if to be continued; and
vi) to analyze the priority in the expenditure on agriculture and allied sectors by the States and the Central Government to suggest ways to augment it.

vii) to estimate the requirements of rice, wheat, maize, other coarse cereals, pulses, foodgrains, oilseeds, sugarcane, cotton, jute, fruits, vegetables, flowers and animal products viz. milk, meat, egg, fish and wool etc. including their demand for export, domestic use and make the supply projections for the year terminal years 2019-20, 2023-24 and -2032-33.

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 visits / 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. For non-official members NITI Aayog born the TA/DA members as admissible to Class-I Officers of the Government of India. The non-official members may please book their air ticket by Air-India only either on Air India website directly or through Balmer & Lawrie or Ashoka Travels (authorized travel agents).

7. The Working Group will submit its Interim Report by November, 2016 and Final Report to NITI Aayog by December 2016.

8. Dr. Ramanand, Senior Research Officer (Agri.) R. No. 439, NITI Aayog, New Delhi, Telephone-011-23042455, Telfax -23096796, e-mail: ramanand@gov.in will be the nodal officer for this group in NITI Aayog. Further queries / correspondence in this regards may be made with him and the Member Secretary of the working group (Room No 223, NITI Aayog, New Delhi Tel : 011-23096796, Telefax : 23096796 and E-mail: adviser.agri-pc@nic.in).

(Dr. J.P. Mishra) 1/8/2016
Adviser (Agriculture)
E mail: adviser.agri-pc@gov.in
Telfax-01123096796

Distribution:
Chairman and all Members of Working group

Copy to:
(i) Sh. S. K. Pattanayak, Secretary, Department of Agriculture, Cooperation & Farmers Welfare, Krishi Bahwan – 110001 with reference to D.O. No. 6-5/2016-Coord.-ES Dated 25.05.2016
(ii) Sh. Devendra Chaudhary, Secretary, Department of Animal Husbandry, Dairying & Fisheries Krishi Bhawan – 110001 for kind information

Copy for information to
(i) DS to Vice Chairman
(ii) PPS to Member RC
(iii) Sr. PPS to CEO
(iv) PPS to AS(YSM)

File No. Q-11018/02/2016-Agri.
Government of India
NITI (National Institution for Transforming India) Aayog
(Agriculture Vertical)

NITI Aayog, New Delhi – 110001
Date : 10th December, 2016

OFFICE MEMORANDUM

Subject: Constitution of subgroups of the Working Group on Demand & Supply Projections in Agriculture – reg.

Reference is invited to letter of even number dated 7th October, 2016 on the subject cited above. In continuation , the following changes have been made in in constitution of the subgroups I, II and III (as indicated in bold italics) after the discussions with the chairs of the subgroups I and II and Chairman CACP expressing his unavailability to chair the subgroup –III.

S.No.	ToR	Team
I.	To study and analyze the trends in agricultural sector, agricultural productivity, investment 'in' and 'for' agriculture and farmers' income and suggest policy initiatives and other interventions required to increase these;	**Subgroup- Chairman** Dr Ganesh Kumar, Professor, IGIDR **Members** (i) Dr. Sursh Pal, Director, NIAP-ICAR (ii) Dr Pratap Birthal, NIAP-ICAR (iii) Dr PK Joshi, IFPRI (iv) Dr. Praduman Kumar, (v) Shri Surinder Singh, Former Adviser, NITI Aayog (vi) Shri Bodh, Adviser, Directorate of Economics & Statistics, M/O Agriculture ***Member Secretary –Shri Manash Choudhury, Dy Adviser, NITI Aayog***
II.	(i) To examine the changing preference and consumption habit of consumers for food and related items; (ii) To estimate the requirements of rice, wheat, maize, other coarse cereals, pulses, foodgrains, oilseeds, sugarcane, cotton, jute, fruits, vegetables, flowers and animal products viz. milk, meat, egg, fish and wool etc. including their demand for export, domestic use and make the supply projections for the year terminal years 2019-20, 2023-24 and -2032-33.	**Subgroup- Chairman** Dr C. Ravi, Professor, CESS Hyderabad and Dr Pramod Kumar (Co-Chairman) **Members** (i) Dr Shashank Bhide, Chennai (ii) Shri Bodh, Adviser, Directorate of Economics & Statistics, M/O Agriculture (iii) DDG (NSSO – Household Expenditure Survey (iv) Managing Director, National Horticulture Board (v) Adviser, Horticulture, DACFW, Ministry of Agriculture (vi) Dr Ganesh Kumar, Professor, IGIDR ***Member Secretary- Anuradhaa Batana, Research Officer, NITI Aayog***
III.	(i) To assess the demand and supply of fertilizers, seeds, credit, feed & fodder and other inputs for 2019-20, 2023-24 and 2032-33 and suggest measures to meet the demand and judicious management of inputs to achieve higher use efficiency;	***Dr S K Malhotra, Agriculture Commissioner, M/o Agriculture-Chair*** ***Dr. S .S. Honnappagol, Animal Husbandry Commissioner, DAHDF-Co-Chair*** **Members** (i) Shri Satish Chander, DG, FAI, New Delhi

		(ii) Adviser (Agriculture), NITI Aayog (iii) Joint Secy. (Crops) DAC, Krishi Bhawan, New Delhi (iv) Jt. Secretary (Seeds) DAC, Krishi Bhawan, New Delhi (v) Jt. Secretary, Deptt. of Fertilizer, Nirman Bhawan, New Delhi. (vi) Jt. Secretary, Deptt. of Water Resources (vii) ADG, Seeds, ICAR (viii) Chief Executive, NFDB, Hyderabad (ix) CGM, Technical Services Division, NABARD, Mumbai (x) ADG (Soils and Water,), ICAR (xi) Adviser, Directorate of Economics & Statistics, M/O Agriculture ***Dr Ganesh Ram, Research Officer, NITI Aayog - Member Secretary***
IV.	(i) To assess the extent of farm mechanization and suggest strategies for its promotion, also covering all farm implements and machines / equipment.	**Subgroup- Chairman** Dr. K K Singh Director CIAE, Bhopal-Subgroup Chairman **Members** (i) Adviser, Agriculture, NITI Aayog (ii) ADG (Agri Engineering), ICAR (iii) Joint Secretary (Mechanization) (iv) Director General, NIPHM, Hyderabad **Member Secretary –Dr P S Tiwari, Head, AMD, CIAE, Bhopal**
V	(i) To review the performance of centrally sponsored and central sector schemes implemented by the Ministry of Agriculture & Farmers Welfare during 12th Plan with reference to their targets of production and suggest modifications to improve the schemes, if to be continued; and (ii) to analyze the priority in the expenditure on agriculture and allied sectors by the States and the Central Government to suggest ways to augment it.	**Subgroup- Chairman** Shri Ashok Dalwai, Additional Secretary, DACFW **Members** (i) Agriculture Commissioner (ii) Animal Husbandry Commissioner, DAHDF (iii) Adviser (Agriculture), NITI Aayog (iv) Joint Secretary (PMFBY/Credit) (v) Joint Secretary (Crops) (vi) Joint Secretary (INM) (vii) Joint Secretary (MIDH) (viii) Joint Secretary (RKVY) (ix) Joint Secretary (Extension) (x) Joint Secretary (RFS/NRM) **Shri Manash Choudhury, Dy Adviser (Agri), NITI Aayog-Member Secretary**

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

3. The subgroup may also examine and address any other issues which are important though not specifically spelt out in the ToR.

4. The expenditure of the members on TA / DA in connection with the meetings of the subgroups or any work incidental to the functions of the sub-group will be borne by the parent Department / Ministry / organization/ State Government for official members. For non-official members, the TA/DA will be borne by NITI Aayog as admissible to Class-I Officers of the Government of India. The non-official members are required to book their air ticket by Air-India only either directly through Air

India website or through authorized travel agents like Balmer & Lawrie or Ashoka Travels/other Air India authorized travel agent (s).

5. The subgroups will submit its Report to chairman of the Working Group by 30th of November, 2016.

8. Dr. Ganesh Ram, Research Officer (Agri.) R. No. 331, NITI Aayog, New Delhi, Telephone- 011-23042367, Telfax -23096796, e-mail: bgram@gov.in is the nodal officer in NITI Aayog for this working group. Further queries / correspondence in this regards may be made with him and the Member Secretary of the working group (Dr J P Mishra, Adviser, Agriculture, NITI Aayog, New Delhi, email adviser.agri-pc@gov.in)

(Dr. J.P. Mishra)
Adviser (Agriculture)
Telfax-01123096796

14/10/16

Distribution:
Chairman and all Members of the subgroups

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(i) DS to Vice Chairman
(ii) PPS to Member RC
(iii) Sr. PPS to CEO/PPS to SS(YSM)

NITI AAYOG
(Agriculture Vertical)

Subject: Minutes of the first meeting of Working Group on Crop Husbandry, Agricultural Inputs, Demand and Supply Projections held on 6th September, 2016, NITI Aayog.

The list of participants is annexed.

At the outset, Dr. Ramesh Chand, Member welcomed the participants. He mentioned that the NITI Aayog is in preparation of 15 years Vision Document and 7 years Strategic Plan to contemplate Policy & Programme and 3 years Action Plan aligned to financial resources indicated in the 14th Finance Commission to achieve goals of the Government by 2019. He further mentioned that medium and long term projections of demand & supply of agricultural commodities and that of inputs as well as requirements of agricultural, livestock & fisheries produces is essential for vision and strategy.

Dr. Parmod Kumar, Chairman of the Working Group briefed term of reference and mentioned that TOR includes all factors of agriculture and allied sectors development. The chairman of the working group emphasized the need for the concerned departments to give best inputs on their respective subjects. The chairman emphasized that the Working Group while preparing its report should target for the macro picture at all India but also should not ignore the micro picture bringing up issues related at least up to the state level. He further stated that, feasibility of the target at macro level needs special attention. He stated that taskforce can build alternative scenarios to provide a range of estimates for future projections and also workout field requirements. For estimating seed, feed and wastage ratio on which there is hardly any latest estimates available the Chairman indicated that this working group can request IASRI to make some estimation on wastage and other requirements of agricultural produce based on their recent study.

Professor C. Ravi stressed the need for a background paper on issuesthat will be useful for assessing the demand and supply projections. He further suggested for commissioning special study on the same and wondered whether that is covered in the TOR of Working Group.

Dr.Ganesh Kumar stated that the Working Group needs to consider alternate growth scenarios on food and nutrition and thereby it needs to at least cover state level analysis. He further corroborated that targets set for the national level may not appropriately cover state level requirements which might need alternate strategies/programmes at the state level. In the case of farmer's income, a part of their incomes comes from non farming activities. Therefore, for projecting future growth of farmers income we need a clear picture about the share of farming and non farming income in total income of the farmers.

Advisor (Agri.) NITI Aayog advocated the necessity of outcome oriented results that will be useful achieving the targeted additional production. In this regard achievements of National Food Security Mission need to be taken in to account.Dr. Pani, Joint Secretary (Fertilizer) mentioned that Group of Secretaries' recommendations which are farmer centric needs to be considered. He indicated that the same will be circulated among members but pointed out that only actionable issues were being implemented by different Ministries/ Departments.

Dr. Honnappagol pointed out that fisheries sector has not found a place in Working Group and requested that Fisheries Development Commissioner may be included in the Working Group.Dr. Tiwari mentioned that mechanisation in view of shortage of farm labour was now an important input and therefore it needs focus in this Working Group. He advocated different approaches for North and South India for mechanisation.Advisor (Agri.) NITI Aayog sought from the concerned ministry official with regard to data on mechanisation to which the official replied that there was some data available. Chairman stated that under TOR (iv) the group should see whether mechanisation has reduced manpower requirement and improve mechanical power in agriculture production. Principal Secretary (Agriculture), Government of Rajasthan suggested that there was need to reduce over capitalization of mechanisation in agriculture.

Chairman suggested that this group should get some estimates of wastage. He further stated that taskforce can have alternative components to workout field requirements. In this respect, this working group can request IASRI to make some estimation on wastage of agricultural produce.

Smt. Neelkamal Darbari Principal Secretary, Govt. of Rajasthan mentioned that the government officials have become source of subsidy distribution whereas agriculture extension is completely lacking at the field. In this regard, World bank T&V programme needs revival for strengthening the extension services. The long term vision needs to be set without subsidy programmes keeping sustainability in focus while input subsidies needs to be streamlined.

Sh. Sunil Jain, DDG, National Accounts Division, CSO mentioned that data on horticulture sector was not reliable. Additional Commissioner (Horticulture), M/O Agri. stated that they do not have sufficient staff to get the details at ground level. Ministry of Agriculture is interacting/getting information from the States on horticulture.

Advisor (Agri.) NITI Aayog stated that WG needs to assess the consumption vis-a vis agricultural production and suggest ways and mean to focus more on commercial crops to increase farmers income. The Group opined to request Indian Agriculture Statistics Research Institute (IASRI) to make some estimation on Seed, Feed and Wastage of agricultural produce.

The Working Group discussed at length about the Terms of Reference (TOR) and decided to further form Sub Groups to have more focused discussion on the main issues in TOR. The Working group constituted the following fiveSub-groups as per the TOR for assessment of the demand and supply of agriculture produce and other issues

Sub Group I: study and analyse trends in agricultural sector, agricultural productivity, investment 'in' and 'for' agriculture and farmers' income and suggest policy initiatives- Dr Ganesh Kumar as Chairperson

Sub Group-II: Changing preference and consumption habit and estimating the requirements of food grains, horticulture and animal produce and their supply estimates- Dr. C. Ravi as Chairperson.

Sub Group III: Assess the demand and supply of fertilizers, seeds, credit,feed & fodderand other inputs for 2019-20, 2023-24 and 2032-33 and suggest measures to meet the demand and judicious management of inputs to achieve higher use efficiency –Dr V P Sharma/Agriculture Commissioner/Animal Husbandry Commissioner as Chairpersons

Sub Group IV: Farm Mechanisation – DDG (Agril Engineering), ICAR/Director, CIAE, Bhopal as Chairperson

Sub Group V: Review the performance of CSS and CS – Additional Secretary, (Ashok Dalwai) & Advisor, Agriculture as Chairperson.

Chairman pointed out that above Sub-Groups may be constituted in consultation with Member Secretary of Working Group. The TORs of these Sub-Groups may be discussed and firmed up in the forthcoming meetings.

The meeting ended with thanks to the Chair.

List of participants

1) Dr. Ramesh Chand, Member, NITI Aayog.
2) Dr. Pramod Kumar, Professor & Head, ADRTC, ISEC, Bangalore.
3) Dr. Ganesh Kumar, Professor, IGIDR, Mumbai
4) Dr. C. Ravi, Professor, CESS Hyderabad.
5) Dr.Suresh S. Honnappagoi, Animal Husbandry Commissioner Krishi Bhavan, New Delhi.
6) Dr. A.K. Padhee, JS, Deptt. of Fertilizer, Govt. of India.
7) Smt. Neelkamal Darbari, Principal Secretary, Agriculture & Horticulture, Govt. of Rajasthan.
8) Dr. J.S. Chauhan, ADG (Seeds), ICAR, Krishi Bhawan, New Delhi, Dr. P.S Tiwari, Principal Scientist & Head , CIAE , Bhopal.

9) Dr. J.P. Mishra, Advisor (Agri.), NITI Aayog.
10) Dr. P.C. Bodh, Advisor & ES, DAC & FW.
11) Dr. T.K. Chanda, Advisor, the Fertilizer Association of India.
12) Sh. Sunil Jain, DDG, National Accounts Division, CSO, New Delhi.
13) Sh. S. Sahoo, Director, NAD, CSO, New Delhi.
14) Ms. Anuradha Verma, Additional Commissioner (Hort.) DAC & FW.
15) Dr. P.R. Choudhury, Principal Scientist (Seeds), Krishi Bhawan, New Delhi.
16) Dr. M.M. Singh, Deputy Commissioner (Crops), DACFW, Krishi Bhawan, New Delhi.
17) Shri. Y.N. Khare, Director, Agriculture, NITI Aayog
18) Shri. M. Choudhury, Deputy Advisor, NITI Aayog
19) Dr. Ramanand , Sr. Research Officer (Agriculture), NITI Aayog
20) Dr. B. Ganeshram, Research Officer (Agriculture) NITI Aayog.
21) Smt. B. Anuradha, Research Officer (Agriculture).

F. No. Q-11018/02/2016-Agri.
Government of India
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(Agriculture Vertical)

Minutes of the Meeting of Different Subgroups held on 20th October, 2016 at NITI Aayog

The second meeting of Working Group on Demand and Supply Projections in Agriculture was held on 20th October, 2016 at NITI Aayog to discuss the scope of the ToRs and other issues related to various sub-groups.

The meeting was chaired by Dr. Pramod Kumar, Professor ISEC and Chairman, Working Group. While initiating the proceedings, he briefed the observations and opinions expressed by different members of the working group in the first meeting. He also impressed upon the remarks of the Member (RC). He summarised the shift in Planning approach from earlier five year Plans to the current 15 year vision with a mid-term and long term perspective. He recommended that Senior Experts/Officers should lead the sub groups.

Subgroup 1: To study and analyse the trends in agricultural sector, agricultural productivity, investment 'in' and 'for' agriculture and farmers' income and suggest policy initiatives and other interventions required to increase these.

- It was discussed that studying concerned factor beyond state level might be difficult, as data disaggregated at the district level may not be available.
- Growth of agriculture sector starting from 1980's may be looked at.
- Within agriculture, growth in crop sector needs to be closely looked at. Horticulture and fisheries have good growth prospects. Animal husbandry has been performing better than the crop sector. The factors that contribute to such growth and the role of technology in leveraging the prospects need to be analysed.
- The groups should also deliberate and give recommendations for mid-term growth (5 to 7 years) and long term growth (15 years) along with econometric tools to be employed.
- A suggestion was given to divide the growth period into pre reform and post reform stage. A sub sector wise growth in various states was proposed to be looked at.
- National and state level decadal growth rates in agricultural productivity (total factor productivity and partial productivity) could also be looked at. The importance of state level variations was iterated, for instance, Gujarat has 12 percent growth rate in some crops; Andhra Pradesh, Madhya Pradesh and Rajasthan are forerunners; Punjab, Haryana and UP are stagnating.

- The subgroup also needs to address the issues relating to increase farmers' income.The subgroup should carry out specific work in this context to form benchmarks for states and devising a strategy to measure farmer income. Some of the issues that require further deliberations by the group are:
  - Does the investment in agriculture actually reach the farmer?
  - Farmer income has to be calculated at gross level.
  - Farmers' income consists on crop income and income from allied/non-farm activities. Since productivity of crops cannot be changed within a short time, there needs to be focus on animal husbandry and allied sector.
  - A committee is already working on methodology for calculation of farmer income using secondary data. Mr. Suresh Pal (NCAP) could be contacted for its report.
- Dr. Ganesh Kumar raised issues regarding tracking the factors driving the growth while assessing past performance. It was suggested that World Bank report on total factor productivity will be a desirable first step in gathering secondary studies in that direction. However, more such studies will be needed to be looked.
- Productivity as a driver of growth may not take us very far. There is a need to focus on income flow to the farmer. Price collapse can eliminate all gains from productivity. Marketing and price differential (including spatial differences) are important for farmer income. There is a difference in what a farmer gets and what a consumer pays – margin of intermediaries needs to be squeezed.
- Price transmission between states need to be made perfect. No data is available on aspects like movement of price in one state vis a vis other and product flow across states. Analysis will be at best rudimentary in such a scenario. The issues, however, must be flagged. Feedback also needs to be given to Ministry for data needs.
- Procurement of pulses by government is showing some positive result. Farmers' confidence in the government to support them has improved.
- It was highlighted that some uniformity within all the subgroups will need to be maintained in terms of a common methodological framework for components of farm income and how they are distributed among states.
- Dr P.K. Joshi highlighted the need of delineating priorities for public and private sector so that they can come together from an investment standpoint. Institutions need to be made more participatory in terms of incentives for marginal farmers (How do we incentivise cooperatives and FPO models for these farmers to come together?).
- Need to strengthen R&D and extension systems were highlighted, especially as they have a crucial role for bringing technology to the centre stage. Much has been talked about this issue, but not much has been done to resolve it.
- It was suggested to delineate areas where we need to increase productivity by mapping the whole district and focussing on low productivity areas (especially for public sector).
- It was stated that projection of 6 to 7 percent growth may spell trouble. APMC had a major role to attract private sector. However, this did not materialise because of lack of enabling factors such as presence of organised markets and branding.

- It was decided that Shri Bodh, Advisor, Directorate of Economics and Statistics, M/o Agriculture will be appointed as the member secretary of the first subgroup. Ms. Saxena, Advisor, Horticulture, DACFW will be appointed as member secretary of 2nd subgroup.
- Dr. Ganesh Kumar concluded the discussion for 1st subgroup stating that increasing farmer income and understanding the related factors was their first goal. He mentioned success stories like One Crop One Village to obtain scale for making value chain more friendly; poultry at Namakkal as an example of contract farming.
- It was also mentioned that cooperative farming has not made an impact as has happened in livestock sector.

Subgroup 2: i) To examine the changing preference and consumption habit of consumers for food and related items; ii) To estimate the requirements of wheat, rice, maize, other coarse cereals, pulses, food-grains, oilseeds, sugarcane, cotton, jute, fruits, vegetables, flowers and animal products viz. milk, meat, egg, fish and wool etc. including their demand for export, domestic use and make the supply projections for the terminal years 2019-20, 2023-24 and 2032-33.

- Concerns were raised on data availability for all the states at a disaggregated level on consumption habits. Direction of physical quantities of food and related items including processed food (e.g. Bread, cheese etc.) will be mapped, subject to availability of unit level data. The data for processed food is available in NSS for some items but is not disaggregated group wise. Data for spices is available only with Spices Board. Question was raised whether to include agro forestry products or not.
- Supply of an agri-commodity can be considered as what is produced plus what is imported. Feed can be linked to livestock. Subtracting exports from supply will give us the amount available for consumption.
- For consumption, a distinction is made between direct use and indirect use of agriculture produce for human consumption. 11th Five year Plan working group considered 12.5 percent as indirect use.
- Trend growth rate for export projections will be used. Historical data from NSS will be considered for demand projections.
- Dr. Ganesh Kumar suggested to includerepresentative of CSO with subgroups for working with Input-Output tables. CSO has recently released data for 2011-12 and 2012-16.
- It will be easier to make calculations for wheat, rice, maize, other coarse cereals, pulses, food-grains, oilseeds, sugarcane, cotton, jute. Rest of the commodities mentioned in the TOR maybe tricky in absence of adequate data.
- Data on flowers – total area and export data (value and quantity) is available. Demand elasticity for flowers is not available.

- Multiple suggestions were given to calculate Supply projections for milk/meat/eggs. Department of Animal Husbandry, Dairying and Fisheries conducts a sample survey to estimate milk production which can be used. Estimates for income elasticity can be derived from international data such as with FAO. A methodology to fill missing spaces in data will also be decided. Milk and meat may be clubbed together.
- A point was also made that Linear model may not be the best suited model for 15 year projections. The decision on a suitable model is to be taken by the group.

Subgroup 3: To assess the demand and supply of fertilisers, seeds, credit, feed & fodder and other inputs for 2019-20, 2023-24 and 2032-33 and suggest measures to meet the demand and judicious management of inputs to achieve higher efficiency.

- The chairman suggested to review the previous working group reports.
- Since Dr. Vijay Paul Sharma has expressed his inability to chair the subgroup, it was decided that Agriculture Commissioner and Animal Husbandry Commissioner may be requested to chair and co-chair the sub-group with an officer from DAC&FW as Member Secretary.
- Use of fertilisers, pesticides, feed and fodder depends on crop requirement and is dynamic. The considered view must be taken on the projections and matching enhancement in productivity to arrive at the replacement of chemical inputs.
- There have been projections for fertilisers and credits but not seeds. Seed requirement for major crops can be considered for projections.
- The group need to work in tandem with sub-groups I and II.

Subgroup 4: To assess the extent of farm mechanisation and suggest strategies for its promotion, also covering all farm implements and machines/equipment.

DG, NIPHM made the following observations :

- Reliable technology is unavailable at small scale and farmers end up applying more than required pesticide.
- Individual subsidies should be stopped for equipment, especially small equipment like sprayers which are used for 4-5 days in a year. Tractors are diverted for other uses like transportation. Farm machinery also lies idle due to shortage of labour. Investment in machines by way of individual subsidies is getting less useful. CHCs and other stations are helpful in reducing idle hours of machines.
- Need for skilling commensurate to mechanisation was highlighted. In Andhra Pradesh, farmer negotiates with labour on the basis of number of tanks. The labour finishes the tank hurriedly without regard to technique. She suggested that universities can have a diploma/polytechnic for such technical skilling at field level.
- Banks should provide loans for appropriate machinery only.
- Agri-clinics have been successful in cash crop regions and areas where state sponsored extension services are unavailable. They provide 2 month training to 10+2 students.

Agri-preneurs provide business services and extension services to farmers on charge. Around 48000 people have been trained through this.

- She summed up with following three points :
  - Investing in appropriate technology.
  - Skill training.
  - Making every equipment available to every farmer.

Dr. Pramod Kumar highlighted the questions that this subgroup needs to seek answers for:

- Future course of action on electricity and other trends that have a bearing on machine usage and demand.
- How have animals given way to tillers ?
- How to develop Custom Hiring Centres (CHCs) for best use ?
- Feminisation of agriculture – making women friendly machines since they are now more involved in agriculture with men increasingly migrating.
- Mechanisation for the country, its problems and underutilisation of capital, changing contexts and technologies (diversification), commensurate required changes in the mechanisation industry.
- How can existing machines be better used ?
- How can farmers be motivated to adopt mechanisation ?

Dr. K.K Singh, Director CIAE made the following observations :

- Dr. K.K Singh briefly explained the areas in which CIAE has been working.
- Advisor (Agriculture) observed that mechanisation in agriculture has three aspects: Ease, Efficiency and Economy.Mechanisation in horticulture is too low. A need to focus on this sector was highlighted since horticulture is a profitable sector. Presence of mechanisation in animal husbandry is negligible.
- Lack of proper machinery at village level for processing was highlighted.
- Majorly, mechanisation sector is unorganised. Therefore, standardisation of machinery is an issue. At present, there is only a set of 'voluntary' standards available.
- Regional variation in mechanisation will also need to be focussed on for streamlining inter-state priorities and promotion.
- Dr. Pramod Kumar observed that a brief note on past and present scenario to assess status of farm mechanisation may be prepared. This can be followed with a note on changing focus of agriculture and its implication on development of suitable machinery. Finally, a note on future direction to new avenues like women in agriculture, horticulture and animal husbandry.
- National and state wise data on trend towards moving towards higher horse power machinery and its relation with custom hiring for last four years will be seen.
- Issues regarding standards of machinery to be sold under RKVY were highlighted. There is no checking of batches at the manufacturers' place. Quality of test equipment is seen only at designated government centres.

- Dr. K.K Singh observed that in view of escalating operations, mechanisation is crucial. He also informed that the databank on farm machinery is available with ICAR and the same will be shared with NITI Aayog.

Subgroup 5: i) To review the performance of centrally sponsored and central sector schemes implemented by Ministry of Agriculture and Farmers Welfare during 12th Plan with reference to their targets of production and suggest modifications to improve the schemes, if to be continued, and; ii) to analyse the priority in the expenditure on agriculture and allied sectors by the states and the Central government to suggest ways to augment it.

- JS, RKVY attended the meeting. She highlighted the need to do away with subsidies in terms of inputs to individual farmers. Instead she suggested to utilise funds for meeting infrastructure needs like certification labs.
- There have been cases of institutionalisation of subsidies as well as distribution of subsidies in an inequitable manner among farmers. To this, questions were raised by participants regarding communication and outreach activities for farmers' awareness by the government.
- A suggestion was made for single point subsidy either at procurement or at marketing stage.
- A need for engaging a battery of experts behind agriculture projects was also highlighted, as is done in the case of other sectors.
- Advisor (Agriculture) observed that purpose to constitute this subgroup is to evaluate against an agriculture matrix for various schemes and recommend modifications/ up-gradation in scope and design of the schemes.
- The Chairman suggested to complete the contribution of the subgroup with nominations of Member Secretary for various groups at the earliest.

NITI AAYOG

Agriculture Vetical

Subject: Minutes of the Meeting of Working Group on Demand and Supply Projections in Agriculture held on 12 January 2017 at NITI Aayog

1. Third meeting of the working group was held on 12 January 2017 at NTIT Aayog New Delhi to discuss the progress on estimations made by the working group and follow up with other subgroups constituted under the Working Group. The list of participants is annexed.
2. Dr. Pramod Kumar, chairman of the working Group made a presentation on Demand and Supply Forecast of Foodgrains and Oilseeds: Preliminary Estimates. He mentioned that the projections are to be made for next 15 years, unlike earlier working groups which made projections for only 5 years. He also highlighted the issues related to forecasting for horticulture due to unavailability of time series data and a large product portfolio. The foodgrains remain the core of agriculture. Methods of demand model estimations were briefly touched upon. Estimation depends on multiple factors like price of commodity, price of substitute commodity, share of income on other aspects like health. It takes into account both food and non-food expenditure. The data was sourced from NSS.The equations and their details of the Almost Ideal Demand System were explained along with income elasticity and formula for demand projection. The growth rate of economy affects increase in incomes and living standards. Income augmentation shows an inverse relationship with consumption of cereals. Expenditure elasticity for cereals is negative for both urban and rural areas. For estimation of supply system, estimating area and yield may be better than estimating production. A simultaneous equation model was used with area, yield, price and export variables. Estimations for Rabi and Kharif crop cycles have been done separately. Three approaches for demand prediction has been looked at – static behaviour of consumption, normative approach and behaviouristic approach.
3. The projected decennial growth rate of population for the decades 2011-21 and 2021-31 have been pegged at 1.32 and 1.13 respectively. This projection, especially the rural-urban split, is suggested to be validated/confirmed from CSO. The projected growth rates in national income have also been calculated according to 9%, 12% and 6% growth scenarios.
4. Seed, Feed and Wastage (SFW) have been estimated using residual approach. Under this approach, net consumption is deducted from net production and the balance represents the quantity of SFW.
5. Joint Secretary (NFSM) briefed that the 12th FYP targeted to produce 25 million tonne additional foodgrains. This year's pulses production is 21 million tonne as compared to 18 million tonne of last year. The requirement for edible oil in the country is 24 million tonne while production is only 9 million tonne. The rest of the requirement is met through import, 60 % of which is palmoline oil.

6. It was discussed that the Joint Secretaries (JS) of the various commodities at Krishi Bhawan need to look at the estimates for validation and additional suggestions. The JS's need to actively partner in the projection process, especially to comment on aspects related to the focus of programmatic components. Dr. Pramod Kumar suggested to share write ups with the JS's.
7. Dr. JP Mishra, Advisor (Agri.), clarified that the per capita calculations should be adjusted for infant and young population as consumption for them is not the same as adults.
8. Ministry's representative requested articulation of how the exercise is more useful for the JS's to participate. Advisor (Agri.) clarified that the TORs articulate the objectives and were shared with all the members of the working group. The participation of the ministry is critical since the findings of the working group will feed into implementation of the programmes.
9. Dr Pramod Kumar also discussed the conversion ratio of various commodities and their end products. A conversion ratio of 28% is used for oilseeds to oil. The calculation of projections of edible oils needs to be re-evaluated. A discrepancy was noted in the data presented by the Ministry's representative and the base consumption used for the projections by the working group. He mentioned that the oilseed data will be matched with NSS data. It is tricky to merge different data sets in the absence of a uniform conversion ratio. Industrial uses of oilseeds have increased which may not have been captured by NSS data.
10. Dr Ganesh Kumar mentioned that rice bran is used less than 1 % for edible oils. This however, might see a structural change in the future.
11. Huge difference in state growth rates was noted in supply projections for pulses. Advisor (Agri.) briefed that areas with assured irrigation is favourable for summer pulses; North-east has rice fallows land that can be utilised for pulses; West India leads in oilseeds. The area under cereals might stagnate. The rice fallows in AP is used for pulses but some of the areas is seeing a shift towards groundnut and maize production. Deliberation on ways to capture these trends is needed.Area under Rabi pulses and coarse cereals seems to be increasing with a pull towards areas with availability of irrigation facilities.
12. It was agreed that projections for horticulture crops may be made by choosing a basket of crops such as tomato, potato and onion. The conversion ratios for milk and meat will also be decided.
13. Chairman suggested that meetings of all members of the sub groups may be organised in coming 15-20 days and the write-up from Central Institute for Agricultural mechanisation and Centrally Sponsored Scheme may be expedited.

NITI AAYOG

(Agriculture Vertical)

Subject:Minutes of meeting of Sub-Group III of the Working Group on Demand and Supply Projections in Agriculture held on 20th March, 2017 at Room no. 136 at NITI Aayog.

The list of participants is annexed.

A meeting was held under the Chairmanship of Dr. S.K. Malhotra, Agriculture Commissioner, Ministry of Agriculture and Farmers Welfare to assess the demand and supply of fertilizers, seeds, credit, feed & fodder and other inputs to achieve higher use efficiency.

1. At the outset, Chairman of the Sub Group welcomed the participants and explained the background of the meeting after introduction of all the participants. He highlighted the importance of the meeting and said that the demand and supply projections of crop husbandry and agricultural inputs are available only upto the terminal year of 12th Plan i.e., 2016-17. Therefore, for proper Planning we need to make projections for demand and supply of agriculture including the critical inputs like fertilizers, seeds, credit and feed and fodder and other inputs at all India level. He also emphasized that there is an urgent need to assess the projected/ estimated demand and supply in short, medium and long term ie., for 2019-20, 2023-24 and 2031-32.
2. Dr. J.P. Mishra, Advisor (Agriculture), NITI Aayog stated that as there is little scope for increase in area we need to give more focus on productivity and thus inputs are more critical. Obviously, for 3 years action Plan, 7 years strategy and 15 year's vision the projection should be more focused and the whole agriculture sector to be considered.
3. Shri Selvaraj, Deputy Commissioner (Seeds), Department of Agriculture Cooperation and Farmers Welfare, M/O Agriculture gave a presentation. He suggested that nutritional requirement study to be done to project the requirement of seeds. He highlighted the importance of diversified agriculture and suggested that pulses and vegetable production needs to be increased.
4. Chairman mentioned that at present the foodgrain production is 270 million tonnes the requirement may increase by 301 million tonnes by 2020 and 333 million tonnes by 2023, thus for that requirement we need to project the requirement of seed and its replacement. Advisor (Agriculture), NITI Aayog added that traditionally 12.5 percent of total production of grain meant for seeds feed and wastages now we need to decide whether it remain same or will be changed. For high yielding variety area has grown rapidly but in the last decade this trend has declined to 2.4 percent per year. Decline in breeder seed production clearly indicates that availability of new variety seeds in near future will be restricted; and also a large area of crops continues to be sown with farmers saved seeds. Therefore all these issues to be critically analysed to present the seed demand and supply projection. Dr. Mishra further emphasized that we need to project region wise demand for seeds and therefore requested to analyse accordingly.

5. Director (Fertilizer), Deptt. of Fertilizer stated that Demand for fertilizer is assessed by Ministry of Agriculture before the start of season and he also suggested that thorough assessment for projection is needed, though it is observed that the projection was more while consumption is less. It was explained that reason for consumption was less due to neem coated urea. Dr. S.K. Malhotra, added that fertilizers need to be included for demand and supply projection for efficient use of drip irrigation which may reduce the consumption of fertilizers. Dr.D.K.Yadav pointed out that as per the estimate we are importing 6 million tonnes of fertilizers and producing 20 million tonnes but the estimated production is not known therefore it need to be provided and JS INM, Ministry of agriculture to be involved to assess the demand.
6. Dr.R.K.Tewatia, FAI added that fertilizer consumption will also depend on use of type of seeds, soil status etc. water soluble and micronutrient demand has increased as we need liquid fertilizers for high value crops. Chairman requested the Addl. Director, FAI to give a note on requirement of these fertilizers.
7. Chairman highlighted the importance of credit for farmers and requested the Dr. Gopakumaran, Dy.General Manager, NABARD to provide information on growth in crop loan, investment in agri-infrastructures and investment in cold chain infrastructure, protected cultivation and exclusive funding in micro-irrigation. Dr.Gopakumaran, Dy.General Manager, NABARD agreed to consider all these important points to evaluate the projection for next 15 years. Chairman requested all the participants to provide information regarding the issues discussed and suggested to form small groups.

The following decisions were taken:

(i) An urgent need to assess the demand and supply in short, medium and long term ie., for 2019-20, 2023-24 and 2031-32.

(ii) To decide the percentage of seed feed and wastage requirement.

(iii) To assess the demand of fertilizers is with consultation of Joint Secretary (INM), Ministry of agriculture need to be involved to assess the demand.

The meeting ended with thanks to the Chair.

List of participants

22) Dr. S.K.Malhotra, Agriculture Commissioner, Ministry of Agriculture
23) Dr. J.P.Mishra,Advisor (Agriculture), NITI Aayog.
24) Dr.S.S.Tomar, ADC (Crops), Deptt. of Agriculture, Cooperation and Farmers Welfare
25) Dr. Gopakumaran Nair, Dy.GM, Dept. of Eco. Analysis & Research, NABARD, Mumbai
26) Dr.R.K.Tewatia, Addl. Director (Agriculture Science), Fertilizer Association of India, New Delhi
27) Shri V.S Rana, Director (Fertilizer), Deptt. of Fertilizer, Govt. of India.

28) Shri S.Selvaraj Deputy Commissioner (Seeds), Deptt. of Agriculture, Cooperation and Farmers Welfare
29) Dr. P.P.Biswas, Principal Scientist (Soil)), ICAR, Krishi Bhawan, New Delhi
30) Dr. D.K.Yadav, ADG (Seed), ICAR, Room No.225 Krishi Bhavan, New Delhi
31) Shri P.R.Meshram, Advisor(AS), DES, M/O Agriculture&Farmers Welfare, Krishi Bhavan, New Delhi
32) Shri. M. Choudhury, Deputy Advisor (Fisheries), NITI Aayog
33) Dr. B. Ganeshram, Research Officer (Agriculture) NITI Aayog.
34) Smt. B. Anuradha, Research Officer (Agriculture)
35) Dr.Babita Singh, Research Asst, NITI Aayog
36) Dr.Shwetal Wankhade, Singh, Research Asst, NITI Aayog
37) Shri Satya YP, NITI Aayog

No. Q-11018/02/2016-Agri (Part).
Government of India
National Institution for Transforming India (NITI) Aayog
Knowledge and Innovation Hub (KIH)
(Agriculture Vertical)

SUBJECT : Proceedings of the Meeting of Sub-Group V of the Working Group on Demand and Supply Projections in Agriculture - reg.

1. The meeting of the Sub-Group : V of the Working Group on Demand and Supply Projections in Agriculture was held at NITI Aayog (Committee Room No. 228) on 28th April, 2017 under the Chairmanship of **Sh. Ashok Dalwai, Additional Secretary, Department of Agriculture, Co-operation & Farmers' Welfare (DAC&FW), Ministry of Agriculture and Farmers' Welfare (MoA&FW), Government of India** to review the performance of Centrally Sponsored and Central Sector Schemes implemented by the Ministry of Agriculture & Farmers Welfare during 12th Plan with reference to their targets of production and suggest modifications to improve the schemes; if, to be continued and to analyse the priority in the expenditure on agriculture and allied sectors by the States and the Central Government to suggest ways to augment it.

2. In addition to this, the discussions also addressed the instructions of the O.M. of Department of Expenditure, Ministry of Finance (GoI), vide F. No. 42(02)/PF-II/2014 Dated, 23rd Feb. 2017 about the continuation of schemes beyond the 12th Five year Plan ended on 31st March, 2017 taking into account the financial resource co-terminous with the 14th Finance Commission resource cycle, 2020 and based on outcome review, for further implementation of selected in a smooth, rationalised and effective manner with due attention to possible skill development areas, awareness about various schemes through the reinforcement of extension mechanisms and financial integrations for improved service delivery.

3. At the outset of the meeting **Prof. Ramesh Chand, Member (Agri.), NITI Aayog** elaborated the purpose of it following his opening remarks about the developmental scenario of agriculture took place during recent times. However, its further progress will continue with the supports of various schematic interventions either in the same contour or, in a revised form based on considerations and priorities under new initiatives of three years action Plan with due assessment of programmatic expenditures incurred by the Ministry; and with the special reference to centrally sponsored schemes, achievements made and the outcome of various implemented activities. There is a need to bring reform in agriculture not only in terms of production and productivity but emphasising the core objective of doubling farmers' income, which is of nation's one of the major priorities. It is also the high time to insulate the operational efficiencies of

different schemes either through the convergence with other programs of intra-ministry or, inter-ministerial. The implementation process for achieving identified actionable agenda may thrust upon skill development, additional resource mobilisation in simulation with the pradhan mantri krishi sinchai yojana (PMKSY) as one of the instances and harnessing of traditional knowledge as a complementarity to optimum level of water resource use efficiency in agriculture. It was stressed upon that the review or, modification of schemes/ programs must be linked to the - outcome based findings, scope of accessing appropriate inputs from set of schemes considering its advantages, promotion of allied activities like bamboo development, apiculture, social forestry with the prime objective of doubling of farmers' income by 2022, resource use efficiency and achieving sustainability in terms of optimisation of production and productivity.

4. **Dr. Ashok Dalwai, Addl. Secretary, DAC&FW** made special mentions about the paradigm shift in agricultural policies being articulated by the Hon'ble Prime Minister to double the farmers' income by 2022. Hence, there is a need to come out from the era of generic approaches in agriculture; since the income enhancement of farming communities is the top of the agenda and it can only be possible with the vision of enterprising agriculture in terms of its profitability, employability, production optimisation, reducing the cost of cultivation, cost of production and earning the value of produces at optimal rate looking at the net positive return. The promotion of area based activities in agriculture will be the best option to bring the farm sustainability at its operational level integrating with the dairy and fisheries with the ultimate objective of increasing productivity and the further conversion of output to value gain. The continuity of activities of the Ministry should not be viewed in isolation or stand-alone programme as the emphasis lies on integrated way of natural resource management and appropriate handling of degraded resources in the backdrop of sustainability. The Ministry has to rework upon its ongoing activities, to identify possible interventions under the agriculture and its allied sectors for building up of seven years strategies splitting to consecutive three years of action Plans with the additional margin of one year for any further moderations, if any required for future reinforcement to reach to the milestone related to the doubling of farmers' income either by August, 2022 or, latest by March, 2023 through the meticulous economic evaluations.

Since, the Ministry is reviewing all schemes following instructions of the Ministry of Finance (which has specific time-line for completion), it provides ample opportunities to assess short-comings, if any and to attend modifications without considering it as a compartmental approach, in order to bring the synergy between different schemes including horticulture, fruit crops and to explore further possibilities of inter-cropping targeting new areas such as horticulture-pulses as a way forward to reach to the production target of 335 million ton of food-grain by 2030. The cropping pattern of the country needs to be reviewed concurrently in the background of soil nutrient status so that, the activities under the integrated nutrient

management can be synchronised efficiently with the specific reference to the manoeuvre of excessive nitrogen load of soil, following the balance of sulphur content in the soil; however, it is also necessary to see the areas, whether at any level the sub-components under the integrated nutrient management is overlapping with the integrated pest management for prudent schematic operations. The alignments between various schemes including its relevancy under the present situations desires attention to bring possible synergy and catalytic effect while implementing such schemes in the line of new directions for agricultural development.

To undertake, higher level of demonstrations under various schematic activities, the possibilities for future alignments of different directorates of the ministry may be examined to create a single window mode of operations for wider facilitations, which will not only help in re-deployment of field staff but this approach will also reduce administrative costs in running series of directorates under the same ministry. The issue related to skill development under the agriculture and its allied sector needs further greater attention to build the space for new job opportunities focusing on pradhan mantri fasal bima yojana, integrated nutrient management, new generation agri-marketing, operation of automatic weather stations, rain gauge stations, soil testing labs, labs meant for pesticides & residual analysis and bio-assay labs. The model for business services to engage youth, will play a significant role in establishing fresh economic activity integrating with viable multiple services without depending only on setting up of soil labs, since the operation of such labs may be seasonal in nature. Appropriate back-ended subsidy model including its channelization may be designed to promote this type of off-farm activities as a prelude to the raising of farm income.

Finally, it was reiterated to assess, whether the continuation of schemes and its implementation will be in a modifiable form aiming towards the enhancement of farm income, employability and cost of cultivations on exploring the possibility for integration of last mile activity.

While referring about the ATMA, it was mentioned that half of its activities are not visible in the field; so, it is the high time to understand about the introduction of PPP mode of services in agriculture extension. The private or, paid type extension services may also deliver efficient services harmonising with existing public extension systems, provided it is conceived as an agri. extension revenue model. The manpower based extension services has appeared to be a costly affair, hence there is a need for scoping of real time extension services in terms of knowledge and information dissemination aligning with the ICT in extension. However, this approach may further be enriched on accessing supports from the information base already available under the spatial/ space/ geo-spatial sources. These type of improved and new age venture provides the opportunity for re-jigging of ongoing ATMA programme.

In addition to all these details, this sub-group will also examine the modus operandi related to the fixation of targets for the increase in production, income enhancements, channelizing financial resources for effective implementation of schemes and estimation of critical input (viz. seed and quality Planting materials) requirements by 2032.

The discussions were further extended to share the schematic details under the agriculture, horticulture, animal husbandry, dairy development, fisheries and aquaculture sectors.

I. Sector : Agriculture – a. Integrated Nutrient Management (INM)

Joint Secy. (INM) briefed about the ongoing all four schemes related to Soil Health Management (SHM), Soil Health Card (SHC), Paramparagat Krishi Vikas Yojana (PKVY) and Mission Organic Value Chain Development for NE region (MOVCDNER), which are in operation under the INM. These schemes have synergy with the activities under the National Mission for Sustainable Agriculture (NMSA). As one of the follow-up initiatives, the INM Division will develop the EFC on clubbing of activities under the SHC, SHM, Integrated Rain-fed Area Development (RAD) and micro-irrigation.

The National Productivity Council (NPC) has prepared the evaluation report on SHM, utility of SHCs on the basis of its survey to study the impact of soil health card on farmers. It's previous study on fertiliser use efficiency covering 75 Districts and 2000 nos. farmer's respondents' provided a broader picture collating with SHCs; however, in another approach to study the role of DBT in fertiliser with the special reference to the use of neem coated urea covering 2 to 3 Districts shown limited response. However, the SHC Scheme will take some time in the process its stabilisation, as it directly relates with the rational application of inorganic fertiliser under the principle of resource use efficiency. The outcome, evaluation and impact study report on two other programs, namely, PKVY and MOVCDNER will be submitted by the MANAGE in next two months. Study of the MANAGE will be proved useful, as it will come out with actual field level achievements. However, the Department has a fair idea about the various shortcomings of these schemes including the PGA Certifications, all of which will be attended systematically, once the evaluation reports are appropriately analysed along-with the interactions with the farmers' as documented in the study.

Under the Organic Farming, the target was to cover 10,000 clusters (for PKVY) and 100 FPOs for MOVCDNER during the F. Y. 2016-17. So far, 40 FPOs are formed and the formation of rest 60 FPOs are already spilled over to 2017-18. The Organic Farming area has already been covered to the extent of 2.5 lakh ha, against its potentiality to cover approximately 14 million ha. of rain-fed areas of the hilly region. The APEDA is operating over the 14 lakh ha. of organic farming area. The departmental budgetary supports to the level of Rs. 300 Cr. per year is exceeding the capacity of absorption of States promoting organic cultivation, as the

States are constrained with the mobilisation towards the formation of new groups/ clusters to take up organic farming as innovative and sustained farming practice. During the F.Y. of 2016-17, States could absorb an amount of Rs. 150 crore only under the organic farming programme.

As regard to various kinds of support available under these program was narrated by the JS in brief and the details are as follows :

Schemes	Details of Supports
Organic Farming by individual entrepreneur	@ Rs. 0.50 Lakh/ Farmer including the supports for small scale mechanisation, rental transportations, linking to organic bazar for a period of three years.
MOVCDNER	@ Rs. 3 Cr. to 4 Cr. to individual Farmers' Interest Groups aligning with the Farm Producers' Organisations to operate under the whole gamut of organic farming operations for the entire sustaining period of three years. The institutions are provided with the holistic supports from lead agencies, service providers, organic certifications, post-harvest management, integrated storages, refrigeration and transportations.

The aggregating and financial agencies like, *NERAMAC and NeDFi,* as independent entities are supporting to up-scale these activities in the NE region and they have come out with the report of positive impact towards the propagation of organic farming in the N.E. region on formation of clusters.

Prof. Ramesh Chand, Member (Agri.), NITI Aayog emphasised that, the DAC&FW may keep a track about the follow-up adoptions by the groups volunteered to take up organic farming as a matter of motivational drive, seeing the performance of already established clusters. However, the attempt should be there for conversion of entire collection of crop residues to bio-compost material for its best use in organic farming. He has also mentioned that the proposal may be prepared with details of its rationale considering the scope of organic farming in the country.

JS, INM further shared that the synergy between available market services and product developments needs to be intensified following further extension of linkages with the MoFPI to scale up existing services and the MSME for skill development specifically to design the packaging of "organic foods as safe food". In addition to this, greater participation of the NCOF, Ghaziabad will be meeting twin objectives of swach bharat abhiyan (as experienced in the Akola District of the Maharashtra State) and expansion of paramparagat krishi using bio-decompose resources with the launch of incubation centres at selected places of the Country, which will be an added advantage to augment PKVY. Avenues to replicate the same practice may be searched for different states according to their local requirements on experiencing the successes of management of food processing

industry, as happened in Tanjavur, Tamil Nadu State and Assam. The success of MSME's cluster approach for cluster development under the PKVY to develop incubation centres may also be explored under the MOVCDNER. She has mentioned that, all four ongoing schemes including the PGA Certification system are proposed to continue beyond the 12th Plan.

b. Agri. Insurance, Price Support Scheme etc.:

Joint Secy. (Agri. Insurance, Co-operation and Credit) briefed about the various ongoing schemes viz. Pradhan Mantri Fasal Bima Yojana (PMFBY), Interest Sub-ventions, Integrated Scheme on Agriculture Census (ISAC), Price Supports Scheme (PSS) and Market Intervention Scheme (MIS). The PMFBY was introduced during the period of Kharif, 2016 onimprovisation of earlier insurance schemes and its evaluation process is on. Within the Ministry, the monitoring of progress under the PMFBY is carried out on weekly basis following the track of details of participating banks and all 18 insurance companies. The increase in agriculture insurance coverage has been noticed on launching of the new scheme of PMFBY. The enhanced level of sum insured was occurred due to low premium amount @ 1.5% fixed for kharif crops and 2% for rabi crops and ease in pay-out. However, the budget allocation for PMFBY during the F.Y. 2016-17 was Rs. 13,240 crore, now reduced to Rs. 9000 crore in current year against the estimated requirement of Rs. 13,000 crore to Rs. 14,000 crore; hence, the less allocation is an impediment in early settlement of claims/ insurance pay out to farmers'. In order to resolve the budgetary crisis, the risk mitigation/ calamity relief coverage is proposed to be merged with the available fund generated under the krishi kalyan cess and placed in krishi kosh. The targets for insurance coverage of farmers' was finalised as follows: 30% coverage during the F.Y. 2016-17, 40% coverage during the F.Y. 2017-18 and 50% coverage during the F.Y. 2018-19.

The technology leverage under the PMFBY will be the prudent approach to address irregularities in CCEs (which is found to be the weakest link), assist in appropriate production estimations and assessment of crop yield; since, the claim settlement is not the sole factor of performance of a programme or, it can be treated as yardstick of any scheme. In this connection, it was apprised that, the app based technology module developed by the Bengaluru based "Crop In" under the start-up initiative for the assessment of crop damage in reference to potato, maize and wheat was found to be a way forward to this direction and the DAC&FW has developed a platform for data repository generated through the technology module of the "Crop In" for further correlation with the CCEs data base. However, it has been apprised in the meeting that the Karnataka State has adopted the composite mode of premium payments aligning with the data base support generated through technology use (to the level of 10%) and of CCEs. The States of Gujarat and Madhya Pradesh are not using any technology supports to capture the data base associated with the crop cutting results. The entire operation related to agricultural insurance formalities are

completed within the period of seven days schedule; but, private insurance companies have expressed their limitations in accomplishing the targeted work. The adoption of modified guidelines under the PMFBY along-with the participation of multiple private insurance agencies and seeding of Aadhar nos. of beneficiaries is a critical and challenging job; however, the target of the govt. to complete the whole work by 01st April, 2018 with the special reference to seeding of Aadhar nos. of farmers'. It was also shared in the meeting that, the tendering methods to determine the rate of premium is an outdated process now, accordingly, the govt. should fix the premium amount during each cropping season through appropriate assessment. The General Insurance Company is the world's biggest re-insurer and it has handled the increased level of 15% of insurance and re-insurance efficiently following the implementation of the PMFBY. In order to bring the transparency in agricultural insurance, there is a need to capture crop cutting experiments data in simulation of land revenue details; maintaining the prudency of records is necessary for prompt identification of shifting of crops by the farmers' beyond the recorded data in insurance documents but it will be difficult to track. In States like, Gujarat and Karnataka the provisions for 5% level of sample scrutiny is always carried out to maintain the sanctity of the crop insurance programme. The possibility to induct independent assessment of losses through the third parties or, any independent agencies will definitely be a correct step to this direction but, there should be rationales in terms of area based approach, yield index and crop coverage etc. The recent agricultural insurance has revealed hybrid scenario with the disaggregated break-ups viz. the coverage of area of fruits and vegetables were more under the WBCIS, area of field crops were at the higher level under the PMFBY and the responses for UPCIS were very limited. The evaluation studies related to various insurance programs including the PMFBY will be taken up by the DAC&FW shortly.

The ***interest subvention scheme*** was a non-Plan scheme and it was implementing by the DFS till 2014-15 with the limited/ low level of budgetary supports; however, w.e.f 2015-16 onwards, the programme has been transferred to DAC&FW for implementation on shifting of budgetary supports from non-Plan to Plan.

During the year 2016-17, the allocation for the ISS, was Rs. 15,000 Cr. and the maximum share was taken by the RRBs. The govt. had constituted a committee under the chairmanship of Sh. U. C. Sarangi, Former Chairman, NABARD to assess the impact of interest subvention scheme; recently, the committee has submitted its report with the mention of established smooth recovery mechanisms of lending financial institutions, which constitutes approximately, 6.5 lakh unit of crop loan besides other segment of credit supports available in farming sector. The committee has mentioned about few recommendations in its final report in order to streamline the agricultural credit system of the country, which will be taken up in cabinet for its appropriate action concurrently with the cabinet note for interest subventions for the year 2017-18. Referring the scenario of Tamil Nadu State, Member (Agri) informed that, the credit coverage in the state has reached to

the level of 38% but it shares only 18% of the GCA. Accordingly, at national level there should be a balanced mechanisms for extending agricultural credit supports, which may be linked to crop output share; in order to determine the level of eligibility for the States to claim its' proportionate share of agricultural credit; this approach along-with other meticulous steps e.g. collating the credit with beneficiaries Aadhar nos. and land records will prevent leakages since multiple lending institutions, existing multiple bank accounts and insurance companies are associated with the agricultural credit systems.

The ***price support systems and market intervention supports*** are mainly serving the purpose of SFAC and NAFED in terms of procurement of pulses, oil seeds and cotton to support small scale farmers', clusters and FPOs. The Member (Agri) mentioned about the price deficiency payment systems followed in Maharashtra and Goa towards the procurement of soybean and oilseeds in order to strengthen the collection mechanisms of these produces, as the procurement of produces from aggregation centres is a costly affairs which needs special provision like PSS. However, the benchmark for such price deficiency payments needs to be worked out and to make it effective, a continuous study of price structures/ fluctuations for a continuous duration of six weeks in recognised markets of states may be accessed to reach to a consensus for easy determination of actual scale of price deficiency payments to be supplemented. The recent incident of price crash of chillies in Telangana State and the demand of farmers' for the procurement of chillies by govt. agencies is also discussed in the meeting. The incentives for such procurement may be tried through the market intervention supports as a way forward to provide better window to chilli cultivators in disposal of their farm produces. The role PSS/ MIS may be effective to procure and sale out perishable commodities, where MSP is not feasible. The Government's price policy for agricultural commodities seeks to ensure remunerative prices to the growers for their produce with a view to encourage higher investment and production and to safeguard the interest of consumers by making available supplies at reasonable prices with low cost of intermediation. The price policy also seeks to evolve a balanced and integrated price structure in the perspective of the overall needs of the economy.The MIS so far implemented to handle items like apples, kinnoo, garlic, oranges, grapes, mushrooms, clove, black pepper, pineapple, ginger, red-chillies, coriander seed, chicory, onions, potatoes, cabbage, mustard seed, castor seed, copra and palm oil etc. in the States/UTs of Himachal Pradesh, Haryana, Punjab, Andhra Pradesh, Maharashtra, Karnataka, Rajasthan, Gujarat, Kerala, Jammu and Kashmir, Mizoram, Sikkim, Meghalaya, Tripura, Uttar Pradesh, WestBengal, Madhya Pradesh, Andaman & Nicobar and Lakshadweep islands. The evaluation process of MIS has already been taken up and the concerned agency will submit its report by June, 2017. Hon'ble Member informed that the deficiency price payments proved to be a successful model in Goa and for some crops in Maharashtra. However, suggested to explore the possibility for price insurance scheme.

The agricultural co-operatives are to be strengthened and as a promotional support to agricultural co-operative activities, there is a need to provide adequate attention, to evolve suitable schemes for revival of businesses of agricultural cooperatives in the country; which may be an actionable agenda.

c. Natural Resource Management : Rain-fed Farming System (RFS)

Joint Secretary (RFS), briefed about the National Mission on Sustainable Agriculture (NMSA), which was one the part of National Plan of Action(s) related to Global Warming and Climate Change in India; out of nine missions one mission was NMSA and the initial funding for the entire programs/ all nine missions of the country was about rupees one lakh eight thousand crore. The activities under the NMSA was re-builded following re-structuring of existing schemes viz. Rain-fed Area Development (RFAD), On Farm Water Management (OFWM) and Soil Health Management (SHM). During the year, 2015-16, the OFWM was sub-sumed with the Pradhan Mantri Krishi Sinchai Yojana (PMKSY). Rain-fed Area Development is the part of Integrated Farming, which is functioning as an important tool to insulate farmers' under the rain-fed situations.

During the period of 12th Five Year Plan, the allocation under the NMSA was *rupees thirteen thousand thirty four crore,* the CCEA allocated Rs. 3100 crore for the implementation of RFAD/RAD scheme, however, the revised allocation was later changed to Rs. 1860 crore for the first three years of the twelfth Plan following the release of Rs. 708 crore only. The physical coverage was 1.98 lakh ha. against the target of 6 lakh ha. for its implementation through cluster mode. The assessment of the RFAD programme was taken up by the Agricultural Finance Corporation (AFC) and the report to this context has been submitted by the AFC. The impact of the RFAD revealed that, there were instances of rise in income of farmers' to the extent of 25 to 30%.

The programme had covered 1.32 lakh to 1.82 lakh farmers' households in arid and semi-arid parts of the country and the expenditure of farmers' came down to the level of 32% in farming operations. However, to other side, no FPO could be formed to dispose of surplus farm produces in certain areas; the scheme would have been more affective through area approach integrating with the animal husbandry sector e.g. piggery and poultry and as a matter of example in Karnataka State the programme implementation should have covered preferably sericulture activities to bring more efficiency in rain-fed area development activities; similarly, linking of milch cattle and fisheries based activities with the RFAD would have provided significant results in Maharashtra and Odisha States respectively.

It is intended to continue the RFAD programme, but non-integration with the induction of cattle in a unit area will be the limiting factor in achieving its potentialities. The paucity of

fund availability under the RFAD may call for tweaking of existing guidelines in order to cope up with the intrinsic limitation in implementations; at present the scheme extends the subsidy @ Rs. 1.25 Lakh/ Ha./ Farmer. At the initial stage of its implementation, the schematic support was embedded with the grant of 100% contribution to States, to a later stage changed to 75:25 ratio basis (Centre: State), further changed to 60:40 financial sharing basis; still the adoption status and its replication was significant at the ground level. The schematic intervention may imbibe with the dairy based activities in order to start a new beginning and may be added with additional activities in the process of its scaling up to a later course. In Jharkhand State, the cropping activities under the National Food Security Mission (NFSM) has the resemblance with the RFAD, in addition it has other farming components also. The ICAR has developed thirty eight climatic specific farming models and steward the synergy between the integrated farming system, adoption of good agricultural practices along-with the development of a portal and certification processes. However, to this context, the JS (INM) has shared the details related to the PGS certification *[**PGS**-India (**Participatory Guarantee System** of India) is a quality assurance initiative aiming towards balanced approach between producers and consumers and operate outside the frame of third party* ***certification] for organic produces, which addresses the residual testing to denote as "safe food", embracing the first target of organic products and the second as safe to eat.***

As regard to the PMKSY, it was informed that, the yojana has already been approved for continuation till 2019-20 in its revised format by the EFC; but the programme has suffered during the year 16-17 due to shortfall in financial outlay to the extent of Rs. 350 crore. The physical achievement under the PMKSY (Per Drop More Crop) was 5.72 lakh ha. area, against the target of 5.00 lakh ha. area during the year 2014-15; similarly, in the year 2015-16 the achievement was 8.30 lakh ha. area against the target of 8.00 lakh ha. area. The targeted area of 12.00 lakh ha. is to be covered under the PMKSY during the current year of 2017-18. However, in addition to the PMKSY, there are demands from States to intensify the implementation of RFAD to augment the creation of small water harvesting structures for localised irrigations. The target for RFAD was 90,000 ha. in the year 2015-16 under the drought proof initiatives, but restricted to 75,000 ha. on account of financial limitations. In Maharashtra, the entire sugar-cane area, to the extent of 7.50 lakh ha. has been brought under the ambit of micro/drip-irrigation with the support of NABARD's irrigation corpus fund and in convergence of State's 4% contribution to an amount of Rs. 1200 crore out of the total cost of micro-irrigation project. The States of West Bengal and Rajasthan could not reap such benefits to launch similar programme in the line of Maharashtra State, due to limited access to NABARD's corpus fund since, the non-availability of respective State's contribution was also one of the limiting factors to tap the financial resources of NABARD. However, the corpus fund allotted to NABARD was Rs. 5000 million followed by the physical target to cover 2 million ha. of area on y-o-y basis and collectively to achieve 10 million ha. in a period of five years subject to the joint contribution of States out of its own resources.

Additional Secretary was in the view to popularise the micro-irrigation programme vigorously and to bring the balance in differential subsidies in DPAP and non-DPAP States; hence, suggested for modifications of existing guidelines targeting to cover an area of 63 million ha. within a negotiable period. There may be the piloting of this activity with 100% special grant in non-priority areas.

As regard to the agro-forestry based scheme, the JS (RFS) did not favour to bring any changes in the scheme till 2019-20, since its operational details are already been approved by the EFC and being the new initiative; the changes at this stage may affect its implementation strategy.

d. National Food Security Mission (NFSM) :

Joint Secy. (NFSM/ Crops) highlighted about the schematic progress under the National Food Security Mission targeting the increase in production of rice, wheat, pulses and coarse cereals including the area expansion, which took place on commissioning of the programme; in addition to this, it has supported the enhancement of farm economy also. The production of food grains viz. rice production has reached to 25 million ton, wheat is produced at 8 million ton, pulses at 4 million ton and the coarse cereals production has reached to the level of 3 million ton followed by the interventions under the NFSM. The evaluation process of NFSM programme is in progress and it is expected that the concerned institution will deliver its report during July, 2017. The report will state the details about the area expansion and the productivity. The main interventions under the NFSM is to promote production of pulses in identified 65 potential districts of 9 States; instead of concentrating only in 21 districts, which was practised earlier. At present, these selected districts are producing 90 to 95% of pulses in the country. However, in addition to the area expansion under pulses, the DAC&FW is finding out modalities to promote diversifications in rice and wheat growing areas by introducing the cultivation of coarse cereals. The NFSM is also targeting to enhance the per capita availability of food-grains.

Addl. Secy. emphasized upon the varietal replacement under the NFSM instead of Seed Replacement Rate (SRR) alone. He has further stressed upon the need to review the status of farm producer organisations and the role of SFAC in collective supports to these FPOs. As regard to the financial assistance, the SFAC was allocated with an amount of Rs. 52.11 crore for the improvement of procurement mechanisms involving 81 FPOs and it should also take initiatives to constitute 30 more FPOs as targeted. The NFSM programme needs strengthening with the possibility to introduce DBT arrangements towards the procurement of micro-nutrients, improvement in breeder seed certifications and use of bio-fertiliser as sustainable inputs. In addition to these, there should a holistic approach in all 629 districts of the Country for both the NFSM, Kharif and Rabi to attempt for the establishment of primary processing unit(s) with the installations of cleaner and grader; however, separate

emphasis may be accorded for the 100 nos. of selected pulses districts on mapping its status. There is a need for appropriate review of NFSM programme keeping in view of output and demand since the output sinks with the demand with the passage of time. In order to bring adequate clarity about the NFSM programme - it has been decided to develop a brief of the scheme, its salient feature, highlighting main activities, the performance of the NFSM during the 12th five year Plan, unit costs etc., budget details, expenditure priorities, modifications required and detailing of actionable points specifically related to oilseeds. The crop division's premptive actions may be focussed on the development of crop Plan and possible crop alignments on reviewing the existing cropping patterns of different states and UTs taking into considerations the irrigation facilities of major irrigation projects of the country besides the 17 other projects to be completed by the MoWR,GR&RD shortly; the concentration should be linked to determine the targets of production of main crops, possible area expansions and modalities to use post kharif fallow areas in order to ensure the food security keeping in view of projected population estimates of 2022-23 and 2025-30. The gap assessment in terms of productivity of front line demonstration plots and farmers' field is also one of the distinct areas where the appropriate strategy to bridge such gaps may be adopted. The reforms agenda of the govt. with the special reference to agricultural land leasing should get priority in the implementation process of various sub-components under the NFSM programme.

JS (Crops) has shared various information related to the National Mission on Oilseeds and Oil Palm (NMOOP) along-with the mention of present level production of 9 million ton against the national requirement of 24 million ton and hence, the govt. is importing 15 million ton spending millions of rupees. Accordingly, to encourage farmers' to take up the oil-palm cultivation to a bigger scale, the govt. may enhance the unit scale of finance towards the oil palm cultivation instead of incurring huge expdrs. to import edible oil to meet up domestic requirements.

There is a need to promote coconut cultivation in southern states and in certain UTs and it may also be brought under the NMOOP programme in order to meet up it's growing demand in such States and UTs to the extent of 1.00 million ton. According to the assessment of the DAC&FW the oil-palm cultivation can be extended up-to 19.50 lakh ha., whereas, the present level of cultivation has covered the area of 3.50 lakh ha. only; unless the domestic level of edible oil production is scaled up, it is difficult to attend the recommended per capita requirement of 14 gm. and the business as usual under the edible oil sector is not going to provide the self-sufficiency in edible oil production in the country. In pursuance of these issues, the coconut Plantations may be brought under the NMOOP and the same unit costs etc.The encouragement towards coconut Plantations and its inclusion under the NMOOP will be able to fulfil the need of 1.00 million ton of edible oil in the country.

Addl. Secy was in the view to organise a half day seminar jointly with the ICAR to address this critical issue and as a matter of suitable strategy, a special mission may also be thought of to expand the area of cultivations under the oil seeds and oil palm.

e. National Horticulture Mission (NHM) :

Joint Secy. (NHM) made a presentation highlighting schematic activities, performances under the National Horticulture Mission and future propositions targeting the production of horticultural items in the light of projected population growth, towards the provisioning of requirements of fruits and vegetables @ 540 gm/ day and to tap export potentials of horticulture produces. There is a need to pay special attention to the cultivation of potato, onion and tomato; since 62% of farmers' engaged for the production of these horticultural produces, which forms 42% of domestic vegetable basket. However, to intensify the yield of potatoes, the details of varieties are to be inventorised in order of the merit of it's cultivation and production potentials to make further headway in potato productions. In Telangana State approximately 6800 nos. of farmers' are formed horticulture producers' group and in Southern part of Kerala about 7100 farmers' formed clusters in the name of "Sangamitra" to augment various activities under the NHM; hence, they deserve further supports to upgrade their initiatives to the next higher level. However, in order to increase the export of horticultural produces, the establishment of "Track and Trace" quarantine centres may be explored to address the criticalities at different exit points of potential export destinations. He has also stressed upon the need for the installation of cold chain concept under the horticulture sector instead of cold storages in order to prevent the distress sale at the time of excess productions. The role of SFAC and FPOs in promotion of horticulture sector of the country needs a relook and their supports in establishment of crop specific processing facilities may be encouraged. The activities under the NHM may further be strengthened following the procurement of good quality Planting materials for selected crops to the extent of approximately 13 million nos., skill up-gradation of farmers' and entrepreneurs, quality certification issues for horticultural produces and establishment of registered horticultural nurseries to bring excellence in propagation facilities. He was in favour of continuation of the scheme in its existing form, since the EFC related to NHM is already been completed.

f. Agriculture Extension :

Joint Secy. (Agriculture Extn.) narrated the details of activities under various sub-missions of the NMAET with the special reference about the allocation of fund to the tune of Rs. 6700 crore and expdrs. to an amount of Rs. 6008 crore; however, approximately 35% of the allocation/ release has remained unutilised during the 12th Plan period. However, the level of physical achievements was at 75% during the 12th five year Plan. The impact assessment of the programme is in progress but the Joint Secy. has suggested for the continuation of

the activity with its existing components and observed that, there is a need to bring reforms in extension with the induction of PPP mode of agricultural extension services.

Addl. Secy. mentioned that, that the extension is a last mile activity. The issue of reduced ATMA field staff by 50% (effect of post revisions of Fourteenth Finance Commission), it needs to be re-designed with a focus on animal husbandry and other sub-sectors of agriculture and not just for crops. It was also shared that the avenues other than extension (which is based on manpower) due to high costs involved in such extension system; accordingly, the methods to disseminate information on real time basis needs to be explored (e.g. ICT/GPS based systems).

He was also of the opinion that, there should be a synergy with "Skill India" for comprehensively training rural youth in multiple employment generation activities such as composting, buffer stock maintenance, analysis for soil health through regional centres for PGS, perishable testing labs, automatic rain gauze station etc. Some activities such as soil testing are only seasonal, training youth in multiple complementary activities (such as managing nurseries) will help them stay employed year round. Lead resource persons are to be trained as a part of the group based activities; individual activities may be linked to assistance towards mechanisation, organic bazaars, etc. There should be adequate collation in activities of similar nature for removing overlaps in functioning.

JS (Crops) mentioned about the sharing of minutes related to the recently attended a conference on agricultural extension in presence of 500 extension workers of the country. JS (RFS), informed about a pilot has been done, blending with the concept of ICT and local knowledge with the support of GIZ in terms of advancements of the agriculture extension system of the country. The outcome of the project is encouraging, as experienced in Jharkhand, Odisha and Maharashtra. The newer means of extension supports has provided a different platform for agricultural development particularly in rain fed areas.

Prof. Ramesh Chand, Member (Agri.), NITI Aayog informed the house to develop suitable formats showing the details of three years action Plan of the DAC&FW and DAH,D&F highlighting all schemes (CS and CSS) with the mention of objectives, target, evaluation status, details of earlier findings and of expected output and outcome during the forthcoming years. He has also mentioned about the discussions to be taken up in the next meeting related to AICRPs of the ICAR/ DARE to apprise with its performances/ contributions made in the agriculture and its allied sectors since its operationalization.

II. Animal Husbandry, Dairying and Fisheries :

g. Fisheries and aquaculture sector :

Asst. Commr. (Fisheries) highlighted about the ongoing activities under the fisheries and aquaculture sector under the restructured title of Integrated Management and Development of Fisheries and all its components brought under the ambit of "Blue Revolution" as approved by the CCEA. The gap assessment study under the fisheries sector is completed and the national Plan of action to achieve Blue Revolution in the country with the special thrust on reservoir fisheries development in identified states. The mission on production of quality fingerlings/ advanced fish fingerlings is prioritised as the primary step to land with Blue Revolution in the country.

h. Animal Husbandry and Dairying:

Asst. Commr. (Dairy Dev) spoke about the details of Dairy Entrepreneurship Development Scheme (DEDS), National Programme on Bovine Breeding and Dairy Development (NPBB&DD) and the National Dairy Plan (NDP). He has informed that, the NDP I is extended up-to 2018-19 and the NDP II will be launched after 2018-19. It was mentioned that the disease prevalence and occurrence in livestock sector (e.g. PPR, FMD, brucellosis and classical swine fever) is the major reason, which is hampering the milk production in the country to take it to the next level; however, in order to handle these critical issues practically, the generation of aadhar cards for animals may be the suitable step following the introduction of pulse polio mode of animal immunisation programme. The financial constraints is the major hindrance to the DAH,D&F to support states to the desired level under the CSS program to handle the dreaded disease like FMD, which has the frequency to recur six monthly interval. However, to establish the concept of animal disease free zone (DFZ) in certain parts of the country in terms of minimising the rate of disease prevalence and incidences; the proposal of the DAH,D&F was to allot Rs. 460 crore during the 12th five year Plan, but it received a meagre amount of Rs. 290.77 crore for all nine sub-components under the LH&DC. The suggestion received from the participant to address the bio-security concept in the country collectively of Plant and animal quarantines to adopt a rational approach under the ease of inter-state movement of live items.

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National Institution for Transforming India (NITI) Aayog
Agriculture Vertical

Subject: Minutes of meeting of the Working Group on Crop Husbandry, Agricultural Inputs, Demand and Supply Projections in Agriculture

1. The final meeting of the working group on **Crop Husbandry, Agricultural Inputs, Demand and Supply Projections in Agriculture** was held on **31st July, 2017 NITI Aayog, New Delhi.** Prof. Ramesh Chand, Member (Agriculture), NITI Aayog was chair and Dr Pramod Kumar, Chairperson of the Working Group was co-chair of the meeting. **The list of participants is annexed.**
2. Dr.J.P. Mishra, Advisor (Agriculture), NITI Aayog & Member- Secretary of Working Group welcomed the participants and apprised about the progress of the working group report so far. He also reported that the chairs of the subgroups III on inputs and subgroup V on centrally sponsored schemes have assured to provide the report of their subgroups with two weeks.Dr Mishra also mentioned that in case these two subgroups fail to submit their reports within next 15 days the working group may consider submitting its report either without the two chapters or NITI Aayog, based on the information made available to NITI Aayog by the respective departments of M/O Agriculture would write the two chapters to be included in the Working Group Report.
3. Prof. Ramesh Chand, Member NITI Aayog thanked all the members of the Working Group for their contribution. He emphasized that in view of Government moving from 5 year Plan exercise to 15 year vision for various sectors including agriculture, the projections made by this Working Group would be crucial for next 15 years and many activities of development and Planning will have to be aligned with these projections He also agreed with the statement of Member-Secretary of the Working Group to wait for 15 days for the reports of the subgroups –III and V and later prepare its own to be included in the final report of the working group. He requested Dr. Pramod Kumar, Professor & Head, ADRTC, ISEC, Bangalore &Chairman of the working group, to make detailed presentations on the demand and supply projections for next 15 years.
4. Dr. Pramod Kumar informed the participants that already three meetings were conducted and five sub-groups formed. He explained about the report of three Sub-groups i.e., I, II and IV, which were received by him. He wanted similar action from other Sub-groups also. He categorically mentioned that the report and projections of subgroup-III related to inputs would be crucial to decide upon the projections of agricultural commodities both at micro and macro level. While initiating his presentations, he expressed his concern that due to growing dynamism in consumer behaviour and preferences, changing ecologies and new technologies and production

protocols and tools, 15 years projections were difficult and rather a tough to arrive at some accurate forecast.He further added that many new areas for projections were added in the TOR of the working group which was not included earlier.

5. Dr. J.P. Mishra joined the chairman of the working group and added that the demand and supply of feed and fodder is rather difficult in view of non-availability of time series data for the sector. He further stated that the subgroup-III on inputs has been made inclusive by making Dr. S.S. Honnappagol, Animal Husbandry Commissioner, DAD&F, Co-chairman of Sub-group-III along with Agriculture Commissioner, DACFW. Dr. Honnappagol was of the view that livestock sector needs to be dealt separately to understand the contribution of this sector. He requested for one more week time to submit the report for inputs and CSSs related to livestock sector.

6. Dr. Pramod Kumar while making detailed presentation on Demand and Supply forecast explained the three approaches- Static Behavior of consumption, Normative and Behavioristic approach that were used for making the projections. The supply projections were made on the basis of three considerations (i) Based on trends in area and yield at all India, (ii) Based on trends in area and yield among major growing states, (iii) Simultaneous equations model forecast. Dr. Pramod Kumar also raised his concern about non-availability of data in time series and public domain for many of the critical segments that are affecting the precise projections. The following suggestion were made by the members:

   (i) The contribution of rural sector in GDP forecast for the year 2020-21 may be revisited

   (ii) Human demand to be mentioned as household demand and edible oil as vegetable oil.

   (iii) Quite sizeable amount of palm oil is also used for non-edible purposes; hence palm oil may be excluded from edible oil and dealt separately.

   (iv) Estimates based on behavioral approach seem to be unrealistic.

   (v) The National Commission on Farmers recommendations 2007 and National Agriculture Policy (2001) may be suitable mentioned in the first chapter.

   (vi) Fruits and vegetables may be grouped together while nuts due to premium price tag should be kept separately

   (vii) Milk and meat are the two different groups and hence to be provided separately for data and analysis

   (viii) Fertilizer requirement cannot show increase in demand as during last 5-6 years there is no growth in this sector

   (ix) Need to critically analyse how much area is required for the increased production. As the biggest input for agriculture is area. The land use balance sheet should be examined before making such projections.

   (x) Seed,feed,wastage and industrial needs to be added. To assess the demand and

supply of seed is critical, as we are not only diversifying in area but also in methods of cultivation which are reducing the seed rates per unit area to a great extent.

(xi) The forestry have huge potential in high value commodities, hence, along with fruit, vegetables, dairy, meat, fisheries, etc the forestry need to be added.

7. Prof. Ramesh Chand, Member (Agriculture), stated that we are importing edible oil but only small amount is being utilised in food. He emphasized that NITI Aayog, should analyse to which sector these edible oils are being used.

8. Dr. J.P. Mishra observed that very impressive projections has been made for demand and also for supply which has put a challenge on the land mass available for agriculture. Since many of the ecologies particularly of rice is shrinking and those for rainfed crops will suffer for both intra and inter group competitions, the challenge would be on researchers and technology generators to change this competition into complimenatrity. He suggested that for achieving the demand projections the area requirement may also be worked out by the subgroup-III.

9. Shri. P.C. Bodh, Economic & Statistical Advisor, DES, DACFW,stated that for area projections, the land use balance sheet scenario by 2033 nedd to be taken into consideration. He also promised to extend his services for this activity.

10. Dr. R.L. Tewatia, Additional Director, Agriculture Sciences, Fertilizer Associations of India, informed that crop wise fertilizer use per acre data is available but is published every 5 years.

11. Dr. P.S. Tiwari, Head, AMD, CIAE, Bhopal, discussed the report of sub-group IV on Farm Mechanisation. Differential level of mechanisation is required for different operations which were presented in the report. The level of mechanisation varies in geographies as well as operation within a commodity. The mechanisation in tillage and seed Planting except rice transPlanting has reached close to 90%. The leading geographies are Punjab, Haryana and Uttar Pradesh while in eastern and southern states, the level of mechanisation is less. The mechanisation has two major challenge –(i) economy of scale and (ii) optimum utilization. While small farm implements and tilling machine are required at every household the larger machine of heavy duty and poer may be placed at custom hiring centre to facilitate small and marginal farmers. He also stated the non-availability of disaggregated data for farm machinery a larger concern to make any precise projections. Dr J P Mishra stated that the farm mechanisation is diversifying within and also the demand is increasing for newer machines for newer operations. He cited the examples of cotton harvesters for high density Plantations of cotton and also the fruit plucking machines in horticulture. Prof. Ramesh Chandsuggested that there is lot of emphasis on diversification within mechanisation; therefore small tools which can be used by small and marginal farmers can be taken into consideration. He added that mapping to be done in terms of technology, if mechanisation done today is appropriate. Comments on what kind of tools and equipment are appropriate for this country considering the small land holdings need to be incorporated. He also

suggested that there is a need to allow free import for tools and equipment as fresh R&D will take more time to develop cost effective farm implements of the same status. Machines are also important to avoid excessive usage of herbicides for the control of weeds. Appropriate machinery is also required for precision farming. Dr. Tiwari has assured to update the chapter incorporating the sugegstions to the extent possible and sent it to chairman very soon.

12. Dr. P.K. Joshi, Director-South Asia, IFPRI, suggested that a systematic study on fruits and vegetables needs to be done to capture the dynamism in consumption behaviour and pattern to arrive at commodity wise and state-wise consumption pattern for major fruits and vegetables. Prof. Ramesh Chand, Member (Agriculture), added that similar study can be done for milk and processed commodity. He stated that the study can be done through SAMAVESH to estimate the demand for fruits, vegetables, milk products and processed foods.
13. Dr. D.K. Yadav, ADG (Seeds), ICAR, and member subgroup III mentioned that the group will finalize the report within a week time.
14. Shri Manash Choudhury, Dy Advisor (Fishery), NITI Aayog & Member Secretary, subgroups-V on Centrally Sponsored Schemes stated that the report of the subgroup may take about two to three weeks.
15. The meeting concluded with following decisions:
    (i) The reports of the Sub-group III on inputs and sub group V on CSSs are very important and critical to the Working Group Report projections and final report. Hence, the chairman of these subgroups may be requested to expedite submission of the reports within two weeks. **(Action: NITI Aayog and Chairman of subgroups-III and V)**
    (ii) The demand supply projections as presented by Dr Pramod Kumar, Professor & Head, ADRTC, ISEC, Bangalore & Chairman, Working Group may be improved/revised based on the suggestions of the members in the meeting and also seeking inputs from the two subgroups on inputs and CSSs, if they are made available in due time. **(Action: Chairman, WG and Chairman of subgroups, NITI Aayog)**
    (iii) The improved version of the subgroup report on Farm Mechanisation should be submitted within a week. **(Action: Member Secretary, subgroup-IV and NITI Aayog)**
    (iv) The data on land use balance sheet scenario by 2033 will be provided by DES, DACFW to Chairman of the working group. **(Shri. P.C. Bodh, Economic & Statistical Advisor, DES)**
    (v) The studies should be commissioned to capture the dynamism in consumption behaviour and pattern of fruits and vegetables, milk and milk products and also the processed food article so as to arrive at commodity wise and state-wise consumption pattern for major fruits and vegetables, milk and milk products and processed food **(Action: NITI Aayog)**

(vi) The livestock sector should be mentioned in the report as separate sub-chapter for which Animal Husbandry Commissioner would provide detailed note on status and demand projections of feed and fodder and other inputs for livestock as well as on centrally sponsored schemes (CSSs) related to livestock sector **(Action: AH Commissioner, DAHDF and NITI Aayog).**

16. The meeting ended with thanks to the Chair.

ANNEXURE-I

List of Participants

1.	Prof. Ramesh Chand, Member (Agriculture), NITI Aayog
2.	Dr. Pramod Kumar, Professor and Head, ADRTC, ISEC, Bangalore
3.	Dr. P.K. Joshi, Director, South Asia, IFPRI
4.	Dr. J.P.Mishra, Advisor (Agriculture), NITI Aayog
5.	Dr. P.S. Tiwari, Head, AMD, CIAE, Bhopal
6.	Dr. S.S. Honnappagol, Commissioner, Animal Husbandry, A HD&F, Krishi Bhavan, New Delhi
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17.	Shri. Manash Choudhury, Deputy Advisor, Agri. Vertical, NITI Aayog
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APPENDIX TABLE

Appendix Table 1.1A: Growth rate in Area, Yield and Production of Major Crops

Description	Name of the state	1980 to 1994	1995 to 2014	1980s	1990s	2000s (up to 2014)
Paddy	Andhra Pradesh	2.18	1.59	2.51	1.69	1.85
	Assam	2.68	2.07	1.08	1.06	2.60
	Bihar	1.58	2.16	4.14	3.05	2.56
	Haryana	4.09	3.45	2.25	4.36	3.37
	Karnataka	2.74	0.92	0.24	3.64	1.15
	Kerala	-2.04	1.45	-2.95	-18.45	7.32
	Madhya Pradesh	3.42	3.38	2.03	-0.12	5.67
	Orissa	4.06	2.18	3.98	-1.29	2.93
	Punjab	5.71	2.48	6.74	2.50	1.73
	Tamil Nadu	3.89	0.52	3.86	-0.14	0.46
	Uttar Pradesh	4.83	1.08	5.67	3.19	1.45
	West Bengal	5.61	0.84	6.83	2.49	0.36
Wheat	Bihar	4.34	0.49	4.88	3.53	1.65
	Gujarat	-0.06	7.96	-6.42	1.70	11.48
	Haryana	5.40	2.21	5.94	3.78	1.90
	Madhya Pradesh	5.00	3.47	3.65	5.55	7.68
	Maharashtra	0.27	3.08	-2.16	5.23	3.86
	Punjab	3.67	1.13	4.30	2.26	0.91
	Rajasthan	3.94	2.35	2.58	6.47	4.42
	Uttar Pradesh	3.51	1.33	3.75	3.17	1.19
	West Bengal	0.84	0.43	2.91	5.62	-0.44
Kharif Coarse Cereals	Andhra Pradesh	-3.23	2.49	-4.49	0.24	1.82
	Bihar	-1.61	2.17	1.79	-5.95	3.33
	Gujarat	-1.85	-0.76	-5.00	1.79	-0.46
	Haryana	0.18	2.51	-3.49	3.68	1.78
	Karnataka	1.09	2.60	1.06	2.73	3.78
	Madhya Pradesh	-1.03	0.79	1.39	-3.23	0.64
	Maharashtra	2.39	-1.59	1.46	-1.63	-0.93
	Rajasthan	2.39	4.89	1.28	-1.12	4.09
	Tamil Nadu	-0.74	4.07	1.56	-5.61	7.81
	Uttar Pradesh	1.47	0.33	2.68	0.02	1.02
Rabi Coarse Cereals	Andhra Pradesh	-2.65	10.45	-7.22	5.72	11.13
	Gujarat	-5.97	10.24	-10.69	-6.16	20.98
	Haryana	-1.28	2.61	-5.10	-1.89	4.69
	Karnataka	4.08	2.07	4.38	5.13	3.41
	Madhya Pradesh	-5.16	0.62	-7.50	0.25	1.75
	Maharashtra	1.38	0.55	2.29	2.25	1.79
	Rajasthan	-2.77	5.52	-4.29	0.20	7.45
	Tamil Nadu	-0.05	13.12	2.94	9.25	14.92
	Uttar Pradesh	-1.37	-2.47	-1.49	-0.90	-1.60
Kharif Pulses	Andhra Pradesh	5.59	-0.33	7.88	-5.19	-1.34
	Bihar	1.55	3.87	4.73	-4.47	6.35
	Gujarat	7.15	-0.73	6.06	-3.79	2.25
	Karnataka	3.92	2.19	5.24	-6.27	3.38
	Madhya Pradesh	2.31	1.64	5.97	-6.88	4.20
	Maharashtra	8.70	-0.54	13.22	-2.56	-0.56
	Rajasthan	10.89	4.71	5.27	-14.29	7.39
	Tamil Nadu	7.48	-1.58	20.11	-17.30	2.61
	Uttar Pradesh	-0.24	-0.52	0.54	-2.48	0.12

Rabi Pulses	Andhra Pradesh	12.29	4.92	21.09	-8.83	3.76
	Bihar	6.03	0.94	10.00	-10.33	3.38
	Haryana	-0.01	-6.15	-1.02	-9.83	-0.56
	Karnataka	7.04	7.12	7.24	3.30	8.52
	Madhya Pradesh	5.83	2.59	4.52	0.68	4.61
	Maharashtra	7.79	6.24	10.03	6.15	8.78
	Orissa	-7.70	4.24	9.53	-25.48	8.38
	Rajasthan	-1.52	0.29	-5.00	5.83	7.51
	Uttar Pradesh	4.74	-2.53	5.96	-6.73	-2.46
Kharif Oilseeds	Andhra Pradesh	6.0	-2.6	8.7	-5.3	-2.5
	Gujarat	1.5	3.8	-4.3	7.0	5.5
	Karnataka	6.3	-2.3	8.1	-0.9	-1.0
	Madhya Prd.	15.5	3.3	14.3	9.3	5.8
	Maharashtra	6.3	6.3	5.2	10.1	6.3
	Orissa	-2.9	-2.7	7.7	-15.4	-0.1
	Rajasthan	13.6	6.9	12.7	9.0	9.5
	Tamil Nadu	6.1	-2.5	6.4	-3.4	-1.9
	Uttar Pradesh	-6.1	0.9	-9.8	-1.6	3.8
Rabi Oilseeds	Andhra Pradesh	6.74	0.20	6.64	-3.96	0.53
	Assam	2.30	0.50	4.36	-1.62	1.79
	Bihar	2.57	5.11	2.52	1.17	7.80
	Gujarat	4.36	0.98	-0.40	-2.68	3.42
	Haryana	15.70	1.48	14.80	-1.73	1.34
	Karnataka	7.33	-1.84	10.51	-4.51	-2.83
	Madhya Prd.	7.94	2.74	8.09	1.22	5.77
	Maharashtra	2.23	-5.44	3.14	-4.02	-5.43
	Orissa	-6.09	2.90	4.22	-17.79	4.23
	Rajasthan	14.42	3.18	17.24	3.78	5.34
	Tamil Nadu	4.53	0.32	1.73	-0.29	-1.13
	Uttar Prd.	0.93	-2.23	-4.20	-1.64	-1.92
	West Bengal	10.53	4.52	17.86	-1.57	3.28
Cotton	Andhra Pradesh	4.93	9.45	-1.05	3.85	13.28
	Gujarat	-0.15	10.93	-6.69	10.36	15.88
	Haryana	6.27	4.69	4.63	-1.35	6.44
	Karnataka	3.45	4.42	4.38	0.48	11.03
	Madhya Pradesh	2.39	10.41	2.59	3.97	15.20
	Maharashtra	4.24	7.99	2.86	6.72	11.27
	Punjab	5.35	3.72	9.54	-11.20	3.20
	Rajasthan	6.57	2.08	4.19	1.18	9.43
	Tamil Nadu	3.92	1.95	7.89	-2.63	8.70
Sugarcane	Andhra Pradesh	1.97	-0.37	-1.87	3.09	-1.35
	Bihar	4.10	5.70	4.85	-4.89	10.14
	Gujarat	5.91	0.74	5.01	3.23	-0.04
	Haryana	2.79	-1.26	1.99	-0.12	-2.64
	Karnataka	6.49	1.50	4.97	5.16	3.22
	Maharashtra	2.63	4.26	0.55	4.40	7.09
	Tamil Nadu	4.42	0.64	3.94	4.19	1.52
	UttarPradesh	3.62	0.73	3.53	1.89	0.97
Jute & Mesta	Andhra Pradesh	0.46	0.43	-1.41	1.26	-0.24
	Assam	1.38	0.61	0.20	-0.47	0.44
	Bihar	3.80	3.21	4.61	-3.13	4.96
	Orissa	1.70	0.43	2.69	-8.56	1.30
	West Bengal	3.22	1.43	3.96	1.31	1.07

Appendix Table 3.1A: Area Estimates Based on Growth Trends at All India (Million hectares)

	Rice	Wheat	CC	Cereals	Pulses	Foodgrains	Oilseeds	Cotton	S cane	J&M
Exponential Growth Rate of Past 10 Years										
2015	44.08	31.99	24.20	100.27	24.01	124.28	26.01	13.41	5.13	0.80
2016	44.06	32.52	23.74	100.33	24.23	124.56	26.00	14.03	5.19	0.79
2017	44.04	33.06	23.30	100.41	24.45	124.86	26.00	14.68	5.25	0.78
2020	43.98	34.74	22.03	100.76	25.15	125.91	26.04	16.82	5.44	0.75
2021	43.96	35.32	21.62	100.91	25.40	126.31	26.07	17.60	5.51	0.74
2028	43.83	39.65	18.98	102.46	27.33	129.79	26.45	24.17	5.99	0.67
2029	43.81	40.31	18.63	102.75	27.63	130.38	26.52	25.29	6.06	0.66
2032	43.75	42.36	17.63	103.74	28.59	132.33	26.80	28.97	6.28	0.63
Exponential Growth Rate of Past 15 Years										
2015	44.13	31.92	24.51	100.56	24.01	124.57	26.01	13.27	5.14	0.80
2016	44.16	32.39	24.21	100.76	24.30	125.07	26.36	13.73	5.22	0.78
2017	44.19	32.86	23.92	100.97	24.60	125.58	26.70	14.22	5.29	0.77
2020	44.29	34.32	23.07	101.67	25.54	127.21	27.78	15.77	5.53	0.74
2021	44.32	34.81	22.79	101.92	25.87	127.80	28.16	16.32	5.61	0.72
2028	44.54	38.52	20.94	104.00	28.42	132.43	30.95	20.78	6.20	0.65
2029	44.57	39.08	20.69	104.34	28.83	133.17	31.38	21.51	6.30	0.64
2032	44.67	40.81	19.96	105.44	30.09	135.53	32.70	23.85	6.57	0.61

Appendix Table 3.2A: Area Estimates Based on Growth Trends at state level (Million hectares)

	Rice	Wheat	CC	Cereals	Pulses	Foodgrains	Oilseeds	Cotton	S cane	J&M
Exponential Growth Rate of Past 25 Years										
2015	44.17	31.78	24.92	100.87	23.33	124.20	25.93	13.12	5.15	0.81
2016	44.24	32.10	24.68	101.02	23.12	124.14	26.28	13.44	5.23	0.81
2017	44.31	32.42	24.44	101.18	22.93	124.10	26.65	13.77	5.31	0.80
2020	44.53	33.43	23.79	101.75	22.40	124.16	27.92	14.85	5.57	0.80
2021	44.61	33.78	23.59	101.98	22.25	124.23	28.39	15.24	5.67	0.80
2028	45.25	36.37	22.42	104.04	21.46	125.50	32.45	18.50	6.40	0.79
2029	45.36	36.77	22.28	104.41	21.38	125.79	33.15	19.04	6.52	0.79
2032	45.68	38.00	21.93	105.62	21.21	126.83	35.45	20.84	6.90	0.79
Exponential Growth Rate of Past 35 Years										
2015	44.27	31.76	24.85	100.88	23.50	124.39	26.24	13.06	5.16	0.81
2016	44.44	32.05	24.54	101.04	23.46	124.50	26.92	13.30	5.26	0.81
2017	44.62	32.35	24.24	101.21	23.43	124.64	27.63	13.56	5.36	0.80
2020	45.16	33.27	23.39	101.82	23.37	125.19	30.00	14.38	5.69	0.80
2021	45.35	33.58	23.12	102.05	23.36	125.42	30.87	14.68	5.80	0.80
2028	46.82	35.88	21.48	104.18	23.49	127.67	38.30	17.07	6.70	0.80
2029	47.05	36.23	21.27	104.55	23.54	128.09	39.58	17.46	6.84	0.80
2032	47.77	37.30	20.70	105.77	23.70	129.47	43.79	18.73	7.30	0.80

Appendix Table 3.3A: Area Estimates Based on Three stage Least Square Estimates at All India (Million hectares)

	Rice	Wheat	CC	Cereals	Pulses	Foodgrains	Oilseeds	Cotton	S cane
Exponential Growth Rate Pre Liberalisation									
2015	43.0	29.0	23.9	95.9	24.1	120.0	27.3	!!"# $	4.9
2016	43.4	29.7	23.7	96.8	24.7	121.5	27.7	12.4	5.2
2017	43.6	30.1	23.3	96.9	25.0	122.0	27.8	12.8	5.4
2020	43.8	30.4	21.5	95.7	25.4	121.1	28.2	14.0	5.7
2021	43.7	30.4	20.9	95.0	25.7	120.6	28.3	14.4	5.8
2028	43.0	30.0	16.9	89.8	27.7	117.5	28.9	17.7	6.4
2029	42.8	29.9	16.4	89.2	28.0	117.2	29.0	18.2	6.4
2032	42.4	29.7	15.0	87.2	29.3	116.5	29.3	19.9	6.6
Exponential Growth Rate Post Liberalisation									
2015	43.4	29.4	25.1	97.9	24.1	122.0	27.6	11.7	4.8
2016	44.3	29.8	25.3	99.4	24.8	124.3	28.4	12.4	5.1
2017	45.0	30.2	25.3	100.4	25.3	125.7	28.9	12.9	5.3
2020	46.5	30.8	24.7	102.0	25.8	127.8	30.2	14.5	5.5
2021	46.9	31.0	24.5	102.3	26.0	128.4	30.7	15.0	5.6
2028	49.1	32.0	22.7	103.9	28.7	132.6	35.1	19.7	6.0
2029	49.4	32.1	22.5	104.1	29.2	133.3	35.8	20.5	6.1
2032	50.4	32.6	21.8	104.7	30.9	135.6	38.0	23.0	6.3

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