

FINAL REPORT OF THE WORKING GROUP

ON

**AGRO-CLIMATIC ZONAL PLANNING INCLUDING AGRICULTURE DEVELOPMENT
IN NORTH-EASTERN INDIA**

FOR

XI FIVE YEAR PLAN (2007-12)

Volume I – Main Report

By

**Dr. Panjab Singh
Vice Chancellor
Banaras Hindu University
Varanasi – 211 005**

AGRO-CLIMATIC ZONAL PLANNING INCLUDING AGRICULTURE DEVELOPMENT IN NORTH-EASTERN INDIA

Executive Summary

A Working Group on “Agro-climatic Zonal Planning including Agricultural Development in North Eastern India” was constituted vide the Planning Commission letter No. 11016/4/2005-PC dated 24/01/2006 in the context of formulating Eleventh Five Year Plan (2007-2012), under the Chairmanship of Dr. Panjab Singh, Vice-Chancellor, BHU, Varanasi. The Working Group met on 11th July 2006 for the first time and constituted 5 Sub-Working Groups to look into various aspects related to Agro-Climatic Zonal Planning. It was decided to have a uniform format for report writing by different Sub Working Groups. The reports were to be compiled under the following sections: Introduction, Current status, Present needs, Gaps existing, Priority areas, Infrastructure needs, Linkages with Stakeholders, Funding Requirement and Annexures.

The Working Group met subsequently on August 30, September 30, October 30, November 30 and December 15, 2006, to review the progress made by the various Sub-Working Groups and finalize the report. The Chairmen of the various Sub-Working Groups had conducted meetings of their committees separately to obtain inputs for the report. After detailed discussions on all the items stated in the “Terms of Reference” the report has been prepared.

The “Introduction” describes the background and importance of agro-climatic zonal planning, the earlier developments, present status and its relevance for future planning in India. The section on “Current status” dwells in detail about the present status of agricultural development, programmes under different agencies, progress made in different areas etc. Under the “Present needs”, the developmental activities needed to shore up the falling supplies in various sectors have been narrated. In the next section on “Gaps existing”, the shortfalls in various sectors have been highlighted. They need to be attended to on priority during the next Plan period. The “Priority areas” under different

sectors for agro-climatic zonal planning have been listed under various themes of the Sub-Working Groups. The “Infrastructure needed” to fulfill the requirement specified in the different sectors during the ensuing planning period have also been described in the section earmarked for it. The linkages among the governmental, non-governmental, other developmental agencies and stake holders i.e. farmers, agro-industries, marketing and other agencies involved have been highlighted under the section “Linkages with stakeholders”. The quantum of funds required for carrying out the existing programmes and implementing new programmes proposed under different heads have been highlighted in the “Funding requirements”. Volume I is the main report containing the details of the proposed developmental activities and relevant Annexures. Volume II is the detailed report of each Sub Working Group based on which the main report was compiled.

The Working Group after detailed, in-depth discussions felt that the emphasis has to be laid on acceleration of growth in production and productivity in irrigated and rainfed areas, rapid transfer of technology, crop diversification, post-harvest management and value addition, food and nutritional security across the regions, sustainability of resource endowments, augmentation of the farmer’s income for agricultural development in the various agro-climatic zones for achieving the required agricultural growth rate of 4%. It was further stressed that besides this national emphasis, fine tuning of the same needs to be undertaken at micro-level based on the resource potential of the sub-regions for the targeted growth rate.

Under the agricultural extension, management and functional linkages, it was expressed that a holistic approach is needed for the survey/PRA studies documentation and data-base as basic to scientific extension planning as well as working through organized farmers groups like Self Help Groups (SHGs). It was further felt that participatory approach, involving stakeholders at all levels, women empowerment, recognizing training as another basic function, fine tuning lab to land programmes for small and marginal farmers including agricultural labourers and organic farming in selected pockets for specific commodities are some of the key issues that should be given utmost priority following a systems approach.

Creating non-farm employment opportunities at village level to prevent mass migration to urban areas, stress on energy conserving farming to reduce the reliance on diesel and petrol, making available the extension services at the doorsteps of the farmers and sustenance of farmers' health through nutritious foods are some of the critical areas that need urgent attention. These concerns are paving way for neutra farming and pharma farming which would require a new breed of technocrats to manage the paradigm shift so essential for the second green revolution.

Emphasis has to be on increasing the per hectare productivity of important agri-horti crops in a partnership mode by addressing the issue of non-availability of seed (crops, animal and fishes) and planting materials, amelioration of problematic and degraded soils, cultivating at least 30% of low altitude area under double cropping, increasing irrigation potential, *in situ* farm input generation, agri-mechanization etc.

For achieving the desired growth rate in agriculture, development of infrastructure is absolutely essential like processing units, storage godowns, quality control and value addition units, rural connectivity, information centers and market linkages as well as facilitating the production of high-value low-volume crops including round the year production of ornamental fish and flowers for eradication of poverty and providing improved livelihood options for farmers. Capacity building would be required in selected institutions for faster animal disease diagnosis, vaccine production and storage, developing organic road map and systematically working on it so as to produce complete organic food, particularly in the North Eastern Region.

Value addition at pre-harvest production level, high value crops and other commodities like basmati rice, dicoccum wheat, durum wheat, broccoli etc., and a similar focus on post-harvest/primary processing, proper cleaning, grading and packaging e.g. vegetables, potatoes, fruits etc. and secondary processing like packaging and branding e.g. packed *atta*, *suji*, rice, etc., is needed. High end processing, supply chain management, modern processing technology, packaging of processed foods, branding, marketing e.g. potato

chips, breakfast foods, noodles, macaroni etc. are required to be set up at the sub zonal level.

For encouraging organic farming, benchmarking and documentation, market linkages at the local, national and global level, supporting farmers' groups engaged in organic farming, creating an institute or a centre for training, product certification, regulation and review, awareness and education programmes under value addition, infrastructure and organic farming etc., have also been emphasized.

After taking into consideration the fund allocations during the 10th Five Year Plan, the Working Group proposes the following budgetary requirement under different heads during the 11th Five Year Plan:

Sl.No.	Particulars	Budget Rs. (Crores)
1	Agricultural Development in various Agro-Climatic Zones	51600.00
2	Agricultural Extension, Management and Functional Linkages	6832.00
3	Agricultural Education, Research and Training	9300.00
4	North Eastern Region	1511.25
5	Value Addition, Infrastructure and Organic Farming	4888.90
	Total	74132.70

AGRO-CLIMATIC ZONAL PLANNING INCLUDING AGRICULTURE DEVELOPMENT IN NORTH-EASTERN INDIA

1. BACKGROUND

The Planning Commission constituted 12 Working Groups to prepare the 11th Five Year Plan document on Agriculture. Of the 12 working groups, one Working Group was constituted with the specific objective of preparing a document for Agro-climatic Zonal Planning including Agriculture Development in North-Eastern India. The composition of this Working Group and the Terms of References are given in *Annexure I* and *Annexure II*, respectively.

The Working Group, under the Chairmanship of Dr. Panjab Singh, had its first meeting on 11 July 2006 followed by several meetings subsequently. In the first meeting, it was decided to constitute 5 sub-working groups to prepare the detailed material on the various issues essential for agro-climatic zonal developmental planning. The sub-groups constituted were as follows:

- I. Priorities for Agricultural Development in various Agro-climatic Zones.
Chairman: Dr. N.B.Singh, Agriculture Commissioner, Department of Agriculture & Cooperation, Krishi Bhawan, New Delhi.
- II. Agricultural Extension, Management and Functional Linkages.
Chairman: Dr. C. Prasad, Former DDG (Extn.), ICAR, EB-106, Maya Enclave, New Delhi-110 064.
- III. Human Resources Development.
Chairman: Dr. S.A. Patil, Director, IARI, New Delhi-110012
- IV. North Eastern Region.
Chairman: Dr. S. N. Puri, Vice-Chancellor, Central Agricultural University, P.O. Box-23, Imphal-795 004, Manipur.
- V. Value Addition/Infrastructure/Organic Farming.
Chairman: Dr. Nagendra Sharma, Vice-Chancellor, Sher-e-Kashmir University of Agricultural Sciences & Technology, Jammu.

The sub-working groups met independently and prepared the detailed work plan related to their assigned topic. The composition of sub-working groups is given in *Annexure III*.

The Working Group decided to follow the following format for report writing: Introduction, Current status, Present needs, Gaps existing, Priority areas, Infrastructure needs, Linkages with stakeholders, Funding Requirement and Annexures.

The Interim Report was submitted to the Planning Commission based on which this Final Report has been prepared. It consists of two volumes. Volume I is the main report which gives the details of Agro-Climatic Zonal Planning, while Volume II gives the detailed report submitted by each sub-working group.

2. INTRODUCTION

Green Revolution provided the much needed food security to the vast population of the Indian Nation but in spite of being one of the top producers of almost all agricultural commodities, the productivity is still very low compared to many other countries in the world. The fatigue in the post-green revolution era has now attained serious dimensions. For achieving the required production targets to feed more than 1.5 billion in 2050, it is imperative to develop strategies that can sustain higher levels of production without an adverse affect on the environment. In order to maximize the production from the available resources and prevailing climatic conditions, need-based, location specific technology needs to be generated. Delineation of agro-climatic zones based on soil, water, rainfall, temperature etc. is the first essential step for sustainable production.

Failures of many agricultural developmental projects in various parts of the world were linked with the failure to assess and classify agro-climatic conditions properly. FAO defined an agro-climatic zone (ACZ) as a land unit delineated in terms of major climate and growing period, which is climatically suitable for certain range of crops and cultivars. Agro-climatic conditions mainly refer to soil types, rainfall, temperature and water availability which influence the type of vegetations. Planning Commission (Khanna, 1989) had identified fifteen resource development regions in the country with fourteen regions in the main land and the remaining one in the islands of Bay of Bengal and the Arabian Sea. The main objective was to integrate plans of the agro-climatic regions with the state and national plans to enable policy development based on techno-agro-climatic considerations. In the agro-climatic regional planning, further sub-regionalization was possible based on agro-ecological parameters.

National Agricultural Research Project (NARP) was launched by ICAR for initiating agricultural research in the agro-climatic zones of the country. The objective was to set up or upgrade a zonal research station in each agro-climatic zone for generating location specific, need based research targeted for specific agro-ecological situations. The focus was on analyzing agro-ecological conditions and cropping patterns and come out with a programme directly targeted to solve the major bottle necks of agricultural growth in a zone based on natural resources, major crops, farming systems, production constraints and socio-economic conditions prevalent in that zone. Stress was on technology generation. In NARP, the country was divided into 126 agro-climatic zones. Later on three zones for Andaman & Nicobar Islands and two zones for Pondicherry were added. Agro-climatic zones corresponding to each of the 15 agro-climatic regions as defined by NARP were identified.

The National Bureau of Soil Survey & Land Use Planning (NBSS&LUP) came up with twenty agro-ecological zones based on the growing period as an integrated criteria of effective rainfall, soil groups, delineated boundaries adjusted to district boundaries with a minimal number of regions. Subsequently, these twenty agro-ecological zones were sub-divided into 60 sub-zones.

Over the years a considerable amount of information has been generated through the various programmes in the country related to technologies that can enhance productivity.

It is now imperative to analyze and synthesize the information to identify zone-wise constraints and evolve strategies for future agricultural production.

Agro-Climatic Regional Planning in India (ACRP) is considered as a distinctive planning approach applied to agriculture and allied sectors. It is essentially resource based planning. All other parameters or features associated with ACRP are either derived from this essentiality or are incidental to it. The rationale of this approach stems from the significance of long term resource efficiency (or sustainability).

Obviously, the dimensions of technology and sustainability are integral to resource based planning as technology is a means of utilization of natural resource endowments within the constraints of finance, institutions and social imperatives. In another sense, technology lends an element of dynamism in the changing and more efficient use of land and water resources. The logical corollary of this would imply that in the ultimate analysis ACRP approach seeks to achieve the best trade off between maximization of productive efficiency of given resource endowments through use of appropriate technology and institutions and long term sustainability of such resource use both in the sense of maintaining inter-generational and social equity in the access to resources.

The next important consideration in the ACRP approach is its area specificity. A holistic approach combining area based planning, as against a sectoral or schematic approach, characterizes the ACRP exercise. The inherent assumption is that resource based planning is meaningful only for homogeneous regions with respect to natural resource endowments, specifically agro-climatic factors, in planning for agriculture and allied sectors. The ACRP approach has gone beyond the essential features or dimensions of planning for agriculture and allied sectors with the passage of time. These extensions in the approach hover around the following two considerations:-

- i. Resource based planning, which aims at the best trade off between maximization of productive efficiency and sustainability, should finally be linked to the two intrinsic parameters of national planning namely; income generation and income up-gradation leading to poverty alleviation; and
- ii. Operational feasibility of this approach to be established in relation to the institutional, financial and social parameters as obtained in a specific area or at national level.

As a sequel to the decision taken by the Planning Commission in its meeting held on 20th July, 1987, 15 agro-climatic regions were delineated based on similarity in soil type, climate (temperature & rainfall) and captive water resources in the country to serve as the level of planning. An overview of all the 15 Agro-Climatic Regions so delineated is provided at *Annexure-IV*. A perusal of the same indicates that the maximum geographical area (400.10 lakh ha) lies in the Southern Plateau & Hills Region-X amongst 15 regions in the country. The maximum Gross Cropped Area of 292.90 lakh ha lies in the Western Plateau & Hills Region. The maximum Cropping Intensity of 176% has been realized in Lower Gangetic Plains Region-III (15 districts of West Bengal) followed by Trans-gangetic Plains Region-VI (Delhi, Haryana, Punjab, Chandigarh UT & Siranganagar and Hanumangarh districts of Rajasthan State). The sub-region specific

delineation made by the Planning Commission is also appended at *Annexure-V* in order to reckon the sub-region specific priorities.

As stated earlier, ICAR had launched the National Agricultural Research Project (NARP) with support from the World Bank with a view to generate location specific and need-based technologies based on researches in the specific agro-ecological situations (Ghosh, 1979). In 131 Agro-climatic Zones (ACZ) identified, 120 Zonal Research Stations were strengthened or newly established if non-existent. In absence of adequate resources, even though they are so important, they are dying centres. They are being recommended to be revitalized. The “farming situations” under each ACZ were also delineated, which could be considered for planning of location specific research through NARP as reported by Ghosh. A Status Report for each zone covering information on the natural resources, major crops, farming systems, production constraints and socio-economic conditions prevailing in the zone were prepared by Ghosh (1991). The ACZs for Goa, Daman, Diu, Dadra Nagar Haveli and Lakshadweep were not delineated.

The Indian sub-continent represents a very diverse set of agro-climatic conditions and the North east is one such distinct region which did not receive due attention earlier. The North-Eastern region comprising eight states viz., Assam, Arunachal Pradesh, Meghalaya, Manipur, Mizoram, Nagaland, Tripura and Sikkim has a total geographical area of 262180 km² which is nearly 9.8% of the total area of the country with more than thirty nine million population. About 35% area in the region consists of plains excepting Assam where plains account for 84.44% of its total geographical area. About 1.6 M ha area is under shifting cultivation in NE region and out of 4.0 M ha net sown area of the region, roughly 1.3 M ha suffers from serious soil erosion problem. The region, by and large, is characterized by fragility, marginality, inaccessibility, cultural heterogeneity, ethnicity and rich biodiversity. Rural population is around 82%. In the absence of major industries excepting in the state of Assam, the Society is agrarian and depends on agriculture and allied sectors for livelihood and other support.

The region receives an annual average rainfall of 2000 mm accounting for around 10% (42.50 mham) of the country's total precipitation of 420.00 m ha m. The soil of the region is acidic to strongly acidic in reaction. The low pH of the soil is basically due to the leaching of the bases under influence of high rainfall. The soils are, however, rich in organic matter. The depth of the soil varies from shallow inceptisols to very deep alluvial soils. Total forest cover in the region is 14.2 million ha, which is about 77.1% of the geographical area as against the national average of 19.39%.

Around 56% of the area is under low altitude, 33% mid altitude and the rest under high altitude. Agricultural production system is, by and large, of CDR type. The system is characterized by low cropping intensity (114%), subsistence level and mono-cropping. Average landholding is 2.5 ha compared to national average of 0.69 ha. Although the landholding appears to be higher, the entire holding can not be used for agricultural purposes due to topographical disadvantages. Land use pattern is relatively faulty for which annual loss of top soil is much higher (46 t/ha) than all India average of 16 t/ha. Similarly, due to lack of proper water harvesting measures, only 0.88 mham out of 42.5 mham water is used. There is no reliable assessment of total irrigated area. Records gathered from different sources indicate that around 20.74% area is irrigated out of which

18.78% is through bamboo drip irrigation systems, particularly for less water demanding crops. Fertilizer consumption in the region is also very low and stands at around 11 kg/ha ranging from as low as 2.7 kg/ha in Arunachal Pradesh to as high as 72 kg/ha in Manipur.

Farming is predominantly rice-based with little exception in the state of Sikkim where maize is the dominant crop. Mixed farming system is prevalent as most of the farmers want to produce his food and nutritional requirements without having to depend on outside sources. The system, therefore, supports a large horticulture and animal husbandry based partly due to preference of the population (almost 100% tribal) is for non-vegetarian food. With this production practices, the region produces a total of 5.8 million tonnes of total food grain against a requirement of around 7.40 million tonnes. The deficiency is, therefore, around 1.6 million tonnes of food grain. Similarly, in spite of a desired aptitude towards animal husbandry practices, per capita availability of milk, meat, egg and fish per annum is only 31.53 litres, 9.36 kg, 33.50 and 4.12 kg, respectively.

Agriculture and allied activities are the main source of livelihood for the people of NE region and any attempt to reduce poverty as well as to place the region in developmental paradigm shall have to be based on locally adapted system-wise eco-regional planning of agricultural development with the intervention of Production Company concept. This concept visualizes a company for the farmers - of the farmers and – by the farmers, but run by professionals in rural (or even urban) areas, and the professionals draw their salaries by value addition to the produce of farmers thus creating employment and with potential of complementing with the on-going employment guarantee scheme; taking over all responsibilities of the farmers after a crop is produced and leaving farmers to farm and on farm activities. It may be noted that this concept potentially addresses weaknesses of the co-operative societies. This was discussed in a recent international conference “Reorienting Agricultural Research to meet the Millennium Development Goals” organized by Global Fund for Agricultural Research (GFAR – A body of the United Nations), 9-11 Nov. 2006, New Delhi, India. While planning this, the strength of farming system approach for judicious utilization and conservation of natural resources of the region with concurrent policy and research back up to increase production, value addition to the produce and their disposal sale management, shall be of paramount importance.

In the light of the above scenario, there is a need to formulate need-based policies to support the population dependent on agriculture and allied sectors for their sustainability, and poverty reduction as well as put in place structures for their prosperity.

For regaining agriculture dynamism, reversing deceleration in agriculture growth and there by addressing the problem of rural distress, there is a need to identify important challenges in 11th Plan. From the low level of 1% growth in agriculture in three years of 10th plan we have to achieve 4% growth rate from the farm sector in order to have overall 9% growth rate during the 11th plan. To achieve that, top priority will have to be given to mix of perennial-annuals, non-cereals, cereal crops and from production to processing adding value locally in rural areas so that there is a link for policies such as “Employment Guarantee Scheme”. Hence, a “farm to fork” development strategy must incorporate in it the objective of realizing the maximum benefit to small-holding farmers and rural communities from agriculture sector. Agriculture to industry linkage in the country is still

in its infancy. Value addition and agro-based industry require local interventions manned by professionals, of, for and by the farmers, taking full responsibility of all activities, leaving farmers to farm and on farm activities. Countries like Thailand have achieved value addition of over 25% of their farm produce through such small but farmer-friendly changes. The long supply chain from farmer to consumer is waiting to be harnessed for value, and this is where the right policy supporting the local communities mix can spur growth. Infrastructure and human capital development is also essential for proper value addition. Potential bottlenecks have to be removed. Massive investment in the agri-rural areas for value addition, infrastructure for production, processing, storage, marketing and training of human resources has to be given priority during the 11th plan investment. In recent times organic farming is gaining wide attention among farmers, entrepreneurs, policy makers and agricultural scientists for varied reasons, such as, on-farm production of inputs which minimizes the dependence on purchased inputs (fertilizers, pesticides, herbicides and other agro-chemicals) thus safeguards/improves quality of resources, is environment friendly, labour intensive and provides an opportunity to increase rural employment as well as achieve long term improvements in the quality of resource base.

To accomplish and translate all that is needed for speeding up agricultural growth rate as envisaged by the Planning Commission, Govt. of India, adequate attention has to be paid to Human Resource Development in terms of agricultural education, research, extension and development. In fact, one of the main reasons why “Green Revolution” happened in India but not in many other similarly-placed countries, was the availability of trained manpower in the country which enabled a very rapid transfer of improved technology. There are enough evidences to indicate that agricultural education existed in India even during medieval period. The subject of Agriculture was included in the curricula of Nalanda and Takshila Universities as one of the 18 arts. However, organized courses in agricultural education were started in the beginning of the twentieth century when six agricultural college were established at Kanpur, Lyallpur, Coimbatore and Nagpur in 1905, Pune in 1907 and Sabour (Bihar) in 1908 with diploma programme. The degree programmes, however, were started in early 1920s. The veterinary colleges were started even earlier at Bombay (1886), Calcutta (1893) and Madras (1903). Madras Veterinary College started offering B.V.Sc. Four-year degree programme in 1936, the first in the country. By 1947, there were 17 agricultural Colleges offering degree programme in agriculture under the umbrella of State Departments of Agriculture and Animal Husbandry with sporadic efforts on research and development.

Now with 45 State Agricultural Universities, Deemed-to-be-Universities and Veterinary Universities along with 5 Central Universities and a large number of Agricultural Colleges affiliated to the traditional Universities, the total number of graduates produced from the system is around 21,370 under graduates and 10,000 post-graduates comprising of only 0.57% of the total graduates. This is in contrast to the fact that 65% of the population is dependent on agriculture. They maybe graduates in their area of specialization but do not have the multidimensional knowledge in agriculture, essential to facilitate farmers for optimization of their land resources and their sustainability. Further, there is no curriculum in primary and secondary education on agriculture, biodiversity, animal husbandry, forestry, etc, essential knowledge for the prosperity of agri-rural communities. There is big mismatch between graduates produced and the actual requirement. There is, therefore, an urgent need to rectify this anomaly to reinvigorate the agricultural education, extension and research systems and bring about knowledge and scientific

outlook to agriculture which ultimately culminates in vibrant agriculture with enhanced quality, nutrition, productivity and sustainability.

The basic issues being raised in this zonal planning process are:

1. NARP was a wonderful basic concept towards generating need-based and agro-climatically specific technologies but the Zonal Research Stations in many locations are non-functional institutions in absence of adequate funds after the withdrawal of the World Bank support. They need to be revitalized with adequate funding, provided they focus on farming systems of those areas.
2. The statement that the primary objective of NARP was “technology generation” rather than “technology transfer”, documenting the agro-climatic resources and prevalent conditions received greater consideration in the delineation of the NARP ZONES (Ghosh, 1991). It was felt that probably it was not the correct proposition. as NARP effort was to generate appropriate technologies for effective transfer. This was, perhaps, not clearly understood, which affected the overall outcome and led to generation of inappropriate technologies for many farming situations.
3. The NARP report has also delineated farming situations in each State/Zones, which gave way to ‘farming system research’ and ‘farming system extension’. But the research efforts had focused mainly on cropping systems, perhaps inadvertently. Farming systems should be the future approach of our research endeavours. In the process rainfed agricultural research suffered and did not get the emphasis it deserved.
4. Did the institutions dealing with the agro-climatic zoning and mapping in NARP look into the cost factor or in utilizing the zonal agro-climatic exercises for research as well as extension ?
5. To a lay observer, it may appear that there should have been a uniform and common platform for such a difficult but essential planning exercise incorporating the basic agro-ecological factors as well as the socio-economic factors. But unfortunately, the latter was completely ignored. The research work done in NARP generally did not, by and large, consider pro-poor, pro-women or pro-environmental issues as always highlighted by Prof. M. S. Swaminathan.

3. CURRENT STATUS

3.1. Agricultural development in the various Agro-Climatic Zones

Indian Agriculture has made impressive strides in last five decades. The highest Gross Cropped Area of 190.84 m ha has been realized during 2003-04 registering an increase of about 26.7% over that of quinquennium (1956-1961) average being 150.51 m ha. During this period, food grains production has increased over 4 times from about 51 million tonnes during early fifties to 213.19 million tonnes during 2003-04. The food grains production consisted of 198.28 million tonnes of cereals and 14.91 million tonnes of pulses by 2003-04. It has contributed significantly in achieving self-sufficiency of food in the country. The food grains production in the year 2005-06 is estimated to be of the

order of 208.30 million tonnes which will consist of 195.19 million tonnes of cereals and 13.11 million tonnes of pulses.

The annual production of oilseeds, which was only 5.16 million tonnes during early fifties, has risen to 27.73 million tonnes in the year 2005-06. The annual production of cotton, which was 3.04 million bales during early fifties, has risen to 19.57 million bales in the year 2005-06. Similarly, annual production of sugarcane has risen to a level of 278.39 million tonnes of cane from the level of merely 57.05 million tonnes during early fifties.

Though the overall growth in agriculture sector had been encouraging, the signs of productivity deceleration had started emerging since 90s onwards. It is important to note that the growth during recent past as well as during the last three decades has been attributed to the high cost of farm inputs driven by new agro-technologies. Thereafter, the impact of technology appears to have been less effective. The markets have also not supported creation of a proper incentive environment for the growth in agriculture. The present era of globalization of trade may further usher in new technological opportunities but for that the market and price front have to be congenial.

Increase in agricultural production over time had been achieved by creating enabling infrastructure through public investment and by policy changes affecting agricultural production, marketing, processing and trade. The capital formation in agricultural sector during this period was quite satisfactory and well contributed by public as well as private sources. However, during 80s, public investment in agriculture started declining even though the private investment kept the same pace of growth. Despite this decline, output of agricultural sector showed higher growth compared to the previous three decades. This was made possible by spread of modern technology to wider areas, increasing cropping intensity, crop diversification, increased use of technology enhancing input use driven by market forces and policy support. The decade also witnessed some improvement in terms of trade going in favour of agriculture. During nineties, there was further decline in public sector investment. The pace of technological inputs also slowed down and the prices as well as market ceased to provide the required response. Thus, the annual increased requirement of the high cost of inputs, without a proportionate increase in productivity, reduced farmers' net incomes. The decade also witnessed some improvement in terms of trade going in favour of agriculture. The pace of technological inputs also slowed down and the prices as well as market ceased to provide the required response.

The growth in productivity of all crops was showing declining trend across the regions by the end of 2004-05. Wheat, which is an important constituent of National Food Security, showed a declining trend in productivity. While rice and *ragi* seem to have reached yield plateau after 1992-93. This seems to be a matter of serious concern, especially in view of a growth strategy from globalization and trade angles. The growth in the agriculture sector and non-agriculture sector has been quite modest during 90s. Growth in agriculture after mid-nineties was totally different than before mid-nineties mainly because of three continuous climatically abnormal years at the end of Nineties. The purchased input based crop production and protection system did not yield expected proportionate increase in production (now a well known yield stagnation phenomenon). In

fact, over the years, there has been deterioration in soil quality and increase in serious pest incidences.

The ACRP specific analysis indicates that productivity deceleration in wheat had taken place by the period ending 2003-04 in region II to VI. It is noteworthy that these regions contribute maximum to the production of wheat in the country. Similarly, the productivity deceleration has also been witnessed in rice in region-IV (Bihar and eastern Uttar Pradesh), a region which has vast potential for enhancing the productivity of rice and IX (Western parts of Madhya Pradesh, parts of Vidarbha & Madhya Maharashtra region of Maharashtra and Jhalawar district of Rajasthan). The productivity of maize has also declined in regions I,V, VI,IX and XIV, for the same reasons as in the case of wheat.

Among horticulture crops, annual production of potato has risen to a level of 23.63 million tonnes in the year 2004-05 from the level of 1.66 million tonnes during the period of early fifties. Similarly, the production of onion and other horticultural crops namely coconut, cashewnut, mango, apple, banana, grapes, guava, pine-apple, kinno, lime, orange and vegetable crops has also increased substantially. The highest growth in the area and production has been registered in pine-apple, orange, mosambi, cauli-flower, ginger followed by mango, grapes, lime, tomato and cabbage. This shows great strides on horticultural front but we have to be cautious in sustaining it through eco-friendly crop husbandry so that it does not face the problems being faced by the annual crops. A mix of perennial horticultural crops and annuals on a given farm seems a better option and needs encouragement through policy options.

According to Livestock Census-2003, the total livestock population in the country was 485 million animals compared to 485.4 million animals in 1997 i.e. the numbers are almost at par. The composition of total livestock in the year 2003 indicated that there were 185.2 million of cattle as against 198.8 million in the year 1997 registering a decrease of about 9%. However, the population of adult female cattle had increased to 64.5 million in the year 2003 which was 63.6 million in the year 1997. The population of buffaloes was 97.9 million in the year 2003 as against 89.9 million in the year 1997 registering an increase of 9%. In case of the population of buffaloes also, the population of adult female buffaloes had increased to 51 million in 2003 which was 46.8 million in 1997. The population of sheep and goats increased to 61.5 million and 124.4 million in the year 2003 as against 57.5 million and 122.7 million in the year 2003. The population of poultry has also substantially increased to 489 million birds in the year 2003 as against 347.6 million in 1997.

Some local species of animals are indeed high yielding. These species should be promoted as a policy matter because these are locally adapted. Bovine animals in particular, have a great economic value even when they stop producing milk (Dry dairy). This is because of their ability to convert essentially low-value grasses and crop residues into a high value cow-dung rich in beneficial microorganisms. Such cattle are of value in organic farming. Keeping this in mind, dry dairy should be encouraged and data on dry dairy should be collected.

The production of milk has increased to 91 million tonnes in the year 2004-05 which was 38.8 million tonnes in the year 1983-84 registering an increase of 135% over a period of 22 years. Similarly production of eggs has increased to 41 billion eggs in the year 2004-05 as against 12.8 billion eggs in the year 1983-84 registering an impressive increase of 220% over a period of 22 years. The production of wool increased to 50 million kgs in the year 2004-05 as against 36.1 million kgs in the year 1983-84 registering an increase of 39% over a period of 22 years. The production of fish has increased to 6.39 million tonnes in the year 2003-04 which was 0.752 million tonnes in the year 1950-51.

Thus, it is amply clear that spectacular growth had been witnessed in agriculture and allied sectors due to the green revolution technologies which has shown sluggishness over the last decade (phenomenon of farmers' suicides and thus, the early signs of stress is that old - at least in some areas). In other words, growth has not been steady through out and needs a correction long overdue.

3.2. Agricultural Extension, Management and Functional Linkages

It may sound almost impossible to believe but unfortunately, the country does not have a National Agricultural Extension System in the country. In USA in 1914 as per Smith Liver Act, the Cooperative Extension Work was established and till date this system remains the same, though, many extension projects and designs evolved and disappeared. In India, we went by extension projects (CD, AES, IADP, IAAP, HYVP and T&V) one after another for agricultural development, not by a lasting and stable extension system. After T&V of the World Bank was withdrawn in 1993, virtually no extension system exists; it has been now left in the hands of states by and large. Most of the earlier projects were foreign supported. Thus, we never developed a strong programme of our own and hence, this growing crisis today. The sub-group recommends drastic changes for effective extension education system in the country.

There are conceptual differences between Agricultural Extension in the Ministry of Agriculture (MOA) and the one that exists in ICAR. Extension is basically an educational design better known as extension education. This being a basic and universal phenomenon, it is applied in all transfer of technology (TOT) projects/programmes, whether agricultural or industrial. It is named accordingly: Agricultural Extension (to be accurate – Agricultural Extension Education) or Veterinary Extension or Veterinary Extension Education. However, the extension being promoted in the ICAR system including SAUs (State Agricultural Universities) is, unwittingly, termed as extension education, whereas the extension is being done by the MOA and the States is termed as extension services, the latter typifies the mechanical manner of transferring technologies, not the educational approach.

3.3. Human Resource Development

All major states of the country have now been brought under Agricultural University System and currently there are 34 Agricultural Universities, 4 ICAR based Deemed Universities, 7 Veterinary Universities, 5 Central Universities with agricultural faculty, 200 Agricultural Colleges and traditional Universities with a total intake capacity of 21,370 for undergraduate programme and 10,000 M.Sc and Ph.D (Postgraduate) capacities.

The total number of educated and trained personnel in the agricultural sector is far low vis-à-vis the magnitude of agricultural sector. Yet the unemployment rate is also quite high among them owing to mismatch between the demand and the specifically trained personnel. There is a need to revise the course curricula right from the primary and secondary schools onward to suit the need of this sector. Further, there is a need to restructure education in Agricultural Universities to produce General Practitioners (GPs) on the lines of medical system, in addition to the present focus on generating specialists (breeders, entomologists, pathologists, etc) so that they facilitate farmers to optimize their resources and achieve sustainability and ultimately prosperity. Articulating science to traditional knowledge of farmers is long felt need and the GPs can address that more efficiently. At least one university in Germany has started a Ph.D. program in 'organic farming' and this again signifies the need of GPs.

3.4. North East Region

This is one of the 12 mega bio-diversity hot spot areas with abundant natural resources. There are vast areas of forest land, water bodies, indigenous germless and orchids, medicinal and aromatic and dye plants, bamboo resources, livestock, aquatic germplasms. These are not utilized effectively so far. Continued negligence may nullify these advantages over the time due to indiscriminate tapping.

3.5. Value Addition, Infrastructure and Organic Farming

Despite being a major producer of many crops, there is very little attention in value addition to the agricultural, livestock and horticultural produces leading lower market values, low returns. The present facilities for value addition are quite meagre and far below the desired level. There is a vast scope for value addition. Countries like Thailand have achieved value addition to over 25% of their farm produce through small subtle changes in their policies that are farmer-friendly and allow value addition in rural areas resulting in employment generation for agri-sector. Lack of appropriate policies and infrastructure is the major handicap in many areas and commodities for dismal scenario in value addition. The organic farming is emerging as a big way of agricultural production due to environmental concerns and booming market for organically produced agricultural produces. States like North Eastern States, Uttaranchal, Jharkhand have natural advantages for organic farming due to their geographical locations.

4. PRESENT NEEDS

4.1. Agricultural development in the various Agro-Climatic Zones

In so far as demand of food articles is concerned, it depends on the growth of population, income per capita, distribution of income, elasticity of demand for food (price & income and other requirements. Among twin forces, an increase in the growth rate of population leads to a direct increase in the growth rate of total demand for food while growth in per capita income increases rate of growth of demand for food grains albeit at lower rate. The rapid growth in population in the country results in rapid growth in demand for food

grains. It has been observed from the demand estimates that if the country has to be self-sufficient in food grains production, the growth rate of domestic demand output should henceforth accelerate to 3.5 to 4% per annum from the level of 2.7% per annum achieved during the period from 1949-50 to 1989-90. The annual growth rate of food grains production was 2.67% during 1967-68 to 1995-96. It was 2.86% during the period from 1980-81 to 1995-96 and 1.7% during the period from 1990-91 to 1996-97. These figures reveal that incremental output per must be more than what the country realizes. Therefore, there should be need of additional production of food grains to meet the growing demand by the year:2010 from the present level of 195.44 (TE:2004-05). The demand of agricultural commodities on long by term basis by the period ending 2020 has been estimated as under (Table 1).

Table 1. Demand for agricultural commodities.

Commodity	Level of Production by TE:1998-99			Demand by the Year:2020 (million tonnes)		Targeted Yield (kg/ha)	
	Area (million ha)	Production (million tonnes)	Yield (kg/ha)	LIG	HIG	LIG	HIG
Rice	42.2	85.7	1903	112.4	111.9	2664	2652
Wheat	26.2	69.1	2582	82.3	79.9	3137	3045
Coarse cereals	30.7	30.4	1041	38.9	37.3	1268	1214
Cereals	99.1	185.2	1814	233.6	229.0	2357	2311
Pulses	21.7	13.8	608	22.3	23.8	1029	1095
Foodgrains	120.8	199.0	1595	255.9	252.8	2119	2092
Edible oils	28.6	6.4	269	10.8	11.4	380	399
Potato	1.2	21.6	17188	27.8	30.6	22279	24566
Vegetables	5.3	74.5	14204	135.6	168.0	25673	31812
Fruits	3.2	43.0	13437	77.0	93.6	24064	29259
Sugarcane (Gur)	3.7	26.9	7006	32.6	33.7	8788	9088
Milk	-	71.2	-	115.8	137.3	-	-
Meat	-	5.0	-	8.8	11.4	-	-
Eggs (in numbers)	-	2873	-	7750.0	10000.0	-	-
Fish	-	5.3	-	10.1	12.8	-	-

**The above demand estimates includes exportable surplus of 4.7 million tonnes of rice, 3.6 million tonnes of whea, 2.2 million tonnes of vegetables, 1.4 million tonnes of fruits and 0.49 million tonnes of fish.*

Source: R. S. Paroda & Praduman Kumar (2000): Food Production and Demand in South Asia. Agril. Econ. Res. Rev. 13 (1):1-24.

LIG: Low Income Growth (3.5% per capita GDP Growth);

HIG: High Income Growth (5.5% per capita GDP Growth);

Primarily agriculture and allied sectors need be a viable proposition in terms of profitability, employment opportunities and utility. The rising cost of inputs has affected all the sectors of economy, as commensurate rise in the procurement price of agricultural commodities has not been feasible. The fluctuation in the productivity due to aberrant weather conditions, climate change and soil/system fatigue need be addressed to make agriculture a viable proposition. Besides, improved agricultural technology, irrigation, timely supply of electricity livestock sector and literacy are the most important instruments for improving the productivity and nutritional security of the farm-households. There is a need to improve the efficiency of delivery systems for agriculture development by empowering the local elected institutions. Education, skill development, livestock, irrigation, diversification, rural infrastructure and credit support have tremendous impact on productivity. Science-led knowledge based productivity growth need special attention in future. Several ecological problems have cropped-up as a result of past growth sources. These emerging threats in the irrigated agriculture systems call for greater emphasis on research supported by extension, infrastructure and education. Over-irrigation and alarming rates of groundwater depletion have been causing land degradation and other environmental problems. Introduction of water-saving technologies and establishment of secure water rights to users, the decentralisation and privatisation of water management functions up to certain appropriate levels, pricing reforms, markets in tradable property rights may help in enhancing the productivity. Higher investment in education and skill development in low-growth areas will accelerate growth. Thus, the present needs are:-

- Acceleration of growth in production & productivity in irrigated and rainfed areas by ensuring that states have farmers-friendly agricultural policies;
- More support for generating farmer-friendly agro-technologies and their transfer;
- Crop diversification by enhancing legumes and perennial horticultural trees (will provide biomass) on a field to address soil-health issues;
- Post-harvest management and value addition;
- Food & nutritional security across the regions;
- Sustainability of resource endowments;
- Augmentation of the farmer's income and enhancing their purchasing power by providing funds to farmers' groups (and not to individual farmers – because it results in social stigma particularly for defaulters) through concepts such as PC, explained earlier.

The above issues will be addressed adopting a paradigm shift as explained below:-

- **Arresting deceleration of Total Factor Productivity (TFP):**

- o Natural resource management embracing soil & water management and Integrated Plant Nutrition System (IPNS);
- o Augmentation of irrigated potential;
- o Delineation of potential areas;
- o Focussed development of rainfed ecosystems;
- o Focus on Transfer of Technology (TOT) measures;
- o Enhancement of Seed Replacement Rates (SRRs);
- o Increased investment in agriculture research, education and infrastructures;

- o Increased investment in horticulture crops namely; fruits, vegetables, spices; plantation crops, medicinal plants; aromatic plants; and floriculture; and,
- o Increased investment for livestock production including preservation, improvement of stocks, dairy development, poultry/duck development, development of inland & marine fisheries.

- **Enhancing farmers' income:**

- o Diversification of agriculture;
- o Post harvest management and value addition;
- o Development of subsidiary enterprises in rural areas; and
- o Agriculture Insurance;

4.2. Agricultural Extension, Management and Functional Linkages

Time and again, Sub-Working Groups of the Planning Commission have questioned the KVKs being run in the ICAR - a research system. In the past, the Parliamentary Committee has suggested re-structuring the national extension set-up. A study on the KVKs (Prasad, 2000) stated: "when the KVK system reaches the 500 plus KVK mark, its management has to be critically thought of by the ICAR/Ministry of Agriculture". Perhaps, it may need an independent management structure. One may contemplate integrating and reorganizing the Extension Division of the ICAR and the Directorate of Extension of the Ministry of Agriculture as a long-term viable strategy. Some other alternatives can also be considered.

4.3. Human Resource Development

The present graduates and post-graduates who are coming out from the University are mostly absorbed in agricultural universities which are present in each state; ICAR institutes, line departments in the state namely Agriculture, Veterinary, Horticulture, Engineering, Home Science, Fisheries and Forestry etc. Except veterinary service, only 25% of graduates/post graduates get these secured employment. Another 25% of the graduates go to private seed/fertilizer/pesticide companies and banks etc. However, 50% or even more go to non professional jobs, viz. Central Civil Services, State Civil Services, Indian Forest Service and Police Service, Income tax, Excise Co-operatives, State Transport and Railways etc. The university and ICAR system (NARS) has responsibility to the extent of higher education, research and Pilot extension through KVKs. However, the dimension of the society requirement are changing so fast that the contents of the agriculture degrees which are being taught are not in a position to meet the changing situations in agriculture and most focus on basic and academic side but the requirement of the farming community and also the society is towards applied side and, that to, in newer fields like biotechnology, nano-technology, business management, contract, cooperative and corporate farming, seed production, high-tech horticulture, post harvest technology and value addition, agri-business and marketing, WTO and export, patenting and farmers rights etc. There is no proper human resource available with required skills which otherwise is very much required to enhance the capability of the farmers for not only increasing the productivity but also the quality, marketing and value addition which

are very much required to increase the income level of the farmers. A new, holistic and pragmatic approach utilizing a new breed of technocrats and skilled manpower to handle these issues in agriculture is called for.

4.4. North Eastern Region

The North Eastern Region has special needs for the development of agriculture and allied sectors. There is a need for development of agro-ecological zone specific farming and production systems to increase agricultural production by 2-3 folds through input maximization. Emphasis on extensive organic farming under upland ecosystem, mechanization of hill agriculture for increasing production and reducing drudgery, rain water conservation management, agro-forestry intervention particularly in classified waste lands/marshy lands and permanent fallow. Conservation and utilization of bio-resources through conventional and biotechnological innervations; development of apiculture and floriculture, post harvest processing, value addition and export/domestic market tapping, ITKs for validation and utilization, ornamental fish farming is needed to attract the youth through industrial approach to agri-horti-animal-fish sector.

4.5. Value Addition, Infrastructure and Organic Farming

Conventional production system has resulted in deceleration in Agriculture Production. Many issues related to rainfed agriculture have not been given due attention. Diversification in agriculture production system has become imperative for improving the production/productivity as well as the income of the farmers but it is still not clear how this mantra of diversification is to be implemented and in which form and for which commodity. If we want to come out of agriculture production saturation point the real challenge of risk minimization, however, comes through high value agriculture like fruits and vegetables, dairy, livestock, and fishery. In India today, this kind of high value agriculture already contributes towards 45% of the total agriculture revenue. But the powers that be in the agriculture sector are still infatuated with food grains. The high value agriculture sector is highly perishable in nature and requires fast moving infrastructure and innovative institutions to link the farmers with the processors and the consumers. Value addition provides high returns to farmers, safe longer transport, high returns from export and marketing period for perishable commodities. This would help not only in the production of value added products either at production level or at processing level but also open new marketing and consumerism mechanism either for domestic market or export. There is a need, therefore,

- To adopt low-cost and biological approach of farm production, which is economical for the farmers, because inputs are generated on-farm, products of organic farming command premium price. With increase in production, premiums will level out, but the market size will increase. Therefore, promotion should focus on reduced cost of production and sustainable productivity.
- To grow the products which are free of contaminants like pesticides and heavy metal residues.
- To recycle biomass (weed, crops, trees etc.) farm waste compost through composting for supplementing nutrients which besides will reduce the weeds growth due to incorporation of plant biomass as a surface mulch.

- To apply nitrogen nutrient through compost, bio-fertilizers/liquid manures/ Vermi-vash to the crop at any stage of growth and thus eliminate the application of nitrogen produced through synthetic source.
- To devise/refine various crop production technologies under organic farming and encouraging natural enemies of crop pests for minimizing dependence on pesticides etc.
- In-situ biomass production and conservation strategies based on knowledge and experience.
- Value addition of the biomass to potentially meet crop nutrient needs, can be achieved through:
 - Encouraging use of traditional knowledge items known to contain agriculturally beneficial micro-organisms.
 - Market availability of high quality microbial inoculants found wanting in farmers fields.
 - In-situ production of botanicals to address the need of protecting crops and producing biomass e.g *Gliricidia* and neem etc. on field bunds, will overcome the problem of shortage of FYM. Dilute slurry of cow dung and urine that are reported rich in beneficial microorganisms after fermentation of 2-3 days can serve as low-cost inoculants. More research on such farmer-empowering topics is needed.
 - To build institutional support for better organic farming research through developing need based technologies and capacity building of manpower from Scientist to farmers Chain.
 - To develop efficient monitoring mechanism, so that the overall goal for realizing qualitative eco-friendly and vertical crop production is achieved.

5. GAPS EXISTING

5.1. Agricultural development in various agro-climatic zones

There are several region specific gaps, which limit the opportunity of realizing full yield potential of the crops/livestock/fish potential (Table 2).

Table 2. Existing yield gaps of major cereals, oilseeds and cotton crops

Crop	Percent yield gap	
	Between Improved Practices <u>versus</u> Farmers Practices	Improved Practices <u>versus</u> State average yield
Wheat	5 – 39%	6-652%
Rice	6 -134%	35-286%
Barley	13-35%	30-149%
Jowar	23-213%	13-219%
Mustard	10-207%	5-155%
Soybean	16-32%	7-185%
Sugarcane	10-51%	16-167%

These gaps have basically emanated due to ecological distortions i.e., soil & water, climate, availability of inputs particularly certified/quality seeds of improved varieties and imbalanced use of fertilizers across the regions. The most critical region specific gaps, which are responsible for deceleration in the productivity of agriculture and horticulture sector in particular and allied sectors in general, are presented below (Table 3).

Table 3. Region Specific Factors for deceleration in Productivity

Agro-Climatic Region	States / Parts of States	Region Specific Constraints
Western Himalayan Region-I	J & K, H.P., Uttarakhand	Severe soil erosion, degradation due to heavy rainfall/floods and deforestation, low SRRs, poor road, poor input delivery and inadequate communication infrastructure and marketing
Eastern Himalayan Region-II	Assam, N.E. States, Sikkim	Al. toxicity and soil acidity, Soil erosion and floods, shifting cultivation, low SRRs, non availability of electricity, poor road, poor input delivery system and communication infrastructure.
Lower and Middle Gangetic Plains Regions-III & IV	West Bengal, Bihar, Eastern UP	Flood/ water logging, improper drainage, Salinity/alkalinity, Arsenic contamination, low SRRs, non availability of electricity, high population growth, poor road and communication infrastructure.
Upper and Trans-gangetic Plains Region-V & VI	Western U.P., Punjab, Haryana	Groundwater depletion, decreasing total factor productivity, micronutrient deficiency, non-availability of electricity and high population density.
Eastern Plateau & Hills Region-VII	Orissa, Jharkhand, Chattisgarh	Moisture stress, drought and Soil acidity, Iron toxicity, low SRRs, non availability of electricity, high population growth, poor road, poor Input delivery and communication infrastructure.
Central, Western and Southern Plateau and Hills Regions-VIII, IX & X.	Bundelkhand (in U.P & MP), parts of Rajasthan, Maharashtra, AP, Karnataka & Tamil Nadu	Drought, moisture stress, Soil crusting & cracking, soil salinity / alkalinity, low SRRs
East & West Coast Plains & Ghats Region-XI & XII.	Pondicherry, Coastal area of Orissa, AP, TN and Kerala, Goa, parts of Karnataka & Maharashtra	Poor water management, Poor nutritional status of soil, saline lands
Gujarat Plains & Hills & Western Dry Region Regions-XIII & XIV.	Gujarat, D&N Haveli, Daman & Diu, North Western Rajasthan	Aridity, Frequent drought, moisture stress poor soil, habitation of desert
The Islands Region-XV	Andaman & Nicobar, Lakshadweep	Soil salinity & acidity, frequent cyclones, low SRRs, poor road and communication infrastructure.

5.2. Agricultural Extension, Management and Functional Linkages

The Land to Lab programmes and the SC/ST Operational Research Projects of the ICAR were very successful for poorer sections of the farming communities, but could not be continued for long. The KVKs, besides functioning for last 30 years, continue to be under Plan Scheme— they die or survive every five years. The KVKs are successful rural institutions—they must be converted into a non-plan item after successfully working for the initial 10 years. The Trainers Training Centres (8) with the specialized ICAR research institutions have been closed lately, in a situation where training is considered as a strong mechanism for TOT the world over. There are 543 KVKs in the country today, and very shortly they will be 600 – one in each district. The management of such a big scheme should be the concern of the ICAR/ GOI. It would demand an independent set-up to administer it effectively and efficiently. Lately NGOs have been discouraged in running the KVKs, because they must have their own lands (25-50 acres) which should be mortgaged to the ICAR. Even land (50 acres or so) being leased by the State Govt. to good NGOs/ Institutions has been ignored. It has been easier to dump KVKs in the SAUs— all eggs in the similar baskets. Even core resources available to KVKs by the ICAR are not totally available to the KVKs — they are being diverted by major institutions for salaries etc.; and the KVKs are also becoming government institutions depending totally on ICAR resources, whereas they could generate additional resources from outside agencies through productive projects. These issues require serious considerations.

5.3. Human Resource Development

Non availability of suitably qualified personnel who can work with the farming community in their area, enterprise based skilled personnel, lack of Institutes for monitoring the personnel requirement and management, lack of auxiliary personnel to cater to the generalized needs of agriculture, horticulture, animal husbandry, fisheries, lack of training for teachers, researchers and extension personnel are some of the major gaps at present.

5.4. North Eastern Region

Because of lack of attention and prolonged unchecked exploitation, there is a danger of extinction of valuable bio-resources, larger areas being barren/degraded due to shifting cultivation, gradual replacement of ecosystem people by ecological refugees, danger of loosing biodiversity due to germplasm piracy on account of international boundaries and people loosing interest in agriculture sector due to poor productivity and resultant poverty. Suitable measures are necessary to arrest these.

5.5. Value Addition, Infrastructure and Organic Farming

As the markets are opening up for exchange of commodities across the borders, there is a stiff competition in the market for all agro based commodities. At present there are no mechanisms for quality control, certification and marketing. Besides, there are no sufficient facilities and infrastructure for under taking value addition at different levels.

The spurt in demand for organic products is not being fully exploited due to lack of production technologies, lack of awareness and quality assurance mechanisms.

6. PRIORITY AREAS

6.1. Agricultural development in the various Agro-Climatic Zones

The Common Priorities across the regions are

- Judicious use of natural resource potential for resource endowment ;
- Enhancement of Seed Replacement Rates (SRRs) ;
- Adoption of Integrated Plant Nutrition System (IPNS) embracing judicious use of secondary & micro-nutrients ;
- Green manuring and crop residue management for sustained productivity;
- Greater emphasis on non-monitory inputs ;
- Revival of agriculture extension system and Transfer of Technology (TOT) modules ;
- Land leveling through laser levelers;
- Strengthening of rural electrification for farm sector ;
- Lowering interest rates for agricultural credit;
- Integrated Pest Management (IPM) with greater emphasis on Bio-pesticides / Bio-agents ;
- Use of Micro-irrigation methods for efficient water management;
- Enhancing farm mechanization;
- Strengthening of crop insurance programmes;
- Strengthening and improving the Input Quality Control System;
- Cultivation of export oriented crops;
- Post-harvest management and value addition technologies;
- Agro-forestry and pasture management;
- Introduction of cross-bred animals;
- Animal health care; and
- Adequate emphasis on fodder production.

In addition there are several zone specific priorities which need to be looked into for overall development are as follows:

I. Western Himalayan Region - I (J & K, HP & Uttarakhand).

(1) Typology :

- Fragile Eco system prone to soil erosion
- Low land productivity; and

(2) Potential Crops, Fruits & Livestock:

(2.1) Agricultural Crops: Maize, *Basmati* rice, baby corn, *Ragi*, *foxtail millet*, *barnyard millet*, wheat, barley & *Rajmash* (French bean pulse type).

(2.2) Horticultural crops: Potato, cauliflower, parsley, lettuce, chinese cabbage, cauliflower, turnips, carrot, radish, mushrooms, *Kala jeera*, saffron, medicinal plants (*Kuth*, Kuroo & Himalayan Yew), Aromatic plants (*Dioscorea*, *Banafsha*, Lavender, *Brahmi*, *Harad*, seabuck thorn, cedar wood).

(2.3) Fruit crops: Apple, cherry, strawberry, peach, plum, kiwi, apricot, almond & walnut.

(2.4) Livestock & others: Yak, Sheep, Horses, Rabbits, Mules, Turkey, Quail & bee-keeping.

(3) Farming Systems

- Wheat based cropping system;
- Sheep/Yak/Quail/turkey/horse/Mules rearing; and
- Temperate horticulture.

(4) Cropping sequences

- Rice-wheat / potato ; maize + *Rajmash* – potato - green gram.

(5) Sub-region specific development related priorities:

(5.1) High altitude temperate sub-region-1:

- Promotion of plastic culture;
- Rational use of land resources;
- Adoption of “Integrated Farming System” with emphasis on temperate fruits and vegetable crops;
- Development of meadows;
- Promotion of micro-irrigation methods;
- Promotion of farm mechanization; and
- Development of marketing infrastructure.

(5.2) Hill temperate-2:

- Integrated Water Management with emphasis on soil and water conservation programmes ;
- Promotion of plastic culture in high hills ;
- Rational use of land resources;
- Development of pastures;
- Adoption of “Integrated Farming System” with emphasis on fruit and vegetable crops ;
- Promotion of micro-irrigation methods;
- Promotion of farm mechanization; and
- Development of marketing infrastructure.

(5.3) Valley Temperate-3:

- Rational use of land resources;
- Integrated Water Management with emphasis on soil and water conservation programmes ;
- Promotion of micro- irrigation methods ;
- Amelioration of soil acidity ;
- Promotion of plastic culture in hills ;
- Promotion of farm implements;
- Adoption of “Integrated Farming System” with emphasis fruit and vegetable crops.

(5.4) Sub-tropical region-4:

- Rational use of land resources;
- Integrated Water Management ;
- Promotion of micro- irrigation methods ;
- Promotion of plastic culture in high hills ;
- Amelioration of soil acidity ;
- Promotion of farm implements;
- Adoption of “Integrated Farming System” with emphasis on horticulture crops; and
- Strengthening of agriculture/horticulture/livestock extension system.

(6) Research priorities:

- Integrated Farming Systems;
- Delineation & mapping of multi-nutrient deficiency;
- Watershed management;
- Breeding of acid tolerant/cold resistant cultivars of crops;
- Development of Improved farm machinery; and
- Post-harvest Technology.

II. Eastern Himalayan Region - II

Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Tripura, Sikkim and 3 districts of West Bengal.

(1) Typology :

- Fragile land;
- Low productivity ; and
- Fragile ecology prone to soil erosion with low level of irrigation & recurrent floods.

(2) Potential crops, fruits & Livestock :

(2.1) Agricultural crops: Rice (*kala joha*), *Rabi* maize, rape seed & mustard and pulses.

(2.2) Horticultural crops: Potato, ginger, cauliflower, cabbage, mushrooms, turmeric, Black pepper, cardamom, medicinal &

aromatics (Cinchona, *Chiryata*, Himalayan Yew, *Bhumi aonla* & *Tejpat*) & ornamentals(orchids).

(2.3) Fruit crops: Orange, lemon, banana, *Kagzi* lime, pine apple, papaya & cherry.

(2.4) Plantation crops: Tea.

(2.5) Livestock & others: Mithun, Pigs, poultry, seri-culture & bee-keeping.

(3) Farming systems :

- Rice based cropping system;
- Pig/Mithun rearing;
- Poultry; and
- Fisheries

(4) Cropping sequences :

- Rice– Wheat / *Rabi* maize -Jute ;
- Rice-Potato –Jute ; and
- Rice-pulses/ Oilseeds.

(5) Sub-region specific development related priorities:

(5.1) Himalayan Hills-1:

- Integrated Water Management ;
- Promotion of plastic culture in high hills;
- Rational use of land resources;
- Development of meadows;
- Adoption of “Integrated Farming System” with emphasis on livestock and horticulture ;
- Promotion of micro-irrigation methods;
- Promotion of farm mechanization; and
- Development of marketing infrastructure.

(5.2) North east Hills-2 & Southern Hills:

- Comprehensive plan for soil conservation and introduction of terraced cultivation in the hills ;
- Substitution of *jhum* system with settled cultivation in conjunction with land reforms and extension methods ;
- Amelioration of acidic soils;
- Promotion of farm implements;
- Adoption of Integrated Farming System with emphasis on the livestock, forestry and horticulture ; and
- Development of marketing infrastructure.

(5.3) Lower Brahmaputra-4 & Upper Brahmaputra-5:

- Management of *Rabi* fallows;
- Crop management in flood prone areas;
- Harnessing ground water potential in valley and *In situ* water harvesting;
- Amelioration of Boron deficiency and Iron toxicity;
- Amelioration of acidic soils;
- Promotion of farm implements; and
- Adoption of Integrated Farming System with emphasis on livestock, forestry and horticulture ;

(6) Research priorities.

- Watershed management;
- Delineation & mapping of multi-nutrient deficiency;
- Breeding of acidity tolerant/cold resistant cultivars of crops;
- Integrated Farming System;
- Alternative to *jhum* cultivation;
- Post-harvest technology;
- Development of Improved farm machinery.

III. Lower Gangetic Plains Region – III: 15 Districts of West Bengal.

(1) Typology :

- Rich water and soil resources ; and
- Low productivity level and high population pressure beyond carrying capacity.

(2) Potential Crops, fruits & Livestock :

(2.1) Agriculture crops: *Boro* rice, *Rabi* maize, Jute, rape seed & mustard.

(2.2) Horticulture crops: Potato, brinjal, tomato, sweet pea, black pepper, onion, cucurbits, chillies, mushrooms, water chestnut, beetle vine, flowers (Dahlia, tuberose, marigold) and medicinal & aromatics (*Kalmeg*, chinchona, bael & *Neem*).

(2.3) Fruit crops: Litchi, mango & guava.

(2.4) Livestock & others: Cattle, goats, sheep, poultry , bee-keeping & fisheries.

(3) Farming systems :

- Rice based cropping system;
- Buffaloe rearing;
- *Hilsa* fish culture;
- Black Bengal goat rearing; and
- Garol sheep rearing.

(4) Cropping sequences:

- Rice-potato-Jute ;
- Rice-wheat-Jute ;
- Rice-vegetables-summer rice / jute ; and
- Rice-oilseeds-pulses / jute

(5) Sub-region specific development related priorities:

(5.1) Barind plains-1:

- Water harvesting and Recycling ;
- Amelioration of Boron deficiency and Iron Toxicity;
- Amelioration of Iron deficiency;
- Emphasis on *Rabi* maize, Boro rice and hybrid rice cultivation;
- Adoption of Integrated Plant Nutrition System (IPNS);
- Adoption of Integrated Farming System with the emphasis on crops, livestock and fisheries;
- Improvement of Drainage system; and
- Promotion of farm implements.

(5.2) Central alluvial Plains-2 & Alluvial coastal saline Plains-3:

- Reclamation of soil salinity in coastal areas and soil acidity in lateritic soils ;
- Conjunctive use of canal and ground water.
- Adoption of Integrated Plant Nutrition System (IPNS);
- Adoption of Integrated Farming System with the emphasis on crops and livestock;
- Improvement of Drainage system;
- Promotion of farm implements ; and
- Promotion of rice hybrids; and
- Crop management in flood prone areas.

(5.3) Rarh Plains-4:

- Strengthening of tanks for effective water harvesting ;
- Amelioration of Boron deficiency and Iron toxicity;
- Emphasis on *Rabi* maize, boro rice and hybrid rice cultivation;
- Adoption of Integrated Plant Nutrition System (IPNS);
- Adoption of Integrated Farming System with emphasis on crops, livestock and fisheries;
- Strengthening of Drainage system;
- Promotion of farm implements ; and

(6). Research priorities:

- Delineation & mapping of multi-nutrient deficiency;
- Efficient Nutrient & water management;
- Development of heat / salinity/arsenic tolerant cultivars; and
- Farm mechanization.

IV. Middle Gangetic Plains Region – IV: 23 Districts of Eastern Uttar Pradesh and 37 Districts of Bihar

(1) Typology :

- Rich soil and water resources ;
- Low productivity level due to mono-cropping of rice on large area; and
- Deteriorating land quality

(2) Potential Crops, fruits & Livestock :

(2.1) Agriculture crops: Rice, wheat, *rabi* maize, pigeon pea, green gram, black gram, lentil & sugarcane.

(2.2) Horticulture crops: Potato, banana, brinjal, okra, tomato, sweet pea, onion, cucurbits, colocasia, flowering plants (marigold & gladiolus), medicinal & aromatics (*Safed musli, Makoy, Berberis spp; Gloe, bael, lemon grass, Khus, Neem & mentha*), *Makhana, Singhada*, and beetle vine.

(2.3) Fruit crops: Litchi, papaya, mango, guava and *Jamun*.

(2.4) Livestock & others: Cattle, goats & poultry.

(3) Farming systems :

- Rice based cropping system;
- Poultry;
- Fishery; and
- Dairy.

(4) Cropping sequences :

(a) Low lying areas :

- Maize-potato-*boro* rice
- Rice-early potato-timely sown wheat-summer green gram;
- Rice-potato + *Rabi* maize- fallow ;
- Rice-*Toria*-sugarcane-sugarcane ratoon-wheat ; and
- Maize-mustard-summer rice.

(b) Uplands :

- Fodder *Jowar*-potato-wheat ;
- Maize + black gram -wheat-summer green gram ; and
- Maize - *Toria* – potato – *Jute*.

(5) Sub-region specific development related priorities:

(5.1) North-west alluvial-1& North-east alluvial-2:

- Adoption of Integrated Plant Nutrition System (IPNS);
- Reclamation of problem soils, salinity and alkalinity;
- Amelioration of Boron deficiency & Iron toxicity;
- Efficient use of canal and ground water;
- Emphasis on maize, fruits and vegetable crops ;
- Development of oxbow lakes and derelict water bodies ;
- Promotion of rice-fish farming ;
- Promotion of cultivation of pulses and oilseeds in *Tal* areas ;
- Promotion of *Rabi* maize cultivation ;
- Promotion of short duration varieties of rice in rice-wheat system; and
- Promotion of farm mechanization.

(6). Research priorities:

- Delineation & mapping of multi-nutrient deficiency;
- Development of heat tolerant varieties of wheat ;
- Development of salt tolerant and deep water paddy varieties ;
- Efficient water management;
- Management of '*Diara*' & '*Tal*' areas; and
- Farm mechanization.

V. Upper Gangetic Plains Region - V: 40 districts of Western and Central parts of Uttar Pradesh

(1)Typology :

- Rich soil and water resources ;
- Medium productivity level due to salinity / alkalinity ;
- Unscientific irrigation practices, poor drainage and weak input supply structure ;
- Moderate population pressure on land deteriorating environment with respect to land quality.

(2) Potential Crops, fruits & Livestock :

(2.1) Agriculture crops: Wheat, *Basmati* rice, *Bajra*, maize, black gram, green gram, pigeon pea and bengal gram.

(2.2) Horticulture crops: Potato, tomato, brinjal, colocasia, sweet pea, carrot, onion, mentha, cauliflower, cabbage, cucurbits, chillies, coriander, fennel, medicinal & aromatics (*Ashwagandha*, bael, *Khus*, lemon grass) and mushrooms.

(2.3) Fruit crops: Mango, papaya, guava, peach, *Jamun* & aonla.

(2.4) Livestock & others: Cattle, buffalo & poultry.

(3) Farming systems :

- Rice and Wheat based cropping system;
- Buffalo/cattle rearing;
- Poultry.

(4) Cropping sequences :

- Rice – wheat – summer black gram / moong ;
- Maize – potato – wheat /cucurbits; rice-berseem-sugarcane, sugarcane, ratoon;
- Pigeon pea-wheat / lentil –summer moong ;
- Pigeon pea-sweet pea – summer *Bajra* ; and
- *Bajra*-mustard /black gram / green gram.

(5) Sub-region specific development related priorities:

(5.1) Central Plains-1, North-western Plains-2 & South-western Plains-3:

- Delineation & mapping of multi-nutrient deficiency;
- Adoption of Integrated plant Nutrition system;
- Reclamation of *Usar* lands through improving irrigation, drainage and adoption of physical and chemical methods of treatment and using saline resistant crop varieties ;
- Efficient use of canals and ground water to minimize the risk of over exploitation of and degradation of soil and water;
- Adoption of zero tillage, furrow irrigated raised bed (FIRB) planting, ridge and furrow planting, crop residue / stubble management ;
- Promotion of diversification of crops; and
- Promotion of organic fertilizers / FYM to improve soil health

(6). Research priorities:

- Management of Sodic soils;
- Farm mechanization;
- Development of salt tolerant varieties of rice ;
- Development of heat tolerant varieties of wheat ; and

VI. Trans-gangetic Plains Region – VI: Delhi, Haryana, Punjab, Chandigarh UT and two districts of Rajasthan State.

(1)Typology :

- Rich water & soil resources ; and
- Comparatively high land productivity level except salinity / alkalinity problem in some areas and also delicate water balance in the region as exploitation of ground water has already surpassed hundred per cent of utilizable balance.

(2) Potential Crops, fruits & Livestock :

(2.1) Agriculture crops: Wheat, barley, *basmati* rice, baby corn, *Bajra*, maize, green gram, black gram, rape seed & mustard, *Guar* & cotton.

(2.2) Horticulture crops: Potato, sweet pea, cauliflower, tomato, cucurbits, flowers (roses, marigold & gladiolus), medicinal & aromatics (*Safed musli*, *Tulsi*, lemon grass, & *Khus*) and mushrooms.

(2.3) Fruit crops: Kinnow, guava, apple & mango.

(2.4) Livestock & others: Cross bred cattle, buffalo, goat, sheep & poultry.

(3) Farming systems :

- Rice and Wheat based cropping system;
- Buffalo/cattle rearing; and
- Poultry

(4) Cropping sequences :

(a) Rainfed Areas :

- Fallow – bengal gram ;
- Fodder *Jowar* + green gram / black gram –mustard / barley ;
- *Bajra* – mustard / wheat ; and
- Cowpea – Wheat

(b) Irrigated Areas :

- Rice - *Toria* – wheat - green Manure ;
- Rice – bengal gram - summer green gram / black gram – maize – wheat – green manure ;
- Maize – bengal gram – sugarcane – ratoon – wheat – green manure ;
- Rice – *Toria* – Rabi maize - tomato ;
- Cotton – wheat - green manure ; and
- Maize – potato – sugarcane

(5) Sub-region specific development related priorities:

(5.1) Foot hills of Sivalik & Himalayas-1:

- Soil & Water shed development;
- Adoption of Integrated Plant Nutrition System;
- Adoption of zero tillage/ furrow irrigated raised bed (FIRB) technology. In rice-wheat cropping system areas;
- Promotion of hybrid rice cultivation with SRI method of cultivation;
- Promotion of '*Basmati* hybrid rice' with SRI method of cultivation;

(5.2) Plains-2:

- Adoption of Integrated Plant Nutrition System;
- Reclamation of waste lands ;
- Reclamation of soil salinity / alkalinity through the use of pyrites/ gypsum ;
- Adoption of zero tillage/ furrow irrigated raised bed (FIRB) technology in wheat in rice-wheat cropping system areas;
- Promotion of hybrid rice cultivation with SRI method of cultivation;
- Promotion of '*Basmati* hybrid rice' with SRI method of cultivation;
- Introduction of pulse crop/green manure in the crop sequence as a rule to relieve soil fatigue in rice-rice-wheat cropping sequence;

(5.3) Scarce rainfall-arid region-3:

- Adoption of Integrated Plant Nutrition System;
- Reclamation of soil salinity / alkalinity through the use of pyrites / gypsum ;
- Promotion of hybrid rice cultivation with SRI method of cultivation in command areas;
- Inter-cropping of oilseeds/pulses with Coarse cereals in rainfed areas;
- Promotion of Bt. Cotton; and
- Use of organic manure and agricultural waste to improve soil health.

(6) Research priorities:

- Crop diversification;
- Delineation & mapping of multi-nutrient deficiency;
- Development of salt tolerant varieties of rice ;
- Development of high yielding varieties of wheat ; and
- Post-harvest Technology.

VII. Eastern Plateau & Hills Region-VII.

16 districts of Chattisgarh, 18 districts of Jharkhand, 3 of Madhya Pradesh, 4 of Maharashtra, 15 of Orissa & 1 district of West Bengal.

(1) Typology :

- Large volume of land and water resources exists in the region;
- Very low productivity
- Large of runoff of rain water eroding soil fertility; and
- Low development of irrigation.

(2) Potential crops, fruits & Livestock:

(2.1) Agriculture crops: Rice, wheat, maize, black gram, pigeon pea, bengal gram, linseed and *Rabi* groundnut.

(2.2) Horticulture crops: Sweet pea, cabbage, ginger, turmeric, potato, onion, garlic, medicinal & aromatics (*Sarpgandha*, *Ashwagandha*, glory lilly, *Mulaithi*, *Gudmar*, aloe), flowers (Tuberose, gladiolus & Jasmine), banana, beetle vine and mushrooms.

(2.3) Fruit crops: Mandarin, mango, guava, *Aonla*, lac, lemon, pomegranate, custard apple, papaya & *Jatropha*.

(2.4) Livestock & others: Cattle, buffalo, goat, poultry, fishery, bee-keeping and sericulture.

(3) Farming systems :

- Rice & Coarse cereals based cropping systems;
- Cattle/buffaloe rearing;
- Goat rearing;
- Piggery; and
- Poultry.

(3) Cropping systems :

- Rice & Coarse cereals based cropping systems.

(4) Cropping sequences :

(a) Rainfed Areas :

- Ragi + Pigeon pea – Niger/Linseed + Rabi Maize ;
- Rice + Black gram-Niger/Linseed;
- Rice + Sesame-Niger/Linseed; and
- Pigeon pea + Black gram – Linseed.

(b) Irrigated Areas :

- Rice – linseed + *Rabi* maize – fodder *Bajra* ;
- Rice – *Rabi* maize – black gram;
- Rice – *Rabi* groundnut + *Rabi* maize;
- Rice – potato – maize;
- Groundnut – *Rabi* maize/bengal gram-summer moong ;
- *Ragi* + soybean – *Rabi* maize – vegetables; and
- Castor – vegetables.

(5) Sub-region specific development related priorities:

(5.1) Dry sub-humid-1 & Eastern Highland-2:

- Adoption of Integrated Plant Nutrition System;
- Reclamation of soil salinity /alkalinity;
- Reclamation of acidic soils;
- Inter-cropping of pulses and oilseeds with cereals;
- Adoption of Integrated Farming System with emphasis on forestry and livestock;
- Enhancing of Seed Replacement Rate of improved cultivars;
- Emphasis of maize and sorghum hybrids; and
- Enhancing cropping intensity by using of fallow lands.

(5.2) North-central Plateau-2, Eastern Plateau-3 & Tribal-4:

- Delineation & development of water shed at macro and micro levels;
- Construction of check dams for conserving rain water and its recycling;
- Reclamation of saline /alkaline soils;
- Reclamation of acidic soils;
- Inter-cropping of pulses and oilseeds with cereals;
- Promotion of hybrid rice technology in conjunction with SRI method of cultivation;
- Adoption of Integrated Farming System with emphasis on forestry and livestock;
- Enhancing of Seed Replacement Rate of improved cultivars;
- Promotion of maize and sorghum hybrids; and
- Enhancing cropping intensity of fallow lands.

(6) Research priority:

- Development of salt tolerant varieties of rice ;
- Development of heat tolerant varieties of wheat;
- Delineation & mapping of multi-nutrient deficiency;
- Water shed management; and
- Integrated Farming system.

VIII. Central Plateau & Hills Region-VIII.

31 districts of Madhya Pradesh, 20 of Rajasthan and 7 of Uttar Pradesh.

(1) Typology :

- Large volume of land and water resources exists in the region;
- Very low productivity with predominance of subsistence agriculture;
- Excessive runoff;
- Under utilize potential of horticulture and livestock; and
- Low development of irrigation.

(2) Potential crops, fruits & Livestock:

(2.1) Agriculture crops: Maize, sorghum, pearl millet, durum wheat, barley, black gram, green gram, pigeon pea, bengal gram, field pea, lentil, soybean, rape seed & mustard, linseed and groundnut.

(2.2) Horticulture crops: Coriander, opium, brinjal, okra, onion, flowers (Roses, marigold, Jasmine & gladiolus) medicinal & aromatics (*Safed musli*, *Ashwagandha*, *Sarpagandha*, *Guggal* & *Aloe vera* (*Gwar patha*)).

(2.3) Fruit crops: *Aonla*, *ber*, *mango*, mandarin & *Jatropha*.

(2.4) Livestock & others: Cattle, buffalo, poultry, goats & sheep.

(3) Farming systems :

- Coarse cereals based cropping systems; and
- Poultry.

(4) Cropping sequences :

(a) Rainfed Areas :

- Maize/*Jowar* + soybean – durum wheat;
- *Jowar* + pigeon pea – bengal gram/linseed; and
- *Bajra* + black gram/green gram – barley/bengal gram/field pea/mustard.

(b) Irrigated Areas :

- Maize + soybean –wheat – summer moong; and
- Rice – wheat – summer moong;

(5) Sub-region specific development related priorities:

(5.1) Bundelkhand-1, Bundelkhand-2, North Hills-3, Kymore Plateau Satpura Hills-4, Vindhya Plateau-5, Satpura Plateau-6 & Central Narmada Valley-7:

- *In-situ* water harvesting/conservation;
- Development of waste land;
- Development & strengthening of irrigation infra-structure to promote input intensive technologies and multiple cropping system;
- Adoption of modern water harvesting techniques;
- Diversification of small millets with high value crops, agro-forestry, silvi-pastoral and agri-horti system;
- Adoption of improved rainfed farming system; and
- Promotion of hybrids of maize, *Bajra*, *Jowar* & cotton.

(5.2) Gird-8, South-eastern Plains-9, Southern plains-10, Transitional Plains11, Southern Plains& aravali Hills-12:

- *In-situ* water harvesting/conservation through adoption of cultural practices;
- Development of waste lands;
- Development & strengthening of irrigation infra-structure ;
- Adoption of modern water harvesting techniques ;
- Diversification of small millets with high value crops;
- Adoption of improved rainfed farming system; and
- Promotion of hybrids of maize, *Bajra*, *Jowar* & cotton.

(5.3) Semi-arid eastern Plains-13 & Flood prone eastern Plains-14:

- *In-situ* water harvesting/conservation;
- Inter-culture in between rows to create soil mulch and vegetative/bio-mulching;
- Promotion of agro-forestry, silvi-pastoral and agri-horti system.

- Adoption of improved arid farming system;
- Promotion of hybrids of maize, *Bajra* & cotton

(6) Research priorities:

- Development of abiotic tolerant varieties of rice, wheat, pulses & oilseeds ;
- Delineation & mapping of multi-nutrient deficiency;
- Water harvesting and recycling;
- Farming systems;
- Soil and water salinity management.

IX. Western Plateau & Hills Region-IX.

14 districts of Madhya Pradesh, 25 of Maharashtra and 1 district of Rajasthan.

(1) Typology :

- Crop pattern dominated by low value cereals;
- Under develop irrigation potential;
- Large runoff and soil erosion; and
- Soils with high clay content with low drainability.

(2) Potential crops, fruits & Livestock:

(2.1) Agriculture crops: Maize, sorghum, durum wheat, bengal gram, green gram, black gram, soybean, groundnut & cotton.

(2.2) Horticulture crops: Chillies, potato, brinjal, onion, okra, cucurbits, flowers (Marigold, liliun, gerbera & gladiolus), medicinal & aromatics (*Safed musli*, bael, Gudmar & senna), opium & mushrooms.

(2.3) Fruit crops: Mandarin, lemon, malta, pomegranate, papaya, banana, grapes, mango, Jatrophia.

(2.4) Livestock & others: Cattle, buffalo, sheep, goat & poultry.

(3) Farming systems :

- Coarse cereals based cropping systems;
- Goat rearing; and
- Poultry..

(4) Cropping sequences :

Rainfed Areas :

- *Jowar* + soybean – bengal gram/durum wheat; and
- *Bajra* + black gram/green gram- safflower;

Irrigated Areas :

- Cotton – wheat – summer green gram;
- Maize – durum wheat – summer green gram; and
- Soybean – Rabi maize – vegetables.

(5) Sub-region specific development related priorities (all the 4 sub-regions):

- *In-situ* water harvesting/conservation;
- Development of waste land;
- Creation of additional irrigation potential;
- Emphasis on high value crops;
- Promotion of agri-horti-pastoral system ;
- Enhancing use of fertilizers; and
- Promotion of hybrids of maize, *Bajra* and cotton

(6) Research priorities:

- Development of heat tolerant varieties of bread wheat;
- Development of special varieties of durum wheat for export;
- Delineation & mapping of multi-nutrient deficiency;
- Water shed management; and
- Farming systems.

X. Southern Plateau & Hills Region-X.

14 districts of Andhra Pradesh, 21 districts of Karnataka and 13 districts of Tamilnadu

(1)Typology :

- Large rainfed area;
- Large scale cultivation of low value cereals; and
- Tank led irrigation.

(2) Potential crops, fruits & Livestock:

(2.1) Agriculture crops: Rice, sweet sorghum, foxtail millet, maize, horse gram, green gram, sunflower, safflower, cotton & groundnut.

(2.2) Horticulture crops: Tapioca, gherkins, onion, okra, chillies, brinjal, tomato, flowers (Gomphrena, crossandra & Jasmine), garlic, ginger and medicinal & aromatic (Sandal wood, glory lilly, senna, *ashok*, cinchona).

(2.3) Fruit crops: Mango, banana, grapes, guava, sapota, & citrus.

(2.4) Plantation crops: Rubber, coconut, mulberry, cashew nut, areca nut & cocoa.

(2.5) Livestock & others: Cattle, buffalo, sheep, goat, poultry, piggery, fishery, bee-keeping & seri-culture.

(3) Farming systems :

- Rice and Coarse cereals based cropping systems;
- Piggery; and
- Marine fisheries.

(4) Cropping sequences :

(a) Rainfed Areas :

- Sweet sorghum – cotton - groundnut; and
- Sweet sorghum – green gram – fodder;

(b) Irrigated Areas :

- Rice – *Rabi* maize – green gram; and
- Cotton – *Rabi* maize – fodder.

(5) Sub-region specific development related priorities (all the 6 sub-regions):

- Creation additional irrigation potential to harness full potential of agriculture;
- *In-situ* water harvesting/conservation through adoption of cultural practices like ridge and furrow planting, inter-cropping of legumes in uplands, planting against slope in undulating terrain/hilly tract;
- Inter-culture in between rows to create soil mulch and vegetative/bio-mulching;
- Reclamation of saline/alkaline/acidic/water logged/ill drained soils;
- Productive use of barren and un-cultivated lands, cultivation of waste and permanent fallows through afforestation;
- Diversification of crops to high value crops;
- Diversification of sugarcane area by Cotton;
- Adoption of Integrated farming system with a component of crops, livestock, silvi-pastoral system and agri-horticulture;
- Promotion of Rice hybrids in conjunction with SRI method of cultivation;
- Promotion of hybrids of maize, cotton, sorghum, sunflower; and
- Adoption of improved rainfed farming system.

(6) Research priorities:

- Development of salt tolerant varieties of rice;
- Delineation & mapping of multi-nutrient deficiency;
- Water harvesting and recycling; and
- Soil & water salinity management.

XI. East Coast Plains & Hills Region-XI.

9 districts of Andhra Pradesh, 15 of Orissa, 15 districts of Tamilnadu and Pondicherry State.

(1) Typology :

- Rich water resources with relatively unfertile land;
- Fragile ecology due to water logging, soil salinity/acidity and soil erosion; and
- Tank led irrigation.

(2) Potential crops, fruits & Livestock:

(2.1) Agriculture crops: Rice, sweet sorghum, maize, sugarcane, black gram, green gram, groundnut, niger, sunflower, cotton, Jute & mesta.

(2.2) Horticulture crops: Black pepper, turmeric, brinjal, okra, tapioca, chillies, onion, sweet potato, flowers (Tube rose, enthurium & Gompherina), medicinal & aromatics (Coleus & scented geranium).

(2.3) Fruit crops: Cashew nut, mango, sapota, banana, custard apple and pine- apple.

(2.4) Plantation crops: Cashew nut & coconut.

(2.5) Livestock & others: Cattle, buffalo, sheep, goat, poultry, duck & fishery.

(3) Farming systems :

- Rice based cropping systems;
- Fish and Prawn culture;
- Piggery; and
- Poultry.

4) Cropping sequences :

Rainfed Areas :

- Sweet sorghum – cotton - groundnut; and
- Sweet sorghum – green gram – fodder;

Irrigated Areas :

- Rice – groundnut - green gram ;
- Rice – green gram /black gram;
- Cotton- green gram – green manure; and
- Soybean – sunflower – green gram.

(5) Sub-region specific development related priorities (all the 6 sub-regions):

- Productive use of barren and uncultivated lands, cultivable waste and permanent fallows through afforestation;
- Reclamation soil salinity/alkalinity through use of Gypsum/Pyrites;
- Reclamation of acidic soil through liming/mills sludge;
- *In-situ* water harvesting/conservation through adoption of cultural practices like bed furrow in deep black cotton, uplands and flat sowing and ridging later in red soils;
- Diversification of the area of low value crops to high value crops;
- Promotion of hybrid rice in conjunction with SRI method of cultivation; and
- Development of Tribal agriculture.

(6) Research priorities:

- Development of salt tolerant cultivars of rice ;
- Delineation & mapping of multi-nutrient deficiency;
- Farming systems and
- Crop management in flood prone areas.

XII. West Coast Plains & Ghats Region-XII.

6 districts each of Karnataka and Maharashtra, 2 districts of Andhra Pradesh, Goa and Kerala State.

(1)Typology :

- Rich water resources with relatively unfertile land; and
- *Fragile* eco-system due to excessive runoff soil salinity/acidity/irregular stretches of back water/mound formation/inadequate drainage.

(2) Potential crops, fruit crops & Livestock:

(2.1) Agriculture crops: Rice, foxtail millet, sugarcane, sunflower, cowpea, horse gram, green gram & cotton.

(2.2) Horticulture crops: Potato, onion, garlic, tomato, ginger, black pepper, cloves, cardamom, cinnamon, medicinal & aromatics (*Asparagus*, glory lilly & *Guggal*) and orchids.

(2.3) Fruit crops: Cashew nut, mango & citrus.

(2.4) Plantation crops: Coconut, areca nut, Oil palm & cocoa.

(2.5) Livestock & others: Cattle, buffalo, poultry & fishery.

(3) Farming systems :

- Rice based cropping systems;
- Marine fish & prawn culture.

4) Cropping sequences :

- Cow pea/groundnut/barnyard millet (*Virippu* uplands)-Rice-green gram;
- groundnut/little millet/foxtail millet (*Kuttanad/Kole* areas)-Rice-green gram;
- Cow pea/green gram- rice (*Mundakan*)- green gram; and
- Cotton + foxtail millet – green gram/green manure.

(5 Sub-region specific development related priorities (all the 4 sub-regions):

- Reclamation of degraded lands through soil conservation measures along slope of hills for promotion of agri-horticulture;
- Reclamation of low lands such as *Khar, Kole, Pekhali* and *Kasam* for assured rice crop with high productivity;
- Augmenting area under irrigation by restoring and harvesting of water at upper reaches, construction of tanks and percolation ponds at middle low lands.
- Intensification of fish production using cost effective technologies for catch and processing, prawn culture in brackish water;
- Strengthening of dairy activity;
- Promotion of hybrid rice in conjunction with SRI method of cultivation; and
- Adoption of sustainable crop sequence by discouraging rice after rice cultivation in the region.

(6) Research priorities:

- Development of salt tolerant cultivars of rice;
- Soil & Water Management ;
- Integrated farming system ; and
- Delineation & mapping of multi-nutrient deficiency;

XIII. Gujarat Plains & Hill Region-XIII.

Gujarat, Daman & Diu and Dadra & Nagar Haveli.

(1)Typology:

- Semi-arid to arid conditions;
- Large rainfed areas with frequent weather perturbations;
- Water logging in canal areas;
- Depletion of groundwater in northern and western parts at alarming rate; and
- Low forest cover.

(2) Potential crops, fruit crops & Livestock:

(2.1) Agriculture crops: Maize, *Bajra*, durum wheat, green gram, groundnut, castor, sugarcane & cotton.

(2.2) Horticulture crops: Onion, cumin, fennel, fenugreek, garlic, flowers (Aster, spider lilly, marigold & chrysanthemum) aromatic plants & medicinal plants (*Isabgol, Guggal* & aloe) and *Jatropha*,

(2.3) Fruit crops: Sapota, banana, guava, dates, mango, grapes.

(2.3) Plantation crops: Coconut.

(2.4) Livestock & others: Cattle, buffalo, goats, sheep, rabbit, poultry and bee-keeping.

(3) Farming systems:

- Coarse cereals based cropping systems;
- Cattle rearing;
- Goat rearing; and
- Poultry.

4) Cropping sequences:

Rainfed Areas :

- *Bajra* + Black gram – Mustard;
- Maize + Soybean – Durum wheat; and
- Groundnut – Durum wheat – Summer *Bajra*.

Irrigated Areas:

- Rice – Rabi maize/Groundnut-Summer Moong;
- Cotton – Durum wheat – Summer Moong; and
- Groundnut – Potato – Summer *Bajra*.

(5) Sub-region specific development related priorities (all the 7 sub-regions):

- Promotion of integrated water management in dry areas with greater emphasis on rain water harvesting;
- *In-situ* water harvesting/conservation through adoption of cultural practices like bed furrow in deep black cotton uplands and flat sowing & ridging later in light soil;
- Restriction on overdrawl of groundwater in semi-arid and arid region through regulatory measures;
- Reclamation of salinity through application of Gypsum;
- Conjunctive use of canal and groundwater to control rise in water table;
- Adoption of inter-cropping in groundnut and cotton to improve productivity per unit area;
- Promotion of hybrid rice in conjunction with SRI method of cultivation;
- Promotion of fodder development programme to support livestock population;
- Development of inland and brackish water fisheries through adoption of intensive fisheries production technology.

(6) Research priorities :

- Development of salt tolerant cultivars of rice;
- Delineation & mapping of multi-nutrient deficiency;
- Development of extra early maturing hybrids of *Bajra* for arid region;
- Integrated Water Management ;
- Integrated farming system .

XIV. Western Dry Region-XIV: 9 districts of Rajasthan.

(1) Typology :

- Arid conditions with hot climate; and
- Fragile eco-system.

(2) Potential crops, fruits & Livestock:

(2.1) Agriculture crops: Cotton, castor, *Taramira*, *Bajra*, barley, green gram & guar.

(2.2) Horticulture crops: Chillies, carrot, cumin and medicinal plants (Isabgol, senna, aloe & Guggal).

(2.3) Fruit crops: *Ber*, pomegranate, kinnu & Mausambi.

(2.4) Livestock & others: Cattle, buffalo, goat, sheep, camel, mules & horses.

(3) Farming systems :

- Coarse cereals based cropping systems;
- Cattle rearing;
- Goat/sheep rearing;
- Camel rearing; and
- Poultry.

(4) Cropping sequences :

- castor – chillies – fallow;
- *Bajra* + *Moth/Guar*- barley- fallow;
- *Bajra* – mustard/*Isabgol*/cumin;
- *Bajra* – *Taramira* – fallow; and
- Cotton – wheat – fallow;

(5) Sub-region specific development related priorities (Western dry region – one sub region only):

- *In-situ* water harvesting/conservation through adoption of cultural practices like ridge furrow planting, inter-cropping/mixed cropping with legumes, planting against slopes (in hilly tract), inter-culture in between rows to create soil mulch and vegetative/bio-mulching;
- Reclamation of soil salinity through application of Gypsum especially in oilseed crops;
- Enhancement of water use efficiency by popularization of *Diggies* in canal command areas;

- Adoption of integrated farming system with a component of crops, livestock, silvi-pastoral system, agri-horti system and agri-horti-silvi-culture to sustain arid ecosystem to cater food, feed, fodder and fuel requirement in the region;
- Development of arid pastures; and
- Massive programme of “*Khejri*” plantation.

(6) Research priorities:

- Development of extra early maturing hybrids of *Bajra* for arid region;
- Delineation & mapping of multi-nutrient deficiency;.
- Integrated farming system ; and
- Rainwater harvesting management.

XV. Islands Region-XV.

A & N Islands and Lakshdweep.

(1) Typology :

- Rich water resources with relatively poor land; and
- Fragile eco-system.

(2) Potential crops, fruits & Livestock:

- (2.1) Agriculture crops:** Rice, maize & cow pea.
- (2.2) Horticulture crops:** Chillies, cucurbits, brinjal, okra and aromatics (*Khus*).
- (2.3) Fruit crops:** Papaya, mango & sapota.
- (2.4) Plantation crops:** Coconut.
- (2.5) Livestock & others:** Goats, buffalo, poultry & fishery.

(3) Farming systems :

- Rice based cropping systems;
- Fisheries;
- Goat rearing; and
- Poultry.

4) Cropping sequences :

- Rice – cow pea/horse gram-vegetables.

(5) Region specific development related priorities (sub-regions not delineated):

- Removal/leaching of salts, construction of dykes to check ingress of sea water on the surface and in lower soil profile and plantation mangroves;
- Promotion of SRI method of rice cultivation;
- Promotion of the cultivation of plantation crops;
- Mari-culture of oysters & mussels ;

- Ornamental fish breeding & culture; and
- Diversified fishing activity.

(6) Research priorities:

- Development of fish technology; and
- Integrated farming system.

6.2. Agricultural Extension, Management and Functional Linkages

There is a need for drastic change in the Agricultural Extension System. Firstly, as explained earlier, there is no national extension system; there has been projects and programmes – not a sustainable mechanism. We may name this system as the **National Agricultural Extension System (NAES)**. This national system needs an independent autonomous body – Council, Board or Bureau or Say, **Council for Agricultural Transfer of Technology (CATT) with following arms/divisions:**

- (i) Farm Advisory Services Division: demonstrations of technologies, vocational training, Mass-Communication, Field-days, Exhibitions & Fairs, KVKs, ATMA etc;
- (ii) Research and Monitoring & Evaluation Division Research in TOT and **Social Science applied** to agricultural extension: operational research, action-research, adaptive trials, monitoring and evaluation and impact studies.
- (iii) **In-service training and entrepreneurship development:** advanced training and re-training to all shades of people and personnel in agriculture including management training & foreign training & visits.
- (iv) **Information and Communication Division:** Blending Conventional and modern communication technologies and devices – electronic media and mechanisms ATICs development of educational and training material, audio-visual aids, films, cassettes, CDS, inter networks, knowledge Centers, extension publications etc.
- (v) Establishment: dealing with all the administrative and institutional matters – finances, personnel management & infrastructures.

This proposed Council may be established by integrating and merging the two Sub-Ordinate Offices referred to earlier – Directorate of Extension of the Ministry of Agriculture and the Division of Extension of the ICAR deploying all the staff, budgets and allied infrastructures. Since the Agricultural Extension System works with over 65% of the rural population for their livelihood security and upliftment, as a policy of the Government, the Union Ministry of Rural Development should share with CATT at least five percent of its budget for extension education purposes. Since the Agricultural Extension System represents over one-third of the agricultural R&D, the budget should be accordingly provided in the 11th Five Year Plan.

The major Extension projects and programmes:

1. The KVK network & ATMA for F0rum **Advisory Services** including various approaches and methods, mass-communication and electronic designs and devices should be continued and strengthened.

2. The old **Lab to Land** programmes of the ICAR for small and marginal farmers and agricultural labourers should be revived with enhanced budget and norms. Commodity Directors such rice, wheat, cotton, millets, sorghum, jute etc. should be strengthened and infrastructures need to be developed.
3. The IVLP, Operational Research Project, Action – research project and studies in social sciences applied to agriculture should be strengthened and multiplied.
4. The **demand and market driven** extension mechanisms may be adopted using the farms of the model and awarded farmers, farms of the KVKs NARPs, SAUs & the ICAR Institutes. The holistic model of extension on the line of **AMUL/NDDDB** by organizing farmers to organized marketing and investments should be introduced in agriculture for value addition at all levels of production and marketing.
5. The information and communication Wing of CATT should deal with extension approaches and methods including electronic devices – ATIC, Audio-Visual Labs, diagnostic Teams, Mobile extension vans and mass-communication.
6. Advanced Training Centres(ATCs) to be established or strengthened if already exists, in all SAUs and ICAR Research Institutes with only core training staff and by deploying relevant scientists of the institutions. Training is a strong mechanism of the Transfer of Technology.
7. **NARP** which is devoted to generating appropriate technologies for the specific agro-climatic zones should be strengthened to support the extension system at large – the legacy of the Zonal Planning.
8. The KVK Chief should be in the rank of Professor so that the KVK gets the right leadership. The Chief in the rank of senior scientist with very young staff in the S₁ rank represent a weak structure. The KVK farms and demonstration units should be also utilized for improved seeds, animals, planting materials and finger links.
9. In the North-Eastern hill States, while the Knowledge Centres may be established at the Panchayat level with latest communication devices, the small hemlets may be approached by Radio Groups and mass contact methods. The extension system in hills should deal with women empowerment – SHGs model may also be followed for male farmers in hills. Hill states may need larger budgets for basic extension infrastructures – Vehicles, transportation, cold storage, warehousing facilities etc. The traditional leadership of the hill villages – the village Chief or Pradhan should always be taken into confidence for getting acceptance and cooperation from the farmers.

6.3. Human Resource Development

There is a need for establishment of manpower planning institute for agriculture and allied services; revision of courses in agricultural universities; creation of para-agricultural graduates to cater to the enterprises based needs; higher specialized training for in service personnel; creation of 1000 post-doctoral fellowships in specified fields; starting of specialized courses in farming systems, water management, natural resources, post-harvest, value addition, hi-tech horticulture, dairy, sericulture, apiculture, business and export management; inclusion of farmers knowledge in research and extension programmes on participatory mode: establishment of farmer field school, germplasm, seed, grain, fodder and fuel banks at village or panchayat levels; seed production, organic farming, storage processing and marketing consortiums; teachers, researchers and extension personnel training institutes; high level training centers at district level of practical nature; highlighting extension activities of NGOs, private

companies, line departments and university KVKs and extension units; external evaluation and monitoring of ICAR institutes, SAUs, line departments, private companies and NGOs.; incentives and awards and corporate benefits to performers; utilization of services of retired experts; micro-financing managers at village level; missionary approach for augmenting the productivity of pulses, oilseeds, extra-long staple cottons etc.

6.4. North Eastern Region

Making agriculture sector in the region remunerative to lure unemployed youth to the untapped Agri-based entrepreneurship and employment. Empowering the region to be a player in the emerging global organic food market and thus building its capacity to contribute to national food basket and export earning. Addressing the constraints of deliverables to ensure production optimization. Skill up gradation and capacity building of each stakeholder. And facilitating cross border Agri-based trade in the areas of competitive advantage are some of the major priority areas in the North Eastern region.

6.5. Value Addition, Infrastructure and Organic Farming

The important priority areas are:

- Cost-effective production for reasonable prices to poor farmers.
- Climbing up in the value-chain by diversifying in value-added products.
- Sustained building of loyalty of customers.
- Facilitating reach to customers throughout the country by a strong chain of distribution outlets
- The investment in relationship with business partners
- To adopt low-cost and biological approach of farm production, which is economical for the farmers as products of organic farming command premium price. With increase in production, premiums will level out, but the market size will increase.
- To grow the products which are free of contamination with substances such as pesticides and heavy metal residues.
- To recycle biomass (weed, crops, trees etc.) farm waste compost through composting for supplementing nutrients which besides will reduce the weeds growth due to incorporation of plant biomass as a surface mulch.
- To apply nitrogen nutrient through compost, bio-fertilizers / liquid manures / Vermi-vash to the crop at any stage of growth thus eliminates the application of nitrogen produced through synthetic source.
- To devise/refine various crop production technologies under organic farming and encouraging natural enemies of crop pests for minimizing dependence on pesticides etc.
- In-situ biomass production and conservation strategies based on knowledge and experience.
- Value addition to the biomass to potentially meet crop nutrient needs, which can be achieved through;
- Encouraging use of traditional knowledge items known to contain agriculturally beneficial micro-organisms.

- Market availability of high quality microbial inoculants found wanting in farmers field.
- In-situ production of botanicals to address the need of protecting crops e.g gliricidia and neem etc. on field bunds, and cow dung and urine, thereby will overcome the problem of shortage of FYM and to exploit its futuristic research for efficiency and improvement.
- To build institutional support for better organic farming research through developing need based technologies and capacity building of manpower from Scientist to farmers Chain.
- To develop efficient monitoring mechanism, so that the overall goal for realizing qualitative eco-friendly and vertical crop production is achieved.

7. INFRASTRUCTURE NEEDS

7.1. Agricultural development in the various Agro-Climatic Zones

The need of necessary infrastructure was initially realized during the period of green revolution in agriculture, horticulture, dairy and fisheries sector to stabilize the production as well as to handle the agriculture & horticulture produce effectively. The infrastructure need in irrigation, quality control, storage, marketing, processing and logistics was considered imminent in order to manage the increased production and also to sustain the growth in these sectors. The existing infrastructure is not yet adequate leading to pitfalls in production and productivity of these sectors. The infrastructure in logistic sector is abysmally inadequate even at ports besides rural roads and State/National highways/rail heads. Therefore, the following infrastructure need be created with private-public-partnership for required resource response:-

- Strengthening of seed processing & conditioned storage facilities;
- Strengthening of Input Quality Control organizations through customized mode;
- Irrigation infrastructure;
- Rural electrification;
- Modernization of agriculture markets with post harvest management storage / logistics ;
- Rural roads ;
- Setting up of fruits, vegetables, flowers, spices, oil and Oleoresin processing units
- Setting up of cold chain for fruit & flower processing; and
- Augmentation of docking & storage infrastructure at ports.

7.2. Agricultural Extension, Management and Functional Linkages

- Establishment of the Council for Agricultural Technology Transfer (CATT)
- Modernizing all extension grids/units with latest information and communication gadgets and devices – computers, Fax, Machines, E-mail, Website, etc.
- Rural infrastructure needed for holistic extension approach including roads, cold storage, food processing units, warehousing facilities and organized marketing.
- Mobility facilities including transportations and mobile extension vans.

7.3. Human Resource Development

The human resource development requires development of physical facilities for higher studies with renovation of infrastructure wherever they are quite old, up gradation laboratory facilities with modern equipments and instruments. Exposure of faculty to the recent developments through researchers exchange programmes with advanced countries. There should be adequate provision of mid career opportunities for short training programmes for research personnel and development of problem specific research centers etc.

7.4. North Eastern Region

Packaging, processing, marketing, referral labs for pests and diseases, development of information network,

7.5. Value Addition, Infrastructure and Organic Farming

At each village there should be missionary planning for creation of tube wells, watershed approach for water harvesting techniques, lay out of metal farm roads, weir, dam, land reclamation mechanism, pumping station etc. Besides the infrastructure for the development of creation and establishment of no. of organic food testing and other allied laboratories for production of bio-agents at each farmers constituted group villages of international standards.

Development of more and more packaging centers and establishment of small and large-scale value added industrial units for processing of agricultural foods.

Creation of small-scale laboratories for research and development works either managed through authorized farming groups or by state agencies.

Financial support for commercial production units for production of organic inputs like fruits and vegetables waste compost, bio-fertilizer and establishment of vermi-culture hatcheries at large scale.

- a. Allocation of funds for establishment for various location specific organic farming modules for impact analysis.
- b. Construction for buildings at potential organically specified villages where all the activities for organic farming from seed to seed and marketing of the produce at retailer level will be monitored.
- c. The creation of online facility for global information regarding the recent production and marketing trends (under information technology).
- d. Promotion and establishment of organic vegetable and fruit markets at site specific places of the representative areas.
- e. Infrastructure requirement in terms of man and material of establishment of centers for promotion and organization of organic farming activities.
 - a). Food park scheme.
 - b). Packaging centres.

- c). Integrated cold chain facility
- d). Value added centers.
- e). Irradiation facility.
- f). Modernized abattoirs
- g). Upgradation of infrastructure

8. LINKAGES WITH STAKEHOLDERS

8.1. Agricultural development in the various Agro-Climatic Zones

The management of agriculture sector is largely public sector driven which often lacks competition and required level of efficiency due to inherent weaknesses of the system. It will, therefore, be appropriate to assign some of the activities to the private sector particularly transfer of technology of the inputs produced in private sector, quality control on customized basis, storage and processing in order to make the system more competitive and effective with suitable safeguards. Accordingly the linkages proposed as under (**Table 4**) need be implemented through public and private partnership in customized mode:-

Table 4. Linkages flow-chart.

Public sector	Private sector
ICAR-SAU system: Technology generation. ▼ Concerned line Departments at State level and GOI level: Technology Transfer ▼ Farmers/Farmer Groups ► Industry ► Consumers. ▼ Consumers.	Private research ▼ Farmers ► Industry ► Consumers. ▼ Consumers.

8.2. Agricultural Extension, Management and Functional Linkages

Management is a Social Science; it is defined as working with people of an organization/institution devoted to certain mandates, specific objectives and goals. Management would mean working and managing men, money and allied resources of an organization/institution for achieving its goal most effectively and efficiently.

Management is an applied social science which can be utilized by any organization or group or institution and hence the names are likewise designated, for instance, Agricultural Management, Research Management, Extension Management or industrial management. It has several components or processes, such as Planning, Organizing, Staffing, Directing, Coordinating, Reporting, and Budgeting (POSDCoRB) – Gullick, 1973. These processes being relatively broad and abstract, seven more processes were added to this list namely, Supervision, Communication, Linkage, Human Relations, Decision-making, Evaluation and Monitoring (MEDHLiCS) – Prasad, 1993.

Likewise, linkage process is extremely important for mutual interactions between scientists and workers of an organization, where fuller division of labour can take place

and they mutually reinforce each other in working as teams. But, there is a basic pre-requisite for proper linkage, i.e. they must have common objectives and goal, and they must share rewards or punishments equally, as it happens at any point of working together. But in a team, conventionally, reward is taken by somebody and punishment by somebody else. Under such circumstances, how linkage can take place? There are several such pre-requisites for good linkages, governance and implementation of the programmes. We need to study them.

8.3. Human Resource Development

Since the human resource development has to be linked to the demands of the other sectors, there is a need for multipronged linkages with the stakeholder at different levels. The most crucial linkages that are to be strengthened are linkages with the centers of excellence in the field of learning and R&D institutes for students and in service personnel at different levels. The linkages among the agro-industries, processing, and commerce also need to be fine tuned to augment the skills of agricultural research staff. Further the cross linkages with public and private sectors in the field of research, product development on the specific local problems and commodities will be helpful in the overall development of the agricultural scenario in the country.

8.4. North Eastern Region

The North Eastern Region needs linkages with the mainland in several areas. In the field of research it should be linked with the major research centres to take up the problems faced by the farmers for evolving remedial measures. The development of processing centres, agro-based industries and marketing infrastructure are to be developed to provide remunerative prices for the produces of the region. The linkages of the farmers with the knowledge centers for newer and innovative ideas for broadening their understanding of the problems and developing solutions for them. The very nature of scattered and unfriendly geographic situation also needs several special linkages to bring about all-round development in the region.

8.5. Value Addition, Infrastructure and Organic Farming

Since marketing of products is more remunerative than raw commodities, farmer-processor linkages are needed to add value as per demands of the consumers.

Action is needed for providing effective financial support, favourable government policies and laws, and linkages among producers, industry, R&D institutions and other partners in order to make agribusiness a profitable venture it is necessary to have a holistic approach to various activities inherent to it. In order to release the true potential it is necessary to establish efficient linkages between storage and marketing. In addition to providing sufficient storage capacity, it is also necessary to introduce a sound marketing system so as to minimize losses. The *Panchyats* can help to develop the linkages. In addition to formation of linkages, through *Panchyats*, self help groups (SHG) can help to extend micro finance as viable tool for extending credit to the poor farmers which in turn will help in risk management arrangements as a measure to improve profitability. Through involvement of *Panchyats*, cold storages can be constructed on community basis. Panchyat can play role in organizing awareness camps through imparting trainings on value addition aspects.

9. FUNDING REQUIREMENT

9.1. Agricultural development in the various Agro-Climatic Zones

In view of the declining public investment in agriculture and allied sectors and deceleration in the productivity of major cereals in the country, it appears to be inevitable to enhance the public investment in these sectors substantially to achieve targeted growth rate for domestic consumption and export of the agriculture produce/products, dairy products, fish and fish products. The outlays in respect of seed sector, agricultural extension, fertilizers, plant protection, agricultural marketing and natural resource management need be enhanced three times from the existing level in order to enhance the production & productivity of agriculture and horticulture sectors.

The proposed outlay for crop development programmes during XI Five year Plan period *vis-a-vis* Plan Outlays during X five year plan is given below (Table 5).

Table 5. On going programmes, Plan & Non-Plan, upscaling of the programmes and new programmes for XI Five Year Plan (2007-12)

On going programmes during X Plan		Upscaling of the programmes during XI Plan		New programmes during XI Plan	
Activity	Outlay In (Rs. in Crores)	Activity	Outlay In (Rs. in Crores)	Activity	Outlay (Rs. in Crores)
Agriculture Extension	513.53			-	-
On-farm water Management including micro-irrigation	100.00	On-farm water Management including micro-irrigation	500.00		-
Field formations	22.52	Field formations	100.00	-	-
Crop Development Programmes including Horticulture	7136.00	Crop Development Programmes including Horticulture	28500.00	Seed minikit programme of cereals	2000.00
Seeds production & distribution	209.00	Seeds production & distribution	800.00	(1) Setting up of National oilseeds & Pulses Seeds Corporation	500.00
				(2) Seeting up of Vegetable seeds Corp.	500.00
Fertilizers & manures	44.76	Fertilizer & manures	100.00	Composition of Green manuring	200.00
Plant protection	168.40	Plant protection	500.00	-	-

Marketing & Quality control	697.26	Marketing & Quality control	1200.00	(1) Post-harvest management at APMC's	5000.00
Other activities & services	8076.88	Other activities & services	11700.00	-	-
Total	16968.35	Total	43400.00	Total	8200.00
Grand total					51600.00

***Rs. 1000 under agricultural extension has been added to total operational budget requirement of the states/UTs under agricultural extension management and functional linkages.**

9.2. Agricultural Extension, Management and Functional Linkages

At least one-third of the total budget of the agricultural sector including budgets of the ICAR and the Ministry of Agriculture, should be ear-marked for agricultural extension education; the task more complex and arduous.

Five percent Budget of the Ministry of Rural Development should be shared for Agricultural Extension, for the larger part of rural development is done by agricultural sector. The estimated budget requirement is as follows (Table 6).

Table 6. Budget requirements in 11th Five Year Plan: summary

Total budget requirements at Central Headquarters level	2910
Total Operational budget requirements of the states/UTs	2950
For new project	972
Grand Total	6832

9.3. Human Resource Development

The budgetary requirements for the human resource development are as follows (Table 7).

Table 7. Budget required for various components of Agricultural education, Research and Training (XI Plan 2007-2012)

Sl. No.	Particulars	Fund required (Rs. in crores)
1.	Higher education and Research in Agriculture	5,000.00
2.	Starting newer branches of sciences (Biotechnology, Nano-technology, Organic farming, Neutra and Pharma farming, WTO and export management including Patents and rights,	400.00

	Hi-tech horticulture, Post-harvest technology and value addition, Water management, Dairy-technology (Depending on the importance of these in the zones- universities of the state can pick of the subjects)	
3.	Cutting edge technology, PG Diploma Courses	400.00
4.	Diploma Courses (Crop production, Seed production, horticulture nursery, green house/poly house cultivation, Hitech water management, Organic farming, Farm machinery, Plant protection, Biofertilizers, Bio-control agents, Post harvest technology and value addition, Dairying sericulture, poultry, Apiculture, Medicinal and aromatic plants and floriculture etc.)	400.00
5.	Vocational courses (of two years) in all above subjects	800.00
6.	Skilled manpower training to handle agriculture services at village level (two weeks to one year)	500.00
7.	Establishment of higher level training institutes for training teachers/researchers and extension specialists (one for each state)	400.00
8	Establishment of farmers field schools/knowledge centres (one for each Hobli/Panchayat)	1000.00
9	Establishment of State level Agril. Council to articulate the activities of Government Universities, NGOs, Private Co., industries, export promotion cells and Banks etc.	500.00
10	Agril. Manpower assessment, human resource development, production, price and export management institutes (1+4)	100.00
11	Village level Agriculture technology and microfinance managers training institute (one for each university)	175.00
12	External Evaluation institute for GOI funded projects	25.00
	Total	9300.00

9.4. North Eastern Region

The total budget requirement inclusive all sectors viz. agriculture, horticulture, fisheries, animal husbandry, human resource development and miscellaneous is given below (Table 8).

Table 8. Budget for North Eastern Region

Particulars	Fund required (Rs. in crores)
Total fund required for different activities	1141.25*
For organic farming	370.00**
Total	1511.25

*

The budget requirement for different activities:

A. Agriculture sector.		
Sl. No.	Particulars	Budget
1.	Rice production	5.25
2.	Maize production	10.00
3.	Wheat production	3.00
4.	Pulses production	2.50
5.	Placing the region in the organic food production map of the world	
6.	Harnessing the benefit of plant, animal and fish biotechnology	30.00
7.	Validating ITKs in agriculture and allied sector	2.00
B. Horticulture sector		
8.	Plan for Fruit sector development	80.00
9.	Vegetable sector development	40.00
10.	Spices Sector development	40.00
11.	Plantation crops: coconut, arecanut, cashew	13.00
12.	Floriculture Sector	80.00
C. Animal Science Sector		
13.	Production and health aspect (Pig and poultry as example); cattle and poultry sector development; Important support services	320.00
D. Fishery sector:		
14.	Riverine fishery	25.00
15.	Reservoir fisheries	40.00
16.	Beel fisheries	16.00
17.	Pond aquaculture	24.00
18.	Rice-fish culture	16.00
19.	Common issues to be addressed	40.00
E. Some Common Issues to promote agricultural growth		
20.	Intensive integrated farming system	120.00
21.	Precision farming	20.00
22.	Post Harvest handling of the produce	80.00

23.	Research on sanitary and phytosanitary measures; Establishment of referral laboratory for plant and animal diseases; Establishment of an organic certification laboratory; Strengthening knowledge base of women involved in agriculture; Addressing lack of education, training, women specific technologies and Entrepreneurs among women;	15.60
24.	Disseminating evolved technologies for enhancing production	15.60
25.	Utilization of agricultural and other waste	15.60
26.	Using information technology in agriculture	20.00
27.	Development and support issues	80.00
28.	Development of HRD	
29.	Total	1141.25

**

Proposed Infrastructure and budget outlay for organic farming for NE Region

S. No	Schemes	Proposed plan (Rs. in crore)
1	Schemes for Infrastructural Development: a). Organic food testing and other laboratories for producing bioagents (for product certification etc. b). Packaging centers c). Infrastructure for farmers group centers d). Others	90.00
2	Schemes for technology upgradation, Establishment/ Modernization of organic farming centers	35.00
3	Scheme for backward and forward integration and other promotional activities: a). Backward linkage b). Forward integration c). Generic advertisement d). Promotional activities such as participation in exhibition / fairs /supporting seminars / workshops / studies and Bench mark surveys e). Preparation of short films and material for different meetings f). Strength centre for organic farming activities g). Financial support for commercial production units for production of organic inputs like:- Fruits and Vegetable waste compost; Bio-Fertilizer production; and Hatcheries for vermin-culture Promotion and extension of Organic Farming.	80.00

4	Scheme for quality Assurance, Codex standards and R&D a). Food safety and quality assurance mechanisms b). Strengthening of organic farming Associations c). Setting up / upgradation of testing laboratories	55.00
5	Scheme for Human Resource Development a). Capacity building through service providers b). Setting up of FPTC. c). Imparting training to update skills. d). Facilitating NE Universities / Institutions for running / diploma courses and extension services. e). Foreign Exposures	50.00
6	Scheme for Strengthening Institutions a). Strengthening of state nodal agencies b). Meeting expenditures of pay and allowances for plan posts. c). Information technology	70.00
	Total	370.00

9.5. Value Addition, Infrastructure and Organic Farming

Table 9. Proposed budget outlay for infrastructure during 11th plan for value addition & organic farming:

Sl. No	Scheme	Funds required (Rs. in Crores)
1	Scheme for infrastructure development through the Planning Commission concept to generate rural employment a) Food Park b) Packaging centre c) Modernized abattoirs d) Integrated cold chain facilities e) Irradiation facilities f) Value added centres	310.00
2	Scheme for technology upgradation, Establishment/ Modernization of Food Processing Industries. Processed food industries in general	370.00
3	Scheme for backward and forward integration and other promotional activities. a) Backward linkage b) Forward integration c) Generic advertisement d) Promotional activities such as participation in exhibition / fairs / supporting seminars / workshops / studies and surveys. e) Preparation of short films and material for different meetings.	110.00

	f) Strengthening of Directorate of Food and Vegetable Processing g) Strengthening of Industry Associations h) Fortification of wheat flour	
4	Scheme for quality assurance, Codex standards and R and D a) Food safety and quality assurance mechanisms. b) Bar coding system c) Strengthening the Codex cell d) Continuous R&D e) Setting up/upgradation of quality control laboratories	185.00
5	*Scheme for Human Resource Development a) Setting up of FPTC b) Imparting training to update skills c) Entrepreneurship Development Programme d) Facilitating Universities/Institutions for running degree/ diploma courses and extension services e) Foreign Exposures	
6	Scheme for strengthening of institutions a) Strengthening of Agro-processing Research Centre b) Strengthening of State nodal agencies c) Meeting expenditure of pay and allowances for Plan posts. d) Information Technology.	100.00
7	Commodities wise for different agro-climatic zones of India	3813.90
	Total	4888.90

* Rs. 135 crores under scheme for human resource development has been removed as it is covered under human resource development

Total budget requirement for the 11th Five Year Plan for Agro-climatic Zonal Planning including agriculture development in North-Eastern India (Table 10)

Table 10. Total budget requirement

Sl.No.	Particulars	Budget in Rs. (Crores)
1	Agricultural Development in Various Agro-Climatic Zones	51600.00
2	Agricultural Extension, Management and Functional Linkages	6832.00
3	Agricultural education, Research and Training	9300.00
4	North Eastern Region	1511.25
5	Value Addition, Infrastructure and Organic Farming	4888.90
	Total	74132.15

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Annexure V. Selected Agro-climatic features of Sub-regions.

Annexure I. The composition of the Working Group

(i)	Dr. Panjab Singh , Vice Chancellor, Banaras Hindu University, Varanasi -211005 & former Secretary, DARE & DG, ICAR Email: vc_bhu@sify.com ; panjabsingh03@yahoo.com	Chairman
(ii)	Dr. (Mrs.) Rita Sharma , Additional Secretary & FA DARE & ICAR, Krishi Bhavan, New Delhi-110001 Email: rita_sha@nic.in	Member
(iii)	Dr. J.S. Samra , DDG (NRM), Natural Resource Management Division, Krishi Anusandhan Bhavan-II, Pusa, New Delhi-110012; Email: jssamra@icar.org.in	Member
(iv)	Dr. Nagendra Sharma , Vice Chancellor, Sher-e-Kashmir University of Agricultural Sciences and Technology, Jammu, 180012, J&K Email: vc_nsharma@rediffmail.com	Member
(v)	Dr. S.N. Puri , Vice Chancellor, Central Agricultural University, PO Box: 23, Imphal-795004 Manipur, Email: snpuri04@yahoo.co.in ; snpuri@rediffmail.com	Member
(vi)	Dr. B.N. Singh , Director of Research, Birsa Agricultural University, Kanke, Ranchi-834006, Jharkhand Email: vc_bau@rediffmail.com	Member
(vii)	Dr. B.S. Dhillon , Director of Research, Punjab Agricultural University, Ludhiana-141 004; Email: vcpau@glide.net.in	Member
(viii)	Dr. Pratap Singh , Director of Research, Maharana Pratap University of Agriculture and Technology, Udaipur, Rajasthan-313001; Email: vcmtptau@sancharnet.in	Member
(ix)	Dr. K.P. Singh , Director (Extension), GB Pant University of Agriculture and Technology, Pantnagar-236145, Uttaranchal; Email: pl_gautam@yahoo.com	Member
(x)	Dr. C. Ramasamy , Tamil Nadu Agriculture University, Coimbatore-614003, Tamil Nadu Email: vc@tnau.ac.in	Member
(xi)	Shri Atul Sinha , Member-Secretary, National Commission on Farmers, Office Block, II floor, NASC Complex, Opposite Todapur village, Pusa, New Delhi-12	Member
(xii)	Shri Arvind Kaushal , Joint Secretary, Department of Animal Husbandry, Dairying & Fisheries, Krishi Bhavan, New Delhi-110001	Member
(xiii)	Dr. S.K. Patil , Vice Chancellor, University of Agricultural Sciences, Dharwad, Karnataka: Email: sapatil_uas@rediffmail.com	Member
(xiv)	Dr. R.C. Maheshwari , ADG (TC&Zonal Committees) ICAR, Krishi Anusandhan Bhavan, Pusa, New Delhi-110012 Email: rcm.icar@nic.in ; rcm@icar.org.in	Member
(xv)	Dr. A.K. Mehta , Zonal Coordinator, Zonal Coordinator, Zone-I, PAU, Ludhiana 141 004	Member

(xvi)	Shri Satish Chandra , Joint Secretary (INM), DAC, Krishi Bhavan,, New Delhi-110001: Email:	Member
(xvii)	Joint Secretary ,DONER,Vigyan Bhawan Annexe, New Delhi-110001.	Member
(xviii)	Dr. C. Prasad , Former DDG(Extension), ICAR Email: EB-106, Maya Enclave, New Delhi-110064 Email: vardan@mantraonline.com	Member
(xix)	Dr. R.K. Gupta , Regional Facilitator, CIMMYT-RWC, NASC complex, DP Shastri Marg, New Delhi-110012 Email: rgupta@cgiar.org	Member
(xx)	Dr. N.B. Singh , Agriculture Commissioner, DAC, Krishi Bhavan, New Delhi-110001	Member
(xxi)	Dr. K.N. Tiwari , 133, Sector 23, Krishi Kunj, Guagaon-122017, Haryana Email: kntiwari@ppi-ppic.org	Member
(xxii)	Dr. O.P. Rupela , Senior Scientist-II, ICRISAT, Patancheru-502324, Andhra Pradesh: Email: o.rupela@cgiar.org	Member
(xxiii)	Secretary, Agriculture , Government of Madhya Pradesh, Bhopal;	Member
(xxiv)	Secretary of Agriculture , Government of Gujarat, Gandhinagar; Email: seccoop@gujarat.gov.in	Member
(xxv)	Secretary of Agriculture , Government of Andhra Pradesh, Hyderabad	Member
(xxvi)	Director of Agriculture , Government of Kerala, Trivandaram	Member
(xxvii)	Member-Secretary, NEC , Shillong	Member
(xxviii)	Dr. G.R. Desai , Director, MANAGE, Rajnendranagar, Hyderabad-500030 Email: dqmanage@manage.gov.in	Member
(xxix)	Dr. Rugmini Parmar , Director (Plan Finance), Department of Expenditure, North Block, New Delhi-110001	Member
(xxx)	Dr. V.V. Sadamate , Adviser (Agriculture), Planning Commission, Yojana Bhavan, New Delhi-110001: Email: sadamate1@nic.in	Member
(xxxi)	Secretary (Agriculture) , Government of Tripura, Agartala. Email: secyagr@trp.nic.in	Member
(xxxii)	Secretary (Agriculture) , Government of Manipur, Imphal	Member
(xxxiii)	Director (Horticulture) Government of Mizoram, Aizwal	Member
(xxxiv)	Director (Horticulture) Government of Nagaland, Kohima	Member
(xxxv)	Secretary (Animal Husbandary) , Government of Arunachal Pradesh ,Itanagar.	Member
	Secretary(Agriculture) , Government of Meghalaya, Shillong	Member
(xxxvi)	Secretary(Agriculture) , Government of Sikkim,	Member

	Gangtok	
(xxxvii)	Dr.S.S.Baghel , Vice-Chancellor, Assam Agricultural University, Jorhat	Member
(xxxviii)	Dr. Jayant Madhab , Ramsa Hill, Kharghuli, Guwahati-781 003, Assam.	Member
(xxxix)	Shri D.N. Bezbaruah , Former Editor, the Sentinel, Guwahati, Assam	Member
(xl)	Dr. Anil Kumar Singh , Project Director, Water Technology Centre, IARI, New Delhi – 110012 Email: aks_wtc@yahoo.com	Member
(xli)	Director, IARI , Pusa, New Delhi-110012: Email:aksingh@iari.res.in;aks_wtc@yahoo.com	Member-Secretary

Annexure II. The Terms of Reference (TOR)

- (i) To identify and prioritize the key areas to be addressed under Agro-climatic Regional Planning.
- (ii) To assess the availability of natural resources and infrastructure necessitated for developing sustainable farming systems and to explore rationalization of region-specific potential for various enterprises.
- (iii) Identify the potential of crops and commodities for different agro-climatic regions and suggest measures to exploit the export/ commercial potential by way of reducing the production cost.
- (iv) To suggest a viable mechanism for technology development, refinement and adoption as also for operationalizing development programmes on agro-climatic region basis converging existing arrangements.
- (v) To assess the scope for diversification in agriculture and allied areas so as to harness the ground /surface water potential on sub-zone basis keeping in view the comparative advantage.
- (vi) To examine the marketing and value addition related bottlenecks in the development of zonal planning and to suggest measures for correcting them.
- (vii) To assess the performance of the commercial crops in the NE region.
- (viii) To review programmes for the development of Animal Husbandry, Dairying and fishery and to suggest measures for accelerating the growth of these sectors in NE region.
- (ix) To study the trends in capital formation and organic farming in NE region.
- (x)** To review the progress of agricultural development programmes in the North-Eastern States in the 10th Five Year Plan with a view to assessing their impact and suggest improvement.

Annexure III. The composition of Sub-Working Groups

Sub Working Group I	Sub Working Group II	Sub Working Group III	Sub Working Group IV	Sub Working Group V
Agril. Develop. in various Agro-climatic zones	Agril. Extension, Managemnt and Functional Linkages	HRD	North-Eastern Region	Value addition/ Infrastructure/Organic farming
Dr. N.B. Singh (C) Agriculture Commissioner DAC, Krishi Bhavan Email: ag.comm@nic.in	Dr. C. Prasad (C) Former DDG (Extn.) EB-106, Maya Enclave New Delhi-64 Email: vardan_ngo@yahoo.com	Dr. S.A. Patil Director, IARI New Delhi – 110 012 sapatil_uas@rediffmail.com director@iari.res.in	Dr. S.N. Puri (C) Vice-Chancellor Central Agril. University Imphal Email: snpuri04@yahoo.co.in snpuri@rediffmail.com	Dr. Nagendra Sharma (C) Vice-Chancellor Sher-e-Kashmir University of Agricultural Science & Technology, Jammu vc_nsharma@rediffmail.com
Dr. (Ms.) Rita Sharma Additional Secretary & FA, DARE/ICAR, Krishi Bhavan Email: rita_sha@nic.in	Dr. K.P. Singh Director (Extension) GBPUA&T, Pantnagar kamal_p_singh@rediffmail.com	Sh. Satish Chander Joint Secretary (INM) DAC, Krishi Bhavan, N.Delhi	Sh. Rajendra Mishra Joint Secretary, DONER Vigyan Bhawan, Annexe, N.Delhi Rajendra_mishra1@yahoo.com	Dr. B.N. Singh Director of Research Birsa Agril. University, Kanke, Ranchi
Dr. J.S. Samra DDG (NRM), ICAR jssamra@icar.org.in	Dr. C. Ramasamy Vice Chancellor TNAU, Coimbatore, Tamilnadu Email: vc@tnau.ac.in	Dr. G.R. Desai Director, MANAGE Hyderabad grdesai@manage.gov.in	Sh. P. Kharkongar Secretary, Agriculture Govt. of Meghalaya, Shillong Email: pochister@yahoo.com	Dr. Pratap Singh Director of Research MUA&T, Udaipur, Rajasthan vc_mptau@sancharnet.in
Dr. B.S. Dhillon Director of Research, PAU, Ludhiana Email: vcpau@glide.net.in	Dr. R.C. Maheshwari ADG (TC), ICAR, KAB-I Email: rcm.icar@nic.in	Dr. M.H. Mehta Gujarat Agril. University Gandhinagar	Sh. L. Haokip Secretary, Agriculture Govt. of Manipur, Agriculture Department, Imphal, Manipur	Dr. O.P. Rupela Principal Scientist ICRISAT, Patancheru Andhra Pradesh Email: o.rupela@cgiar.org
Sh. Atul Sinha Member-Secretary, NCF, NASC Complex, Pusa, New Delhi Email: atul.sinha@nic.in	Dr. A.K. Mehta Zonal Coordinator, PAU, Ludhiana Email: zculldh@yahoo.com zculldh@sify.com	Dr. S.K. Saha DG, Fertilizer Association of India, New Delhi	Pu Lalramthanga Tochhawng Secretary (Agriculture) Govt. of Mizoram Aizawl-796 001	Director of Agriculture Govt. of Kerala, Trivendrum

Sub Working Group I	Sub Working Group II	Sub Working Group III	Sub Working Group IV	Sub Working Group V
Dr. K.N. Tiwari 133, Sector 23 Krishi Kunj, Gurgaon kntiwari@ppi-ppic.org	Dr. V.V. Sadamate Advisor (Agriculture), Planning Commission, Yojana Bhavan, New Delhi sadamate1@nic.in	Secretary, Agriculture Govt. of Andhra Pradesh, Hyderabad	Sh. Alemtemshi Secretary (Agriculture) Govt. of Nagaland, Civil Secretariat, Kohima-797 001	
Dr. R.K. Gupta Regional Facilitator, CIMMYT-RWC, NASC Complex, Pusa Email: rgupta@cgiar.org	Secretary, Agriculture Govt. of Gujarat, Gandhinagar Email: seccoop@gujarat.gov.in	Dr. R.C. Gautam Ex-Dean & Jt. Director (Edn.), IARI, C-41, Pusa Campus, New Delhi	Sh. T. Taloh Secretary (Agriculture) Govt. of Arunachal Pradesh Itanagar Ph.0360-2212493	
Secretary, Agriculture Govt. of Madhya Pradesh, Bhopal	Secretary, Agriculture Govt. of Tripura, Agartala Email: secyagr@trp.nic.in		Sh. G.K. Gurung Secretary (Agriculture) Govt. of Sikkim, Krishi Bhawan, Tadong., Gangtok	
Dr. J.P. Tandon Former ADG (Crops) ICAR, New Delhi	Dr. P.N. Jha Former Vice Chancellor, RAU, B-38, Indrapuri Colony, P.O. Bihar Veterinary College, Patna-800014, Bihar		Member Sectary NEC Shillong	
Dr.P.C.Bhatia Former ADG(Agronomy) ICAR, New Delhi	Dr. B.P.Sinha Ex-Head, Div. Agril. Ext., IARI AN-9C, Shalimarbagh, Delhi-88		Dr. Jayant Madhab Ramsa Hill, Kharghuli, Guwahati, Assam	
	Dr.S.P.Ghosh Ex-DDG (Horticulture) 68, Kutub View Apartments Katwaria Sarai, New Delhi-16		Sh. D.N. Bezbaruah Former Editor The Sentinel, Guwahati Assam	
	Dr. N.K.Sanghi Adviser, WASSAN 12-13-452, Street No.1 Tamaka, Secunderabad-500017		Sh. Bhaskar Mushahary, Principal Secretary (Agriculture), Govt. of Assam, Assam Secretariat (Civil), Dispur – 781 006, Guwahati	
	Dr.N.L.Gupta Training Organizer Krishi Vigyan Kendra Divyodaya, Dibanandapali, Cenbre, Khowali Sub Division West Tripura-799207			

Annexure IV. An overview of Agro-Climatic Regions in India.

ACRP No.	Name of ACRP	Geog. Area (Lha)	Names of the States	Number of districts	Rainfall (mm)	Crop growing period (days)	GCA (Lha)	NSA (Lha)	CI (%)	GIA (Lha)	NIA (Lha)	Irri. Int (%)
I	Western Himalayan Region	331.39	H. P; J & K Uttranchal	39	165-2000	<90 - 210	32.85	20.91	157	-	-	-
II	Eastern Himalayan Region	274.94	Arunachal Pradesh; Assam; Manipur; Meghalaya; Mizoram; Nagaland; Sikkim; Tripura & three districts of West Bengal.	79	1400-12000	>270	67.70	46.50	146	-	-	-
III	Lower Gangetic Plains Region	69.73	15 districts of West Bengal	15	1300-2100	150-270	77.00	43.64	176	-	-	-
IV	Middle Gangetic plains region	164.59	23 districts of Uttar Pradesh & Bihar State	60	1211-1470	150-180	152.51	74.52	146	-	-	-
V	Upper Gangetic plains region	141.08	40 districts of Uttar Pradesh	40	721-979	150-180	139.06	101.49	156	-	-	-

Annexure-IV contd..

ACRP No.	Name of ACRP	Geog. Area (Lha)	Names of the States	Number of districts	Rainfall (mm)	Crop growing Period (days)	GCA (Lha)	NSA (Lha)	CI (%)	GIA (Lha)	NIA (Lha)	Irri. Int (%)
VI	Trans-gangetic Plains Region	116.80	Delhi; Haryana; Punjab; Chandigarh UT & two districts of Rajasthan	48	360-890	<90	163.73	93.23	173	135.74	78.46	173
VII	Eastern Plateau & Hills Region	371.23	Chhattisgarh; Jharkhand; three districts of Madhya Pradesh; four districts of Maharashtra; 15 districts of Orissa & one district of West Bengal.	57	1270-1430	<120	143.76	80.14	124	-	-	-
VIII	Central Plateau & Hills Region	371.64	30 districts of Madhya Pradesh; 20 districts of Rajasthan & 7 districts of Uttar Pradesh	57	490-1300	>120-150	216.21	164.84	131	34.97	31.85	110

Annexure-IV contd..

ACRP No.	Name of ACRP	Geog. Area (Lha)	Names of the States	Number of districts	Rainfall (mm)	Crop growing Period (days)	GCA (Lha)	NSA (Lha)	CI (%)	GIA (Lha)	NIA (Lha)	Irri. Int (%)
IX	Western Plateau & Hills Region	334.53	15 districts of Madhya Pradesh; 25 districts of Maharashtra and one district of Rajasthan.	41	602-1040	90-150	292.90	200.5	146	52.8	47.7	111
X	Southern Plateau & Hills Region	400.14	14 districts of Andhra Pradesh; 21 districts of Karnataka and 13 districts of Tamilnadu.	48	576-1051	<90	203.35	177.41	115	-	-	-
XI	East Coast Plains & Hills Region.	214.49	9 districts of Andhra Pradesh; 15 districts of Orissa; 15 districts of Tamilnadu and 4 districts of Pondicherry.	43	800-1904	115-210	114.57	82.10	140	41.61	31.17	133

Annexure-IV contd..

ACRP No.	Name of ACRP	Geog. Area (Lha)	Names of the States	Number of districts	Rainfall (mm)	Crop growing Period (days)	GCA (Lha)	NSA (Lha)	CI (%)	GIA (Lha)	NIA (Lha)	Irr. Int (%)
XII	West Coast Plains & Ghats Region	116.04	Goa; Kerala; 6 districts each of Karnataka & Maharashtra and two districts of Tamilnadu.	30	1457-5000	>270	53.48	43.00	123	9.4	7.8	122
XIII	Gujarat Plains & Hills Region	196.63	Gujarat; D & N Haveli and Daman & Diu	28	340-1793	90-150	107.25	94.70	113	36.34	29.87	122
XIV	Western Dry Region	175.73	9 districts of Rajasthan	9	256	<80	84.51	74.35	114	17.26	13.57	127
XV	The Islands Region	8.28	A & N Islands and Lakshdweep.	3	2836-3159	<270	-	-	-	-	-	-
Total		3287.24	30 States + 5 UTs	597	-	-	1760.00	1328.00	133	725.75	531.31	137

Source: Department of Agriculture & Co-operation, Union Ministry of Agriculture.

Acronyms: **Geog area:** Geographical area;

GCA: Gross Cropped Area;

NSA: Net Sown Area;

CI: Cropping Intensity;

GIA: Gross Irrigated Area;

NIA: Net Irrigated Area; and

Irr. Int: Irrigation Intensity.

Annexure V. Selected Agro-climatic features of Sub-regions.

Sl. No.	Sub-Region	Rainfall (mm)	Climate	Soil	Crops
I. Western Himalayas Region					
1	High altitude temperate	165	Humid to cold arid	Hill soils, mountain, meadow skeletal, tarai	Wheat, maize, rice, <i>Jowar</i> .
2	Hill temperate	2000	Humid	Brown hill	Rice, maize, wheat, rapeseed
3	Valley temperate	400	Sub-humid	Sub-mountain, mountain skeletal, meadow	Wheat, maize, rice, sugarcane.
4	Sub-tropical	1030	Semi-arid to humid	Alluvial (Recent), brown hills.	Wheat, barley, potato.
II. Eastern Himalayas Region					
1	Himalayan Hills	2641	Per humid to humid	Brown Hills	Rice, maize, <i>Ragi</i> , potato
2	North-East Hills	3528	Per humid to humid	Red sandy laterite	Rice, rapeseed, maize
3	Southern Hills	2052	Per humid to humid	Acidic soils	Rice, maize, sesame, sugarcane
4	Lower Brahmaputra	1840	Per humid to humid	Alluvial, red loamy, tarai soils	Rice, rapeseed, wheat, jute, potato
5	Upper Brahmaputra	2809	Humid to per humid	Alluvial, red loamy	Rice, jute, rapeseed, wheat
III. Lower Gangetic Plains Region					
1	Barind Plains	1587	Moist sub-humid & dry sub-humid	Red and yellow alluvial (Recent)	Rice, jute, wheat, rapeseed
2	Central Alluvial Plains	1449	Moist sub-humid to dry sub-humid	Red & yellow, Deltaic, alluvium, red loamy	Rice, jute, wheat, rapeseed, potato
3	Alluvial Coastal Saline Plains	1607	Dry sub-humid to moist sub-humid	Red and yellow deltaic, alluvial	Rice, jute, rapeseed
4	Rarh Plains	1302	Moist sub-humid to dry sub-humid	Red and yellow red loamy	Rice, wheat, rapeseed, sesame

Annexure-V contd...

Sl. No.	Sub-Region	Rainfall (mm)	Climate	Soil	Crops
IV. Middle Gangetic Plains Region					
1	North-West Alluvial	1211	Moist sub-humid to dry sub-humid	Alluvial (Recent), Calcareous	Rice, wheat, maize, sugarcane.
2	North-East Alluvial	1470	Dry sub-humid to moist sub-humid	Alluvial, tarai	Rice, wheat, maize, jute, gram
V: Upper Gangetic Plains Region					
1	Central Plains	979	Dry sub-humid to semi-arid	Alluvial	Wheat, rice, <i>Arhar</i>
2	North-Western Plains	907	Dry sub-humid to semi-arid	Alluvial, tarai	Wheat, sugarcane, rice, maize
3	South-Western Plains	721	Semi-arid	Alluvial	Wheat, <i>Bajra</i> , rice, maize, <i>Arhar</i> , potato
VI: Trans-Gangetic Plains Region					
1	Foothills of Shivalik & Himalayas	890	Semi-arid to Dry sub-humid	Alluvial (Recent) calcareous	Wheat, rice, maize, sugarcane
2	Plains	561	Semi-arid to Dry sub-humid	Alluvial (Recent) calcareous	Wheat, rice, <i>Bajra</i> , maize, sugarcane
3	Scarce Rainfall arid reion	360	Arid and Extreme arid	Calcareous, sierozemic, Alluvial (Recent), desert	Wheat, cotton, gram, <i>Bajra</i> , rice
VII: Eastern Plateau and Hills Region					
1	Eastern Plain	1271	Dry sub-humid	Medium to deep black red and yellow	Rice, linseed, <i>Jowar</i> , wheat, gram, groundnut
2	Eastern Highland	1436	Moist sub-humid to dry sub-humid	Red sandy, red and yellow	Rice, maize, niger, wheat
3	North Central Plateau	1296	Moist sub-humid to dry sub-humid	Red sandy, red and yellow	Rice, maize, wheat, <i>Ragi</i>
4	Eastern Plateau	1369	Moist sub-humid to dry sub-humid	Red & yellow, Red loamy	Rice, maize, <i>Ragi</i> , wheat
5	Tribal	1338	Moist sub-humid to dry sub-humid	Red sandy, red and yellow, red loamy laterite	Rice, <i>Ragi</i> , niger, maize

Annexure-V contd...

Sl. No.	Sub-Region	Rainfall (mm)	Climate	Soil	Crops
VIII: Central Plateau and Hills Region					
1	Bundelkhand (UP)	780	Dry sub-humid to arid	Mixed red & black	Wheat, gram, <i>Jowar</i> , rice
2	Bundelkhand (MP)	700	Dry sub-humid to semi-arid	Mixed red & black	Wheat, gram, <i>Jowar</i> , rice
3	North Hills	1570	Moist sub-humid to dry sub-humid	Red & yellow	Rice, wheat, niger
4	Kymore Plateau Satpura hills	1100	Dry sub-humid	Red and yellow Medium black	Maize, wheat, rice, gram, linseed
5	Vindhya Plateau	1130	Dry sub-humid	Medium black	Wheat, gram, <i>Jowar</i> , rice
6	Satpura Plateau	1220	Dry sub-humid	Shallow black, mixed red and black	<i>Jowar</i> , wheat, <i>Arhar</i>
7	Central Narmada Valley	1300	Dry sub-humid	Deep black, skeletal	Wheat, gram, soybean, <i>Jowar</i>
8	Gird	670	Semi arid (half drier & wetter half)	Medium black, alluvial	Wheat, gram, <i>Jowar</i> , rapeseed, <i>Bajra</i>
9	South Eastern Plains	760	Semi-arid (wetter half)	Medium black	wheat, <i>Jowar</i> , gram, maize
10	Southern Plains	760	Semi-arid to arid	Medium red and black, grey brown	Maize, rice, wheat, gram
11	Transitional Plain	490	Semi-arid (wetter half)	Desert soil, grey brown	<i>Bajra</i> , wheat, sesame, rapeseed, <i>Jowar</i>
12	Southern Plains & Aravali Hills	500	Semi-arid (wetter half)	Red and yellow, grey brown	Maize, wheat, gram, <i>Jowar</i>
13	Semi-arid Eastern Plains	500	Semi-arid (drier half)	Alluvial	wheat, <i>Bajra</i> , <i>Jowar</i> , gram
14	Flood Prone Eastern Plain	500	Semi-arid (drier half)	Alluvial (Recent)	<i>Bajra</i> , wheat, rapeseed, gram, <i>Jowar</i>
IX: Western Plateau and Hills Region					
1	Hill region	988	Semi-arid	Medium to deep black shallow red, red loamy	<i>Jowar</i> , <i>Bajra</i> , groundnut
2	Scarcity region	602	Semi-arid	Medium black, deep black	<i>Jowar</i> , cotton, wheat
3	Plateau region	874	Semi-arid (wetter half)	Medium black, deep black, mixed red	Gram, <i>Jowar</i> , cotton, wheat

Annexure-V contd...

Sl. No.	Sub-Region	Rainfall (mm)	Climate	Soil	Crops
IX: Western Plateau and Hills Region contd...					
4	Plateau region South	1040	Semi-arid to dry sub-humid	Medium black, shallow black	Cotton, <i>Jowar</i> , <i>Tur</i> , wheat
X: Southern Plateau and Hills Region					
1	Sub-region-1	769	Semi-arid & arid	Medium, black, Red loamy	<i>Jowar</i> , cotton, groundnut, <i>Bajra</i>
2	Sub-region-2	677	Semi-arid	Red loamy, medium black, red sandy, coastal alluvium, laterite	Groundnut, <i>Ragi</i> , <i>Jowar</i> , rice
3	Sub-region-3	725	Semi-arid & arid	Red sandy, medium to deep black	<i>Jowar</i> , rice, castor, groundnut
4	Sub-region-4	1001	Semi-arid (wetter half)	Deep black, medium black.	Rice, <i>Jowar</i> , maize, cotton, groundnut
5	Sub-region-5	865	Semi-arid	Red loamy, red sandy	<i>Ragi</i> , <i>Jowar</i> , groundnut, rice
6	Sub-region-6	841	Semi-arid to Dry sub-humid	Mixed red and black red loamy, deltaic alluvium	Rice, <i>Jowar</i> , groundnut, <i>Bajra</i>
XI. East Coast Plains & Hills Region					
1	North Orissa Coast	1287	Moist sub-humid	Deltaic alluvial, coastal alluvial, laterite, red loamy	Rice, groundnut, jute, sesame, <i>Ragi</i>
2	North Coastal Andhra	1128	Dry sub-humid	Red loamy, laterite medium black, red, sandy, coastal alluvial	Rice, <i>Ragi</i> , groundnut, <i>Bajra</i> , sesame
3	South Coastal Andhra	996	Semi-arid	Deltaic alluvium, deep black, red, sandy, red & black	Rice, cotton, <i>Jowar</i> , tobacco, groundnut
4	North Coastal Tamilnadu	1036	Semi-arid	Red loamy, red sandy, coastal alluvium	Rice, groundnut, <i>Bajra</i> , <i>Jowar</i>
5	Tanjavur	1113	Semi-arid to dry sub-humid	Deltaic alluvium, red loamy	Rice, groundnut, sesame, sugarcane
6	South Coastal Tamilnadu	780	Semi-arid (drier half)	Mixed Red & Black, coastal alluvium	Rice, cotton, <i>Bajra</i> , groundnut

Annexure-V contd...

Sl. No.	Sub-Region	Rainfall (mm)	Climate	Soil	Crops
XII. West Coast Plains & Ghats Region					
1	Coastal Hilly	3640	Per humid & humid	Laterite, red loamy, coastal alluvium	Rice, <i>Ragi</i> , sesame, niger
2	Coastal Midland	3127	Dry sub-humid & per humid	Red loamy, coastal alluvium, laterite	Rice, tapioca, <i>Ragi</i> , banana
3	Midland	2727	Per humid	Laterite, red loamy, coastal alluvium	Rice, tapioca, groundnut, banana
4	Hilly	226	Per humid	Red loamy, mixed red and black	Rice, <i>Ragi</i> , <i>Jowar</i> , groundnut
XIII. Gujarat Plains & Hills Region					
1	South Gujarat (heavy rainfall)	1793	Semi-arid to dry sub-humid	Deep black, coastal alluvium	Rice, <i>Ragi</i> , sugarcane, <i>Jowar</i>
2	South Gujarat	974	Semi-arid to dry sub-humid	Deep black, coastal alluvium	<i>Jowar</i> , <i>Arhar</i> , cotton, wheat
3	Middle Gujarat	904	Semi-arid	Medium black	Rice, maize, <i>Bajra</i> , cotton
4	North Gujarat	735	Arid to semi-arid	Grey brown, Coastal alluvium	<i>Bajra</i> , cotton, <i>Jowar</i> , wheat
5	North-West arid	340	Arid to semi-arid	Grey brown, deltaic alluvium	<i>Bajra</i> , groundnut, <i>Jowar</i> , cotton
6	North Saurashtra	537	Dry sub-humid	Medium black	<i>Bajra</i> , <i>Jowar</i> , groundnut, cotton
7	South Saurashtra	844	Dry sub-humid	Coastal alluvium, medium black	Groundnut, wheat, <i>Bajra</i> , cotton
XIV. Western Dry Region					
	Western Dry	395	Arid to extremely arid	Desert soil, grey brown	<i>Bajra</i> , gram, wheat, rapeseed
XV. The Islands Region : Sub-regions not delineated.					

Source: Guha; G. S. & D. N. Basu: Agro-Climatic Regional Planning in India (Vol.I: concept and applications),pp. 127-131

FINAL REPORT OF THE WORKING GROUP

ON

**AGRO-CLIMATIC ZONAL PLANNING INCLUDING AGRICULTURE DEVELOPMENT
IN NORTH-EASTERN INDIA**

FOR

XI FIVE YEAR PLAN (2007-12)

Volume II

By

**Dr. Panjab Singh
Vice Chancellor
Banaras Hindu University
Varanasi – 211 005**

AGRO-CLIMATIC ZONAL PLANNING INCLUDING AGRICULTURE DEVELOPMENT IN NORTH-EASTERN INDIA

1. BACKGROUND

The Planning Commission constituted 12 Working Groups to prepare the 11th Five Year Plan document on Agriculture. Of the 12 working groups, one Working Group was constituted with the specific objective preparing a document for Agro-climatic Zonal Planning including Agriculture Development in North-Eastern India. The composition of this Working Group and the Terms of References are given in *Annexure I* and *Annexure II*.

The Working Groups under the Chairmanship of Dr. Panjab Singh and Dr.A.K.Singh as Member Secretary, had its first meeting on 11 July 2006 followed by several meetings subsequently. In the first meeting, it was decided to constitute 5 sub-working groups to prepare the detailed material on the various issues essential for agro-climatic zonal developmental planning. These sub-groups constituted are as follows:

- I. Agricultural development in various Agro-climatic Zones.
Chairman: Dr. N.B.Singh, Agriculture Commissioner, Department of Agriculture & Cooperation, Krishi Bhawan, New Delhi.
- II. Agricultural Extension, Management and Functional Linkages.
Chairman: Dr. C. Prasad, Former DDG (Extn.), ICAR, EB-106, Maya Enclave, New Delhi-110 064.
- III. Human Resources Development.
Chairman: Dr. S.A. Patil, Director, IARI, New Delhi-110012
- IV. North East Region.
Chairman: Dr. S. N. Puri, Vice-Chancellor, Central Agricultural University, P.O. Box-23, Imphal-795 004, Manipur.
- V. Value Addition/Infrastructure/Organic Farming.
Chairman: Dr. Nagendra Sharma, Vice-Chancellor, Sher-e-Kashmir University of Agricultural Sciences & Technology, Jammu.

The sub-working groups met independently and prepared the detailed work plan related to their assigned topic. The composition of sub-working groups is given in *Annexure III*.

The working group decided to follow the following format for report writing: Introduction, Current status, Present need, Gaps existing, Priority areas, Infrastructure needs, Linkages with stakeholders, Funding Requirement, Summary and Appendices.

The Interim Report was submitted to the Planning Commission based on which this Final Report has been prepared. It consists of 2 volumes. Volume I is the main report which gives the details of Agro-Climatic Zonal Planning, while Volume II gives the detailed report of the each sub-working groups. Volume I has already been submitted.

Annexure I. The composition of the Working Group

(i)	Dr. Panjab Singh , Vice Chancellor, Banaras Hindu University, Varanasi -211005 & former Secretary, DARE & DG, ICAR Email: vc_bhu@sify.com ; panjabsingh03@yahoo.com	Chairman
(ii)	Dr. (Mrs.) Rita Sharma , Additional Secretary & FA DARE & ICAR, Krishi Bhavan, New Delhi-110001 Email: rita_sha@nic.in	Member
(iii)	Dr. J.S. Samra , DDG (NRM), Natural Resource Management Division, Krishi Anusandhan Bhavan-II, Pusa, New Delhi-110012; Email: jssamra@icar.org.in	Member
(iv)	Dr. Nagendra Sharma , Vice Chancellor, Sher-e-Kashmir University of Agricultural Sciences and Technology, Jammu, 180012, J&K Email: vc_nsharma@rediffmail.com	Member
(v)	Dr. S.N. Puri , Vice Chancellor, Central Agricultural University, PO Box: 23, Imphal-795004 Manipur, Email: snpuri04@yahoo.co.in ; snpuri@rediffmail.com	Member
(vi)	Dr. B.N. Singh , Director of Research, Birsa Agricultural University, Kanke, Ranchi-834006, Jharkhand Email: vc_bau@rediffmail.com	Member
(vii)	Dr. B.S. Dhillon , Director of Research, Punjab Agricultural University, Ludhiana-141 004; Email: vcpau@glide.net.in	Member
(viii)	Dr. Pratap Singh , Director of Research, Maharana Pratap University of Agriculture and Technology, Udaipur, Rajasthan-313001; Email: vcmptau@sancharnet.in	Member
(ix)	Dr. K.P. Singh , Director (Extension), GB Pant University of Agriculture and Technology, Pantnagar-236145, Uttaranchal; Email: pl_gautam@yahoo.com	Member
(x)	Dr. C. Ramasamy , Tamil Nadu Agriculture University, Coimbatore-614003, Tamil Nadu Email: vc@tnau.ac.in	Member
(xi)	Shri Atul Sinha , Member-Secretary, National Commission on Farmers, Office Block, II floor, NASC Complex, Opposite Todapur village, Pusa, New Delhi-12	Member
(xii)	Shri Arvind Kaushal , Joint Secretary, Department of Animal Husbandry, Dairying & Fisheries, Krishi Bhavan, New Delhi-110001	Member
(xiii)	Dr. S.K. Patil , Vice Chancellor, University of Agricultural Sciences, Dharwad, Karnataka: Email: sapatil_uas@rediffmail.com	Member
(xiv)	Dr. R.C. Maheshwari , ADG (TC&Zonal Committees) ICAR, Krishi Anusandhan Bhavan, Pusa, New Delhi-110012 Email: rcm.icar@nic.in ; rcm@icar.org.in	Member
(xv)	Dr. A.K. Mehta , Zonal Coordinator, Zonal Coordinator, Zone-I, PAU, Ludhiana 141 004	Member
(xvi)	Shri Satish Chandra , Joint Secretary (INM), DAC, Krishi Bhavan,, New Delhi-110001: Email:	Member
(xvii)	Joint Secretary , DONER, Vigyan Bhawan Annexe, New	Member

	Delhi-110001.	
(xviii)	Dr. C. Prasad , Former DDG(Extension), ICAR Email: EB-106, Maya Enclave, New Delhi-110064 Email: vardan@mantraonline.com	Member
(xix)	Dr. R.K. Gupta , Regional Facilitator, CIMMYT-RWC, NASC complex, DP Shastri Marg, New Delhi-110012 Email: rgupta@cgiar.org	Member
(xx)	Dr. N.B. Singh , Agriculture Commissioner, DAC, Krishi Bhavan, New Delhi-110001	Member
(xxi)	Dr. K.N. Tiwari , 133, Sector 23, Krishi Kunj, Guagaon- 122017, Haryana Email: kntiwari@ppi-ppic.org	Member
(xxii)	Dr. O.P. Rupela , Senior Scientist-II, ICRISAT, Patancheru-502324, Andhra Pradesh: Email: o.rupela@cgiar.org	Member
(xxiii)	Secretary, Agriculture , Government of Madhya Pradesh, Bhopal;	Member
(xxiv)	Secretary of Agriculture , Government of Gujarat, Gandhinagar; Email: seccoop@gujarat.gov.in	Member
(xxv)	Secretary of Agriculture , Government of Andhra Pradesh, Hyderabad	Member
(xxvi)	Director of Agriculture , Government of Kerala, Trivandarum	Member
(xxvii)	Member-Secretary, NEC , Shillong	Member
(xxviii)	Dr. G.R. Desai , Director, MANAGE, Rajnendranagar, Hyderabad-500030 Email: dqmanage@manage.gov.in	Member
(xxix)	Dr. Rugmini Parmar , Director (Plan Finance), Department of Expenditure, North Block, New Delhi- 110001	Member
(xxx)	Dr. V.V. Sadamate , Adviser (Agriculture), Planning Commission, Yojana Bhavan, New Delhi-110001: Email: sadamate1@nic.in	Member
(xxxi)	Secretary (Agriculture) , Government of Tripura, Agartala. Email: secyagr@trp.nic.in	Member
(xxxii)	Secretary (Agriculture) , Government of Manipur, Imphal	Member
(xxxiii)	Director (Horticulture) Government of Mizoram, Aizwal	Member
(xxxiv)	Director (Horticulture) Government of Nagaland, Kohima	Member
(xxxv)	Secretary (Animal Husbandary) , Government of Arunachal Pradesh ,Itanagar.	Member
	Secretary(Agriculture) , Government of Meghalaya, Shillong	Member
(xxxvi)	Secretary(Agriculture) , Government of Sikkim, Gangtok	Member
(xxxvii)	Dr.S.S.Baghel , Vice-Chancellor, Assam Agricultural University, Jorhat	Member
(xxxviii)	Dr. Jayant Madhab , Ramsa Hill, Kharghuli, Guwahati-781 003, Assam.	Member

(xxxix)	Shri D.N. Bezbaruah , Former Editor, the Sentinel, Guwahati, Assam	Member
(xl)	Dr. Anil Kumar Singh , Project Director, Water Technology Centre, IARI, New Delhi – 110012 Email: aks_wtc@yahoo.com	Member
(xli)	Director, IARI , Pusa, New Delhi-110012: Email:aksingh@iari.res.in;aks_wtc@yahoo.com	Member- Secretary

Annexure II. The Terms of Reference (TOR)

- (i) o identify and prioritize the key areas to be addressed under Agro-climatic Regional Planning.
- (ii) o assess the availability of natural resources and infrastructure necessitated for developing sustainable farming systems and to explore rationalization of region-specific potential for various enterprises.
- (iii) dentify the potential of crops and commodities for different agro-climatic regions and suggest measures to exploit the export/ commercial potential by way of reducing the production cost.
- (iv) o suggest a viable mechanism for technology development, refinement and adoption as also for operationalizing development programmes on agro-climatic region basis converging existing arrangements.
- (v) o assess the scope for diversification in agriculture and allied areas so as to harness the ground /surface water potential on sub-zone basis keeping in view the comparative advantage.
- (vi) o examine the marketing and value addition related bottlenecks in the development of zonal planning and to suggest measures for correcting them.
- (vii) o assess the performance of the commercial crops in the NE region.
- (viii) o review programmes for the development of Animal Husbandry, Dairying and fishery and to suggest measures for accelerating the growth of these sectors in NE region.
- (ix) o study the trends in capital formation and organic farming in NE region.
- (x) o review the progress of agricultural development programmes in the North-Eastern States in the 10th Five Year Plan with a view to assessing their impact and suggest improvement.

Annexure III. The composition of Sub-Working Groups

Sub Working Group I	Sub Working Group II	Sub Working Group III	Sub Working Group IV
Agril. Develop. in various Agro-climatic zones	Agril. Extension, Managemnt and Functional Linkages	HRD	North-Eastern Region
Dr. N.B. Singh (C) Agriculture Commissioner DAC, Krishi Bhavan Email: ag.comm@nic.in	Dr. C. Prasad (C) Former DDG (Extn.) EB-106, Maya Enclave New Delhi-64 Email: vardan_ngo@yahoo.com	Dr. S.A. Patil Director, IARI New Delhi – 110 012 sapatil_uas@rediffmail.com director@iari.res.in	Dr. S.N. Puri (C) Vice-Chancellor Central Agril. University Imphal Email: snpuri04@yahoo.co.in snpuri@rediffmail.com
Dr. (Ms.) Rita Sharma Additional Secretary & FA, DARE/ICAR, Krishi Bhavan Email: rita_sha@nic.in	Dr. K.P. Singh Director (Extension) GBPUA&T, Pantnagar kamal_p_singh@rediffmail.com	Sh. Satish Chander Joint Secretary (INM) DAC, Krishi Bhavan, N.Delhi	Sh. Rajendra Mishra Joint Secretary, DONER Vigyan Bhawan, Annexe, N.Delhi Rajendra_mishra1@yahoo.com
Dr. J.S. Samra DDG (NRM), ICAR jssamra@icar.org.in	Dr. C. Ramasamy Vice Chancellor TNAU, Coimbatore, Tamilnadu Email: vc@tnau.ac.in	Dr. G.R. Desai Director, MANAGE Hyderabad grdesai@manage.gov.in	Sh. P. Kharkongar Secretary, Agriculture Govt. of Meghalaya, Shillong Email: pochister@yahoo.com
Dr. B.S. Dhillon Director of Research, PAU, Ludhiana Email: vcpau@glide.net.in	Dr. R.C. Maheshwari ADG (TC), ICAR, KAB-I Email: rcm.icar@nic.in	Dr. M.H. Mehta Gujarat Agril. University Gandhinagar	Sh. L. Haokip Secretary, Agriculture Govt. of Manipur, Agriculture Department, Imphal, Manipur
Sh. Atul Sinha Member-Secretary, NCF, NASC Complex, Pusa, New Delhi Email: atul.sinha@nic.in	Dr. A.K. Mehta Zonal Coordinator, PAU, Ludhiana Email: zculldh@yahoo.com zculldh@sify.com	Dr. S.K. Saha DG, Fertilizer Association of India, New Delhi	Pu Lalramthanga Tochhawng Secretary (Agriculture) Govt. of Mizoram Aizawl-796 001

Sub Working Group I	Sub Working Group II	Sub Working Group III	Sub Working Group IV
Dr. K.N. Tiwari 133, Sector 23 Krishi Kunj, Gurgaon kntiwari@ppi-ppic.org	Dr. V.V. Sadamate Advisor (Agriculture), Planning Commission, Yojana Bhavan, New Delhi sadamate1@nic.in	Secretary, Agriculture Govt. of Andhra Pradesh, Hyderabad	Sh. Alemtemshi Secretary (Agriculture) Govt. of Nagaland, Civil Secretariat, Kohima-797 001
Dr. R.K. Gupta Regional Facilitator, CIMMYT-RWC, NASC Complex, Pusa Email: rgupta@cgiar.org	Secretary, Agriculture Govt. of Gujarat, Gandhinagar Email: seccoop@gujarat.gov.in	Dr. R.C. Gautam Ex-Dean & Jt. Director (Edn.), IARI, C-41, Pusa Campus, New Delhi	Sh. T. Taloh Secretary (Agriculture) Govt. of Arunachal Pradesh Itanagar Ph.0360-2212493
Secretary, Agriculture Govt. of Madhya Pradesh, Bhopal	Secretary, Agriculture Govt. of Tripura, Agartala Email: secyagr@trp.nic.in		Sh. G.K. Gurung Secretary (Agriculture) Govt. of Sikkim, Krishi Bhawan, Tadong,, Gangtok
Dr.J.P. Tandon Former ADG (Crops) ICAR, New Delhi	Dr. P.N. Jha Former Vice Chancellor, RAU, B-38, Indrapuri Colony, P.O. Bihar Veterinary College, Patna-800014, Bihar		Member Sectary NEC Shillong
Dr.P.C.Bhatia Former ADG(Agronomy) ICAR, New Delhi	Dr. B.P.Sinha Ex-Head, Div. Agril. Ext., IARI AN-9C, Shalimarbagh, Delhi-88		Dr. Jayant Madhab Ramsa Hill, Kharghuli, Guwahati, Assam
	Dr.S.P.Ghosh Ex-DDG (Horticulture) 68, Kutub View Apartments Katwaria Sarai, New Delhi-16		Sh. D.N. Bezbaruah Former Editor The Sentinel, Guwahati Assam
	Dr. N.K.Sanghi Adviser, WASSAN 12-13-452, Street No.1 Tamaka, Secunderabad-500017		Sh. Bhaskar Mushahary, Principal Secretary (Agriculture), Govt. of Assam, Assam Secretariat (Civil), Dispur – 781 006, Guwahati
	Dr.N.L.Gupta Training Organizer Krishi Vigyan Kendra Divyodaya, Dibanandapali, Cenbre, Khowali Sub Division West Tripura-799207		

INTERIM REPORT OF THE SUB-GROUP ON “AGRICULTURAL DEVELOPMENT IN VARIOUS AGRO-CLIMATIC ZONES” OF THE WORKING GROUP OF NATIONAL DEVELOPMENT COUNCIL (NDC) ON AGRO-CLIMATIC ZONAL PLANNING INCLUDING AGRICULTURE DEVELOPMENT IN NORTH-EASTERN INDIA FOR XI FIVE YEAR PLAN (2007-12).

By

**Dr. N. B. Singh
Agriculture Commissioner
Department of Agriculture & Cooperation
Ministry of Agriculture
Krishi Bhavan, New Delhi-110 001**

PRIORITIES IN VARIOUS AGRO-CLIMATIC ZONES'

1. INTRODUCTION: Agro-Climatic Regional Planning in India (ACRP) is considered as a distinctive planning approach applied to agriculture and allied sectors. It is essentially resource based planning. All other parameters or features associated with ACRP are either derived from this essentiality or are incidental to it. The rationale of this approach stems from the significance of long term resource efficiency (or sustainability). *The ACRP approach is, thus, not limited to the dimensions of crop sector alone, but it includes the entire range of land and water resource based activities i.e. "Farming Systems" as a whole.*

The dimensions of technology and sustainability are integral to resource based planning. The technology is means of utilization of natural resource endowments within the constraints of finance, institutions and social imperatives. In another sense, technology lends an element of dynamism in the changing and more efficient use of land and water resources. The logical corollary of this would imply that in the ultimate analysis ACRP approach seeks to achieve the best trade off between maximization of productive efficiency of given resource endowments through use of appropriate technology and institutions and long term sustainability of such resource use both in the sense of maintaining inter-generational and social equity in the access to resources.

The next important consideration in the ACRP approach is its area specificity. A holistic approach combining area based planning, as against a sectoral or schematic approach, characterizes the ACRP exercise. The inherent assumption is that resource based planning is meaningful only for homogeneous regions with respect to natural resource endowments, specifically agro-climatic factors, in planning for agriculture and allied sectors. The ACRP approach has gone beyond the essential features or dimensions of planning for agriculture and allied sectors with the passage of time. These extensions in the approach hover around the following two considerations:-

- resource based planning, which aims at the best trade off between maximization of productive efficiency and sustainability, should finally be linked to the two intrinsic parameters of national planning namely; income generation and income up gradation leading to poverty alleviation; and
- Operational feasibility of this approach to be established in relation to the institutional, financial and social parameters as obtained in a specific area or at national level.

As a sequel to the decision taken by the Planning Commission in its meeting held on 20th July, 1987, 15 agro-climatic regions were delineated based on similarity in soil type, climate (temperature & rainfall) and captive water resources in the country to serve as the level of planning. An overview of all the 15 Agro-Climatic Regions so delineated is provided at **Annexure-I**. A perusal of the same indicates that the maximum geographical area (400.10 Lakh ha) lies in the Southern Plateau & Hills Region-X amongst 15 regions in the country. The maximum Gross Cropped Area of 292.90 Lakh ha lies in the Western Plateau & Hills Region. The maximum Cropping Intensity of 176% has been realized in Lower Gangetic Plains Region-III (15 districts of West Bengal) followed by Trans-gangetic Plains Region-VI (Delhi, Haryana, Punjab, Chandigarh UT & Sirganganagar and Hanumangarh districts of Rajasthan State).

The sub-region specific delineation made by the Planning Commission is also appended at **Annexure-II** in order to reckon the sub-region specific priorities.

2. Current Status: Indian Agriculture has made impressive strides in last five decades. The highest Gross Cropped Area of 190.84 m ha has been realized during 2003-04 registering an increase of about 26.7% over that of quinquennium (1956-1961) average being 150.51 m ha. During this period, food grains production has increased over 4 times from about 51 million tonnes during early fifties to 213.19 million tonnes during 2003-04. Thus, the composition of food grains turned out to be 198.28 million tonnes of cereals and 14.91 million tonnes of pulses by the end of the year:2003-04. It has contributed significantly in achieving self-sufficiency of food in the country. The food grains production in the year 2005-06 is estimated of the order of 208.30 million tones which constitute 195.19 million tones of cereals and 13.11 million tones of pulses.

The annual production of oilseeds, which was only 5.16 million tonnes during early fifties, has risen to 27.73 million tonnes in the year 2005-06.

The annual production of cotton, which was 3.04 million bales during early fifties has risen to 19.57 million bales in the year 2005-06. Similarly, annual production of sugarcane has risen to a level of 278.39 million tonnes of cane from the level of merely 57.05 million tonnes during early fifties.

Though the overall growth in agriculture sector has been encouraging, the signs of productivity deceleration had started emerging since 90s onwards. It is important to note that the growth during recent past as well as during the last three decades has been attributed to the technological inputs. Thereafter, the impact of technology appears to have been less effective. The markets have also not supported to create a proper incentive environment for the growth in agriculture. The present era of globalization of trade may further usher in new technological opportunities but for that the market and price front have to be congenial.

Increase in agricultural production over time had been achieved by creating enabling infrastructure through public investment and by policy changes affecting agricultural production, marketing, processing and trade. The capital formation in agricultural sector during this period was quite satisfactory and well contributed by public as well as private sources. However, during 80s, public investment in agriculture started declining even though the private investment kept the same pace of growth. Despite this decline, output of agricultural sector showed higher growth compared to the previous three decades. This could be made possible by spread of modern technology to wider areas, increasing cropping intensity, crop diversification, increased use of technology enhancing input use driven by market forces and policy support. The decade also witnessed some improvement in terms of trade going in favour of agriculture. During nineties, there was further decline in public sector investment. The pace of technological inputs also slowed down and the prices as well as market ceased to provide the required response. The decade also witnessed some improvement in terms of trade going in favour of agriculture. The pace of technological inputs also slowed down and the prices as well as market ceased to provide the required response.

The growth in productivity of all crops has been showing declining trend across the regions by the end of 2004-05. Wheat, which is an important constituent of National Food Security, showed a declining trend in productivity. While rice and *ragi* seem to have

reached yield plateau after 1992-93. This seems to be a matter of serious concern, especially in view of a growth strategy from globalization and trade angles. The growth in the agriculture sector and non-agriculture sector has been quite modest during 90s. Growth in agriculture after mid-nineties was totally different than before mid-nineties mainly because of three continuous climatically abnormal years at the end of Nineties.

The ACRP specific analysis (**Annexure-III**) indicates that productivity deceleration in wheat has taken place by the period ending 2003-04 in region II to VI. It is noteworthy that these regions contribute maximum production of wheat in the country. Similarly, the productivity deceleration has also been witnessed in rice in region-IV (Bihar and eastern Uttar Pradesh), a region which has vast potential for enhancing the productivity of rice and IX (Western parts of Madhya Pradesh, parts of Vidarbha & Madhya Maharashtra region of Maharashtra and Jhalawar district of Rajasthan). The productivity of maize has also declined in regions I,V, VI,IX and XIV.

Among horticulture crops, annual production of potato has risen to a level of 23.63 million tonnes in the year 2004-05 from the level of 1.66 million tonnes during the period of early fifties. Similarly, the production of onion and other horticultural crops namely coconut, cashewnut, mango, apple, banana, grapes, guava, pine-apple, kinno, lime, orange and vegetable crops has also increased substantially. The highest growth in the area and production has been registered in pine-apple, orange, mosambi, cauli-flower, ginger followed by mango, grapes, lime, tomato and cabbage.

According to Livestock Census-2003, the total livestock population in the country was 485 million animals as against 485.4 million animals in the year 1997 which remained almost at par. The composition of total livestock in the year 2003 indicates that there were 185.2 million of cattle as against 198.8 million in the year 1997 registering a decrease of about 9%. However, the population of adult female cattle has increased to 64.5 million cattle in the year 2003 which was 63.6 million cattle in the year 1997. The population of buffaloes was 97.9 million in the year 2003 as against 89.9 million in the year 1997 registering an increase of 9%. In case of the population of buffaloes also, the population of adult female buffaloes has increased to 51 million in the year 2003 which was 46.8 million in the year 1997. The population of sheep and goats has increased to 61.5 million and 124.4 million in the year 2003 as against 57.5 million and 122.7 million in the year 2003. The population of poultry has also substantially increased to 489 million birds in the year 2003 as against 347.6 million in 1997.

The production of milk has increased to 91 million tonnes in the year 2004-05 which was 38.8 million tonnes in the year 1983-84 registering an increase of 135% over a period of 22 years. Similarly production of eggs has increased to 41 billion eggs in the year 2004-05 as against 12.8 billion eggs in the year 1983-84 registering an impressive increase of 220% over a period of 22 years. The production of wool increased to 50 million kgs in the year 2004-05 as against 36.1 million kgs in the year 1983-84 registering an increase of 39% over a period of 22 years

The production of fish has increased to 6.399 million tonnes in the year 2003-04 which was 0.752 million tonnes in the year 1950-51.

Thus, it amply clear that spectacular growth had been witnessed in agriculture sector and allied sectors on long term basis which has shown sluggishness in recent past.

In other words, growth has not been steady through out which need correction at this point of time.

3. Present need:- In so far as demand of food articles is concerned, it depends on the growth of population, income per capita, distribution of income, elasticity of demand for food (price & income and other requirements. Among twin forces, an increase in the growth rate of population leads to a direct increase in the growth rate of total demand for food while growth in per capita income increases rate of growth of demand for food grains albeit at lower rate. The rapid growth in population in the country results in rapid growth in demand for food grains. It has been observed from the demand estimates that if the country has to be self-sufficient in food grains production, the growth rate of domestic demand output should henceforth accelerate to 3.5 to 4% per annum from the level of 2.7% per annum achieved during the period from 1949-50 to 1989-90. The annual growth rate of food grains production was 2.67% during 1967-68 to 1995-96. It was 2.86% during the period from 1980-81 to 1995-96 and 1.7% during the period from 1990-91 to 1996-97. These figures reveal that incremental output per must be more than what the country realizes. Therefore, there should be need of additional production of food grains to meet the growing demand by the year:2010 from the present level of 195.44 (TE:2004-05). The demand of agricultural commodities on long by term basis by the period ending 2020 has been estimated as under:-

Table.1: Demand for agricultural commodities.

Commodity	Level of Production by TE:1998-99			Demand by the Year:2020 (Million tonnes)		Targeted Yield (Kg/ha)	
	Area (Million ha)	Production (Million tonnes)	Yield (Kg/ha)	LIG	HIG	LIG	HIG
Rice	42.2	85.7	1903	112.4	111.9	2664	2652
Wheat	26.2	69.1	2582	82.3	79.9	3137	3045
Coarse cereals	30.7	30.4	1041	38.9	37.3	1268	1214
Cereals	99.1	185.2	1814	233.6	229.0	2357	2311
Pulses	21.7	13.8	608	22.3	23.8	1029	1095
Foodgrains	120.8	199.0	1595	255.9	252.8	2119	2092
Edible oils	28.6	6.4	269	10.8	11.4	380	399
Potato	1.2	21.6	17188	27.8	30.6	22279	24566
Vegetables	5.3	74.5	14204	135.6	168.0	25673	31812
Fruits	3.2	43.0	13437	77.0	93.6	24064	29259
Sugarcane (Gur)	3.7	26.9	7006	32.6	33.7	8788	9088
Milk	-	71.2	-	115.8	137.3	-	-
Meat	-	5.0	-	8.8	11.4	-	-
Eggs (in numbers)	-	2873	-	7750.0	10000.0	-	-
Fish	-	5.3	-	10.1	12.8	-	-

Source: R. S. Paroda & Praduman Kumar (2000): Food Production and Demand in South Asia. Agril. Econ. Res. Rev. 13 (1):1-24.

LIG: Low Income Growth (3.5% per capita GDP Growth);

HIG: High Income Growth (5.5% per capita GDP Growth);

The above demand estimates includes exportable surplus of 4.7 million tonnes of rice, 3.6 million tonnes of wheat, 2.2 million tonnes of vegetables, 1.4 million tonnes of fruits and 0.49 million tonnes of fish.

Primarily agriculture and allied sectors need be a viable proposition in terms of profitability, employment opportunities and utility. The rising cost of inputs has affected all the sectors of economy, as commensurate rise in the procurement price of agricultural commodities has not been feasible. The fluctuation in the productivity due to aberrant weather conditions, climate change and soil/system fatigue need be addressed to make the agriculture a viable proposition. Besides, improved agricultural technology, irrigation, timely supply of electricity and literacy are the most important instruments for improving the productivity and nutritional security of the farm-households. There is a need to improve the efficiency of delivery systems for agriculture development by empowering the local elected institutions. Education, skill development, livestock, irrigation, diversification, rural infrastructure and credit support have tremendous impact on productivity. Science-led knowledge based productivity growth need special attention in future. Several ecological problems have cropped-up as a result of past growth sources. These emerging threats in the irrigated agriculture systems call for greater emphasis on research supported by extension, infrastructure and education. Over-irrigation and alarming rates of groundwater depletion have been causing land degradation and other environmental problems. Introduction of water-saving technologies and establishment of secure water rights to users, the decentralisation and privatisation of water management functions up to certain appropriate levels, pricing reforms, markets in tradable property rights may help in enhancing the productivity. Higher investment in education and skill development in low-growth areas will accelerate growth. Thus, present needs are:-

- acceleration of growth in production & productivity in irrigated and rainfed areas;
- transfer of technology;
- crop diversification;
- post-harvest management and value addition;
- food & nutritional security across the regions;
- sustainability of resource endowments;
- augmentation of the farmer's income;

The above issues will be addressed adopting paradigm shift as follows:-

● **Arresting deceleration of Total Factor Productivity (TFP):**

- Natural resource management embracing soil & water management and Integrated Plant Nutrition System (IPNS);
- Augmentation of irrigated potential;
- Delineation of potential areas;
- Focussed development of rainfed ecosystems;
- Focus on Transfer of Technology (TOT) measures;
- Enhancement of Seed Replacement Rates (SRRs);
- Increased investment in agriculture research, education and infrastructures;
- Increased investment in horticulture crops namely; fruits, vegetables, spices; plantation crops, medicinal plants; aromatic plants; and floriculture; and
- Increased investment for livestock production including , preservation, improvement of stocks, dairy development, poultry/duck development, development of inland & marine fisheries

- **Enhancing farmers' income:**

- Diversification of agriculture;
- Post harvest management and value addition;
- Development of subsidiary enterprises in rural areas; and
- Agriculture Insurance;

4. Existing Gaps: There are several region specific gaps, which limit the opportunity of realizing full yield potential of the crops/livestock/fish potential. These gaps have basically emanated due to ecological distortions i.e., soil & water, climate, availability of inputs particularly certified/quality seeds of improved varieties and imbalanced use of fertilizers across the regions. The most critical region specific gaps, which are responsible for deceleration in the productivity of agriculture and horticulture sector in particular and allied sector in general, are presented in the following **Table-2:**

Table-2: Region Specific Factors for deceleration in Productivity.

Agro-Climatic Region	States / Parts of States	Region Specific Constraints
Western Himalayan Region-I	J & K, H.P., Uttarakhand	Severe soil erosion, degradation due to heavy rainfall/floods and deforestation, low SRRs, poor road, poor Input delivery and inadequate communication infrastructure and marketing
Eastern Himalayan Region-II	Assam, N.E. States, Sikkim	Al. toxicity and soil acidity, Soil erosion and floods, shifting cultivation, low SRRs, non availability of electricity, poor road, poor Input delivery system and communication infrastructure.
Lower and Middle Gangetic Plains Regions-III & IV	West Bengal, Bihar, Eastern UP	Flood/ water logging, improper drainage, Salinity/alkalinity, Arsenic contamination, low SRRs, non availability of electricity, high population growth, poor road and communication infrastructure.
Upper and Trans-gangetic Plains Region-V & VI	Western U.P., Punjab, Haryana	Groundwater depletion, decreasing total factor productivity, micronutrient deficiency, non-availability of electricity and high population density.
Eastern Plateau & Hills Region-VII	Orissa, Jharkhand, Chattisgarh	Moisture stress, drought and Soil acidity, Iron toxicity, low SRRs, non availability of electricity, high population growth, poor road, poor Input delivery and communication infrastructure.

Table.2 contd..

Agro-Climatic Region	States / Parts of States	Region Specific Constraints
Central, Western and Southern Plateau and Hills Regions-VIII, IX & X.	Bundelkhand (in U.P & MP), parts of Rajasthan, Maharastra, AP, Karnataka & Tamil Nadu	Drought, moisture stress, Soil crusting & cracking, soil salinity / alkalinity, low SRRs
East & West Coast Plains & Ghats Region-XI & XII.	Pondicherry, Coastal area of Orissa, AP, TN and Kerala, Goa, parts of Karnataka & Maharastra	Poor water management, Poor nutritional status of soil, saline lands
Gujarat Plains & Hills & Western Dry Region Regions-XIII & XIV.	Gujarat, D&N Haveli, Daman & Diu, North Western Rajasthan	Aridity, Frequent drought, moisture stress poor soil, habitation of desert
The Islands Region-XV	Andaman & Nicobar, Lakshdweep	Soil salinity & acidity, frequent cyclones, low SRRs, poor road and communication infrastructure.

4.1 The existing yield gap between the yield obtained at farmers' field with farmers' practices *versus* improved practices & average yield of the state of wheat, barley, rice, Jowar, sugarcane and cotton crops in respect of major states are presented in **Annexure-IV (a) to IV (h)**. A summary of the same is reproduced below in **Table-3:-**

Table.3: Existing yield gaps of major cereals, oilseeds and cotton crops:

Crop	Percent yield gap	
	Between Practices Farmers Practices	Improved Practices <i>versus</i> State average yield
Wheat	5 – 39%	6-652%
Rice	6 -134%	35-286%
Barley	13-35%	30-149%
Jowar	23-213%	13-219%
Mustard	10-207%	5-155%
Soybean	16-32%	7-185%
Sugarcane	10-51%	16-167%

4.2 The yield gap between “farmers’ yield with his own practices *versus* farmers yield with improved practices” vary across States as well as with the yield gap compared with States. The yield gaps inherently insinuate resource potential and its endowment also besides technological swing. The yield gaps across regions will continue to exist which need be narrowed down to improve the productivity potential of the region with the deemed development paradigm.

5. PRIORITIES FOR AGRO-CLIMATIC REGIONAL PLANNING DURING XI PLAN (2007-08 TO 2011-12)

A. Common Priorities across the regions :

- Judicious use of natural resource potential for resource endowment ;
- Enhancement of Seed Replacement Rates (SRRs) ;
- Adoption of Integrated Plant Nutrition System (IPNS) embracing judicious use of secondary & micro-nutrients ;
- Green manuring and crop residue management for sustained productivity;
- Greater emphasis on non-monitory inputs ;
- Revival of agriculture extension system and Transfer of Technology (TOT) modules ;
- Land leveling through laser levels;
- Strengthening of rural electrification for farm sector ;
- Lowering interest rates for agricultural credit;
- Integrated Pest Management (IPM) with greater emphasis on Bio-pesticides / Bio-agents ;
- Use of Micro-irrigation methods for efficient water management;
- Enhancing farm mechanization;
- Strengthening of crop insurance programmes;
- Strengthening and improving the Input Quality Control System;
- Cultivation of export oriented crops;
- Post-harvest management and value addition technologies;
- Agro-forestry and pasture management;
- Introduction of cross-bred animals;
- Animal health care; and
- Emphasis on fodder production.

B. ACRP SPECIFIC PRIORITIES.

I. Western Himalayan Region - I (J & K, HP & Uttaranchal).

(1) Typology :

- Fragile Eco system prone to soil erosion
- Low land productivity; and

(2) Potential Crops, Fruits & Livestock:

(2.1) Agricultural Crops: Maize, *Basmati* rice, baby corn, *Ragi*, *foxtail millet*, *barnyard millet*, wheat, barley & *Rajmash* (French bean pulse type).

(2.2) Horticultural crops: Potato, cauliflower, parsley, lettuce, chinese cabbage, cauliflower, turnips, carrot, radish, mushrooms, *Kala jeera*, saffron, medicinal plants (*Kuth*, Kuroo & Himalayan Yew), Aromatic plants (*Dioscorea*, *Banafsha*, Lavender, *Brahmi*, *Harad*, seabuck thorn, cedar wood).

(2.3) Fruit crops: Apple, cherry, strawberry, peach, plum, kiwi, apricot, almond & walnut.

(2.4) Livestock & others: Yak, Sheep, Horses, Rabbits, Mules, Turkey, Quail & bee-keeping.

(3) Farming Systems

- Wheat based cropping system;
- Sheep/Yak/Quail/turkey/horse/Mules rearing; and
- Temperate horticulture.

(4) Cropping sequences

- Rice-wheat / potato ; maize + *Rajmash* – potato - green gram.

(5) Sub-region specific development related priorities:

(5.1) High altitude temperate sub-region-1:

- Promotion of plastic culture;
- Rational use of land resources;
- Adoption of “Integrated Farming System” with emphasis on temperate fruits and vegetable crops;
- Development of meadows;
- Promotion of micro-irrigation methods;
- Promotion of farm mechanization; and
- Development of marketing infrastructure.

(5.2) Hill temperate-2:

- Integrated Water Management with emphasis on soil and water conservation programmes ;
- Promotion of plastic culture in high hills ;
- Rational use of land resources;
- Development of pastures;
- Adoption of “Integrated Farming System” with emphasis on fruit and vegetable crops ;
- Promotion of micro-irrigation methods;
- Promotion of farm mechanization; and

- Development of marketing infrastructure.

(5.3) Valley Temperate-3:

- Rational use of land resources;
- Integrated Water Management with emphasis on soil and water conservation programmes ;
- Promotion of micro- irrigation methods ;
- Amelioration of soil acidity ;
- Promotion of plastic culture in hills ;
- Promotion of farm implements;
- Adoption of “Integrated Farming System” with emphasis fruit and vegetable crops.

(5.4) Sub-tropical region-4:

- Rational use of land resources;
- Integrated Water Management ;
- Promotion of micro- irrigation methods ;
- Promotion of plastic culture in high hills ;
- Amelioration of soil acidity ;
- Promotion of farm implements;
- Adoption of “Integrated Farming System” with emphasis on horticulture crops; and
- Strengthening of agriculture/horticulture/livestock extension system.

(6) Research priorities:

- Integrated Farming Systems;
- Delineation & mapping of multi-nutrient deficiency;
- Watershed management;
- Breeding of acid tolerant/cold resistant cultivars of crops;
- Development of Improved farm machinery; and
- Post-harvest Technology.

II. Eastern Himalayan Region - II

Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Tripura, Sikkim and 3 districts of West Bengal.

(1) Typology :

- Fragile land;
- Low productivity ; and
- Fragile ecology prone to soil erosion with low level of irrigation & recurrent floods.

(2) Potential crops, fruits & Livestock :

(2.1) Agricultural crops: Rice (*kala joha*), *Rabi* maize, rape seed & mustard and pulses.

(2.2) Horticultural crops: Potato, ginger, cauliflower, cabbage, mushrooms, turmeric, Black pepper, cardamom, medicinal & aromatics (*Cinchona*, *Chiryata*, Himalayan Yew, *Bhumi aonla* & *Tejpat*) & ornamentals(orchids).

(2.3) Fruit crops: Orange, lemon, banana, *Kagzi* lime, pine apple, papaya & cherry.

(2.4) Plantation crops: Tea.

(2.5) Livestock & others: Mithun, Pigs, poultry, seri-culture & bee-keeping.

(3) Farming systems :

- Rice based cropping system;
- Pig/Mithun rearing;
- Poultry; and
- Fisheries

(4) Cropping sequences :

- Rice– Wheat / *Rabi* maize -Jute ;
- Rice-Potato –Jute ; and
- Rice-pulses/ Oilseeds.

(5) Sub-region specific development related priorities:

(5.1) Himalayan Hills-1:

- Integrated Water Management ;
- Promotion of plastic culture in high hills;
- Rational use of land resources;
- Development of meadows;
- Adoption of “Integrated Farming System” with emphasis on livestock and horticulture ;
- Promotion of micro-irrigation methods;
- Promotion of farm mechanization; and
- Development of marketing infrastructure.

(5.2) North east Hills-2 & Southern Hills:

- Comprehensive plan for soil conservation and introduction of terraced cultivation in the hills ;
- Substitution of *jhum* system with settled cultivation in conjunction with land reforms and extension methods ;
- Amelioration of acidic soils;
- Promotion of farm implements;
- Adoption of Integrated Farming System with emphasis on the livestock, forestry and horticulture ; and
- Development of marketing infrastructure.

(5.3) Lower Brahmaputra-4 & Upper Brahmaputra-5:

- Management of *Rabi* fallows;

- Crop management in flood prone areas;
- Harnessing ground water potential in valley and *In situ* water harvesting;
- Amelioration of Boron deficiency and Iron toxicity;
- Amelioration of acidic soils;
- Promotion of farm implements; and
- Adoption of Integrated Farming System with emphasis on livestock, forestry and horticulture ;

(6) Research priorities.

- Watershed management;
- Delineation & mapping of multi-nutrient deficiency;
- Breeding of acidity tolerant/cold resistant cultivars of crops;
- Integrated Farming System;
- Alternative to *jhum* cultivation;
- Post-harvest technology;
- Development of Improved farm machinery.

III. Lower Gangetic Plains Region – III: 15 Districts of West Bengal.

(1) Typology :

- Rich water and soil resources ; and
- Low productivity level and high population pressure beyond carrying capacity.

(2) Potential Crops, fruits & Livestock :

(2.1) Agriculture crops: *Boro* rice, *Rabi* maize, Jute, rape seed & mustard.

(2.2) Horticulture crops: Potato, brinjal, tomato, sweet pea, black pepper, onion, cucurbits, chillies, mushrooms, water chestnut, beetle vine, flowers (Dahlia, tuberose, marigold) and medicinal & aromatics (*Kalmeg*, chinchona, bael & *Neem*).

(2.3) Fruit crops: Litchi, mango & guava.

(2.4) Livestock & others: Cattle, goats, sheep, poultry , bee-keeping & fisheries.

(3) Farming systems :

- Rice based cropping system;
- Buffaloe rearing;
- *Hilsa* fish culture;
- Black Bengal goat rearing; and
- Garol sheep rearing.

(4) Cropping sequences:

- Rice-potato-Jute ;
- Rice-wheat-Jute ;
- Rice-vegetables-summer rice / jute ; and
- Rice-oilseeds-pulses / jute

(5) Sub-region specific development related priorities:

(5.1) Barind plains-1:

- Water harvesting and Recycling ;
- Amelioration of Boron deficiency and Iron Toxicity;
- Amelioration of Iron deficiency;
- Emphasis on *Rabi* maize, Boro rice and hybrid rice cultivation;
- Adoption of Integrated Plant Nutrition System (IPNS);
- Adoption of Integrated Farming System with the emphasis on crops, livestock and fisheries;
- Improvement of Drainage system; and
- Promotion of farm implements.

(5.2) Central alluvial Plains-2 & Alluvial coastal saline Plains-3:

- Reclamation of soil salinity in coastal areas and soil acidity in lateritic soils ;
- Conjunctive use of canal and ground water.
- Adoption of Integrated Plant Nutrition System (IPNS);
- Adoption of Integrated Farming System with the emphasis on crops and livestock;
- Improvement of Drainage system;
- Promotion of farm implements ; and
- Promotion of rice hybrids; and
- Crop management in flood prone areas.

(5.3) Rarh Plains-4:

- Strengthening of tanks for effective water harvesting ;
- Amelioration of Boron deficiency and Iron toxicity;
- Emphasis on *Rabi* maize, boro rice and hybrid rice cultivation;
- Adoption of Integrated Plant Nutrition System (IPNS);
- Adoption of Integrated Farming System with emphasis on crops, livestock and fisheries;
- Strengthening of Drainage system;
- Promotion of farm implements ; and

(6). Research priorities:

- Delineation & mapping of multi-nutrient deficiency;
- Efficient Nutrient & water management;
- Development of heat / salinity/arsenic tolerant cultivars; and
- Farm mechanization.

IV. Middle Gangetic Plains Region – IV: 23 Districts of Eastern Uttar Pradesh and 37 Districts of Bihar

(1) Typology :

- Rich soil and water resources ;

- Low productivity level due to mono-cropping of rice on large area; and
- Deteriorating land quality

(2) Potential Crops, fruits & Livestock :

(2.1) Agriculture crops: Rice, wheat, *rabi* maize, pigeon pea, green gram, black gram, lentil & sugarcane.

(2.2) Horticulture crops: Potato, banana, brinjal, okra, tomato, sweet pea, onion, cucurbits, colocasia, flowering plants (marigold & gladiolus), medicinal & aromatics (*Safed musli*, *Makoy*, *Berberis spp*; *Gloe*, *bael*, *lemon grass*, *Khus*, *Neem* & *mentha*), *Makhana*, *Singhada*, and beetle vine.

(2.3) Fruit crops: Litchi, papaya, mango, guava and *Jamun*.

(2.4) Livestock & others: Cattle, goats & poultry.

(4) Farming systems :

- Rice based cropping system;
- Poultry;
- Fishery; and
- Dairy.

(5) Cropping sequences :

(a) Low lying areas :

- Maize-potato-*boro* rice
- Rice-early potato-timely sown wheat-summer green gram;
- Rice-potato + *Rabi* maize- fallow ;
- Rice-*Toria*-sugarcane-sugarcane ratoon-wheat ; and
- Maize-mustard-summer rice.

(b) Uplands :

- Fodder *Jowar*-potato-wheat ;
- Maize + black gram -wheat-summer green gram ; and
- Maize - *Toria* – potato – *Jute*.

(6) Sub-region specific development related priorities:

(5.1) North-west alluvial-1& North-east alluvial-2:

- Adoption of Integrated Plant Nutrition System (IPNS);
- Reclamation of problem soils, salinity and alkalinity;
- Amelioration of Boron deficiency & Iron toxicity;
- Efficient use of canal and ground water;
- Emphasis on maize, fruits and vegetable crops ;
- Development of oxbow lakes and derelict water bodies ;
- Promotion of rice-fish farming ;

- Promotion of cultivation of pulses and oilseeds in *Tal* areas ;
- Promotion of *Rabi* maize cultivation ;
- Promotion of short duration varieties of rice in rice-wheat system; and
- Promotion of farm mechanization.

(6). Research priorities:

- Delineation & mapping of multi-nutrient deficiency;
- Development of heat tolerant varieties of wheat ;
- Development of salt tolerant and deep water paddy varieties ;
- Efficient water management;
- Management of '*Diara*' & '*Tal*' areas; and
- Farm mechanization.

V. Upper Gangetic Plains Region - V: 40 districts of Western and Central parts of Uttar Pradesh

(1) Typology :

- Rich soil and water resources ;
- Medium productivity level due to salinity / alkalinity ;
- Unscientific irrigation practices, poor drainage and weak input supply structure ;
- Moderate population pressure on land deteriorating environment with respect to land quality.

(2) Potential Crops, fruits & Livestock :

(2.1) Agriculture crops: Wheat, *Basmati* rice, *Bajra*, maize, black gram, green gram, pigeon pea and bengal gram.

(2.2) Horticulture crops: Potato, tomato, brinjal, colocasia, sweet pea, carrot, onion, mentha, cauliflower, cabbage, cucurbits, chillies, coriander, fennel, medicinal & aromatics (*Ashwagandha*, bael, *Khus*, lemon grass) and mushrooms.

(2.3) Fruit crops: Mango, papaya, guava, peach, *Jamun* & aonla.

(2.4) Livestock & others: Cattle, buffalo & poultry.

(3) Farming systems :

- Rice and Wheat based cropping system;
- Buffalo/cattle rearing;
- Poultry.

(4) Cropping sequences :

- Rice – wheat – summer black gram / moong ;
- Maize – potato – wheat /cucurbits; rice-berseem-sugarcane, sugarcane, ratoon;
- Pigeon pea-wheat / lentil –summer moong ;
- Pigeon pea-sweet pea – summer *Bajra* ; and
- *Bajra*-mustard /black gram / green gram.

(5) Sub-region specific development related priorities:

(5.1) Central Plains-1, North-western Plains-2 & South-western Plains-3:

- Delineation & mapping of multi-nutrient deficiency;
- Adoption of Integrated plant Nutrition system;
- Reclamation of *Usar* lands through improving irrigation, drainage and adoption of physical and chemical methods of treatment and using saline resistant crop varieties ;
- Efficient use of canals and ground water to minimize the risk of over exploitation of and degradation of soil and water;
- Adoption of zero tillage, furrow irrigated raised bed (FIRB) planting, ridge and furrow planting, crop residue / stubble management ;
- Promotion of diversification of crops; and
- Promotion of organic fertilizers / FYM to improve soil health

(6). Research priorities:

- Management of Sodic soils;
- Farm mechanization;
- Development of salt tolerant varieties of rice ;
- Development of heat tolerant varieties of wheat ; and

VI. Trans-gangetic Plains Region – VI: Delhi, Haryana, Punjab, Chandigarh UT and two districts of Rajasthan State.

(1) Typology :

- Rich water & soil resources ; and
- Comparatively high land productivity level except salinity / alkalinity problem in some areas and also delicate water balance in the region as exploitation of ground water has already surpassed hundred per cent of utilizable balance.

(2) Potential Crops, fruits & Livestock :

(2.1) Agriculture crops: Wheat, barley, *basmati* rice, baby corn, *Bajra*, maize, green gram, black gram, rape seed & mustard, *Guar* & cotton.

(2.2) Horticulture crops: Potato, sweet pea, cauliflower, tomato, cucurbits, flowers (roses, marigold & gladiolus), medicinal & aromatics (*Safed musli*, *Tulsi*, lemon grass, & *Khus*) and mushrooms.

(2.3) Fruit crops: Kinnow, guava, aonla & mango.

(2.4) Livestock & others: Cross bred cattle, buffalo, goat, sheep & poultry.

(3) Farming systems :

- Rice and Wheat based cropping system;
- Buffaloe/cattle rearing; and
- Poultry

(4) Cropping sequences :

(a) Rainfed Areas :

- Fallow – bengal gram ;
- Fodder *Jowar* + green gram / black gram –mustard / barley ;
- *Bajra* – mustard / wheat ; and
- Cowpea – Wheat

(b) Irrigated Areas :

- Rice - *Toria* – wheat - green Manure ;
- Rice – bengal gram - summer green gram / black gram – maize – wheat – green manure ;
- Maize – bengal gram – sugarcane – ratoon – wheat – green manure ;
- Rice – *Toria* – Rabi maize - tomato ;
- Cotton – wheat - green manure ; and
- Maize – potato – sugarcane

(5)Sub-region specific development related priorities:

(5.1) Foot hills of Sivalik & Himalayas-1:

- Soil & Water shed development;
- Adoption of Integrated Plant Nutrition System;
- Adoption of zero tillage/ furrow irrigated raised bed (FIRB) technology. In rice-wheat cropping system areas;
- Promotion of hybrid rice cultivation with SRI method of cultivation;
- Promotion of '*Basmati* hybrid rice' with SRI method of cultivation;

(21.1) Plains-2:

- Adoption of Integrated Plant Nutrition System;
- Reclamation of waste lands ;
- Reclamation of soil salinity / alkalinity through the use of pyrites/ gypsum ;
- Adoption of zero tillage/ furrow irrigated raised bed (FIRB) technology in wheat in rice-wheat cropping system areas;
- Promotion of hybrid rice cultivation with SRI method of cultivation;
- Promotion of '*Basmati* hybrid rice' with SRI method of cultivation;
- Introduction of pulse crop/green manure in the crop sequence as a rule to relieve soil fatigue in rice-rice-wheat cropping sequence;

(5.3) Scarce rainfall-arid region-3:

- Adoption of Integrated Plant Nutrition System;
- Reclamation of soil salinity / alkalinity through the use of pyrites / gypsum ;
- Promotion of hybrid rice cultivation with SRI method of cultivation in command areas;
- Inter-cropping of oilseeds/pulses with Coarse cereals in rainfed areas;
- Promotion of Bt. Cotton; and

- Use of organic manure and agricultural waste to improve soil health.

(6) Research priorities:

- Crop diversification;
- Delineation & mapping of multi-nutrient deficiency;
- Development of salt tolerant varieties of rice ;
- Development of high yielding varieties of wheat ; and
- Post-harvest Technology.

VII. Eastern Plateau & Hills Region-VII.

16 districts of Chattisgarh, 18 districts of Jharkhand, 3 of Madhya Pradesh, 4 of Maharashtra, 15 of Orissa & 1 district of West Bengal.

(1) Typology :

- Large volume of land and water resources exists in the region;
- Very low productivity
- Large of runoff of rain water eroding soil fertility; and
- Low development of irrigation.

(2) Potential crops, fruits & Livestock:

(2.1) Agriculture crops: Rice, wheat, maize, black gram, pigeon pea, bengal gram, linseed and *Rabi* groundnut.

(2.2) Horticulture crops: Sweet pea, cabbage, ginger, turmeric, potato, onion, garlic, medicinal & aromatics (*Sarpgandha*, *Ashwagandha*, glory lilly, *Mulaithi*, *Gudmar*, aloe), flowers (Tuberose, gladiolus & Jasmine), banana, beetle vine and mushrooms.

(2.3) Fruit crops: Mandarin, mango, guava, *Aonla*, lac, lemon, pomegranate, custard apple, papaya & *Jatropha*.

(2.4) Livestock & others: Cattle, buffalo, goat, poultry, fishery, bee-keeping and sericulture.

(3) Farming systems :

- Rice & Coarse cereals based cropping systems;
- Cattle/buffaloe rearing;
- Goat rearing;
- Piggery; and
- Poultry..

(3) Cropping systems :

- Rice & Coarse cereals based cropping systems.

(4) Cropping sequences :

(a) Rainfed Areas :

- Ragi + Pigeon pea – Niger/Linseed + Rabi Maize ;
- Rice + Black gram-Niger/Linseed;
- Rice + Sesame-Niger/Linseed; and
- Pigeon pea + Black gram – Linseed.

(b) Irrigated Areas :

- Rice – linseed + *Rabi* maize – fodder *Bajra* ;
- Rice – *Rabi* maize – black gram;
- Rice – *Rabi* groundnut + *Rabi* maize;
- Rice – potato – maize;
- Groundnut – *Rabi* maize/bengal gram-summer moong ;
- *Ragi* + soybean – *Rabi* maize – vegetables; and
- Castor – vegetables.

(5) Sub-region specific development related priorities:

(5.1) Dry sub-humid-1 & Eastern Highland-2:

- Adoption of Integrated Plant Nutrition System;
- Reclamation of soil salinity /alkalinity;
- Reclamation of acidic soils;
- Inter-cropping of pulses and oilseeds with cereals;
- Adoption of Integrated Farming System with the emphasis on forestry and livestock;
- Enhancing of Seed Replacement Rate of improved cultivars;
- Emphasis of maize and sorghum hybrids; and
- Enhancing cropping intensity by using of fallow lands.

(5.2) North-central Plateau-2, Eastern Plateau-3 & Tribal-4:

- Delineation & development of water shed at macro and micro levels;
- Construction of check dams for conserving rain water and its recycling;
- Reclamation of saline /alkaline soils;
- Reclamation of acidic soils;
- Inter-cropping of pulses and oilseeds with cereals;
- Promotion of hybrid rice technology in conjunction with SRI method of cultivation;
- Adoption of Integrated Farming System with emphasis on forestry and livestock;

- Enhancing of Seed Replacement Rate of improved cultivars;
- Promotion of maize and sorghum hybrids; and
- Enhancing cropping intensity of fallow lands.

(6) Research priority:

- Development of salt tolerant varieties of rice ;
- Development of heat tolerant varieties of wheat;
- Delineation & mapping of multi-nutrient deficiency;
- Water shed management; and
- Integrated Farming system.

VIII. Central Plateau & Hills Region-VIII.

31 districts of Madhya Pradesh, 20 of Rajasthan and 7 of Uttar Pradesh.

(1) Typology :

- Large volume of land and water resources exists in the region;
- Very low productivity with predominance of subsistence agriculture;
- Excessive runoff;
- Under utilize potential of horticulture and livestock; and
- Low development of irrigation.

(2) Potential crops, fruits & Livestock:

(2.1) Agriculture crops: Maize, sorghum, pearl millet, durum wheat, barley, black gram, green gram, pigeon pea, bengal gram, field pea, lentil, soybean, rape seed & mustard, linseed and groundnut.

(2.2) Horticulture crops: Coriander, opium, brinjal, okra, onion, flowers (Roses, marigold, Jasmine & gladiolus) medicinal & aromatics (*Safed musli*, *Ashwagandha*, *Sarpgandha*, *Guggal* & *Aloe vera* (*Gwar patha*)).

(2.3) Fruit crops: *Aonla*, *ber*, *mango*, mandarin & *Jatropha*.

(2.4) Livestock & others: Cattle, buffalo, poultry, goats & sheep.

(3) Farming systems :

- Coarse cereals based cropping systems; and
- Poultry.

(4) Cropping sequences :

(a) Rainfed Areas :

- Maize/*Jowar* + soybean – durum wheat;
- Jowar + pigeon pea – bengal gram/linseed; and
- *Bajra* + black gram/green gram – barley/bengal gram/field pea/mustard.

(b) Irrigated Areas :

- Maize + soybean –wheat – summer moong; and
- Rice – wheat – summer moong;

(5) Sub-region specific development related priorities:

(5.1) Bundelkhand-1, Bundelkhand-2, North Hills-3, Kymore Plateau Satpura Hills-4, Vindhya Plateau-5, Satpura Plateau-6 & Central Narmada Valley-7:

- *In-situ* water harvesting/conservation;
- Development of waste land;
- Development & strengthening of irrigation infra-structure to promote input intensive technologies and multiple cropping system;
- Adoption of modern water harvesting techniques;
- Diversification of small millets with high value crops, agro-forestry, silvi-pastoral and agri-horti system;
- Adoption of improved rainfed farming system; and
- Promotion of hybrids of maize, *Bajra*, *Jowar* & cotton.

(5.2) Gird-8, South-eastern Plains-9, Southern plains-10, Transitional Plains11, Southern Plains& aravali Hills-12:

- *In-situ* water harvesting/conservation through adoption of cultural practices;
- Development of waste lands;
- Development & strengthening of irrigation infra-structure ;
- Adoption of modern water harvesting techniques ;
- Diversification of small millets with high value crops;
- Adoption of improved rainfed farming system; and
- Promotion of hybrids of maize, *Bajra*, *Jowar* & cotton.

(5.3) Semi-arid eastern Plains-13 & Flood prone eastern Plains-14:

- *In-situ* water harvesting/conservation;
- Inter-culture in between rows to create soil mulch and vegetative/bio-mulching;
- Promotion of agro-forestry, silvi-pastoral and agri-horti system.
- Adoption of improved arid farming system;
- Promotion of hybrids of maize, *Bajra* & cotton

(6) Research priorities:

- Development of abiotic tolerant varieties of rice, wheat, pulses & oilseeds ;
- Delineation & mapping of multi-nutrient deficiency;
- Water harvesting and recycling;
- Farming systems;
- Soil and water salinity management.

IX. Western Plateau & Hills Region-IX.

14 districts of Madhya Pradesh, 25 of Maharashtra and 1 district of Rajasthan.

(1) Typology :

- Crop pattern dominated by low value cereals;
- Under develop irrigation potential;
- Large runoff and soil erosion; and
- Soils with high clay content with low drainability.

(2) Potential crops, fruits & Livestock:

(2.1) Agriculture crops: Maize, sorghum, durum wheat, bengal gram, green gram, black gram, soybean, groundnut & cotton.

(2.2) Horticulture crops: Chillies, potato, brinjal, onion, okra, cucurbits, flowers (Marigold, lillium, gerbera & gladiolus), medicinal & aromatics (*Safed musli*, bael, Gudmar & senna), opium & mushrooms.

(2.3) Fruit crops: Mandarin, lemon, malta, pomegranate, papaya, banana, grapes, mango, Jatropha.

(2.4) Livestock & others: Cattle, buffalo, sheep, goat & poultry.

(3) Farming systems :

- Coarse cereals based cropping systems;
- Goat rearing; and
- Poultry..

(4) Cropping sequences :

Rainfed Areas :

- *Jowar* + soybean – bengal gram/durum wheat; and
- *Bajra* + black gram/green gram- safflower;

Irrigated Areas :

- Cotton – wheat – summer green gram;
- Maize – durum wheat – summer green gram; and
- Soybean – Rabi maize – vegetables.

(5) Sub-region specific development related priorities (all the 4 sub-regions):

- *In-situ* water harvesting/conservation;
- Development of waste land;
- Creation of additional irrigation potential;
- Emphasis on high value crops;
- Promotion of agri-horti-pastoral system ;
- Enhancing use of fertilizers; and
- Promotion of hybrids of maize, *Bajra* and cotton

(6) Research priorities:

- Development of heat tolerant varieties of bread wheat;
- Development of special varieties of durum wheat for export;
- Delineation & mapping of multi-nutrient deficiency;
- Water shed management; and
- Farming systems.

X. Southern Plateau & Hills Region-X.

14 districts of Andhra Pradesh, 21 districts of Karnataka and 13 districts of Tamilnadu

(1) Typology :

- Large rainfed area;
- Large scale cultivation of low value cereals; and
- Tank led irrigation.

(2) Potential crops, fruits & Livestock:

(2.1) Agriculture crops: Rice, sweet sorghum, foxtail millet, maize, horse gram, green gram, sunflower, safflower, cotton & groundnut.

(2.2) Horticulture crops: Tapioca, gherkins, onion, okra, chillies, brinjal, tomato, flowers (Gomphrena, crossandra & Jasmine), garlic, ginger and medicinal & aromatic (Sandal wood, glory lilly, senna, *ashok*, cinchona).

(2.3) Fruit crops: Mango, banana, grapes, guava, sapota, & citrus.

(2.4) Plantation crops: Rubber, coconut, mulberry, cashew nut, areca nut & cocoa.

(2.5) Livestock & others: Cattle, buffalo, sheep, goat, poultry, piggery, fishery, bee-keeping & sericulture.

(3) Farming systems :

- Rice and Coarse cereals based cropping systems;
- Piggery; and
- Marine fisheries.

(4) Cropping sequences :**(a) Rainfed Areas :**

- Sweet sorghum – cotton - groundnut; and
- Sweet sorghum – green gram – fodder;

(b) Irrigated Areas :

- Rice – *Rabi* maize – green gram; and
- Cotton – *Rabi* maize – fodder.

(5) Sub-region specific development related priorities (all the 6 sub-regions):

- Creation additional irrigation potential to harness full potential of agriculture;
- *In-situ* water harvesting/conservation through adoption of cultural practices like ridge and furrow planting, inter-cropping of legumes in uplands, planting against slope in undulating terrain/hilly tract;
- Inter-culture in between rows to create soil mulch and vegetative/bio-mulching;
- Reclamation of saline/alkaline/acidic/water logged/ill drained soils;
- Productive use of barren and un-cultivated lands, cultivation of waste and permanent fallows through afforestation;
- Diversification of crops to high value crops;
- Diversification of sugarcane area by Cotton;
- Adoption of Integrated farming system with a component of crops, livestock, silvi-pastoral system and agri-horticulture;
- Promotion of Rice hybrids in conjunction with SRI method of cultivation;
- Promotion of hybrids of maize, cotton, sorghum, sunflower; and
- Adoption of improved rainfed farming system.

(6) Research priorities:

- Development of salt tolerant varieties of rice;
- Delineation & mapping of multi-nutrient deficiency;
- Water harvesting and recycling; and
- Soil & water salinity management.

XI. East Coast Plains & Hills Region-XI.

9 districts of Andhra Pradesh, 15 of Orissa, 15 districts of Tamilnadu and Pondicherry State.

(1) Typology :

- Rich water resources with relatively unfertile land;
- Fragile ecology due to water logging, soil salinity/acidity and soil erosion; and
- Tank led irrigation.

(2) Potential crops, fruits & Livestock:

(2.1) Agriculture crops: Rice, sweet sorghum, maize, sugarcane, black gram, green gram, groundnut, niger, sunflower, cotton, Jute & mesta.

(2.2) Horticulture crops: Black pepper, turmeric, brinjal, okra, tapioca, chillies, onion, sweet potato, flowers (Tube rose, enthurium & Gompherina), medicinal & aromatics (Coleus & scented geranium).

(2.3) Fruit crops: Cashew nut, mango, sapota, banana, custard apple and pine- apple.

(2.4) Plantation crops: Cashew nut & coconut.

(2.5) Livestock & others: Cattle, buffalo, sheep, goat, poultry, duck & fishery.

(3) Farming systems :

- Rice based cropping systems;
- Fish and Prawn culture;
- Piggery; and
- Poultry.

4) Cropping sequences :

Rainfed Areas :

- Sweet sorghum – cotton - groundnut; and
- Sweet sorghum – green gram – fodder;

Irrigated Areas :

- Rice – groundnut - green gram ;
- Rice – green gram /black gram;
- Cotton- green gram – green manure; and
- Soybean – sunflower – green gram.

(5) Sub-region specific development related priorities (all the 6 sub-regions):

- Productive use of barren and uncultivated lands, cultivable waste and permanent fallows through afforestation;
- Reclamation soil salinity/alkalinity through use of Gypsum/Pyrites;
- Reclamation of acidic soil through liming/mills sludge;
- *In-situ* water harvesting/conservation through adoption of cultural practices like bed furrow in deep black cotton, uplands and flat sowing and ridging later in red soils;
- Diversification of the area of low value crops to high value crops;
- Promotion of hybrid rice in conjunction with SRI method of cultivation; and
- Development of Tribal agriculture.

(6) Research priorities:

- Development of salt tolerant cultivars of rice ;
- Delineation & mapping of multi-nutrient deficiency;
- Farming systems and
- Crop management in flood prone areas.

12. West Coast Plains & Ghats Region-XII.

6 districts each of Karnataka and Maharashtra, 2 districts of Andhra Pradesh, Goa and Kerala State.

(1)Typology :

- Rich water resources with relatively unfertile land; and
- *Fragile* eco-system due to excessive runoff soil salinity/acidity/irregular stretches of back water/mound formation/inadequate drainage.

(2) Potential crops, fruit crops & Livestock:

(2.1) Agriculture crops: Rice, foxtail millet, sugarcane, sunflower, cowpea, horse gram, green gram & cotton.

(2.2) Horticulture crops: Potato, onion, garlic, tomato, ginger, black pepper, cloves, cardamom, cinnamon, medicinal & aromatics (*Asparagus*, glory lilly & *Guggal*) and orchids.

(2.3) Fruit crops: Cashew nut, mango & citrus.

(2.4) Plantation crops: Coconut, areca nut, Oil palm & cocoa.

(2.5) Livestock & others: Cattle, buffalo, poultry & fishery.

(3) Farming systems :

- Rice based cropping systems;
- Marine fish & prawn culture.

4) Cropping sequences :

- Cow pea/groundnut/barnyard millet (*Virippu* uplands)-Rice-green gram;
- groundnut/little millet/foxtail millet (*Kuttanad/Kole* areas)-Rice-green gram;
- Cow pea/green gram- rice (*Mundakan*)- green gram; and
- Cotton + foxtail millet – green gram/green manure.

(5 Sub-region specific development related priorities (all the 4 sub-regions):

- Reclamation of degraded lands through soil conservation measures along slope of hills for promotion of agri-horticulture;
- Reclamation of low lands such as *Khar*, *Kole*, *Pekhali* and *Kasam* for assured rice crop with high productivity;
- Augmenting area under irrigation by restoring and harvesting of water at upper reaches, construction of tanks and percolation ponds at middle low lands.
- Intensification of fish production using cost effective technologies for catch and processing, prawn culture in brackish water;
- Strengthening of dairy activity;
- Promotion of hybrid rice in conjunction with SRI method of cultivation; and
- Adoption of sustainable crop sequence by discouraging rice after rice cultivation in the region.

(6) Research priorities :

- Development of salt tolerant cultivars of rice;
- Soil & Water Management ;
- Integrated farming system ; and
- Delineation & mapping of multi-nutrient deficiency;

13. Gujarat Plains & Hill Region-XIII.

Gujarat, Daman & Diu and Dadra & Nagar Haveli.

(1) Typology :

- Semi-arid to arid conditions;
- Large rainfed areas with frequent weather perturbations;
- Water logging in canal areas;
- Depletion of groundwater in northern and western parts at alarming rate; and
- Low forest cover.

(2) Potential crops, fruit crops & Livestock:

(2.1) Agriculture crops: Maize, *Bajra*, durum wheat, green gram, groundnut, castor, sugarcane & cotton.

(2.2) Horticulture crops: Onion, cumin, fennel, fenugreek, garlic, flowers (Aster, spider lilly, marigold & chrysanthemum) aromatic plants & medicinal plants (*Isabgol*, *Guggal* & aloe) and *Jatropha*,

(2.3) Fruit crops: Sapota, banana, guava, dates, mango, grapes.

(2.3) Plantation crops: Coconut.

(2.4) Livestock & others: Cattle, buffalo, goats, sheep, rabbit, poultry and bee-keeping.

(3) Farming systems :

- Coarse cereals based cropping systems;
- Cattle rearing;
- Goat rearing; and
- Poultry.

4) Cropping sequences :

Rainfed Areas :

- *Bajra* + Black gram – Mustard;
- Maize + Soybean – Durum wheat; and
- Groundnut – Durum wheat – Summer *Bajra*.

Irrigated Areas :

- Rice – Rabi maize/Groundnut-Summer Moong;
- Cotton – Durum wheat – Summer Moong; and
- Groundnut – Potato – Summer *Bajra*.

(5) Sub-region specific development related priorities (all the 7 sub-regions):

- Promotion of integrated water management in dry areas with greater emphasis on rain water harvesting;
- *In-situ* water harvesting/conservation through adoption of cultural practices like bed furrow in deep black cotton uplands and flat sowing & ridging later in light soil;

- Restriction on overdrawl of groundwater in semi-arid and arid region through regulatory measures;
- Reclamation of salinity through application of Gypsum;
- Conjunctive use of canal and groundwater to control rise in water table;
- Adoption of inter-cropping in groundnut and cotton to improve productivity per unit area;
- Promotion of hybrid rice in conjunction with SRI method of cultivation;
- Promotion of fodder development programme to support livestock population;
- Development of inland and brackish water fisheries through adoption of intensive fisheries production technology.

(6) Research priorities :

- Development of salt tolerant cultivars of rice;
- Delineation & mapping of multi-nutrient deficiency;
- Development of extra early maturing hybrids of *Bajra* for arid region;
- Integrated Water Management ;
- Integrated farming system .

14. Western Dry Region-XIV: 9 districts of Rajasthan.

(1)Typology :

- Arid conditions with hot climate; and
- Fragile eco-system.

(2) Potential crops, fruits & Livestock:

(2.1) Agriculture crops: Cotton, castor, *Taramira*, *Bajra*, barley, green gram & guar.

(2.2) Horticulture crops: Chillies, carrot, cumin and medicinal plants (Isabgol, senna, aloe & Guggal).

(2.3) Fruit crops: *Ber*, pomegranate, kinnu & Mausambi.

(2.4) Livestock & others: Cattle, buffalo, goat, sheep, camel, mules & horses.

(3) Farming systems :

- Coarse cereals based cropping systems;
- Cattle rearing;
- Goat/sheep rearing;
- Camel rearing; and
- Poultry.

(4) Cropping sequences :

- castor – chillies – fallow;
- *Bajra* + *Moth/Guar*- barley- fallow;
- *Bajra* – mustard/*Isabgol*/cumin;

- *Bajra – Taramira – fallow*; and
- Cotton – wheat – fallow;

(5) Sub-region specific development related priorities (Western dry region – one sub region only):

- *In-situ* water harvesting/conservation through adoption of cultural practices like ridge furrow planting, inter-cropping/mixed cropping with legumes, planting against slopes (in hilly tract), inter-culture in between rows to create soil mulch and vegetative/bio-mulching;
- Reclamation of soil salinity through application of Gypsum especially in oilseed crops;
- Enhancement of water use efficiency by popularization of *Diggies* in canal command areas;
- Adoption of integrated farming system with a component of crops, livestock, silvi-pastoral system, agri-horti system and agri-horti-silvi-culture to sustain arid ecosystem to cater food, feed, fodder and fuel requirement in the region;
- Development of arid pastures; and
- Massive programme of “*Khejri*” plantation.

(6) Research priorities:

- Development of extra early maturing hybrids of *Bajra* for arid region;
- Delineation & mapping of multi-nutrient deficiency;.
- Integrated farming system ; and
- Rainwater harvesting management.

15. Islands Region-XV.

A & N Islands and Lakshdweep.

(1)Typology :

- Rich water resources with relatively poor land; and
- Fragile eco-system.

(2) Potential crops, fruits & Livestock:

- (2.1) Agriculture crops:** Rice, maize & cow pea.
- (2.2) Horticulture crops:** Chillies, cucurbits, brinjal, okra and aromatics (*Khus*).
- (2.3) Fruit crops:** Papaya, mango & sapota.
- (2.4) Plantation crops:** Coconut.
- (2.5) Livestock & others:** Goats, buffalo, poultry & fishery.

(3) Farming systems :

- Rice based cropping systems;
- Fisheries;
- Goat rearing; and
- Poultry.

4) Cropping sequences :

- Rice – cow pea/horse gram-vegetables.

(5) Region specific development related priorities (sub-regions not delineated):

- Removal/leaching of salts, construction of dykes to check ingress of sea water on the surface and in lower soil profile and plantation mangroves;
- Promotion of SRI method of rice cultivation;
- Promotion of the cultivation of plantation crops;
- Mari-culture of oysters & mussels ;
- Ornamental fish breeding & culture; and
- Diversified fishing activity.

(6) Research priorities:

- Development of fish technology; and
- Integrated farming system.

7. Infrastructure needs: The need of necessary infrastructure was initially realized during the period of green revolution in agriculture, horticulture, dairy and fisheries sector to stabilize the production as well as to handle the agriculture & horticulture produce effectively. The infrastructure need in irrigation, quality control, storage, marketing, processing and logistics was considered imminent in order to manage the increased production and also to sustain the growth in these sectors. The existing infrastructure is not yet adequate leading to pitfalls in production and productivity of these sectors. The infrastructure in logistic sector is abysmally inadequate even at ports besides rural roads and State/National highways/rail heads. Therefore, the following infrastructure need be created with private-public-partnership for required resource response:-

- Strengthening of seed processing & conditioned storage facilities;
- Strengthening of Input Quality Control organizations through customized mode;
- Irrigation infrastructure;
- Rural electrification;
- Modernization of agriculture markets with post harvest management storage / logistics ;
- Rural roads ;
- Setting up of fruits, vegetables, flowers, spices, oil and Oleoresin processing units ;
- Setting up of cold chain for fruit & flower processing; and
- Augmentation of docking & storage infrastructure at ports.

8. Linkages with Stakeholders: The management of agriculture sector is largely public sector driven which often lacks competition and required level of efficiency due to inherent weaknesses of the system. It will, therefore, be appropriate to assign some of the activities to the private sector particularly transfer of technology of the inputs produced in private sector, quality control on customized basis, storage and processing in order to make the system more competitive and effective with suitable safeguards. Accordingly the linkages proposed as under (**Table-4**) need be implemented through public and private partnership in customized mode :-

Table-4: Linkages flow-chart.

Public sector	Private sector
ICAR-SAU system: Technology generation. ▼ Concerned line Departments at State level and GOI level: Technology Transfer ▼ Farmers ► Industry ► Consumers. ▼ Consumers.	Private research ▼ Farmers ► Industry ► Consumers. ▼ Consumers.

8. Funding Requirement : - The existing system of flow of funds for the development in agriculture & horticulture sectors is schematic through the following three modes:-

(a) Macro-management mode in agriculture:- The centrally sponsored scheme of Macro-management in agriculture was introduced during the year:2001-02 by integrating 27 centrally sponsored schemes with a view to ensure that central assistance is utilized on a well focused and specific interventions in areas of priority of different states to ensure maximum benefits in terms of increased productivity and consequential increased prosperity of farming community. This scheme aims at development in agriculture through “Work Plans” prepared by States/UTs themselves with a provision of flexibility to States/UTs to develop and pursue the newly identified activities on the basis of their regional priorities as “New Initiatives” which was hither to not available in these schemes. The flexibility is provided within the given parameters to select schemes of their choice out the following 27 centrally sponsored schemes:-

- (1) Assistance to weaker sections;
- (2) Assistance to women cooperatives;
- (3) Non-overdue cover Scheme;
- (4) Agriculture Credit stabilization fund;
- (5) Special scheme for SC/ST;
- (6) Integrated Cereals Development Programmes in rice based cropping systems areas (ICDP-rice);
- (7) Integrated Cereals Development Programmes in wheat based cropping systems areas (ICDP-wheat);
- (8) Integrated Cereals Development Programmes in Coarse cereals based cropping systems areas (ICDP-CC);
- (9) Special Jute Development Programme;
- (10) Sustainable Development of Sugarcane based cropping systems areas;
- (11) Balanced & Integrated use of fertilizers;
- (12) Promotion of Agriculture mechanization among small farmers;
- (13) Integrated Development of tropical, arid & temperate zone fruits;
- (14) Production & supply of vegetable seeds;
- (15) Development of commercial floriculture;
- (16) Development of medicinal and aromatic plants;
- (17) Development of roots & tuber crops;
- (18) Development of cocoa & cashew;
- (19) Integrated programme for development of spices;
- (20) Development of mushroom;
- (21) Use of plastics in agriculture;

- (22) Bee-keeping;
- (23) National watershed development project for rainfed areas;
- (24) Scheme for foundation and certified seed production of vegetable seeds;
- (25) Soil conservation in catchments of river valley projects & flood prone rivers;
- (26) Reclamation & Development of alkali soils;
- (27) State Land Use Boards

Besides, States are also free to include those “New Interventions” which are not covered under any other Scheme of the Central Government or is not part of any ongoing State Scheme. The expenditure on any “New Initiatives” should not be more than 10% of the total allocation of funds to the State under Macro-management Schemes.

The implementation of Work plan under the Macro-management schemes is monitored both at State and Central levels. The Physical monitoring of these Schemes is done by the Subject Matter Divisions in the Department of Agriculture & Co-operation, Union Ministry of Agriculture.

The approved of assistance under the Scheme of Macro-management in agriculture is in the ratio of 90:10 between Centre and States respectively. The Central assistance constitutes 80% of central grant and 20% in the form of loan to state Governments.

The pattern of assistance under the Scheme of Macro-management in agriculture to Union territories is 100%.

Consequent upon the institution of Horticulture mission in the year:2005-06, out of the 27 total Schemes, 10 Schemes of horticulture hitherto subsumed with Macro-management were withdrawn from Macro-management in agriculture. Therefore, now remaining 17 Schemes are being implemented with the Macro-management mode in agriculture.

(b) Mission mode:- Presently, the following four Schemes are being implemented through Mission mode approach in the agriculture & horticulture sector:-

- (1) Technical Mission on cotton ;
- (2) Integrated Scheme of oilseeds, pulses, oil Palm & maize (ISOPOM);
- (3) National Horticulture Mission; and
- (4) Technical Mission on Jute.

The formulation and monitoring of Schemes under Mission mode is done by the Subject Matter Divisions of the Department of Agriculture & Cooperation in the Union Ministry of Agriculture.

(C) Central Sector Schemes: The following major Schemes are being implemented as Central sector schemes for which entire outlay is made available to the implementing agencies as grant-in-aid:-

- (1) Development & infrastructure facilities for production and distribution of quality seeds;

- (2) Development/strengthening of agricultural marketing infrastructure, grading & standardization;
- (3) Rural Godowns Scheme;
- (4) Mass Media Support to Agriculture Extension;
- (5) Extension support to Central Institutes/Directorate of Extension;
- (6) Agri-clinics and Agri-business centers Scheme;
- (9) Kisan Call centers;
- (10) National Agriculture Insurance Scheme;

The formulation and monitoring of these Schemes is done by the Subject Matter Divisions of the Department of Agriculture & Cooperation in the Union Ministry of Agriculture.

It is further mentioned that keeping in view the declining public investment in agriculture and allied sectors and deceleration in the productivity of major cereals in the country, it appears to be inevitable to enhance the public investment in these sectors substantially to achieve targeted growth rate for domestic consumption and export of the agriculture produce/products, dairy products, fish and fish products. The outlays in respect of seed sector, infrastructure development, agricultural extension, fertilizers, plant protection, agricultural marketing and natural resource management need be enhanced in order to enhance the production & productivity of agriculture and horticulture sectors.

The proposed outlay for major crop development programmes during XI Five year Plan period vis-a-vis Plan Outlays during X five year plan is given below in **Table.5:-**

Table.5: On going programmes Plan & non-Plan, upscaling of the programmes and new programmes for XI five year Plan (2007-12).

On going programmes during X Plan		Upscaling of the programmes during XI Plan		New programmes during XI Plan	
Activity	Outlay (Rs. in Crores)	Activity	Outlay (Rs. in Crores)	Activity	Outlay (Rs. in Crores)
ICDPC (Rice)	148.71	ICDP (Rice)	500.00	Seed Minikit demonstration programme	50.00
ICDP (Wheat)	72.00	ICDP (Wheat)	1200.00	Seed Minikit demonstration programme	50.00
ICDP (CC)	117.5	ICDP (CC)	300.00	Seed Minikit demonstration programme	40.00
ICDP (Cotton)	213.10	ICDP (Cotton)	300.00	Seed minikit Programme of cereals	-

On going programmes, Plan & Non-Plan, upscaling of the programmes and new programmes for XI Five Year Plan (2007-12)					
On going programmes during X Plan		Upscaling of the programmes during XI Plan		New programmes during XI Plan	
Activity	Outlay In (Rs. Crores)	Activity	Outlay In (Rs. Crores)	Activity	Outlay in Rs. Crores)
Agriculture Extension	513.53	Agriculture Extension*	1000.00	-	-
On-farm water Management including micro-irrigation	100.00	On-farm water Management including micro-irrigation	500.00	-	-
Field formations	22.52	Field formations	100.00	-	-
Crop Development Programmes including Horticulture	7136.00	Crop Development Programmes including Horticulture	28500.00	Seed minikit programme of cereals	2000.00
Seeds production & distribution	209.00	Seeds production & distribution	800.00	(1) Setting up of National oilseeds & Pulses Seeds Corporation	500.00
				(2) Setting up of Vegetable seeds Corp.	500.00
Fertilizers & manures	44.76	Fertilizer & manures	100.00	Composition of Green manuring	200.00
Plant protection	168.40	Plant protection	200.00	-	-
Marketing & Quality control	697.26	Marketing & Quality control	1200.00	(1) Post-harvest management at APMC's	5000.00
				(2) Value addition**	4000.00
Other activities & services	8076.88	Other activities & services	12000.00	-	-
Total	16968.35	Total	44400.00	Total	12200.00
ISOPOM	1132.00	ISOPOM	2500.00	-	-
Total of above Schemes	1683.31	Total	4800.00	Total	140.00
Grand total	1683.31	4940.00			

The proposed outlay for crop development programmes during XI Five year Plan period vis-a-vis Plan Outlays during X five year plan is given below.

***Rs. 1000 under agricultural extention has been added to total operational budget requirement of the states/UTs under agricultural extension management and functional linkages (SG-II)**

**** Covered under Value addition/Infrastructure/Organic farming (SG-V)**

Annexure-I

An overview of Agro-Climatic Regions in India.

ACRP No.	Name of ACRP	Geog. Area (Lha)	Names of the States	Number of districts	Rainfall (mm)	Crop growing period (days)	GCA (Lha)	NSA (Lha)	CI (%)	GIA (Lha)	NIA (Lha)	Irri. Int (%)
I	Western Himalayan Region	331.39	H. P; J & K Uttranchal	39	165-2000	<90 - 210	32.85	20.91	157	-	-	-
II	Eastern Himalayan Region	274.94	Arunachal Pradesh; Assam; Manipur; Meghalaya; Mizoram; Nagaland; Sikkim; Tripura & three districts of West Bengal.	79	1400-12000	>270	67.70	46.50	146	-	-	-
III	Lower Gangetic Plains Region	69.73	15 districts of West Bengal	15	1300-2100	150-270	77.00	43.64	176	-	-	-
IV	Middle Gangetic plains region	164.59	23 districts of Uttar Pradesh & Bihar State	60	1211-1470	150-180	152.51	74.52	146	-	-	-
V	Upper Gangetic plains region	141.08	40 districts of Uttar Pradesh	40	721-979	150-180	139.06	101.49	156	-	-	-

(i)

Annexure-I contd..

ACRP No.	Name of ACRP	Geog. Area (Lha)	Names of the States	Number of districts	Rainfall (mm)	Crop growing Period (days)	GCA (Lha)	NSA (Lha)	CI (%)	GIA (Lha)	NIA (Lha)	Irri. Int (%)
VI	Trans-gangetic Plains Region	116.80	Delhi; Haryana; Punjab; Chandigarh UT & two districts of Rajasthan	48	360-890	<90	163.73	93.23	173	135.74	78.46	173
VII	Eastern Plateau & Hills Region	371.23	Chhattisgarh; Jharkhand; three districts of Madhya Pradesh; four districts of Maharashtra; 15 districts of Orissa & one district of West Bengal.	57	1270-1430	<120	143.76	80.14	124	-	-	-
VIII	Central Plateau & Hills Region	371.64	30 districts of Madhya Pradesh; 20 districts of Rajasthan & 7 districts of Uttar Pradesh	57	490-1300	>120-150	216.21	164.84	131	34.97	31.85	110

Annexure-I contd..

ACRP No.	Name of ACRP	Geog. Area (Lha)	Names of the States	Number of districts	Rainfall (mm)	Crop growing Period (days)	GCA (Lha)	NSA (Lha)	CI (%)	GIA (Lha)	NIA (Lha)	Irri. Int (%)
IX	Western Plateau & Hills Region	334.53	15 districts of Madhya Pradesh; 25 districts of Maharashtra and one district of Rajasthan.	41	602-1040	90-150	292.90	200.5	146	52.8	47.7	111
X	Southern Plateau & Hills Region	400.14	14 districts of Andhra Pradesh; 21 districts of Karnataka and 13 districts of Tamilnadu.	48	576-1051	<90	203.35	177.41	115	-	-	-
XI	East Coast Plains & Hills Region.	214.49	9 districts of Andhra Pradesh; 15 districts of Orissa; 15 districts of Tamilnadu and 4 districts of Pondicherry.	43	800-1904	115-210	114.57	82.10	140	41.61	31.17	133

Annexure-I contd..

ACRP No.	Name of ACRP	Geog. Area (Lha)	Names of the States	Number of districts	Rainfall (mm)	Crop growing Period (days)	GCA (Lha)	NSA (Lha)	CI (%)	GIA (Lha)	NIA (Lha)	Irri. Int (%)
XII	West Coast Plains & Ghats Region	116.04	Goa; Kerala; 6 districts each of Karnataka & Maharashtra and two districts of Tamilnadu.	30	1457-5000	>270	53.48	43.00	123	9.4	7.8	122
XIII	Gujarat Plains & Hills Region	196.63	Gujarat; D & N Haveli and Daman & Diu	28	340-1793	90-150	107.25	94.70	113	36.34	29.87	122
XIV	Western Dry Region	175.73	9 districts of Rajasthan	9	256	<80	84.51	74.35	114	17.26	13.57	127
XV	The Islands Region	8.28	A & N Islands and Lakshdweep.	3	2836-3159	<270	-	-	-	-	-	-
Total		3287.24	30 States + 5 UTs	597	-	-	1760.00	1328.00	133	725.75	531.31	137

Source: Department of Agriculture & Co-operation, Union Ministry of Agriculture.

Acronyms: **Geog area:** Geographical area;

GCA: Gross Cropped Area;

NSA: Net Sown Area;

CI: Cropping Intensity;

GIA: Gross Irrigated Area;

NIA: Net Irrigated Area; and

Irr. Int: Irrigation Intensity.

Selected Agro-climatic features of Sub-regions.

Sl. No.	Sub-Region	Rainfall (mm)	Climate	Soil	Crops
I. Western Himalayas Region					
1	High altitude temperate	165	Humid to cold arid	Hill soils, mountain, meadow skeletal, tarai	Wheat, maize, rice, <i>Jowar</i> .
2	Hill temperate	2000	Humid	Brown hill	Rice, maize, wheat, rapeseed
3	Valley temperate	400	Sub-humid	Sub-mountain, mountain skeletal, meadow	Wheat, maize, rice, sugarcane.
4	Sub-tropical	1030	Semi-arid to humid	Alluvial (Recent), brown hills.	Wheat, barley, potato.
II. Eastern Himalayas Region					
1	Himalayan Hills	2641	Per humid to humid	Brown Hills	Rice, maize, <i>Ragi</i> , potato
2	North-East Hills	3528	Per humid to humid	Red sandy laterite	Rice, rapeseed, maize
3	Southern Hills	2052	Per humid to humid	Acidic soils	Rice, maize, sesame, sugarcane
4	Lower Brahmaputra	1840	Per humid to humid	Alluvial, red loamy, tarai soils	Rice, rapeseed, wheat, jute, potato
5	Upper Brahmaputra	2809	Humid to per humid	Alluvial, red loamy	Rice, jute, rapeseed, wheat
III. Lower Gangetic Plains Region					
1	Barind Plains	1587	Moist sub-humid & dry sub-humid	Red and yellow alluvial (Recent)	Rice, jute, wheat, rapeseed
2	Central Alluvial Plains	1449	Moist sub-humid to dry sub-humid	Red & yellow, Deltaic, alluvium, red loamy	Rice, jute, wheat, rapeseed, potato
3	Alluvial Coastal Saline Plains	1607	Dry sub-humid to moist sub-humid	Red and yellow deltaic, alluvial	Rice, jute, rapeseed
4	Rarh Plains	1302	Moist sub-humid to dry sub-humid	Red and yellow red loamy	Rice, wheat, rapeseed, sesame

Annexure-II contd...

Sl. No.	Sub-Region	Rainfall (mm)	Climate	Soil	Crops
IV: Middle Gangetic Plains Region					
1	North-West Alluvial	1211	Moist sub-humid to dry sub-humid	Alluvial (Recent), Calcareous	Rice, wheat, maize, sugarcane.
2	North-East Alluvial	1470	Dry sub-humid to moist sub-humid	Alluvial, tarai	Rice, wheat, maize, jute, gram
V: Upper Gangetic Plains Region					
1	Central Plains	979	Dry sub-humid to semi-arid	Alluvial	Wheat, rice, <i>Arhar</i>
2	North-Western Plains	907	Dry sub-humid to semi-arid	Alluvial, tarai	Wheat, sugarcane, rice, maize
3	South-Western Plains	721	Semi-arid	Alluvial	Wheat, <i>Bajra</i> , rice, maize, <i>Arhar</i> , potato
VI: Trans-Gangetic Plains Region					
1	Foothills of Shivalik & Himalayas	890	Semi-arid to Dry sub-humid	Alluvial (Recent) calcareous	Wheat, rice, maize, sugarcane
2	Plains	561	Semi-arid to Dry sub-humid	Alluvial (Recent) calcareous	Wheat, rice, <i>Bajra</i> , maize, sugarcane
3	Scarce Rainfall arid reion	360	Arid and Extreme arid	Calcareous, sierozemic, Alluvial (Recent), desert	Wheat, cotton, gram, <i>Bajra</i> , rice
VII: Eastern Plateau and Hills Region					
1	Eastern Plain	1271	Dry sub-humid	Medium to deep black red and yellow	Rice, linseed, <i>Jowar</i> , wheat, gram, groundnut
2	Eastern Highland	1436	Moist sub-humid to dry sub-humid	Red sandy, red and yellow	Rice, maize, niger, wheat
3	North Central Plateau	1296	Moist sub-humid to dry sub-humid	Red sandy, red and yellow	Rice, maize, wheat, <i>Ragi</i>
4	Eastern Plateau	1369	Moist sub-humid to dry sub-humid	Red & yellow, Red loamy	Rice, maize, <i>Ragi</i> , wheat
5	Tribal	1338	Moist sub-humid to dry sub-humid	Red sandy, red and yellow, red loamy laterite	Rice, <i>Ragi</i> , niger, maize

Annexure-II contd...

Sl. No.	Sub-Region	Rainfall (mm)	Climate	Soil	Crops
VIII: Central Plateau and Hills Region					
1	Bundelkhand (UP)	780	Dry sub-humid to arid	Mixed red & black	Wheat, gram, <i>Jowar</i> , rice
2	Bundelkhand (MP)	700	Dry sub-humid to semi-arid	Mixed red & black	Wheat, gram, <i>Jowar</i> , rice
3	North Hills	1570	Moist sub-humid to dry sub-humid	Red & yellow	Rice, wheat, niger
4	Kymore Plateau Satpura hills	1100	Dry sub-humid	Red and yellow Medium black	Maize, wheat, rice, gram, linseed
5	Vindhya Plateau	1130	Dry sub-humid	Medium black	Wheat, gram, <i>Jowar</i> , rice
6	Satpura Plateau	1220	Dry sub-humid	Shallow black, mixed red and black	<i>Jowar</i> , wheat, <i>Arhar</i>
7	Central Narmada Valley	1300	Dry sub-humid	Deep black, skeletal	Wheat, gram, soybean, <i>Jowar</i>
8	Gird	670	Semi arid (half drier & wetter half)	Medium black, alluvial	Wheat, gram, <i>Jowar</i> , rapeseed, <i>Bajra</i>
9	South Eastern Plains	760	Semi-arid (wetter half)	Medium black	wheat, <i>Jowar</i> , gram, maize
10	Southern Plains	760	Semi-arid to arid	Medium red and black, grey brown	Maize, rice, wheat, gram
11	Transitional Plain	490	Semi-arid (wetter half)	Desert soil, grey brown	<i>Bajra</i> , wheat, sesame, rapeseed, <i>Jowar</i>
12	Southern Plains & Aravali Hills	500	Semi-arid (wetter half)	Red and yellow, grey brown	Maize, wheat, gram, <i>Jowar</i>
13	Semi-arid Eastern Plains	500	Semi-arid (drier half)	Alluvial	wheat, <i>Bajra</i> , <i>Jowar</i> , gram
14	Flood Prone Eastern Plain	500	Semi-arid (drier half)	Alluvial (Recent)	<i>Bajra</i> , wheat, rapeseed, gram, <i>Jowar</i>
IX: Western Plateau and Hills Region					
1	Hill region	988	Semi-arid	Medium to deep black shallow red, red loamy	<i>Jowar</i> , <i>Bajra</i> , groundnut
2	Scarcity region	602	Semi-arid	Medium black, deep black	<i>Jowar</i> , cotton, wheat
3	Plateau region	874	Semi-arid (wetter half)	Medium black, deep black, mixed red	Gram, <i>Jowar</i> , cotton, wheat

Annexure-II contd...

Sl. No.	Sub-Region	Rainfall (mm)	Climate	Soil	Crops
IX: Western Plateau and Hills Region contd...					
4	Plateau region South	1040	Semi-arid to dry sub-humid	Medium black, shallow black	Cotton, <i>Jowar</i> , <i>Tur</i> , wheat
X: Southern Plateau and Hills Region					
1	Sub-region-1	769	Semi-arid & arid	Medium, black, Red loamy	<i>Jowar</i> , cotton, groundnut, <i>Bajra</i>
2	Sub-region-2	677	Semi-arid	Red loamy, medium black, red sandy, coastal alluvium, laterite	Groundnut, <i>Ragi</i> , <i>Jowar</i> , rice
3	Sub-region-3	725	Semi-arid & arid	Red sandy, medium to deep black	<i>Jowar</i> , rice, castor, groundnut
4	Sub-region-4	1001	Semi-arid (wetter half)	Deep black, medium black.	Rice, <i>Jowar</i> , maize, cotton, groundnut
5	Sub-region-5	865	Semi-arid	Red loamy, red sandy	<i>Ragi</i> , <i>Jowar</i> , groundnut, rice
6	Sub-region-6	841	Semi-arid to Dry sub-humid	Mixed red and black red loamy, deltaic alluvium	Rice, <i>Jowar</i> , groundnut, <i>Bajra</i>
XI. East Coast Plains & Hills Region					
1	North Orissa Coast	1287	Moist sub-humid	Deltaic alluvial, coastal alluvial, laterite, red loamy	Rice, groundnut, jute, sesame, <i>Ragi</i>
2	North Coastal Andhra	1128	Dry sub-humid	Red loamy, laterite medium black, red, sandy, coastal alluvial	Rice, <i>Ragi</i> , groundnut, <i>Bajra</i> , sesame
3	South Coastal Andhra	996	Semi-arid	Deltaic alluvium, deep black, red, sandy, red & black	Rice, cotton, <i>Jowar</i> , tobacco, groundnut
4	North Coastal Tamilnadu	1036	Semi-arid	Red loamy, red sandy, coastal alluvium	Rice, groundnut, <i>Bajra</i> , <i>Jowar</i>
5	Tanjavur	1113	Semi-arid to dry sub-humid	Deltaic alluvium, red loamy	Rice, groundnut, sesame, sugarcane
6	South Coastal Tamilnadu	780	Semi-arid (drier half)	Mixed Red & Black, coastal alluvium	Rice, cotton, <i>Bajra</i> , groundnut

Annexure-II contd...

Sl. No.	Sub-Region	Rainfall (mm)	Climate	Soil	Crops
XII. West Coast Plains & Ghats Region					
1	Coastal Hilly	3640	Per humid & humid	Laterite, red loamy, coastal alluvium	Rice, <i>Ragi</i> , sesame, niger
2	Coastal Midland	3127	Dry sub-humid & per humid	Red loamy, coastal alluvium, laterite	Rice, tapioca, <i>Ragi</i> , banana
3	Midland	2727	Per humid	Laterite, red loamy, coastal alluvium	Rice, tapioca, groundnut, banana
4	Hilly	226	Per humid	Red loamy, mixed red and black	Rice, <i>Ragi</i> , <i>Jowar</i> , groundnut
XIII. Gujarat Plains & Hills Region					
1	South Gujarat (heavy rainfall)	1793	Semi-arid to dry sub-humid	Deep black, coastal alluvium	Rice, <i>Ragi</i> , sugarcane, <i>Jowar</i>
2	South Gujarat	974	Semi-arid to dry sub-humid	Deep black, coastal alluvium	<i>Jowar</i> , <i>Arhar</i> , cotton, wheat
3	Middle Gujarat	904	Semi-arid	Medium black	Rice, maize, <i>Bajra</i> , cotton
4	North Gujarat	735	Arid to semi-arid	Grey brown, Coastal alluvium	<i>Bajra</i> , cotton, <i>Jowar</i> , wheat
5	North-West arid	340	Arid to semi-arid	Grey brown, deltaic alluvium	<i>Bajra</i> , groundnut, <i>Jowar</i> , cotton
6	North Saurashtra	537	Dry sub-humid	Medium black	<i>Bajra</i> , <i>Jowar</i> , groundnut, cotton
7	South Saurashtra	844	Dry sub-humid	Coastal alluvium, medium black	Groundnut, wheat, <i>Bajra</i> , cotton
XIV. Western Dry Region					
	Western Dry	395	Arid to extremely arid	Desert soil, grey brown	<i>Bajra</i> , gram, wheat, rapeseed
XV. The Islands Region : Sub-regions not delineated.					

Source: Guha; G. S. & D. N. Basu: Agro-Climatic Regional Planning in India (Vol.I: concept and applications).pp. 127-131

Annexure-III

Compound Growth Rates of Area, Production & Yield of major cereals during 1998-99 & 2003-04 (Base Year TE: 1993-94).

ACR No.	Agro-climatic regions	Crop	CGR (%)					
			Area		Production		Yield	
			1998-99	2003-04	1998-99	2003-04	1998-99	2003-04
I	Western Himalayan Region	Rice	-3.25	-0.72	-2.65	-0.42	0.62	0.31
		Wheat	0.17	-0.02	1.10	0.64	0.94	0.67
		Maize	0.45	0.30	0.65	-0.50	0.19	-0.81
		<i>Bajra</i>	-5.67	4.92	-3.44	12.39	2.35	7.12
		<i>Ragi</i>	-1.23	-0.10	-0.58	-3.94	0.66	-3.83
II	Eastern Himalayan Region	Rice	-0.03	-0.81	0.33	0.62	0.36	1.44
		Wheat	2.40	-2.07	0.28	-4.79	-2.07	-2.77
		Maize	1.04	1.85	-0.53	3.41	-1.55	1.53
		<i>Ragi</i>	0.12	-0.18	1.60	-1.53	1.48	-1.35
III	Lower Gangetic Plains Region	Rice	0.69	-0.07	3.26	2.78	2.55	2.85
		Wheat	3.25	3.07	1.89	1.67	-1.32	-1.36
		Maize	-3.30	23.25	40.27	33.30	45.06	8.15
		<i>Jowar</i>	39.77	11.47	25.89	17.34	-9.93	5.27
		<i>Bajra</i>	7.18	10.31	-12.94	14.87	-18.77	4.14
		<i>Ragi</i>	12.93	20.89	87.57	13.62	66.09	-6.02
IV	Middle Gangetic Plains Region	Rice	2.05	1.67	4.55	-0.11	2.45	-1.76
		Wheat	0.79	0.62	1.52	-1.79	0.72	-2.40
		Maize	-3.62	-0.91	-1.37	-0.13	2.33	0.79
		<i>Jowar</i>	-4.12	-1.87	-2.80	-1.48	1.38	0.39
		<i>Bajra</i>	-2.62	-2.45	0.47	-3.57	3.17	-1.15
		<i>Ragi</i>	-9.54	-8.41	-4.20	-18.70	5.91	-11.24
V	Upper Gangetic Plains Region	Rice	2.06	-2.39	4.22	-2.02	2.12	0.38
		Wheat	0.69	0.09	1.09	0.03	0.40	-0.06
		Maize	-2.09	-2.01	5.54	-9.16	7.80	-7.30
		<i>Jowar</i>	-3.19	-5.24	-12.87	-3.81	-9.99	1.51
		<i>Bajra</i>	-0.54	0.53	4.45	-2.33	5.01	-2.85
VI	Trans-gangetic Plains Region	Rice	4.02	-1.09	2.87	1.44	-1.10	2.56
		Wheat	1.53	-0.68	2.42	-2.69	0.87	-2.02
		Maize	-3.15	-2.24	2.30	-2.53	5.63	-0.29
		<i>Jowar</i>	2.41	-1.48	-4.01	2.69	-6.27	4.24
		<i>Bajra</i>	0.52	1.94	0.63	9.67	0.11	7.58

(i)

Annexure-III contd...

ACR No.	Agro-climatic regions	Crop	CGR (%)					
			Area		Production		Yield	
			1998-99	2003-04	1998-99	2003-04	1998-99	2003-04
VII	Eastern Plateau & Hills region	Rice	-0.71	-0.61	-5.98	2.64	-5.31	3.27
		Wheat	-4.22	-0.12	-7.79	1.59	-3.73	1.72
VIII	Central Plateau & Hills Region	Rice	3.60	-0.53	-2.94	-0.33	-6.32	0.21
		Wheat	5.30	-4.14	6.14	-3.93	0.80	0.22
		Maize	0.01	3.04	11.69	13.93	11.68	10.57
		Jowar	-5.62	3.84	-0.19	18.08	5.75	13.71
		Bajra	1.38	7.64	8.33	15.10	6.85	6.92
IX	Western Plateau & Hills Region	Rice	-1.30	-0.19	1.91	-0.51	3.25	-0.32
		Wheat	3.45	-3.22	3.45	-3.22	At par	At par
		Maize	2.77	5.36	6.59	12.87	3.72	7.12
		Jowar	-2.66	-2.59	-3.17	-5.19	-0.52	-2.66
		Bajra	0.13	-5.63	7.97	-2.21	7.83	3.62
		Ragi	2.19	2.73	0.40	5.64	-1.75	2.84
XIII	Gujarat Plains & Hills Region	Rice	2.02	-1.78	3.56	6.61	1.51	8.54
		Wheat	2.64	14.20	0.99	18.06	-1.61	3.37
		Maize	2.44	6.42	22.73	22.30	19.82	14.92
		Jowar	-8.26	-4.80	1.82	-5.72	10.99	-0.98
		Bajra	-2.86	2.43	3.65	14.57	6.70	11.86
		Ragi	-0.89	3.81	3.74	3.01	4.67	-0.77
XIV	Western Dry Region	Wheat	11.55	-6.08	11.52	7.76	-0.03	14.73
		Maize	-0.95	-8.12	9.90	-10.91	10.96	-3.04
		Bajra	-3.63	2.61	-5.78	32.72	-2.23	29.34
XV	The Islands Region	Rice	-0.16	At par	-3.98	1.67	-3.82	1.67
ALL INDIA		Rice	1.05	-2.02	1.73	-1.92	0.66	0.09
		Wheat	2.04	-0.88	2.30	-1.71	0.25	-0.84
		Maize	0.78	2.73	5.97	4.57	5.15	1.79
		Jowar	-3.64	-2.32	-3.35	-4.47	0.30	-2.20
		Bajra	-1.52	1.09	2.98	11.86	4.57	10.65
		Ragi	-0.74	-1.89	0.34	-9.34	1.09	-7.60

Source: Department of Agriculture & Co-operation, Union Ministry of Agriculture.

(ii)

Annexure-IV(a)**Existing Yield Gap in wheat (TE:2004-05).**

Unit: Yield in Kg/ha

State	Improved Practice (I)	Farmer Practice (F)	State Average (A) (2003-04)	Yield gap % between	
				I and F	I and A
Uttar Pradesh	4206	3324	2794	26.5	50.5
Bihar	3651	2905	1783	25.7	104.8
Punjab	4463	4035	4207	10.6	6.1
Haryana	4751	4520	3966	5.1	19.8
Rajasthan	3948	3724	2794	6.0	41.3
Gujarat	4034	3491	2681	15.6	50.5
Madhya Pradesh	3297	2472	1789	33.4	84.3
Maharashtra	3411	2907	1335	17.3	155.5
Himachal Pradesh	2616	2126	1380	23.0	89.6
West Bengal	2766	2081	2316	32.9	19.4
Uttaranchal	3388	2444	1877	38.6	80.5
Karnataka	3608	2761	480	30.7	651.7

Source: Department of Agriculture & Co-operation, Union Ministry of Agriculture.

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Annexure-IV(b)**Existing Yield Gap in barley (TE:2004-05).**

Unit: Yield in Kg/ha

State	Improved practice (I)	Farmer practice (F)	State Average (A) (2003-04)	Gap % between	
				I and F	I and A
Uttar Pradesh	3232	2627	2198	23.1	47.1
Punjab	4363	3871	3348	12.7	30.3
Haryana	3965	3471	2800	14.2	41.6
Rajasthan	4311	3273	2249	31.7	91.7
Gujarat	2867	2125		35.0	
Madhya Pradesh	3759	2912	1507	29.1	149.4
Himachal Pradesh	2391	1943	1292	23.1	85.1

Source: Department of Agriculture & Co-operation, Union Ministry of Agriculture.

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Annexure-IV (c)**Existing Yield Gap in rice (TE:2004-05).**

Unit: Yield in Kg/ha

State	Improved practice (I)	Farmer practice (F)	State Average (A) (2003-04)	Gap % between	
				I and F	I and A
Rainfed (upland) 2003-04					
Chhattisgarh	3740	3138	1455	19.2	157.0
Jharkhand	2292	1380	1695	66.1	35.2
Manipur	4277	1830		133.7	
Uttar Pradesh	3620	2480	1942	46.0	86.4
Rainfed (shallow lowland) / Boro; 2003/04, 2004/05					
Assam	4520	2550	1534	77.3	194.7
Chhattisgarh	3554	2784	1455	27.7	144.2
Jharkhand	3480	2300	1695	51.3	105.3
Manipur	6350	5095		24.6	
UP	3656	3432	2187	6.5	67.2
Irrigated					
Chhattisgarh	3919	3137	1455	24.9	169.4
Bihar	4883	4158	1516	17.4	222.1
Gujarat	5585	4890	1891	14.2	195.3
J&K	7488	4705	1941	59.1	285.8
UP	7050	5200	2187	35.6	222.4
Uttaranchal	3850	3200	1942	20.3	98.2

Source: Department of Agriculture & Co-operation, Union Ministry of Agriculture.

Annexure-IV (d)**Existing Yield Gap in Jowar (TE:2004-05).**

Unit: Yield in Kg/ha

State	Improved practice (I)	Farmer practice (F)	State Average (A) (2003-04)	Gap % between	
				I and F	I and A
Andhra Pradesh	2402	1513	1145	58.8	109.8
Gujarat	2134	1414	1006	50.9	112.1
Karnataka	1503	1219	471	23.3	219.0
Madhya Pradesh*	1510	984	1332	53.5	13.3
Maharashtra	1832	1242	727	47.5	151.9
Rajasthan*	1911	611	714	212.7	167.6
Tamil nadu	1837	1356	612	35.5	200.2
Uttar Pradesh*	1755	1122	1004	56.5	74.8

* relates for *Kharif* season only.**Source:** Department of Agriculture & Co-operation, Union Ministry of Agriculture.

Annexure-IV (e)**Existing Yield Gap in sugarcane (TE:2004-05).**

Unit: Yield in Kg/ha

State	Improved practice (I)	Farmer practice (F)	State Average (A) (2003-04)	Gap % between	
				I and F	I and A
Uttar Pradesh	90950	70350	55541	29.3	63.8
Bihar	74420	49440	40990	50.5	81.6
Punjab	76230	68970	53821	10.5	41.6
Haryana	82670	72610	58012	13.9	42.5
Rajasthan	79210	61480	53345	28.8	48.5
Gujarat	102950	83030	71820	24.0	43.3
Madhya Pradesh	112550	84660	42089	32.9	167.4
Maharashtra	127440	99520	51297	28.1	148.4
Tamil Nadu	127660	109780	91924	16.3	38.9
Uttaranchal	83350	75590	59773	10.3	39.4
Karnataka	147390	128000	66667	15.1	121.1
Assam	85470	60590	38638	41.1	121.2
Orissa	113180	90360	58774	25.3	92.6
AP	83960	58960	72105	42.4	16.4
Kerala	101650	80190	84265	26.8	20.6
India	99270	79580	58988	24.7	68.3

Source: Department of Agriculture & Co-operation, Union Ministry of Agriculture.

Annexure-IV (f)**Existing Yield Gap in cotton-lint (TE:2004-05).**

Unit: Yield in Kg/ha

State	Improved practice (I)	Farmer practice (F)	State Average (A) (2003-04)	Gap % between	
				I and F	I and A
Punjab	1820	1467	556	24.0	227.2
Haryana	1845	1597	454	15.5	306.4
Rajasthan	1753	1532	351	14.5	399.5
Gujarat	905	688	417	31.6	116.9
Orissa	701	553	409	26.7	71.3
Madhya Pradesh	1166	903	190	29.2	513.7
Maharashtra	1002	861	189	16.4	430.2
Karnataka	1498	1240	174	20.8	760.6
Andhra Pradesh	1711	1543	384	10.9	345.6
Tamil Nadu	1765	1442	213	22.4	728.6

Source: Department of Agriculture & Co-operation, Union Ministry of Agriculture.

Annexure-IV (g)**Existing Yield Gap in mustard (TE:2004-05).****Unit:** Yield in Kg/ha

State	Improved practice (I)	Farmer practice (F)	State Average (A) (2003-04)	Gap % between	
				I and F	I and A
Bihar	1385	942	830	47.0	66.9
Chhattisgarh	1101	772	432	42.6	154.9
Haryana	1640	1410	1559	16.3	5.2
Himachal Pradesh:					
(a) Mustard	1320	790	556	67.1	137.4
(b) Karan Rai	883	287	556	207.7	58.8
Jharkhand	802	440	-	82.3	-
Madhya Pradesh	1966	1675	1007	17.4	95.2
Rajasthan	1667	1413	1306	18.0	27.6
Tamil Nadu	232	155	-	49.7	-
Uttar Pradesh	1545	1130	1008	36.7	53.3
Uttaranchal	1319	1054	846	25.1	55.9
Punjab	1561	1420	1196	9.9	30.5

Source: Department of Agriculture & Co-operation, Union Ministry of Agriculture.

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Annexure-IV (h)**Existing Yield Gap of soybean (TE:2004-05).****Unit:** Yield in Kg/ha

State	Improved practice (I)	Farmer practice (F)	State Average (A) (2003-04)	Gap % between	
				I and F	I and A
Himachal Pradesh	1440	1154	1000	24.9	44.0
Uttaranchal	1973	1496	1294	31.9	52.5
Madhya Pradesh	1442	1134	1130	27.2	27.6
Chhattisgarh	2208	1669	845	32.3	161.2
Maharashtra	1907	1514	1396	25.9	36.6
Rajasthan	1503	1159	1400	29.7	7.3
Karnataka	1517	1303	532	16.4	185.1
Tamil Nadu	1456	1140	-	27.8	-

Source: Department of Agriculture & Co-operation, Union Ministry of Agriculture.

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INTERIM REPORT OF THE SUB-GROUP ON “AGRICULTURAL EXTENSION, MANAGEMENT AND FUNCTIONAL LINKAGES” OF THE WORKING GROUP OF NATIONAL DEVELOPMENT COUNCIL (NDC) ON AGRO-CLIMATIC ZONAL PLANNING INCLUDING AGRICULTURE DEVELOPMENT IN NORTH-EASTERN INDIA FOR XI FIVE YEAR PLAN (2007-12).

By

**Dr. C.Prasad
Chairman, Sub-Group
EB-106, Maya Enclave, New Delhi – 110064,
Ph: 25495254, 25120696, Fax : 25120696,
E-MAIL: vardan_ngo@yahoo.com**

WEBSITE: www.vardanindia.org

Introduction

In the Working Group of Agro-Climatic Zonal Planning and Agricultural Development in North Eastern India, it was decided to have a Sub-Group on **Linkage and Management** together with other four Sub-Groups. In the second meeting of the Working Group as well as in Sub-Group, it was clarified that **linkage** is a component of **management** which was discussed in the context of extension. Therefore, the title could better be **Agricultural Extension, Management and Linkages**. Thus by implications, the task of the Sub-Group is on Agricultural Extension, Management and Functional Linkages which would be treated in the context of Agro-Climatic Zonal Planning and agricultural development in the country in general and in the North Eastern Hill States in particular.

FAO defines an agro-climatic zone (ACZ) as a land unit delineated in terms of major climate and growing period, which is climatically suitable for certain range of crops and cultivars. Agro-climatic conditions mainly refers to soil types, rainfall, temperature and water availability which influence the type of vegetations. FAO recognized 14 major climates (1983) under three climatic broad classification – Temperate (below 5⁰C), tropics (mean temperature 18⁰C) and sub-tropics (between 18⁰ to 50⁰C).

The ICAR launched the National Agricultural Research Project (NARP) with support from the World Bank with a view to generating location specific and need-based technologies based on researches in the specific agro-ecological situations (Ghosh, 1979). Thus, 126 agro-climatic zones for 17 major states were identified including six states/union territories of North Eastern Hill Region; later six more zones for Andaman & Nicobar and two for Pondichary were added (131 zones). The “farming situations under each ACZ were also delineated, which could be considered for research purposes, through Regional Research Station. Planning for the location specific research, reported Ghosh, a Status Report for each zone covering information on the natural resources, major crops, farming systems, production constraints and socio-economic conditions prevailing in the zones were prepared. The ACZs for Goa, Domain, Diu Dadra Nagar Haveli and Lakshadweep were not delineated.

Primary objective being the technology generation **rather than technology transfer**, agro-climatic resources and prevailing conditions received greater considerations in the delineation of NARP Zones.

After almost 10 years, Planning Commission, Govt. of India identified 15 resource development regions; Agro-climatic regions (ACRs) in 1989 – 14 in the main land and one in Islands of Bay of Bengal and the Arabian Sea. Later the NARP Zones of the ICAR (131) were categorized under each of the 15 ACRs of the Planning Commission for the convenience of resources development as well as research.

The National Bureau of Soil Survey & Land Use Planning, Nagpur of the ICAR, has also attempted to delineate agro-ecological zones of India with the concept that an agro-ecological zone is super imposed on physiography and kinds of soils and soil conditions that act as modifiers of climate and length of growing period. With that concept the country has been divided in 54 agro-ecological zones, in which each zone has ‘fairly-uniform, climatic land form (and soil) conditions for generating and transferring agro-technology’ (Sehgal, Modal and Mondal, 1989). Subsequently the Bureau has published another map with 21 agro-ecological regions (Sehgal et al., 1990) This time the major criteria for the delineation of regions were: (i) growing period as an

integrated criterion of effective rainfall (ii) soil groups enjoy precedent over physiography (iii) delineated boundaries adjusted to district boundaries and (iv) number of regions as Minimum as possible.

National Agricultural Research Project – NARP (1979) was the outcome of the zonal planning of the ICAR; this project was supported by the World Bank. This was a great concept and approach devoted to creating/refining technologies most suited the zone/region. These technologies were to be demonstrated by the extension unit of the NARP to other extension agencies like KVKs, then T&V and others, for demonstration and promotion on a larger or national scale. But before the Regional Research Stations (RRSs) could contribute on this line, it was derailed in absence of adequate resources on withdrawal of the support of the World Bank in 1992-93. These RRSs are not now fully functional; several questions have been raised in the past on its survival or otherwise, or could it be converted into KVKs? The re-mandated KVKs in the NARPs (52) were tried under NATP (1998), but the review committee headed by Ex. Deputy Director General, Agricultural Extension (Dr. C. Prasad) did not recommend the re-mandated KVKs as the normal KVK of the ICAR for the concerned district, for it has a small input of extension to the RRS– not all the pre-requisites of the full-fledged KVK. What emerged, however, that the extension component of the RRS, which were non-functional, could be made functional by additional extension resources such as that of remandated KVKs. Such extension resources may be provided to all RRSs for strengthening the transfer of technology unit. It was also recommended that the Joint Director of the RRS should better be designated as Joint Director “Research and Extension” for better functional cohesion and linkages. The R&D components of RRS should be strengthened in the 11th Five Year Plan.

The basic issues being raised in this zonal planning process are:

1. The NARP/ZRSs though a wonderful basic concept towards generating need-based and agro-climatically specific technologies, is almost a dying institution in absence of adequate funds after withdrawal of the World Bank support. **They need to be revived with adequate fundings.**
2. The statements that the primary objective of NARP being the “technology generation” rather than “technology transfer”, agro-climatic resources and prevailing conditions received greater considerations in the delineation of the NARP ZONES (Ghosh, 1991) was not a correct proposition. The NARP effort was to generate appropriate technologies for effective transfer. This has not, perhaps, been clearly understood by the NARP management and scientists affecting the research outcomes, and the hue and cry of inappropriate technologies in many farming situations. The NARP was also provided with a few extension staff and a farmers hostel so that NARP was also alive to transfer to technology.
3. The NARP book has also delineated ‘farming situations’ in each State/Zones, which give way to ‘**farming system research**’ and ‘**farming system extension**’. But largely we have devoted our researchers to cropping system, perhaps, inadvertently. This should be the future approach in our research endeavours, which takes into account several conditions influencing the productivity of crops. **The sufferer basically is rainfed agricultural research and hence rainfed agricultural extension.**

4. Whether or not the institutions dealing with the agro-climatic zoning and mapping have any **linkages and relationship** either for economizing the costs or for utilizing the zonal agro-climatic exercises for research as well as extension? We have our doubts on such a correlations between the institutions.
5. To a lay observer, it seems, there should be a uniform and common platform for such a difficult but essential planning incorporating the basic agro-ecological factors as well as the socio-economic factors; the latter has been completely ignored. The research has not followed the path of pro-poor, pro-women or pro-environmental issues as always highlighted by eminent scientists.

National Agricultural Extension System

Unfortunately, we do not have as yet a **National Agricultural Extension System** in the country. To many, this may sound unbecoming, but this is what it is. In the USA, in 1914 as per Smith Liver Act, the **Cooperative Extension Work** was established and till date this system remains the same, though, many extension projects and designs came and went. In India, we went by **extension projects (C.D., AES, IADP, IAAP, HYVP & T&V)** one after another for agricultural development, not by a lasting and stable extension system. After T&V of the World Bank was withdrawn in 1993, virtually we have no extension system; it has been left loose in the hands of states by and large. Most of the earlier projects were foreign supported. Thus, we never developed a strong teeth of our own and hence this growing crisis today.

Structurally, we have Directorate of Agricultural Extension (DAE) in the Ministry of Agriculture (MOA), Government of India; and the Division of Agricultural Extension (DAE) in the ICAR. Both are Subordinate Offices. After T&V extension projects of the World Bank in the Ministry, ATMA (Agricultural Technology Management Agency) was conceived and launched as an experiment under the NATP of the ICAR supported by the World Bank in seven States and 24 Districts in 2001; this was devoted to decentralized planning involving all stakeholders. In 2005, it was expanded to major states (not Union Territories) in 252 districts. ATMA is a district level integrating and management extension mechanism, and not a total extension system – sporadic and not holistic in nature. Its success or otherwise is yet to be seen.

Similarly, in the National Agricultural Research Systems (NARS) of the ICAR, there is obviously priority to research, Agricultural Education and very limited priority to Agricultural Extension. The ICAR rightly justifies this because in the ICAR, extension education is a first-line (pilot) effort with only limited area jurisdiction, whereas the DAE of the MOA is the main extension system for the country as a whole.

Even there are **conceptual differences** between those two extension mechanisms – one in the Ministry of Agriculture and the other in the ICAR. **Extension** is basically educational in nature and has an educational design better known as **extension education**. This being a basic and universal phenomenon, it is applied in all transfer of technology (TOT) projects/programmes, may that be agricultural or industrial. It is named accordingly: Agricultural Extension (to be accurate – Agricultural Extension Education) or Veterinary Extension or Veterinary Extension Education. However, the extension being promoted in the ICAR system including SAUs (State Agricultural Universities) is, unwittingly, termed as **extension education**, whereas the extension being done by the MOA and the States is termed as **extension services**, the latter denotes the mechanical manner of transferring technologies, not the educational approach. Rightly, it can also be called **extension education services**. The services concept thus has also percolated to the State Extension programmes, which is almost devoid of educational and training role for the farmers, ultimately adversely affecting the whole extension system in the country. Due to these two Sub-Ordinate Offices, the present extension system has no voice and teeth of their own. This is a serious concern directly affecting the agricultural productivity and production. If this basic malady is not corrected, the present plight will continue.

North-Eastern Hill States

The greatest challenge to our society, nay, the developing world, today is hunger, poverty and peace- the number one millennium goal of the UN. The prevailing poverty

for decades is a slap on the face of the Government and the rich people and the intellectuals of the society. Inadvertently, perhaps, we have followed a path of skewed development in favour of mainly economic gains vis-a-vis social development. No doubt, we have done so well on the economic front in agricultural sector, but for the resource poor farm families – the social dimension of development. The two-third of the well-to-do farming families benefited from the conventional extension development efforts, but the one-third families remained poor. The gulf between rich and poor, in fact, has increased manifold: the ratio was 1:30 in 1970s and now it is 1:74, as reported (ICSSR-2002).

The North Eastern eight States comprising Arunachal Pradesh, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, Tripura and Assam represented a different agro-ecological situations and socio-economic conditions from the rest of the country (Assam could be exception), but we followed the same farming research and extension approach and mechanisms for agricultural development. That was not appropriate, it has been realized now; the future extension strategies and management have to be most suited to their local agro-climatic as well as socio-economic conditions and complexities. Lately, the research efforts of the ICAR Research Complex, Barapani, Meghalaya comprising all NEH States/Unions Territories, have been diverted to farming system research – a rare sight in the country in fact.

Our agricultural policy, no doubt, emphasized on rainfed agriculture where majority of the farmers are resource poor; but in implementation of the extension programmes, we could not reach the poorer farm families with appropriate technologies, development strategies, resources or support. Some extension projects demonstrated the potentiality to effectively reach the unreached, (Lab to Land, ORP etc.), but it could not become the national design and the thrust area unfortunately. Thus, well-to-do farmers, by and large, benefited from the scheme of things; resource poor farmers have been left behind unmercifully. The extension system largely followed the soft options-reaching the rich, the receptive, the influential ones. On the contrary, it was also not easy to reach the poor families who suffered from so many socio-economic odds on one hand and non-availability of relevant and appropriate technologies on the other. The programmes were not pro-poor, pro women and pro-youth as always insisted by Dr. M. S. Swaminathan. We followed a general extension system all over the country as if the farming families were all very equal and similar needing similar treatments. This was a mistaken approach in the past by the extension system. This must be corrected in the 11th Five Year Plan.

Our North Eastern Hill States are very different socio economically and agro-ecologically from the mainland plains. Basic infrastructural facilities like roads, communication, transportation, fragility of hill agro-eco system, appropriate technologies, traditional governance and extension system of the plains have left these states far behind vis-à-vis other States of the Country. Over 65% of these States are hilly, 22% basins of Brahmaputra, and 13% Meghalaya plateau – basically rainfed and mono-cropped. The farm families are scattered into several hamlets in one village, and the many villages are governed by the traditional village chief (Pradhan). **Table -1 & 2** present the agricultural situations of the North Eastern Hill States (Annexure-I).

We also need to realize that women play a decisive role in hill agriculture – their empowerment and thickly involvement in extension should be a sine-qua non.

Our Past Extension Experience:

Mahatma Gandhi talked of **Antyodya**— reaching first the poorest of the poor, but we did not do it owing to two reasons: (i) influence of the rich farmers; and (ii) soft options and convenience of the extension personnel in approaching the well-to-do farmers. Thus the small and marginal farmers as well as agricultural labourers were virtually by-passed. Hence rich continues to be richer at the cost of poorer farming communities; we have **poverty among the rich people—hunger and greed for wealth, the latter is more dangerous for the society**. Majority of the farming families belong to small & marginal groups.

The **Land to Lab programmes** and the **SC/ST Operational Research Projects** of the ICAR were very successful for poorer sections of the farming communities, but could not be continued for long. The KVKs, besides functioning for last 30 years, continues to be a **Plan Scheme**— they die or survive every five years. What is this management? The KVKs are successful rural institutions—they must be converted into **non-plan** after successfully working for initial 10 years. The **Trainers Training Centre (8)** with the specialized ICAR research institutions have been lately closed, when training is a strong mechanism for TOT the world over. There are 543 KVKs in the country today, tomorrow they are going to be over 600— one in each district. The management of such a big scheme should be the concern of the ICAR/ GOI. It would demand an **independent set-up to administer it effectively and efficiently**. Lately NGOs have been discouraged in running the KVKs, because they must have their own lands (25-50 acres) which should be mortgaged to the ICAR. Even lands (50 acres or so) being leased by the State Govt. to good NGOs/ Institutions have been ignored. It has been easier to dump KVKs in the SAUs— all eggs in the similar baskets. Even core resources available to KVKs by the ICAR are not totally available to the KVKs — they are being diverted by major institutions for salaries etc.; and the KVKs are also becoming government institutions depending totally on ICAR resources, whereas they could generate additional resources from outside agencies through productive projects. These require serious considerations.

Reference has been made about the general extension work of the MOA/GOI; after T&V virtually there is no extension system. ATMA— a planning and integrating model at the district level is under experimentation and also under gradual expansion with no signs of great hope so far.

There are a few successful extension models such as (i) **Self Help Groups** for organizing the poorer rural women— this could be extended to farm women and men in order to promote organized **farming**; (ii) **SRI— the system of Rice Intensification**—an emerging model from **Madagascar** (1980s) with the rice productivity upto 15 tonnes per hectare; (iii) **WADI—means small orchard** to be promoted as an integrated model in Gujrat and Rajasthan duely implemented by BAIF&RDF and supported by KFW of Germany; (iv) Watershed approach for rainfed agriculture; and (v) AMUL/NDDB holistic approach to dairy enterprises, known as the **white revolution the world over**. Time has come to insist on **AMUL Model** in agriculture as well by connecting all value chains of production – A to Z: inputs to marketing and investments.

Agricultural Management

‘The issue of governance has in the recent times emerged at the forefront of the development agenda. Good governance is one of the most crucial factors required if the targets of the Tenth Plan are to be achieved. It is also this factor, or rather lack of it,

which could be the cause of immense disappointment and missed development opportunities'

'The universally accepted features of good governance are the exercise of legitimate political power; and formulation and implementation of policies and programmes that are equitable, transparent, non-discriminatory, socially sensitive, participatory, and above all accountable to the people at large. There could however be aspects of governance that are contextually driven and geared to address the local concerns'.

'Experience shows that while good governance can help secure human well being and sustained development, it is equally important to recognise that poor governance could well erode the individual capabilities, as well as institutional and community capacities to meet the needs of sustenance'.

Management is a Social Science; it is defined as working with people of an organization/institution devoted to certain mandates, specific objectives and goals. Management would mean working and managing men, money and allied resources of an organization/institution for achieving its goal most effectively and efficiently.

Management is an applied social science which can be utilized by any organization or group or institution and hence the names are likewise designated. For instance, Agricultural Management, Research Management, Extension Management or industrial management. It has several components or processes, such as Planning, Organizing, Staffing, Directing, Coordinating, Reporting, and Budgeting (POSDCoRB) – Gullick, 1973. These processes being relatively broad and abstract, seven more processes were added to this list namely, Supervision, Communication, Linkage, Human Relations, Decision-making, Evaluation and Monitoring (MEDHLiCS) – Prasad, 1993 (Fig.1) — Annexure-II. This means that for the study of any institution/organization, we have to deal with these processes/components of management. By virtue of our experience (not academic training), we deal with some of them and not all of them, and that also in proper relationship and linkages. Private business houses and corporate sectors have taken full advantage of the concept approach and mechanisms of management; we have not.

In a good management system, we talk of de-centralized management and collective decision-making. Are our institutions de-centralized and decisions are all collective? There is another principle of management called **span of control** which means how many executives could be controlled by the number one man – D.G./Secretary? Or for that matter, any Executive. It has been found that the head of the institution can effectively handle 5-6 Executives, and not more than that. But normally we don't want to reduce the empire in order to have more powers and authorities, which affect the efficiency and effectiveness of management, delegation of authorities and responsibilities in right combination and proportion are rare. The size of the institution is another issue in regard to efficient management; the National Commission on Agriculture (1974-76) did recommend on the size of the University or Research Institute. In that comparison all our SAUs and Research Institutes are much bigger affecting the efficiency and effectiveness; still they are growing in size. This requires a thorough study by a Management Expert Team.

Many times there are simple managerial issues, which if not taken care of timely, they affect the functioning of organization/institution. For instance, in one case, in an University a scientist was promoted from Assistant Professor to Associate Professor by internal assessment system, and he was given the salary from the date of his

promotion, **but not the designation for four to five years**. Thus, he continued to be Assistant Professor on papers while drawing the salary of an Associate Professor. For efficient management, this is a gross mistake, for the morale of the scientist was affected and therefore, his talents could not be harnessed fully for that period; it was a case of loss of efficiency in work. Why such a simple mistake one could make, where it results into the loss to the organization? This could not have happened if the management could have understood the intricacy of the personnel management and the morale and human side of the incumbents. Many such instances could be seen in the working of our institutions in absence of management training and proneness.

Likewise, **linkage process** is extremely important for mutual interactions between scientists and workers of an organization, where fuller division of labour can take place and they mutually reinforce each other in working as teams. But, there is a basic pre-requisite for proper linkage, i.e. they must have common objectives and goal, and they must share rewards or punishments equally, as it happens at any point of working together. But in a team, conventionally, reward is taken by somebody and punishment by somebody else. Under such circumstances, how linkage can take place? There are several such pre-requisites for good linkages, governance and implementation of the programmes. We need to study them.

Management is very well understood in the private business or corporate sectors and this is why they make heavy investments in hiring management experts. Examples are not far to seek – our MBA students from Indian Institute of Management, Ahmedabad are picked up even while they are studying on a very high premium by the national and international organizations. Harvard School of Management, U.S.A. is known all over the world for producing best managers and administrators. In agriculture, we have yet to learn about the scope and importance of management. Perhaps, we have just started. The sixth chapter of Vol. 1 of the 10th Plan of the Planning Commission dealt with rightly governance and implementation.

The National Commission of Agriculture (1974-1976) strongly recommended for establishing a Central Institute on Agricultural Management which came in the form of NAARM at Hyderabad in the ICAR set-up; it is now bringing some elements of management in the NARS/SAUs. It has yet to acquire professionalism. They also recommended to have a similar institution on management **one in every State**. This has only happened in Haryana (SAU) and lately in Uttranchal (SAU, Pantnagar). Most of the States are not yet sold to this important idea. Though the concept of agribusiness and management is catching up in the SAUs. Besides **general management**, there is a concept of **development management** which means more flexibility, more partnership in decision-making and opportunities for corrections in the ongoing projects/programmes.

The **fusion process** of management is a practical theory: the values, aims and objectives and the goals of the organization (proprietor) and the incumbents must be mutually inclusive – they must fuse together – a give and take proposition. Under this consideration the incumbents can express their talents to the maximum (Fig. 2) — Annexure-II.. The management by objectives (MBO) and the management by Groups (MBG) are equally good theories. These are only a few instances and pointers. Administration and management by itself is a basic discipline.

Present Need and Priorities

Time and again, Sub-Working Groups of the Planning Commission have questioned the KVKs being run in the ICAR - a research system. Frankly farm scientists of the ICAR itself, do not see eye to eye with the extension scientists in the research environment. The MOA has called it a duplication of extension efforts. The Parliamentary Committee (1990s) in the past have suggested for re-structuring the national extension set-up. A study on the KVKs (Prasad, 2000) stated: "when the KVK system reaches the 500 plus KVK mark, its management has to be critically thought of by the ICAR/Ministry of Agriculture. Perhaps, it may need an **independent management** structure. Even one can think of integrating the Extension Division of the ICAR and the Directorate of Extension of the Ministry of Agriculture as a long-term viable strategy and thus creating an autonomous Council for Agricultural Technology Transfer (CATT) under the able guidance of the Union Minister of Agriculture — organizational structure at Annexure – III A, B & C.

In agriculture, we adopted the USA model development where Teaching, Research and Extension are integrated with the State Agricultural Universities, and not with the State Departments. The basic ideology being that transfer of technology to the farming communities is an **educational and training role** (Extension Education role) – not a routine and mechanical affairs as it has become in the State set-up. However, we modified this model in the context of Agricultural Extension emphasizing that India is a huge country and the heavy demand for extension will jeopardize the research efforts. We have seen, with some exceptions, that states being too pre-occupied with diverse activities – seeds, fertilizers, plant protection chemicals, loans, pricing, procurement, marketing, insurance, etc. could hardly give attention to the educational and training role of TOT. And also, in respect of State Agricultural Universities, which was thought of one per state as per model Act of the ICAR, has been multiplied manifold: five in Maharashtra, three in U.P., three in West Bengal and so on. This trend is on increase unfortunately. Even there are nearly 100 private colleges in Agriculture in Maharashtra affiliated to SAUs, which is totally wrong – only constituent colleges were conceived to be the part of the SAUs for the sake of quality. What to call of private colleges, there are about 400 Agricultural Schools and some of them affiliated to State Agricultural Universities. Where is the Model Act of the ICAR and management the custodians of Agricultural research and education?

Since now the agricultural universities and its constituent colleges have multiplied, the area jurisdictions of the SAUs have been reduced and the load of teaching and research per scientist has been likewise reduced. Earlier the conceptual clarity on 'Extension Education' and 'Extension Services' made clear, the involvement of extension and subject-matter scientists in extension education and training role is rather reduced. Therefore, it is a high time that we may **think of reverting, back to USA original model**, integrating, teaching, research and extension fully. This will economize on our investments and will bring quality in agricultural extension education services, which has dwindled to a lowest ebb today.

National Agricultural Extension System

There is a need for drastic change in the Agricultural Extension System. Firstly, as explained earlier, there is no national extension system; there has been projects and programmes – not a sustainable mechanism. We may name this system as the **National Agricultural Extension System (NAES)**. This national system needs an

independent autonomous body – Council, Board or Bureau or Say, **Council for Agricultural Transfer of Technology (CATT) with following arms/divisions:**

- (i) Farm Advisory Services Division: demonstrations of technologies, vocational training, Mass-Communication, Field-days, Exhibitions & Fairs, KVKs, ATMA etc;
- (ii) Research and Monitoring & Evaluation Division Research in TOT and **Social Science applied** to agricultural extension: operational research, action-research, adaptive trials, monitoring and evaluation and impact studies.
- (iii) **In-service training and entrepreneurship development (HRD):** advanced training and training to all shades of people and personnel in agriculture including management training & foreign training & visits.
- (iv) **Information and Communication Division:** Blending Conventional and modern communication technologies and devices – electronic media and mechanisms ATICs development of educational and training material, audio-visual aids, films, cassettes, CDS, inter networks, knowledge Centres, extension publications etc.
- (v) Establishment: dealing with all the administrative and institutional matters – finances, personnel management & infrastructures.

This proposed Council can be establishment by integrating and merging the two Sub-Ordinate Offices referred to earlier – Directorate of Extension of the Ministry of Agriculture and the Division of Extension of the ICAR deploying all the staff, budgets and allied infrastructures. Since the Agricultural Extension System works with over 65% of the rural population for their livelihood security and upliftment, as a policy of the Government, the Union Ministry of Rural Development should share with CATT at least five percent of its budget for extension education purposes. Since the Agricultural Extension System represent over one-third of the agricultural R&D, the budget should be accordingly provided in the 11th Five Year Plan (see Annexure-IV).

The major Extension projects and programmes:

1. The KVK network & ATMA for Farum **Advisory Services** including various approaches and methods, mass-communication and electronic designs and devices should be continued and strengthened (Annexure -).
2. The old **Lab to Land** programmes of the ICAR for small and marginal farmers and agricultural labourers should be revived with enhanced budget, norms and needed modification.
3. The IVLP, Operational Research Project, Action – research project and studies in social sciences applied to agriculture should be strengthened and multiplied.
4. The **demand and market driven** extension mechanisms may be adopted using the farms of the model and awarded farmers, farms of the KVKs NARPs, SAUs & the ICAR Institutes. The holistic model of extension on the line of **AMUL/NDDB** by organizing farmers to organized marketing and investments

should be introduced in agriculture for value addition at all levels of production and marketing.

5. The information and communication Wing of CATT should deal with extension approaches and methods including electronic devices – ATIC, Audio-Visual Labs, diagnostic Teams, Mobile extension vans and mass-communication.
6. Advanced Training Centres(ATCs) to be established in all SAUs and ICAR Research Institutes with only core staff and by deploying relevant scientists from outside. Training is a strong mechanism of the Transfer of Technology.
7. **NARP** which is devoted to generating appropriate technologies for the specific agro-climatic zones should be strengthened to support the extension system at large – the legacy of the Zonal Planning (Annexure -).
8. The KVK Chief should be in the rank of Professor with a team of senior junior staff so that the KVK gets the right leadership. The Chief in the rank of senior scientist with very young staff in the S₁ rank represent a weak structure. The KVK farms and demonstration units should be also utilized for improved seeds, animals, planting materials and finger links.
9. In the North-Eastern hill States, while the Knowledge Centres may be established at the Panchayat level with latest communication devices, the small hemlets may be approached by Radio Groups and mass contact methods. The extension system in hills should deal with women empowerment – SHGs model may also be followed for male farmers in hills. Hill states may need larger budgets for basic extension infrastructures – Vehicles, transportation, cold storage, warehousing facilities etc. The traditional leadership of the hill villages – the village Chief or Pradhan should always be taken into confidence for getting acceptance and cooperation from the farmers.
10. Extension Approaches
 - Survey/PRA Studies documentation and data-base as basic to scientific extension planning.
 - Working through organized Farmers Groups – SHGs or others preferably SHGs as a national model – An organized effort.
 - A Holistic or Systems/systemic approach – like FELDA in Malayasia, Agro-industrial complexes of Bulgaria or AMUL/NDDB model of India.
 - Participatory Approach – involving all stakeholders at all levels.
 - Women Empowerment– mainstreaming in agriculture
 - Action Research approach – documentation, interpretations and publications.
 - Management processes – training at all levels.

- Recognizing training as the **fourth basic function** – Teaching Research, Extension and Training.
- Refined Lab to Land programmes for small & marginal farmers including Agricultural labourers.
- Organic farming in selected pockets and commodities on the holistic model referred to earlier.

11. Infrastructural Needs

- Establishment of the Council for Agricultural Technology Transfer (CATT) as discussed in the text.
- Modernizing all extension grids/units with latest information and communication gadgets and devices – computers, Fax, Machines, E-mail, Website, etc.
- Rural infrastructure needed for holistic extension approach including roads, cold storage, food processing units, warehousing facilities and organized marketing.
- Mobility facilities including transportations and mobile extension vans.

12. In case, somehow, the CATT concept is not approved, a weak alternative course could be that in the State extension education services, the cadre of extension education personnel may be separated exclusively for the agricultural extension education and training roles. They may be thoroughly trained and motivated in these processes. Their activities must not be mixed up with State agricultural services.

RECOMMENDATIONS

The preceding text of the report and discussions on relevant issues in respect of agricultural/ horticultural extension, small and marginal farmers and women in horticulture, vividly bring to fore that virtually there is no extension system now after the termination of the World Bank supported T&V project. We have worked for agricultural development through projects mostly supported by foreign grants/ soft loans. Even we did not name our national extension system for its stability and sustainability. The extension mechanism in the country has been the weakest link at present which is very much reflected in the agricultural growth rate of around 1.5% –the fatigue in agriculture as we name it, the reported suicides among the farmers, and almost 40% farmers are willing to leave agriculture for some other non-risky occupations for their livelihood security. We were importing only oilseeds and pulses, but now we are importing unfortunately wheat from Australia. The buffer stock for which we were boasting has dwindled. It is indeed alarming; the future of agriculture is bleak unless some drastic changes in the system and its management is brought about.

The fate of agriculture is dependent upon five pillars: (i) research, (ii) education, (iii) extension education, & training, (iv) basic infrastructure and (v) effective management. In spite of several odds and problems, we have still technologies for doubling the productivity and production in all spheres of agriculture including rainfed agriculture as well as oilseeds and pulses. The same is true in horticulture, animal husbandry and fisheries and their allied branches. But we have had mainly extension system devoted to cereal crops in the past; other sub-sectors could not find the priority places, basically because the main food was the immediate concern — meeting the hunger first. Time has come to diversify extension services with equal focus on cereals, horticulture, animal husbandry, fisheries and their allied enterprises.

Today extension system is not integrated, rather it is scattered unmindfully: all sub-sectors are having their own parallel extension mechanisms which is, no doubt expensive, duplications and thus devoid of benefits of synergy among all the disciplines. That shows our partitioned attitude – concern for the reality and, perhaps, more concerned about their own empires. We all know that all agricultural disciplines are integrated at the farmers' level; we must learn to approach them in the same integrated manner on their "integrated farm plan" (this we must help them to develop). Therefore, the agricultural extension system has to be only one with different sub-sectors suitably integrated and functionally linked for its efficiency and effectiveness. **On these premises, the recommendations are given below:**

1. **National Extension System:** In the first instance, let us name the extension system (not a project), say, call it 'national Agricultural Extension System' (NAES) or National Agricultural Technology Transfer (NATT). No matter what we call it, extension is educational in character all the way. Farmers are required to be educated, trained, motivated and persuaded for adoption of technologies, no matter who does it –Ministry of Agriculture or the ICAR, or the industrial sectors.
2. **An Autonomous Extension Council under the Ministry of Agriculture:** At this critical stage of agriculture, we need a drastic structural change for not only effective but also aggressive technology transfer in agriculture. This change could be effected by merging and integrating the Directorate of Extension of the Union Ministry and the Division of Extension of the ICAR, and making it a **Council of Agricultural Technology Transfer (CATT)**. Let us be very frank

and honest in the interest of the nation: the Ministry of Agriculture have never approached extension from educational and training angle on its own, unless they have external support and pressure of the external designs and projects; the State Governments have also done the same in implementing the government programmes mostly in a routinized manner. Let us also recall: the National Demonstrations Project of the Ministry of Agriculture (MOA) was transferred to the ICAR & the SAUs in 1960's — they wisely thought they could not do it or the scientists can do it better. The Extension Educational Institutes of the MOA were transferred and integrated with nearest SAUs — they realized the agricultural scientists could do it more efficiently and effectively. The present front-line demonstrations of the MOA are being implemented by the ICAR system — the NARS. Likewise, the ICAR can not effectively manage the load of nearly 600 KVKs (presently 543) in making by a Sub-Ordinate Division. Extension in order to be effective, efficient, dynamic and rather aggressive, needs its own **strong teeth and voice**, in the form of an autonomous Council better called as CATT as referred to earlier.

The proposed **Council** may run under the able leadership of Hon'ble Minister of Agriculture as its president; the **Budget**, the **Manpower** and allied resources ear-marked for extension in the MOA and the ICAR should be deployed for the said Council, which would have close and strong linkages and relationship with MOA/ICAR/NARS on the one hand and the allied ministries, industries as well as WTO on the other.

The proposed Council may have two routes of extension management — either the (i) USA extension system, where teaching, research and extension are **totally integrated** as proposed — this will be ideal a long-term strategy; or (ii) the present system of extension management, where down-the-line at the state level, there are two extension arms— ICAR/SAU systems on the one hand and the Department of Agriculture of the states on the other. But under the state regime, the 'educational and training roles' for the farmers in the Department must be clearly ear-marked, delineated and defined with no services role assigned to the extension personnel — in fact, it should be a cadre by itself under the said Council at the Centre.

When USA integrated pattern was adopted in 1958 (IARI) and 1960 in SAU (Pantnagar), the logic for bifurcating extension into the ICAR/ SAU system and the MOA was that, the load of extension work may interfere with the research system; therefore, they accepted the first-line role (pilot role) with limited area jurisdiction; the bigger role was given to the MOA/ State Governments. **The policy was decided when there was to be only one SAU in State; now there are more than one SAU in most of the states: Maharastra has five; U.P. five, H.P. two and so-on—** the trend is for more and more universities as well as colleges—Maharastra have over 100 private colleges affiliated to the SAUs and there are over 400 agricultural schools. **Thus, the area jurisdiction of the Universities/Colleges have now been sufficiently reduced and the scientific staff increased.** Therefore, the USA extension system can very well be successfully introduced now. Like the Central resources — Man, Money and allied resources being suggested to be deployed for the National Extension Council, the same would be done by the State Govt. for the SAUs / ICAR Institutes down below upto the block level.

First, the structural arrangements and deployment of human and material resources could be effected and there after closer studies and the actual needs, the further strengthening could be done. This arrangement is a must today for the country; let us ignore our empire building attitude.

3. The KVKs need to be strengthened with additional support; 52 remandated KVK districts should have full-fledged KVK; the Lab to Land Programmes for small and marginal farmers have to be re-launched with additional resources; and Operational Research for SC & ST should be re-vitalized.
4. **Functional linkages – a Partnership approach:**
 - At the village level 'Panchayat' should be the unit of operation consisting of 4-5 villages each. This will also conform to the policy of the GOI, that all the rural development work will be done through the local civic bodies, that is Panchayat Ray System. The lowest field level technical staff will be a B.Sc. (Ag) covering around 4-5 Panchayats - a Block staff. And for 2-3 Panchayats we may have a **para-extension worker** – a tenth passed young farmer duly trained in the field extension work. At the grass-root level, there will be **organized farmers, farm women and young farmers' groups for collective and organized extension work**. These farmer groups will be Federated at the Block, District and State levels for organized inputs, production, processing and marketing completely avoiding the middle men. The local NGOs may also support and work with the para-extension workers as also in concerned extension bodies.
 - The concept of **public-private partnership** (PPP) may be religiously followed where Governments, ICAR/ SAUs, Panchayati Raj system, Federations of the organized farmers' groups and NGOs should converse for synergy and multiplier effects. Linkage is a function of effective manage; we must promote management culture. This is weakest culture in agriculture, even though 'management is the single most important factor for achievements of the plan objective' said Planning Commission (2002-07).
 - ATMA can play a decisive role in integrating these institutions and groups at the district level. The Zonal Research Stations and the KVKs will be the technical arms. The modified version of T&V extension mechanism may be considered to be followed keeping in view the economy of the system and the research –extension effective linkages — the monthly workshop, diagnostic team visits, ZREAC meets and the contact organized farmers groups.
 - While there will be technical units with the Council in (i) crops (ii) horticulture, (iii) Livestock production and (iv) Fisheries for extension education, the service sides will be with MOA as usual: inputs, credits/loans, Prices, marketing, agricultural policies, WTO and so on.
5. **Training as a basic function:** Training is a strong mechanism for Transfer of Technology (TOT). While vocational training of the farmers will be taken care of by the Farm Advisory Wing of the Council, there will be advanced Training Centres in all SAUs and ICAR Institutes for continuous in-service trainings,

entrepreneurship development, extension management and Information and Communication Technology (ICT). The advanced Training Centres (ATCs) will have only a **core staff** – the rest will be deployed from the specialized disciplines of the SAUs and ICAR Institutes.

6. **Approach and Methodology:**

- The experience shows that the approach has to be a holistic one –an A to Z process. This could be in two forms: (i) relatively flexible in case of general extension, for general agriculture, but (ii) in case of commercial agriculture in the form of (a) organic farming, precision farming, protective farming, horticultural industrial complex (like Bulgaria), it has to be on the model of AMUL/NDDDB from inputs to marketing both domestic as well as export.
- The farmers have to be organized in the form of SHGs, Clubs, Forums, Sanghs, Mandals etc. (better it could have one nomenclature); farm women as Self Help Groups (SHGs). If all farmers, farm women and young farmers can be organized on the Self– Help Group model, this could be real revolution in agriculture like white revolution of NDDDB. This is an important policy issue for the government.
- The farmers may be classified broadly in two categories: (i) big or rich farmers, and (ii) small and marginal farmers including agricultural labourers. The former groups require only **knowledge of technologies and methodology basically**, whereas for the latter, the extension work has to be **personalized using individual, group and mass contacts** on one hand and the initial asset creation/ subsidies on the other. For small and marginal farmers, the **Lab to Land programme** of the ICAR was very successful. **This may be revived with added support.**
- For **Demand Driven extension**, the farms of awarded farmers and other progressive farmers should be utilized as the base and hub of all extension activities. Partial privatization of extension education may also be introduced – the big and well to do farmers should pay for the extension services to start with partially.
- The Electronic Media and Information and Communication Technology (ICT) can be utilized through “Knowledge Centres” for villages at the Panchayat level; at village level, it will be too much to be expected.
- Every farmer should be educated and modified to produce seeds of “certified seeds” quality for his own consumption and organized groups of farmers should be encouraged to produce seeds on commercial basis. This is the only way to fully meet the seeds requirements. Farmers must be discouraged to use grains produced for consumption as seeds.

7. **Main streaming women in Agriculture:** For farm women, the SHGs approach is the accepted model all over the world; the same could be strictly followed every where with priority to the poorer sections of the society – the small and marginal farmers as well as landless agricultural labourers.

8. **Agricultural Management:** 'Good governance is, perhaps, the single most important factor in ensuring that the objectives of the Tenth Plan are achieved' (Planning Commission, 2002-2007, Vol.1). Similar document states, "there are 20 to 70% leakages in the system "; the late Hon'ble Prime Minister of India Late Shri Rajiv Gandhi said, only 18% resources ear-marked for the rural poor reach them. The situation in this respect has gone from bad to worse—it has not improved – corruption begets more corruptions. One could compare the performance of the Private Business Houses and Corporate Sectors vis-à-vis the Public Sectors? Management is the pride subject in these private institutions, whereas it is virtually no subject in public sectors—there is only a "hire" system, not a "fire" system. **This appealing work culture must change in favour of effective management with responsibility and accountability.**

Therefore, adequate investment is needed in the agricultural management sub-sector. The recommendation of the National Commission on Agriculture (1974-76) in this context must be insisted upon—each state must have a management institute for management training of the development staff. Training in management should be insisted upon in all academics—limited degree programmes, but a lot of diploma and certificate courses as well as refresher courses in all the disciplines and their allied branches.

9. Though NARP/ZRSs are not directly a part of Agricultural Extension, it has direct relevance, for it is intended to evolve location specific agricultural technologies and it has also a component of extension for supporting transfer of technology. Therefore it is recommended that these institutions must be strengthen in the interest of agricultural development at large. **Since State Governments are only by enlarge contributing for recurring cost, the operational costs amounting to Rs. 100 crores may be provided in the Eleventh Five Year Plan.**
10. In view of inadequate financial support to agriculture by the State Governments and agriculture being so important, the Government of India should consider to put agriculture on the Concurrent List.

Funding Requirements

TOTAL EXTENSION BUDGET REQUIREMENTS FOR CATT, STATES & UNION TERRITORIES

(Budget in crores)

	Budget Requirement (for five Year)(A)	(Budget in Crores) Existing Budget for Five Year*			Additional Requirements (A-B)
		ICAR	Ministry of Agriculture	Total (B)	
Total Requirements at Central Headquarters level	2910	1350	785	2135	775
Headquarters: CATT	20				
Contingency& Operational cost	75				
KVK	2500				
ZCU	30				
NRCW	20				
National Extension Education Institute (New)	20				
Lab to Land & ORPs	25				
MANAGE	20				
Advance Centre for Training &EDP at SAUs & ICAR Institutes (100 Centres)	200				
Requirement of the States &UTs	1950				
State Headquarters:	100				
Operational cost& Contingency) (All States/UTs)	50				
District Coordination Unit:	1050				
Operational cost& Contingency) (All Rural Districts)	250				
Block Coordination Unit:	500				
Panchayat level: (Para Extension worker(one Male & one female per three Panchayats					
BUDGET REQUIREMENTS IN 11 TH FIVE YEAR PLAN : SUMMARY					
Total budget requirements at Central Headquarters level	2910				
Total Operational budget requirements of the states/UTs	1950				
For new project	972				
Grand Total	5832				

ANNEXURE-I

Table: Area, production and yield of Food grain & Oil Seeds and irrigated area and fertilizer consumption level in NER, 1998-99*

State	Food Grain			Oil Seed			Gross Irrigated Area	Fertilizer Consumption
	Area	Production	Yield	Area	Production	Yield		
Arunanchal Pradesh	173	181	1046	27	25	926	14	705
Assam	2701	3434	1271	337	150	445	28.5	78102
Manipur	176	392	2227	2.56	1.50	586	35	17109
Meghalaya	150	212	1404	6	4	661	21	3680
Mizoram	83	136	1639	7	8	1143	9	1142
Nagaland	212	284	1340	37 973	36	-	25.16	663
Sikkim	76	99	1303	10	8	761	12.60	-
Tripura	262	496	-	6	4	667	10.25	9761
Total North East	3833	5234	1366	433	237	547	-	111162

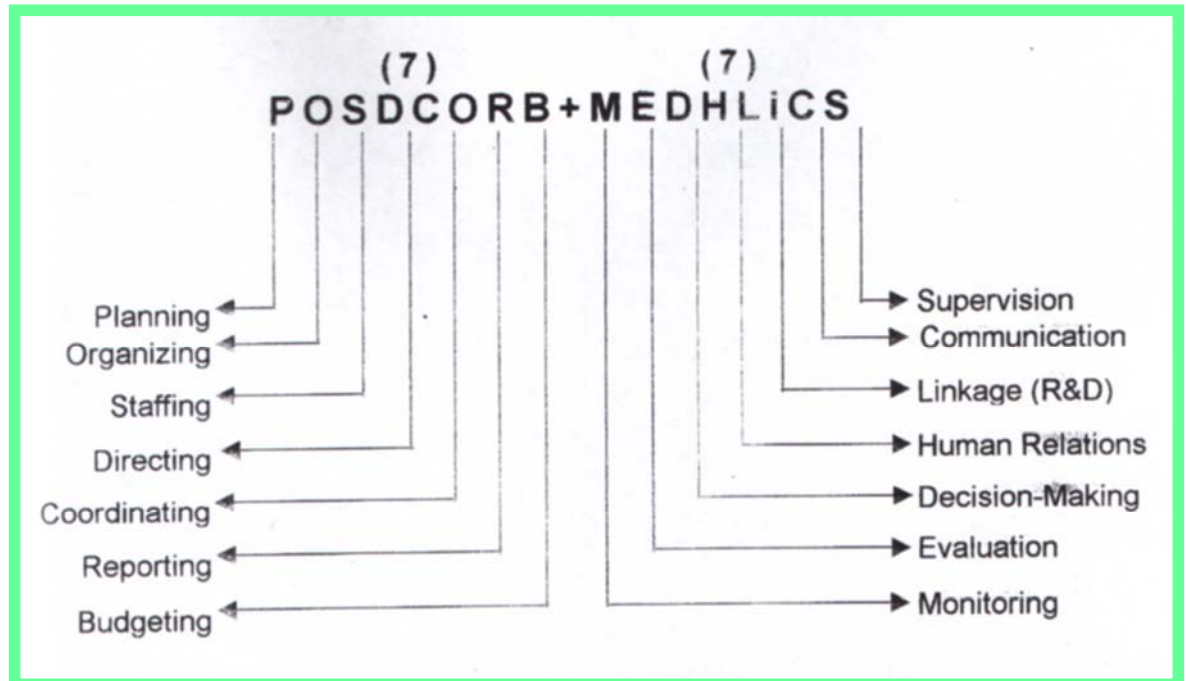
* **Area** : 000 ha,
Production : 000 tonnes,
Yield : Kg/ha,
Irrigated Area : % of G.C.A., &
Fertilizer Consumption : tones.

Table: Projected food grains¹ production and requirement in North eastern states

State	CGR (Prod)	Production 000 tonnes				Requirements, 000 tonnes			
		2005	2010	2015	2020	2005	2010	2015	2020
Arunanchal Pradesh	1.30	217	231	216	263	220	246	276	310
Assam	2.58	4733	5375	6105	6934	5234	5703	6214	6770
Manipur	1.96	416	459	505	55	486	554	630	718
Meghalaya	1.19	215	229	243	257	469	534	608	692
Mizoram	10.37	-	-	-	-	-	-	-	-
Nagaland	6.57	381	524	720	990	443	565	720	917
Tripura	-	584	653	730	816	620	667	717	771
Total North East	-	6546	7471	8549	9817	7473	8269	9165	10178

1. Rice, Wheat, Maize and Pulses are covered under Food grains 2. CGR – Cumulative Growth Rate (Sikkim not covered)

Source: Vision 2020, NAAS & NEC, 2006

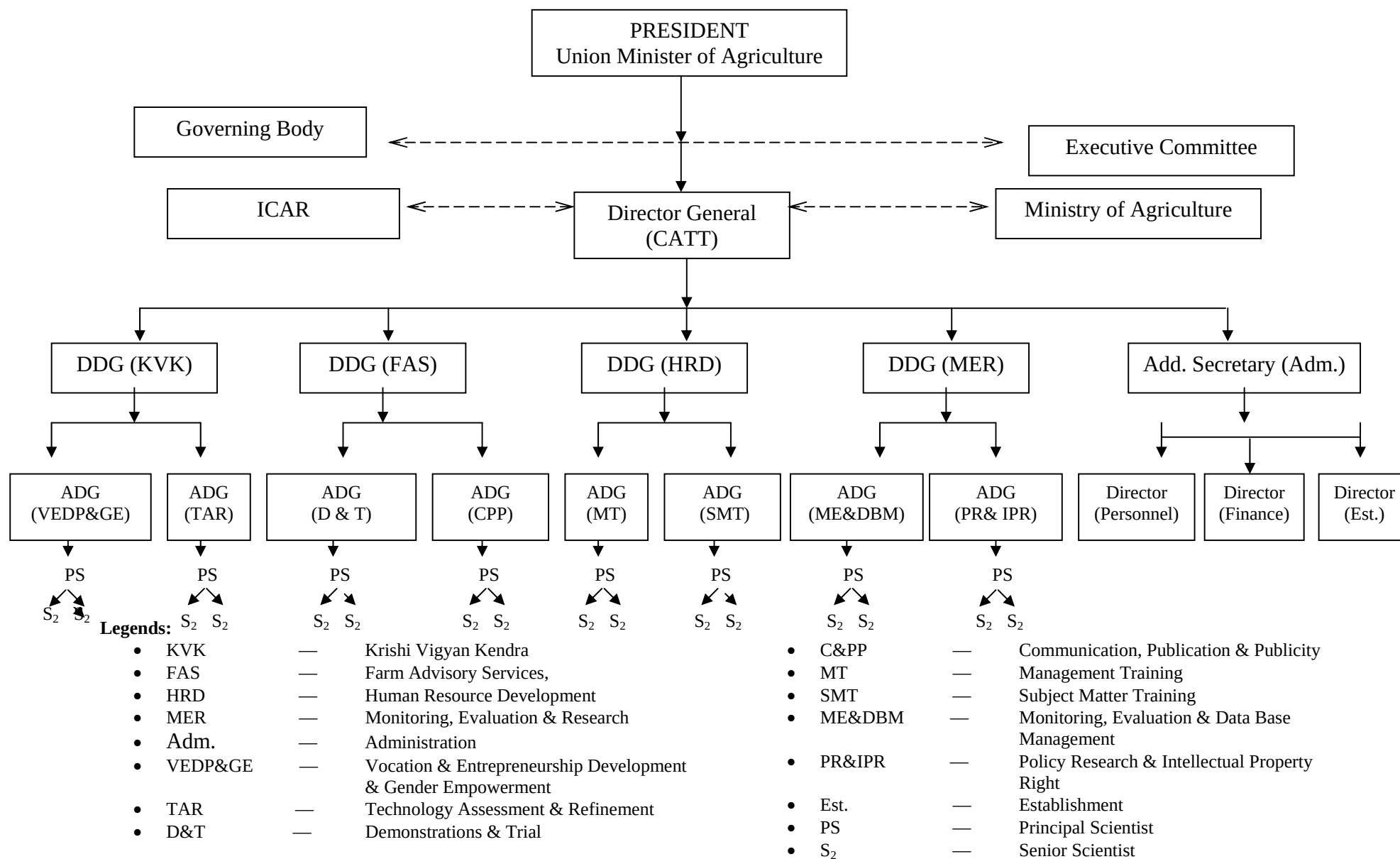
Fig. 1. FOURTEEN PROCESSES OF MANAGEMENT

(GULLICK, 1937)

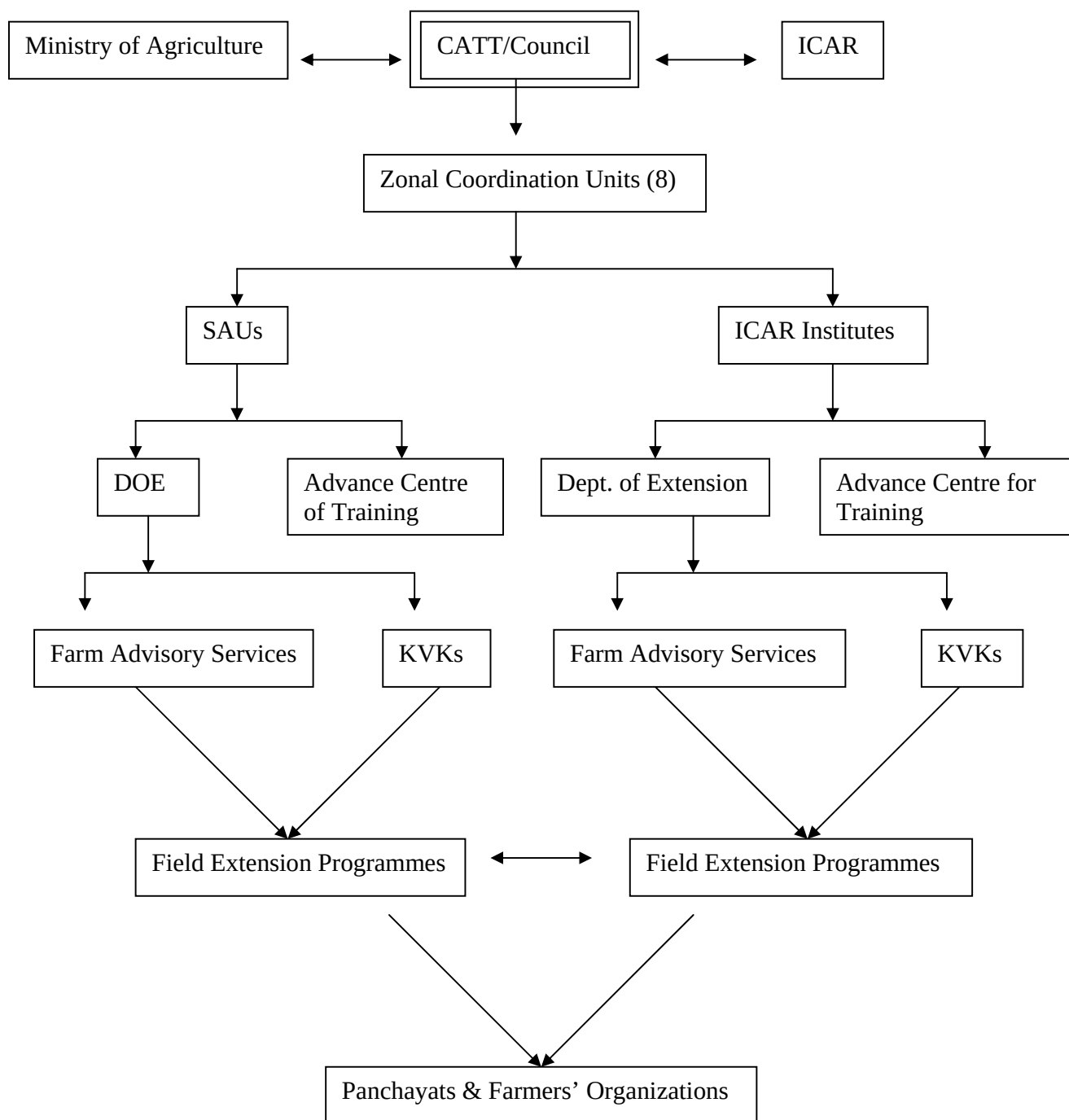
(Prasad, 1993)

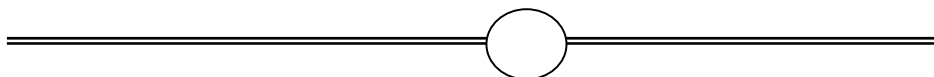
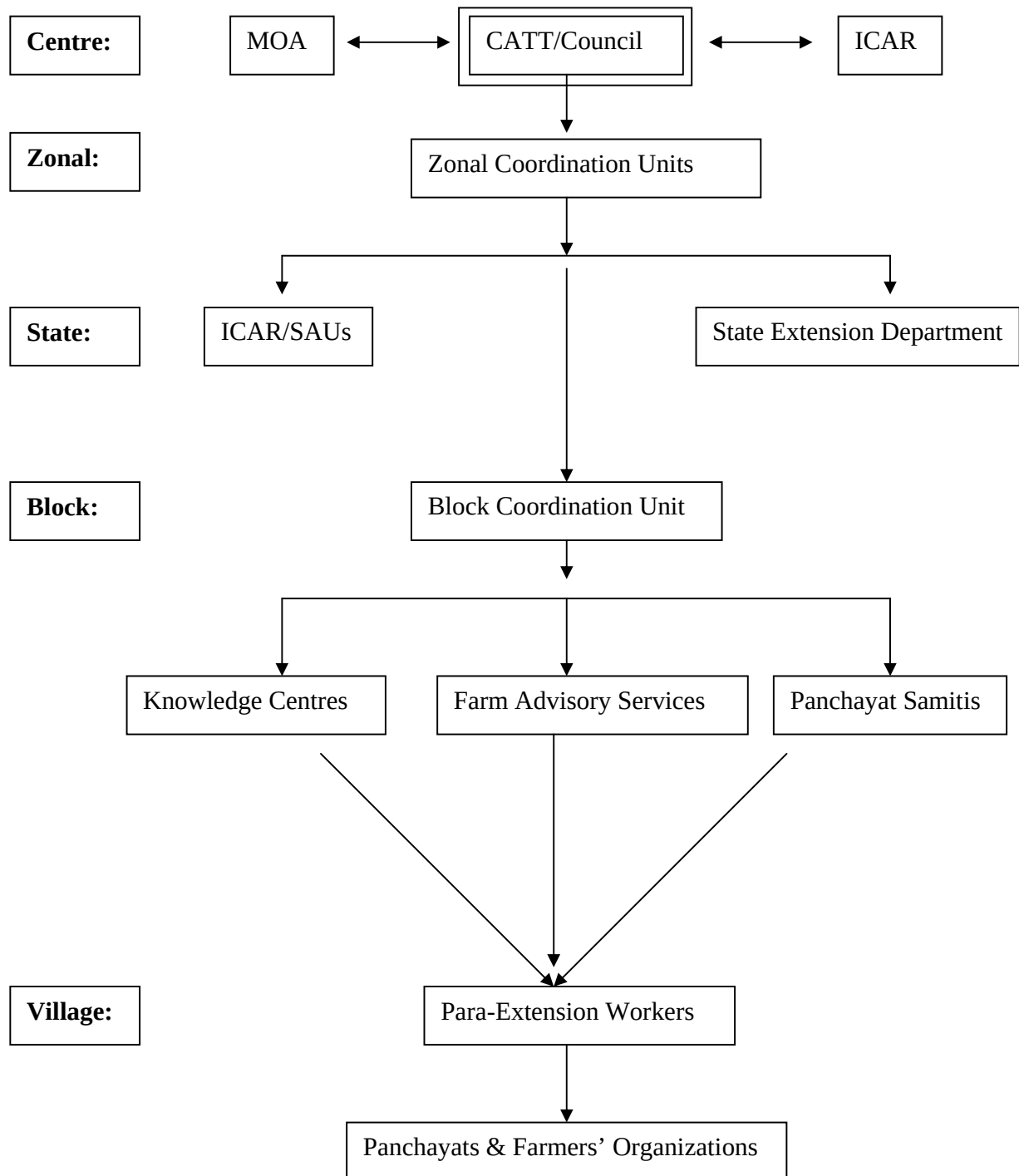
Fig. 2 FUSION THEORY OF MANAGEMENT

Fig. 3: ORGANIZATIONAL STRUCTURE OF THE COUNCIL OF AGRICULTURAL TECHNOLOGY TRANSFER(CATT)



STATE EXTENSION SET-UP: ALTERNATIVE-I (U.S.A Model)



**STATE EXTENSION SET-UP: ALTERNATIVE-II
(EXISTING SET-UP)**

Sub GroupIII

INTERIM REPORT OF THE SUB-GROUP ON “HUMAN RESOURCE DEVELOPMENT” OF THE WORKING GROUP OF NATIONAL DEVELOPMENT COUNCIL (NDC) ON AGRO-CLIMATIC ZONAL PLANNING INCLUDING AGRICULTURE DEVELOPMENT IN NORTH-EASTERN INDIA FOR XI FIVE YEAR PLAN (2007-12).

By

Dr. S.A. PATIL

Director

**Indian Agricultural Research Institute
New Delhi -110 012**

1.1 Historical Background

Human Resource Development is vital for agricultural education, research and development in any nation. There are enough evidences to indicate that agricultural education existed in India even during medieval period. The subject of Agriculture was included in the curricula of Nalanda and Takshila Universities as one of the 18 arts. However, organized courses in agricultural education were started in the beginning of the twentieth century when six agricultural college were established at Kanpur, Lyallpur, Coimbatore and Nagpur in 1905, Pune in 1907 and Sabour (Bihar) in 1908 with diploma programme. The degree programmes, however, were started in early 1920s. The veterinary colleges were started even earlier at Bombay (1886), Calcutta (1893) and Madras (1903). Madras Veterinary College started offering B.V.Sc. Four-year degree programme in 1936, the first in the country. By 1947, there were 17 agricultural Colleges offering degree programme in agriculture under the umbrella of State Departments of Agriculture and Animal Husbandry with sporadic efforts on research and development.

The food crisis due to Second World war and Bengal Famine of 1943 drew the attention of British Government and grow more Food Campaign was launched in 1943 enabling the greater demand for agricultural graduates which was sustained further by launching of community development programme in 1952 and the National Extension Service Programme in 1953. In fact, this increase in the demand of agricultural graduates prompted the establishment of a number of private colleges, with faculties of agriculture, affiliated to general universities. The number of such colleges in the country increased almost three-fold by 1960. Meanwhile Indian Agricultural Research Institute (IARI), New Delhi started a Post-graduate School in 1958, a landmark in the history of higher education in agriculture in India, followed by establishment of PG educational Programmes in Indian Veterinary Research Institute (IVRI), National Dairy Research Institute (NDRI) and Central Institute of Fisheries Education (CIFE). These four National Institutes of ICAR have been granted Deemed to be universities status.

In 1948, the Government of India appointed University Education Commission, headed by Dr. S. Radhakrishnan, which recommended establishment of Rural Universities to provide skilled persons that would be needed by the country to meet the requirements of an educated citizenship and concluded with recommendation that agricultural education be recognized as a major national issue. Subsequently this was discussed and debated by several committees and finally in 1958, the Government of India appointed a Joint Indo-American Team, which recommended establishment of Agricultural Universities in India on the pattern of Land Grant Colleges of the USA. This led to the establishment of first Agricultural University in Uttar Pradesh at Pantnagar in 1960.

1.2 Present Status

All major states of the country have now been brought under Agricultural University System and currently there are 34 Agricultural Universities, 4 ICAR based Deemed Universities, 7 Veterinary Universities, 5 Central Universities with agricultural faculty, 200 Agricultural Colleges and traditional Universities with a total intake capacity of 21,370 for undergraduate programme and 10,000 M.Sc and Ph.D (Postgraduate) capacities (Annexure 1).

Human Resource in Agriculture at a Glance

(approx. figures October, 2006)

1. Stock of agricultural graduates:	2,50,000
2. No. of Agri. Universities	34
3. No. of ICAR Institute based Dus:	4
4. No. of Veterinary Univerisites:	7
5. No. of Central Universities with Agri. Faculty:	5
6. No. of Agri. Colleges in traditional Universities:	200
7. Intake capacity in U.G. of SAUs, Dus, and Cus	
(a) Agriculture	6,000
(b) Horticulture	1,800
(c) Forestry	400
(d) Fishery	360
(e) Home Science:	840
(f) Agricultural Engineering:	860
(g) Dairy Technology	400
(h) Food Science & Technology	360
(i) Agri. Marketing & Cooperation	150
(j) Sericulture:	50
(k) Agri. Biotechnology	150
(l) Veterinary Sciences:	2,000
8. Total intake capacity of ICAR supported Agri., Vet. and allied programmes:	13,370
9. Intake capacity in U.G. in non-ICAR supported Universities etc.:	8,000
10. Total intake capacity in India in Agri. & Allied Science	21,370
Science subjects:	
11. No. of major subject groups in P.G.:	19

12.	No. of subjects in which degree is awarded in P.G.	90
13.	Intake capacity in P.G. in Agri. & Allied Science subjects:	10,000
14.	Universities in NEH region in Agri. & Vet.:	3

The present graduates and post-graduates who are coming out from the University are mostly absorbed in agricultural universities which are present in each state; ICAR institutes line departments in the state namely Agriculture, Veterinary, Horticulture, Engineering, Home Science, Fisheries and Forestry etc. Except veterinary service, only 25% of graduates/post graduates get these secured employment. Another 25% of the graduates go to private seed/fertilizer/pesticide companies and banks etc. However, 50% or even more go to non professional jobs, viz. Central Civil Services, State Civil Services, Indian Forest Service and Police Service, Income tax, Excise Co-operatives, State Transport and Railways etc. The university and ICAR system (NARS) has responsibility to the extent of higher education, research and Pilot extension through KVKs . However, the dimension of the society requirement are changing so fast that the contents of the agriculture degrees which are being taught are not in a position to meet the changing situations in the agriculture field and most of it is towards basic and academic side but the requirement of the farming community and also the society is towards applied side and that to in newer fields like biotechnology, nano-technology, business management, contract, cooperative and corporate farming, seed production, high-tech horticulture, post harvest technology and value addition, agri-business and marketing, WTO and export, patenting and farmers rights etc. There is no proper human resource available with required skills which otherwise is very much required to enhance the capability of the farmers for not only increasing the productivity but also the quality, marketing and value addition which are very much required to increase the income level of the farmers. This calls for altogether a new holistic and pragmatic approach calling for new breed of technocrats and skilled manpower to handle these issues in agriculture.

To reduce the expenditure in farming and also to make available the extension services at the doorsteps of the farmers to increase the income level of farmers in dry land as well as in irrigated land; Agriculture system managers are required. There is greater need for non farm employment opportunities which are to be created at village level so that large scale mass migration to urban areas is minimized.

There is need to give stress on energy farming as the diesel and petrol which are of fossil origin are depleting and there is no other way other than generating energy from bio-mass. From this point of view again agriculture assumes another dimension that is apart from food and fibre, it has to take care of energy requirement also.

The health science is predicting that the diseases are manifestation of physiological process related to the quality of food which human being consume. Therefore, managing health through food will become main say of 21st Century which has to come only from agriculture either change in the nutritional status of the food, quality, taste and aroma etc. Therefore, the new system of farming like neutra farming and pharma farming are going to be the order of the day. This requires all together a new type of technocrats to manage.

Budget required for various components of Agricultural education, Research and Training (XI Plan 2007-2012)

(Rs. In crores)		
1.	Agriculture higher education and Research	5,000.00
2.	Starting newer branches of sciences (Biotechnology, Nano-technology, Organic farming, Neutra and Pharma farming, WTO and export management including Patents and rights, Hi-tech horticulture, Post-harvest technology and value addition, Water management, Dairy-technology (Depending on the importance of these in the zones-universities of the state can pick of the subjects)	400.00
3.	Cutting edge technology, PG Diploma Courses	400.00
4.	Diploma Courses (Crop production, Seed production, horticulture nursery, green house/poly house cultivation, Hitech water management, Organic farming, Farm machinery, Plant protection, Biofertilizers, Bio-control agents, Post harvest technology and value addition, Dairying sericulture, poultry, Apiculture, Medicinal and aromatic plants and floriculture etc.)	
5.	Vocational courses (of two years) in all above subjects	800.00
6.	Skilled manpower training to handle agriculture services at village level (two weeks to one year)	500.00
7.	Creating village level agrobased industries, with value addition to provide non-farm jobs	1000.00

8.	Establishment of higher level training institutes for training teachers/researchers and extension specialists (one for each state)	400.00
9.	Establishment of farmers field schools/knowledge centres (one for each Hobli/Panchayat)	1000.00
10.	Establishment of State level Agril. Council to articulate the activities of Government Universities, NGOs, Private Co., industries, export promotion cells and Banks etc.	500.00
11.	Agril. Manpower assessment, human resource development, production, price and export management institutes (1+4)	100.00
12.	Village level Agriculture technology and microfinance managers training institute (one for each university)	. 175.00
13.	External Evaluation institute for GOI funded projects	25.00
14.	Agril. Biodiversity parks (one for each zone)	300.00
	Total	10,600.00

**INTERIM REPORT OF THE SUB-GROUP ON “NORTH EASTERN REGION” OF
THE WORKING GROUP OF NATIONAL DEVELOPMENT COUNCIL (NDC) ON
AGRO-CLIMATIC ZONAL PLANNING INCLUDING AGRICULTURE
DEVELOPMENT IN NORTH-EASTERN INDIA FOR XI FIVE YEAR PLAN (2007-12).**

By

**Dr. S.N.Puri
Vice-Chancellor
Central Agricultural University
Imphal**

PREAMBLE

Planning Commission, Govt of India constituted a working Group under the chairmanship of Dr Panjab Singh, Vice Chancellor, Banaras Hindu University with a total of members. In the first meeting of the group, it was decided to form – subgroups to go into the details of different issues. Accordingly, a sub group under the chairmanship of Dr S N Puri, Vice chancellor, Central Agricultural University, Imphal, Manipur was constituted to prepare a comprehensive document on agro-climatic zonal planning for agriculture sector development in North East with a total of 11 members. Dr. K.M. Bujarbaruah , Director, ICAR Research Complex of ICAR for NEH Region, Barapani was co-opted as member of the subgroup.

The chairman of the sub group conducted its first meeting at ICAR Research Complex, Barapani, Meghalaya where 6 members participated. Views of each member were recorded.

2nd meeting of the sub group was held at College of Fisheries, CAU at Agartala, Tripura where a total of 8 persons participated.

In addition to the above two meetings, inputs from as many as 16 Vice-Chancellors and 4 National Directors were also taken during the Conference of All India Agricultural University Association held at Imphal from 5th to 6th October, 2006 to discuss agricultural development in N.E. Region.

Based on the inputs received from these three rounds of discussion, present report has been compiled. While preparing the report, published materials from ICAR Research Complex for NEH region as well as the Vision document of both that institute and those by NAAS and NEC were consulted.

(S N PURI)
Vice chancellor
Central Agricultural University
Manipur

INTRODUCTION

The North-Eastern region comprising eight states viz., Assam, Arunachal Pradesh, Meghalaya, Manipur, Mizoram, Nagaland, Tripura and Sikkim has a total geographical area of 262180 Km² which is nearly 9.8% of the total area of the country with more than thirty nine million population. About 35% area in the region is plain excepting Assam where plains account for 84.44% of its total geographical area. Net sown area is highest in Assam (34.12%), followed by Tripura (23.48%). Arunachal Pradesh has lowest net sown area in the region. Cropping intensity is highest in Tripura (156.5%) followed by Manipur (152.1%), Mizoram (136.36%) and Assam (123.59%). About 1.6 million hectare area is under shifting cultivation in NE region. Out of 4.0 million hectare net sown area of the region, roughly 1.3 million hectare suffers from serious soil erosion problem.

The region receives an annual average rainfall of 2000 mm accounting for around 10% (42.50 mm) of the country's total precipitation of 420.00 mm. The soil of the region is acidic to strongly acidic in reaction. The low pH of the soil is basically due to the leaching of the bases under influence of high rainfall. The soils are, however, rich in organic matter. The depth of the soil varies from shallow in incept soils to very deep in alluvial soils. Total forest cover in the region is 14.2 million ha, which is about 77.1% of the geographical area as against the national average of 19.39%.

The region, by and large, is characterized by fragility, marginality, inaccessibility, cultural heterogeneity, ethnicity and rich biodiversity. Rural population is around 82%. In the absence of major industries excepting in the state of Assam, the society is agrarian and depend on agriculture and allied sector for livelihood and other support.

Around 56% of the area is under low altitude, 33% mid altitude and the rest under high altitude. Agricultural production system is, by and large, of CDR type. The system is characterized by low cropping intensity (114%), subsistence level and monocropping. Average landholding is 2.5 ha compared to national average of 0.69 ha. Although the landholding appears to be higher, the entire holding can not be used for agricultural purposes due to topographical disadvantages. Land use pattern is relatively faulty for which annual loss of top soil is much higher (46 tonnes/ha) than all India average of 16 ton/ha. Similarly, due to lack of proper water harvesting measures, only 0.88 mm out of 42.5 mm water is used. There is no reliable assessment of total irrigated area. Record gathered from different sources indicates that around 20.74% area is irrigated out of which 18.78% is irrigated through technique called bamboo drip irrigation particularly for less water demanding crops. Fertilizer consumption in the region is also very low and stands at around 11 kg/ha ranging from as low as 2.7 kg/ha in Arunachal Pradesh to a high of around 72 kg/ha in Manipur.

Farming is predominantly rice-based with little exception in the state of Sikkim where maize is a dominating crop. Mixed farming system is the order as most of the farmers want to produce his household food and nutritional need without having to depend on outside sources. The system, therefore, supports a large horticulture and animal husbandry based partly due to preference of the population (almost 100% tribal) is for non-vegetarian food. With this production practices, the region produces a total of 5.8 million ton of total food grain against a requirement of around 7.40 million tones. The deficiency is, therefore, around 1.6 million tone of food grain. Similarly, in spite of a desired aptitude towards animal husbandry practices, per capita availability of milk, meat, egg and fish per annum is only 31.53 litres, 9.36 kg., 33.50 numbers and 4.12 Kg, respectively.

Agriculture and allied activities are the main source of livelihood for the people of NE region and any attempt to reduce poverty as well as to place the region in developmental paradigm shall have to be based on system wise eco-regional planning of agriculture

development. While planning this, the strength of farming system approach to judicious utilization and conservation of natural resources of the region with concurrent policy and research back up to increase production, value addition to the produce and their disposal sale management shall be of paramount importance.

In the light of the above scenario, present document is prepared keeping in view the Strength, Weaknesses, Opportunities and Threats (SWOT analysis based on studies of ICAR Research Complex for NEH Region) to support the population dependent on agriculture and allied sector for their sustainability, profitability as well as poverty reduction.

An Analysis of the Strength and Weaknesses of the NE Region

Strength :

- One of the 12 mega bio-diversity hot spot areas
- Abundant natural resources (in Lakh ha.)
 - ❖ Geographical area – 262.18
 - ❖ Forest – 171.08
 - ❖ Agricultural Land – 39.08
 - ❖ Water bodies
 - River – 19150 km
 - Reservoirs – 0.24
 - Tanks/lakes – 0.43
 - Ponds – 0.41
 - Paddy cum fish culture – 0.03 mil. Ha water
 - Total Water Resources – 42.50 mil. Ha water
 - ❖ Indigenous Crop Germplasm – 4500 (Approx)
 - ❖ Orchids – 600 (175 rare spp)
 - ❖ Medicinal and aromatic plants including flowering species – 5000
 - ❖ Bamboo resources – 50% of the country
 - ❖ Total livestock – 21.68 million
(100% Mithun, 22.4% Pig and 25% Yak of the country)
 - ❖ Total Poultry – 33.00 million
 - ❖ Fish germplasm including Ornamental fish – 347 species
 - ❖ Agroclimatic zones – 06

Weaknesses of the Region:

- Inaccessibility, marginality and fragility.
- Overexploitation of forest for fuel, timber and fodder.
- Improper land use practices.
- Shifting cultivation on hill slopes.
- Poor infrastructural development.
- Inadequate agricultural mechanization.
- Absence of storage and agro processing activities.
- Limited availability of quality seeds.
- Lack of policy frame work for channelization of production processing marketing components.
- Lack of commercialization and value addition

Opportunities:

- Development of agro-ecological zone specific farming and production system.
- Uncommon opportunities to increase agricultural production by 2-3 folds through input maximization.
- Opportunity for extensive organic farming under upland ecosystem.
- Mechanization of hill agriculture for increasing production and reducing drudgery.
- Rain water conservation Management.
- Agro-forestry intervention particularly in classified waste lands/marshy lands and permanent fallow.
- Conservation and utilization of bio resources through conventional and biotechnological innervations.
- Tremendous opportunities for horticulture sector development including apiculture and floriculture.
- Post harvest processing, value addition and export/domestic market tapping.
- ITKs for validation and utilization.
- Opportunity for giving a meat revolution to the country.
- Ornamental fish farming.
- Opportunities to attract the youths through industrial approach to agri-horti-animal-fish sector.

Threats:

- Danger of extinction of valuable bio-resources
- Larger areas being barren/degraded due to shifting cultivation.
- Gradual replacement of ecosystem people by ecological refugees.
- Danger of loosing biodiversity due to germplasm piracy on account of international boundaries.
- People loosing interest in agriculture sector due to poor productivity and resultant poverty

Agro Climatic Zones of North East

The North-Eastern Hills Region has been divided into three broad geographic regions, namely, Eastern Himalayan Region, Purvanchal Region and Meghalaya-Mikir Region. The Eastern Himalayan Region covers Sikkim and Arunachal Pradesh, excluding Tirap and part of Lohit District, while the Purvanchal Region comprises Nagaland, Manipur, Tripura, Mizoram and Tirap and Lohit Districts of Arunachal Pradesh. The Meghalaya-Mikir Region comprises Khasi, Jaintia and Garo hills of Meghalaya. These broad regions show a wide diversity of climate due to altitudinal, physiographical and edaphic variations contributing to the diversity in the agricultural activities of the people. These geographic regions are further delineated into six distinct agro climatic zones as under:

1. Alpine zone
2. Temperate and sub-alpine zone
3. Sub-tropical hill zone
4. Sub-tropical plain zone
5. Mild -tropical hill zone
6. Mild -tropical plain zone

(Important crops grown in the above zones are indicated in annexure II)

Where the region stands?

On the basis of available data base, present position in the region in so far as the production components are concerned were analysed to identify gaps, if any.

(A) Agricultural Production (major crops as in 2005)

Area (m ha)	Production (million ton, projected)	Yield (Kg/ha)	Requirement (million ton, projected)	Deficit (%)
3.90	6.54	1509	7.47	13

(B) Horticultural Crops

Sectors	Area (Lakh ha)	Production (million ton)	(Yield (ton/ha)	Country average (ton/ha)
Fruit	2.70	2.33	8.65	11.01
Vegetables	3.68	4.05	11.98	15.16
Spices	0.69	0.44	-	-
Plantation crops	1.15	0.10	-	-

(C) Animal Husbandry and Fishery

Sectors	Production (million ton)	Requirement (million ton)	Deficit (%)
Meat	0.22	0.439	40.7
Milk	1.06	2.14	50.50
Egg (million nos.)	902.09	7027.21	87.20
Fish	0.21	0.38	55.26

It will be seen from the above figures that the region is deficient in almost all areas of food.

Why such a situation?

The committee analysed the factors that are responsible for such a situation and identified the following constraints.

Environmental Constraints

- Acidic soil - Low availability of P. also has high concentration of Fe and Al and low Zn.
- High rainfall and humidity – Harbours pests, diseases and weeds
- Shifting cultivation – Both strength as well as weakness
- Land tenure system – Lack of sense of belonging to the land due basically to absentee of ownership as well as allotment of land for cultivation on time scale basis.

Technical constraint

- Seed and planting material.
- Disease and pest management.

- Farm mechanization
- CDR type of agriculture.
- Constraints of various kinds in transfer of technology(TOT).

Physical constrains

- Infrastructural – Road and communication, procurement and distribution, processing and storage, value addition and marketing.
- Undulating Topography – Leads to inaccessibility with resultant constraints in service delivery.
- Unorganized market

Economic Constraints

- Lack of commercialization – Leading to small- scale household production system.
- Limited credit availability
- Non existence of minimum support price
- Presence of large number of money lenders

What will be the food grain requirement by 2015?

Projected food grains¹ production and requirement in North Eastern States³

State	Production 000 tonnes		Requirement 000 tonnes		
	CGR ² (Prod)	2005	2005	2010	2015
Arunachal Pradesh	1.30	217	220	246	276
Assam	2.58	4733	5234	5703	6214
Manipur	1.96	416	486	554	630
Meghalaya	1.19	215	469	534	608
Mizoram	10.37	-	-	-	-
Nagaland	6.57	381	443	565	720
Tripura	-	584	620	667	717
Total North East		6546	7473	8269	9165

Planning/ Approach to XI plan

While preparing the strategies for XI th plan development under agriculture and allied sector following aspects were considered

- I. Making the region food sufficient through production maximization, ameliorating environmental, physical, technical and marketing constrains for production enhancement.
- II. Placing the region in organic food production map in the country/world.

- III. Reducing demand-availability gap of meat, milk, egg and fish.
- IV. Assuring input delivery and competitiveness of producers
- V. Promoting public/private partnership and agri-business for employment generation.
- VI. Assisting research organisation and universities on both technology upscaling and developing new age technology so as to ensure adequate back stopping.
- VII. Bio resources (floral and faunal) inventorisation, identification, use, value addition and marketing.

Aims during the plan.

Production, profitability, permanency, participatory approach to ensure the paradigm shift from mono to multiple cropping, from homestead to commercial farming, from rural hut (market) to organise marketing through a value chain, from subsistence level of farming to community based farming for household food and economic security. Another aim is to prepare the producers and people alike to benefit from the Look East Policy by facilitating the creation of right environment for investors.

Mission

- I. Increasing per hectare productivity of important agri-horti crops in a partnership mode
- II. Ameliorating the constraints of acid soils and addressing the issue of non availability of seed (crops, animal and fishes) and planting materials.
- III. Putting atleast 30% of low altitude area under double cropping increasing irrigation potential.
- IV. In situ farm input generation and assisting in agri mechanisation.
- V. Putting in place infrastructure like processing units, storage godown, quality control and value addition units, rural connectivity , information centres and market linkage.
- VI. Facilitating the production of high value low volume crops including round the years production of ornamental fish and flowers.
- VII. Capacity building in selected institutions for faster animal disease diagnosis, vaccine production and storage.
- VIII. Developing organic road map and systematically working on it so as to produce complete organic food in the XI th plan period.

Sector wise planning

A. Agriculture sector.

The region suffers from an overall food grain deficiency of 1.6 million tones. The deficiency of meat, milk, egg and fish are to the tune of 49.7, 50.5, 87.2 and 55.27%, respectively for a population of 3.9 million as in 2001. With the current production gap, expected deficiency by 2015 would be 2.81 million tones of food grain.

A.1. Rice

Out of the present deficiency of 1.6 million tones of food grains, 1.0 million tone deficiency is in rice alone. Main strategy will be to increase-rice production through:

- I. Developing altitude specific varieties and packages in a participatory mode involving farmers in selection process of such varieties to achieve an average production of 2.2 t/ha from the present level of 1.8 t/ha from 3.5 million ha of rice area i.e. a gain of 1.4 million tones.

Action – Research Institute

- II. Introducing double cropping in at least 25 - 30% of valley land areas of 1.5 million ha.i.e. a gain of 1.12 million tones.

Action – Development Deptt.

- III. To promote irrigation facilities by tapping both surface and ground water resources. Present irrigation potential is only 0.88 mhm, which needs to be increased to at least 1.6 mhm by tapping the water resources of 42.5 mhm in the region thereby increasing irrigated area from the present level of 20.74% to at least 30% that would facilitate additional production of around 1 million t.

Action – Development Deptt through schemes like Bharat Nirman.

- IV. To develop suitable varieties and packages for other cereals namely maize and pulses crops like pigeon pea and mung to achieve an additional food grain production gain of 0.5 million tones.

Action – Research Institute / SAUs

- V. Breeder seed production for the developed varieties shall be taken up by the respective institutes like ICAR, SAU and CAU, besides, universities like Nagaland University having agriculture faculty to facilitate availability of quality seed. Youth groups/SHGs shall be constituted for seed production and delivery systems.

- VI. In addition to the above, rice varieties for the shifting cultivation areas shall be developed to achieve an yield of 1.2 t/ha from the present level of 0.7 t/ha i.e. a gain of 0.8 million tones of rice particularly of glutinous type.

Action – SAUs/ Research Institute

Thus, from the above strategy alone, increase of 4.82 million tones could be possible.

Likely financial involvement : @Rs. 0.15lakh/ha X 3.5 thousand ha = Rs. 5.25 Cr.

A.2. Maize :

Maize is another important cereal crop for both human and animals. The region has to import a substantial quantity of maize for livestock feeding every year increasing the cost of production of livestock and poultry products. A two way strategy is envisaged.

- a. Introduction of Quality Proteins Maize (QPM) at state Govt. farms and major maize growing areas.
- b. Replacement of low yielding traditional maize cultivars with high yielding varieties.
- c. Introduction of rabi maize in select states like Manipur, Sikkim, Tripura, Mizoram, etc.
- d. Horizontal expansion of area under maize.

- e. Promoting collaboration with Agriculture Technology Management Agencies(ATMA) and Krishi Vigyan Kendra for massive FLD programmes involving veterinary Deptts for buy back.

Action - Collaborative

From the intervention proposed an additional contribution of 0.5 million tones from the cereal group is envisioned to be made available.

Likely financial involvement : @Rs. 0.10lakh/ha X 9.4 thousand ha = Rs.10.00 Cr. (Approx)

A.3. Wheat :

Since Agricultural diversification is an issue of importance, a thrust for wheat production is planned to be given although it is not a traditional crop of the region. The strategies for this are:

- Identification of potential wheat growing areas in each state and collection of information on varieties etc from the existing growers.
- Provisioning of irrigation facility in such identified areas in an integrated manner through water shed areas already developed by agriculture and other departments of each state.
- Facilitating 'Jal Kund' as well as 'Roof Top' concepts of water harvesting.
- Tie up with DWR (Directorate of Wheat Research), Karnal for quality seed for each state based on requirement given by each state.
- Targeting coverage of at least 0.5 lakh ha area per year from 2008 so that 2.0 lakh ha area could be covered under wheat in the region by 2012.
- Establishing small scale processing units to harness both wheat and its bran (for animals) and other confectionery items.
- Development of complete package of practices for wheat production in the region and dissemination of the same through 11 KVKs attached to the institute.

Financial Involvement : @ Rs. 0.15lakh/ha X 2.0 thousand ha = Rs. 3.00 Cr.

A.4. Pulses :

Although area under pulses in the region is not very high presently (1.66 lakh ha) , the soil and other environmental factors prevailing in the region have been found to be conducive for pulses production as reflected by per ha productivity of around 800kg against All India average of 630 kg. It is therefore important that this sector is given the support it deserves. Following strategies are planned:

- The regional strength recorded in rice bean shall be fully explored as summer pulse as photo-insensitive rice bean genotypes have been already identified by the institute. Each state shall be adequately supported to promote rice bean.
- State specific pulses like Rajmah in Sikkim, Nagaland, Mizoram and Manipur and Pigeon Peas and Urd Bean, Lentil in Tripura etc.shall be given a boost to increase area and production in collaboration with IIPR and state departments.
- States of the region who have declared to go organic shall be encouraged to grow pulses as it helps in enriching soil quality/health.
- Areas where rice productivity has declined shall be selected to introduce pulses as a means of diversification.

- Other Pulses as per the recommendation of ICAR and SAU shall be promoted.
- Necessary training of farmers shall be arranged.

Action : All Stakeholder

Fund requirement: @ 0.25lakh/ha X 10 thousand ha = Rs. 2.5 Cr.

A.5. Placing the region in the organic food production map of the world

The uncommon opportunity of the region in organic food production shall be converted into strength through development of organic food production process initially in select crops/animals with a view to enlisting the region in the organic food production map of the world. The vision is to convert at least 50% of 16.72 lakh hectare of shifting cultivation areas (fallow *jhum*) into organic zone. Technology for production of export oriented organic glutinous parboiled rice, baby corn and vegetable crops shall be generated and tested. Similarly, organic production of fruit crops and spices like passion fruit, kiwi fruit, orange, pineapple, turmeric, ginger and large cardamom shall be supported in different altitudinal locations. Technology for organic chicken production especially encashing the strength of backyard poultry rearing system shall be generated. This is envisioned to be achieved by 2015.

How to Do :

- Preparation of road map for the conversion of *jhum* land into organic agriculture through participatory approach of *jhumias* in clusters.
 - The *jhum* areas demarcated for organic production would be based on the availability of infrastructure like road, power, storage facilities, marketing, credit facilities and government support.
 - First 3 years @ 25% of *jhum* land will be brought under organic agriculture and remaining 25% in equal proportion in next 2 years. In this way 50% of *jhum* areas will be covered by 2010. This would result in 15-20% increase in production with 20-30% increase in farm income by 2015 and thereafter both will increase even more due to better management and public awareness.
 - Similarly, 50% of 33% mid altitude areas i.e. around 39 lakh h area is to be brought under organic agriculture, animal husbandry. Together with *jhum* areas total area under organic agriculture thus would be around 47 lakh h.
- In order to provide technological backup as well as to ensure the availability of inputs like seed, organic compost, bio control agents etc., steps have already been taken in the institute. These shall be further strengthened in terms of knowledge dissemination to the masses so that the needed inputs become available by 2015. Establishment of one referral laboratory for facilitating service delivery in terms of residue analysis and even certification is envisioned to be explored in a collaborative mode.
- Bio-extracts from the potential herbs/ weeds in the region are planned to be prepared as growth promoter and for insect, pest and disease management in important crops to be pursued under organic farming.
- Employment potential shall also be generated by way of identifying seed, other input production villages to support the cause of organic agriculture and animal husbandry.

Action : State/ Central Govt. Agencies, AUs/ ICAR, NGOs etc.

The above vision of placing the region in organic map has the aim of benefiting both the region and the country as follows :

- Country's area under organic agriculture increases tremendously.
- NE farmers who could not be benefited during green revolution period get benefited through organic revolution.
- System mode production of organic food, their storage, processing, value addition and marketing shall create job opportunities for unemployed youth.

A.6. Harnessing the benefit of plant, animal and fish biotechnology :

How to do :

Agro-climatic conditions in the region are very diverse and demanding. Thus, all crop and animal improvement strategies must address to location specific problems. Although many of these problems can be solved through conventional methods, such methods are time consuming and in some cases the desired character is not available even within the genus or family. Under such situation, biotechnology play an important role in improving the quality and speed of the problem solving approach and helps to overcome the problem of reproductive barrier through transfer of desirable characters with minimum disturbance to the genetic constitution of the recipient. In addition, nucleic acid/protein analysis based technologies provide immense support to disease diagnosis and treatment, gene deployment and understanding the basics of various genetic systems. The region is rich in flora and fauna of immense commercial importance, which are under constant threat of extinction and bio-piracy. Keeping in view the short-term and long-term needs of the region, the following strategies are formulated for improvement of commercially important plants and animals and protection of IPR of the germplasm.

1. Varietal improvement of major crops, livestock, poultry and fish by improving agronomic/production characters, drought tolerance, cold/heat tolerance, pest and disease resistance, keeping and processing quality etc. through wide hybridization and *in vitro* rescue of superior genotypes, transgenics, marker aided selection, gene pyramiding, embryo transfer technology. Development of nutritionally superior varieties of major cereals (rice & maize), vegetables, livestock (pig and small ruminants) and poultry is envisioned through transgenics/gene pyramiding/cloning (wherever necessary).
2. Development of populations from local germplasm for tagging of important genes/QTLs. These genes can then be deployed in new backgrounds either through pyramiding or through cloning and transfer.
3. Development of microsatellite markers for fingerprinting of commercially important flora and fauna of the region. These markers can also be used for developing genetic maps, study of gene flow, distribution and genetic modification patterns for developing strategies for conservation of various flora and fauna.

Functional genomic studies through micro array analysis for identification of and tagging of stress resistant/tolerant genes available in the local germplasm.

4. Production of disease free planting materials of fruits and ornamentals, through tissue culture for supply to growers for producing export quality fruits and flowers.
5. Molecular epidemiology of diseases of crops and animals in the region for prevention, control and developing forecasting system/early warning system.
6. Development of field level diagnostic kits for important crop/animal diseases of the region to provide better support in crop and animal health care.
7. Development of genotype (or serotype/strain) specific new generation vaccine candidates including those for edible vaccines for important diseases of the region.
8. Characterization and sustainable utilization of important microbes of the region in augmenting agriculture and livestock productivity.
9. Development of genetic database for crops, livestock, poultry, fish, microbes, pests including parasites and their utilization through bioinformatics.
10. Establishment of DNA, microbial and semen germplasm bank of the region for conservation, future use as referral library and protection of IPR.

Action : Research Institutes / SAUs/ CAUs

Fund requirement : Rs. 30 Cr. (Approx)

A. 7. Validating ITKs in agriculture and allied sector :

Farmers in the remote and inaccessible areas have been depending on the ITKs developed by their forefathers for diseases/ pests/ parasites control, crop rotation, natural resource conservation and utilization, seed storage etc. Validation and scientific intervention in this system are planned for developing eco-friendly and sustainable production systems particularly in the fragile ecosystem of the region.

How to Do :

1. Identification of major ITKs for IPM and soil and water conservation by conducting survey by a multidisciplinary team of scientists and identification of the major ITKs through participatory means based on applicability and economic viability.

Action : All Stakeholder (All SAUs / Research Institute)

2. Documentation of major ITKs.
3. Scientific validation of selected ITKs by studying their technical feasibility, compatibility with socio-cultural system, compatibility with agro-ecosystem and economic viability.

Action : Research Agencies / SAU / CAU

4. Refinement and integration of ITKs through comparing the performance with that of farmers field from where ITKs have been identified. Selected ITKs would then go through scientific refinement and testing by integration of ITKs in the farming system.

Action : Participatory

5. Popularization of validated and refined ITKs through Demonstration/ verification trials in the farmers' field, mass media campaign and orientation programmes with the help of NGOs and SHGs.

Action : Participatory

Fund requirement : Rs. 25 lakh/State X 8 states = Rs. 2.00 Cr.

B. Horticulture sector

The total area under horticultural crops is around 822.5 thousand hectare which is around 3.14% of the total geographical area of the region (Agril Research Data Book, ICAR-2002) and it gives total production of 6818.4 thousand tonnes. The region is characterized by difficult terrain, wide variability in slope and altitude, land tenure system and cultivation practices. The transport and communication system is poorly developed. As a result majority of the areas in the region still remain inaccessible.

Plan for Fruit sector development

Presently with an average productivity of 8.65 t/ha, the region produces a total of 23.37 lakh t of fruits from a total area of 2.70 lakh ha. The first vision is to raise per ha productivity to the all India average of 11.98 t through the development of suitable agro-techniques so as to achieve a total production of 32.34 lakh t i.e. a gain of around 9 lakh t. a increase in fruit productivity.

How to Do :

1. Gradual replacement of low producing varieties with high yielding varieties screened for different fruit crops for different areas.

Action : SAU / CAU / Research Institutes

Note : Crops shall be selected as per strength of the Zones as indicated in Annexure III.

2. Production of required number of planting material using techniques like tissue culture and other propagation methods both under field and protected conditions.

Action : Research organisation, State Deptt., Private growers.

- 3 Arranging stake holder workshops / trainings to propagate orchard management packages to support production and maximize yield.

Action : State Deptt. In a collaborative mode.

Together with the attempt to increase productivity, simultaneous steps shall be taken with stake holders for horizontal expansion of area under fruit crops. As per estimate given earlier, the region has a cultivable waste land of 14.28 lakh ha which is otherwise very much suitable for fruit crops. The vision is to put 50% of this area under fruit crops to attach an additional area of 7.14 lakh ha (which is 37.8% higher than the presently available area under fruit crops). With an average productivity of around 12 t/ha, an additional production of 85.68 lakh t would be the end result. Thus from these two interventions the total output from the fruit sector in the region can be increased to 118.52 lakh t by 2020 i.e. a gain of 95.15 lakh t.

Action : Sate Deptt., Forest Deptt. In a collaborative mode.

Strategies to achieve the above

- 1 Seed planting material production of screened/recommended varieties and skill up gradation of the producers on improved agro techniques through training and demonstration, preparing master trainers from among the producers, awareness building through press and media, roping in insurance agency and financing houses.
- 2 Different State Governments of the region are presently engaged in the implementation of Technology Mission Project under Horticulture. Each State is also engaged in expansion of area under MM II. A strategic planning in addition to the technical programme of MM II shall be required to identify the cultivable waste land in each State and also the fruit crop based on the topography and other parameters for the proposed expansion of area under fruit crops.
- 3 In order to cover the additional areas, desired initiative shall be taken to make available the planting material for which following steps would be needed.
 - a. Establishment of nurseries in each districts/blocks preferably under State Horticulture Dept. and / or certified growers/progressive farmers.
 - b. Establishment of production sites for organic compost in each identified pocket to support organic nutrient management.
 - c. Training and introduction of integrated nutrient management, integrated pest and disease management concepts in the identified pockets.
 - d. Training and introduction of the concept of *Jalkund* (water storage structure), drip irrigation and other water harvesting devices for life saving irrigation.
4. Facilitating procurement, processing and value addition to the produce at block/district level.
5. Facilitating marketing of the enhanced produce and developing database through IT.

Approx. fund requirement : Rs. 10 Cr. Per State X 8 States = Rs. 80 Cr.

B.1. Vegetable sector development:

Vegetable sector, by and large, would have the same vision and strategy as that of fruits.

Present productivity of vegetable crops in the region is 11 t/ha against all India average of 15.16 t/ha, i.e. a difference of 4.16 t. First vision would be to increase the productivity at least up to 15 t/ha in order to achieve a total output of 55.20 lakh t from an area of 3.68 lakh ha, i.e. a gain of 14.68 lakh t from the present production level.

Strategies to achieve the above

A similar approach outlined under fruit sector shall be followed to achieve the above.

Second vision would be to utilize the fallow lands and the land other than current fallows which together amounts to 16.90 lakh ha as per Table 1. Attempts would be made to utilize 50% of that area i.e. 8.45 lakh ha for vegetable production. With an average productivity of 15 t/ha, an addition output of 126.75 lakh t would be the expected production. Together with the output from the intervention on productivity increase of 55.20 lakh t, total production from the region would be 182 lakh t.

A similar strategy as outlined in the fruit sector would be followed.

Action : As indicated under fruit sector.

Fund requirement : @ Rs. 5 Cr/ State X 8 States = Rs. 40 Cr. (including poly houses)

B.2. Spices Sector development

Among the various spices, the region is known for high quality ginger, turmeric and chilies. In addition, large cardamom and black pepper are also produced to some extent. Average productivity of ginger (6.4 t) is much higher than all India average of 3.5 t, while the average productivity of chilies is almost on par with all India average. However, the productivity of turmeric in the region is only 1.5t against 3.9 t/ ha in the country. Vision therefore would be to

1. Increase the productivity of turmeric to at least 4 t/ha with simultaneous attempt to increase the areas to raise the production at least upto 0.8 lakh t from the present level of 0.21 lakh t (excepting Manipur and Nagaland).
2. Similarly, attempts need be made to increase the area under ginger and chili particularly for the following reasons :
 - A. The State of Assam has been declared as AEZ for ginger and turmeric.
 - B. Hottest chili is grown in pockets like Tezpur in Assam.
 - C. Curcumin content of turmeric in the region is very high (above 7% in Lakadong variety).

Main thrust would be to increase production and explore processing, packaging and marketing both for domestic and export market in the following way :

1. Ginger and turmeric varieties having processing qualities shall be evaluated by research agencies for propagation and production maximization.
2. Facilitating private-public partnership for processing, value addition and marketing.
3. Facilitating local production of inputs for large scale production.

Considering the potentiality, quality and market demand for the above 3 spices products , a mission oriented programme needs to be launched separately for spices sector development in North Eastern Region under the broad umbrella of Technology Mission in Horticulture. Such mission need also to cover large cardamom and black pepper which are growing importance particularly under the Agroforestry programmes in High and low altitudinal conditions, respectively. Cultivation of black pepper need to be made mandatory in the tea garden areas of Assam as well as in the foot hills areas of adjoining states.

Action : Spice Board, SAU / CAU, Research Institutes, Corporate houses, NGOs

Fund requirement : @ Rs 5 Cr/State = Rs. 40.00 Cr.

B.3. Plantation Crop

Coconut

- Development of nurseries for production of high yield hybrids for distribution of seedlings in collaboration with CPCRI station at Kahikuchi and AAU, Kahikuchi.
- Development of processing technology for the high rainfall regions of NE India.
- Multiplication of quality planting materials.

Arecanut

- Development of dwarf hybrids using the Hirehalli dwarf as a parent for NE India in collaboration with CPCRI station at Kahikuchi.
- Multiplication of quality materials and development of Agro-Forestry systems.

Cashew

- Identification of superior clones for plains and low hill regions of NE India.
- Developing high density planting systems.
- Developing technologies for cashew processing and alcoholic beverages from cashew apple such as Fenny.

Approx. Fund requirement : Rs 5.00 Crore for Coconut

Rs 5.00 Crore for Arecanut

Rs. 3.00 Crore for Cashew

Total Rs. 13.00 Crore

B.4. Floriculture Sector :

Due to the varied agro-climatic zones available in the region, the region has been identified as a potential area for promoting floriculture. This sector has already received a boost under Technology Mission program. Flowers from the state like Meghalaya, Mizoram, Sikkim and Nagaland are now being marketed, in a small though, to other parts of the country. However, the floriculturists are now approaching the institute to provide them technological backup to address the issue of quality growing techniques, pest and disease

control, better varieties with planting material, measures to increase shelf life, packaging and transportation technique, maintenance of green / poly houses etc. In view of providing the needed support to this sector where the region has competitive advantage, it is planned to initiate research in these areas besides screening and developing varieties in demand both under protected and natural environment. Necessary tie up with NRC on Orchids and other private companies is also planned to be developed for evolving suitable package from plantation to market.

Approx. Fund requirement : Rs. 10 Cr/State = Rs. 80.00 Cr.

C. Animal Science Sector

Animal Husbandry is a very important sector in the region as the hill farmers integrate crop farming with a large number of livestock and this system supports 11.48 mil cattle, 0.84 buffalo, 0.22 sheep, 4.37 goat, 0.05 horse and pony, 3.81 pig, 26 mil poultry, 0.25 mithun and 0.016 million yak. These livestock benefit the farming community from the complementarities of crop-livestock system, provide insurance coverage during risk period and also meet their demand for livestock products as almost 100% of the indigenous people are non-vegetarian in their dietary habit. No farming system in the region is complete without animal husbandry as one of the important components.

Meat, milk and egg deficiency of 49.7, 50.5 and 87.20% indicated earlier is basically due to indigenous type of animal that constitutes bulk of the population. Quality animal germplasm has been a problem in the region. So, also the service delivery system particularly in animal health and feed sector. Remoteness and inaccessibility delay disease diagnostic process with resultant morbidity and mortality. In many areas the livestock growers still have the concept of production on zero to negligible inputs. It is estimated that around Rs. 1000 crore is annually drained out from the states exchequer to meet the deficiency in meeting the requirement of livestock products and therefore it is very important to develop a strategic approach and implement the same for improving this sector which, if achieved, shall help alleviating rural poverty as livestock has been found to provide insurance coverage to the socially weaker section during the distress period.

C.1. Production and health aspect (Pig and poultry as example)

Pig

- Establishment of nucleus pig breeding farms in each district with tested exotic and selected indigenous breed for the purpose of production of around 20,000 cross bred pigs per annum for distribution to the block level.
- Each block is to be equipped with infrastructure and other facilities for producing 75% cross bred pigs from the stock received from district level. Target of each block be fixed for the production of around 5000 cross bred for distribution to breeder and fattener farmers/NGOs/Co-operatives at village level.
- 2-3 villages in each block are to be identified as pig village with the mandate of multiplying the cross bred pigs of 75% exotic inheritance for distribution to fattener farmer. For this purpose, respective state Govt. may identify suitable plot of lands to be given on lease to the pig growers for a specified period but not less than 20 years with the condition that if the villagers utilize the land for other purposes the Govt. will be free to take it back.

- At least one abattoir in each block to handle the slaughter of around 500 pigs per day need to be established.
- At least three SHGs/farmers' club be formed to take care of service delivery namely, animal health inputs, feed inputs and procurement of finisher pigs from the producers from their door step for the purpose of slaughter at the abattoirs so established. Each SHG be trained on the specified areas.
- Suitable legislations be brought out banning sell of pork in the market without the carcass being certified by the abattoir management so as to ensure uniform price to the producer as well as to protect the consumers from pork related health hazard.
- Implementation of such a programme is expected to generate around 3000 direct employment and around 1 lakh indirect employment per state.

C.2. Similar programme with little modification needs to be taken for cattle and poultry sector development.

C.3. Important support services

- Development of stock farms at state level and breeding, animal supply villages at block level.
- Improving efficiency of breeding farms, semen stations, A.I. service including delivery of semen and liquid nitrogen.
- Feed supply at reasonable rates, promotion of feed industry, formulation of feed from local resources.
- Establishment of fodder banks at strategic locations for providing fodder during emergencies and periods of fodder scarcity.
- Development of simple, fast and reliable diagnostic technique for animal diseases.
- Improving the state veterinary services particularly with respect to adequate vaccination cover and disease diagnostic services.
- Developing weather based disease-forecasting models.
- Choosing NGOs, progressive farmers as future trainers and training them for modern management practices for rearing of dairy animals.
- Using para-vets or educated unemployed local village youth for AI service and veterinary first aid.

Action : Research Organisation, Veterinary Deptts.

Approx. Fund Requirement : Rs 40 crore per state (Rs 10 Cr each for pig, poultry, cattle and goat/sheep) X 8 states = Rs 320 crore

D. Fishery Sector:

The aquatic bodies of the region harbour a rich diversity of ichthyofauna 274 fish species belonging to 114 genera under 37 families and 10 orders have been recorded, which constitute about 34% of the total freshwater fish species of the country. The region also has a good aquatic resources. Even with such resources in the form of water bodies and fish species, the region suffers from a deficiency of 55% of fish requirements which is, by and large, met by procuring fish from outside the region at a

huge cost. The present status of these resources and their optimum utilization is, therefore, envisioned for bridging this gap as outlined below :

D.1. Riverine fishery

Present status

Total riverine stretch of 20,050 km. have not been exploited to the desired level due to various reasons like the steep gradient and inaccessibility to some of the riverine stretches (particularly in the hill States).

There are many problems confronting the riverine fisheries. Siltation, water abstraction, habitat destruction are some of the major hindrances in the development of riverine fishery. Unwanted/undesirable fishing practices like poisoning, dynamiting and juvenile fishing are also rampant resulting in decline in fish stock and habitat alterations. This calls for an urgent need to bring in awareness among the fisher folk so that the rivers are optimally exploited, protecting the habitat.

Action Plan :

- Replenishment of stock through appropriate ranching in rivers where population of natural stock is less. Action : Fisheries Deptt.**
- Identifying/earmarking suitable stretches in hill streams for running water fish culture preferably with hill stream carps like Mahseers and cold tolerant species like common carp. Action : Fisheries Institute/ Colleges.**
- Banning the fishing practices like poisoning, dynamiting etc. through a sort of village law to be enacted by the village council. Action: Respective state Govts.**
- Creating facilities at least at district level for fish seed production. Action ; NEC/ State Govts. Of the region**

Approx. Fund Requirement : Rs 25.00 crore

D.2. Reservoir fisheries

Present status

A major area of 23,792 ha, potential area for reservoirs fisheries has not been utilized. More over, majority of the reservoirs were created as single-purpose reservoirs for hydro-electric power generation.

Studies in the recent past in some of the upland reservoirs have indicated a good fish production potential. The common carp, *Cyprinus carpio* which is cold-tolerant and self-recruiting in nature has been supporting the fishery in upland reservoirs. The highly priced mahseers also contribute to the fisheries and is a much-sought after fish of sport enthusiasts.

Illegal introduction of the banned exotic fish species like the African cat fish, *Clarias garipinus* has become a cause of concern in some of the reservoirs. Lack of fishing regulations has resulted in large-scale exploitation of brood fishes and juveniles in some reservoirs.

Action Plan :

Pen and cage culture to be intensified first in the existing reservoirs built for hydro-electric purposes. Also to introduce regular stocking in these reservoirs as has already been demonstrated in Gomti reservoir of Tripura for optimizing production.

- **Increasing the stocking density and adopting scientific production packages for augmenting yield from the present level of 50 kg/ha/year to at least 150 kg/ha/year in these reservoirs.**
- **Promoting the culture of mahseer for achieving the twin objectives of its in situ conservation as well as enhancing the production of this preferred fish in the region.**
- **Exploring the untapped reservoir areas for fish culture.**

Action : As indicated above

Approx. Fund Requirement : Rs 40.00 crore

D.3. Beel fisheries

Present status

The beels form an important resource of North Eastern Region for fish production. Out of the total area of 143,790 ha under beels, lakes & swamps, about 100,000 ha lies in Assam. However, at present, only few of the beels are registered and are controlled by the Assam Fisheries Development Corporation (AFDC) who leases out to the co-operative societies for fishing. The unregistered beels by and large remain weed-choked and there is no organized fishery in these beels. Besides, undesirable fishing methods like the use of mosquito net for fishing have resulted in large-scale destruction of juvenile fishery. Siltation, water abstraction and reclamation of land for agricultural uses have worsened the situation.

Action plan

Generally, the beels have a production potential of 1000-1500 kg/ha/yr. Therefore, a fish production of at least 71,000 tonnes can be realized from the beels of North-East India, even at a modest yield rate of 500 kg/ha/yr. It is imperative that the beels are registered so that the fishing would be carried out in an organized manner, leading to a hike in production. A regular stocking and harvesting would help to increase the production by many folds. It is also essential to strengthen the embankments to protect the beels from flood. Culture-based fisheries through adoption of pen culture would help to further the yield rate from beels.

Approx. Fund requirement : Rs 16.00 crore

D.4. Pond aquaculture

Present status

Although the region is endowed with 40,826 ha of ponds and mini-barrages, fish production from pond aquaculture is below 600 kg/ha/yr, which is far below the national average of 2000 kg/ha/yr. Quality fish seed and their timely availability have been identified to be the main cause of low productivity. At present seed production is mainly done in some parts of Assam and Tripura, the latter being in a position to meet

their own demand. The other states depend on states like West Bengal for fish seed to meet their demand.

If all the available pond resources of the region are utilized for carp polyculture, a production of over 60,000 tonnes of fish can easily be produced at a moderate yield rate of 1500 kg/ha/yr

Strategies

Dissemination of carp culture technology to the farmers is an urgent need and for this, intensive training and

- On-farm demonstrations and training on carp culture through master trainers/ SHGs
- Establishment of eco hatcheries at district levels for self sufficiency in quality fish seeds in large numbers.
- Establishment of fish producers co-operative society/ farmers club with the concept of fish business centers to act as information and service delivery centers.
- Partnering of village panchayats and community centers with agriculture etc departments implementing watershed development project in the region to harness the benefit of water harvesting structures created under the project for pond fish culture.

Approx. Fund requirement : Rs 24.00 crore

D.5. Rice-fish culture

Present status

Most of the area of 2780 ha under paddy-cum-fish culture is confined to the State of Arunachal Pradesh where rice-fish farming is popular. Though, other states of the region also have the potential, they are not making full use of the resources for organized paddy-cum-fish culture.

Strategies

- Horizontal expansion of area under paddy cum fish culture in a partnership mode
- Popularizing raised and sunken bed technology to utilize marshy land areas for paddy cum fish culture.
- Identifying suitable fish species for paddy-fish culture.

With the above facilities and awareness created, an additional production of 0.13 million ton of fish could be obtained thereby increasing the total production to 0.35 million ton, i.e., reaching the targeted requirement of 0.38 million ton.

Approx. Fund requirement : Rs 16.00 crore

D.6. Common issues to be addressed:

- Improving production of quality fish seed and establishment of controlled maturation pond at block level.
- Control of fish diseases.
- Reservoir development – long term lease of reservoirs and their utilization policy.
- Extending credit for production, processing, preservation, transformation and marketing.
- Also providing appropriate insurance coverage to the producers.
- Popularization of diversified and integrated fish culture.

Approx. Fund requirement : Rs 40.00 crore

Total Fund under Fisheries sector : Rs 161.00 crore

E. Some Common Issues to promote agricultural growth

E.1. Intensive integrated farming system

In order to address the challenge of natural resource conservation, necessity to bring in improvement/suitable modification in shifting cultivation practices, support to organic agriculture movement, harnessing the benefit from crop-animal-fish complementarities as well as to ensure household food and nutritional security for the poor of the region, the vision is to promote in a massive way the concept of intensive integrated farming system

Strategies to achieve this

After identification of 50% of the mid altitude areas and 50% of shifting cultivation areas as outlined already, proper planning of the sites with the involvement of soil and water conservation engineers shall be carried out for the needed intervention like water harvesting structures, hydrological behavior studies, soil conservation strategies (contour bunding, contour trenching, half moon terraces etc. Water harvesting structure so created shall be used for fish production depending on altitudinal advantage which will be supported by animal component in an integrated manner. The animal waste like dung and urine shall be used for vermicomposting, liquid manuring etc. This integration shall further be supported by agri-horticultural crop in the lower and upper terraces as well as through raised and sunken beds technology wherever marshy land exists. *In situ* production of farm inputs shall be attempted including soil health rejuvenation through hedge row system in the bunch. At least 2-3 such IIFS models already developed by ICAR institute at Meghalaya need to be demonstrated in each village.

Approx. Fund requirement : Rs 15 crore/ state = Rs 120.00 crore

E.2. Precision farming :

In the emerging world of precision planning to counter wastes and make the enterprises cost effective for taking a share in the international trade, it has become imperative to develop technology for precision agriculture so as to utilize the scarce resources judiciously and effectively. It would be desirable from the research agencies to provide exact quantity of water and other input requirements to the farmers for each crop on per hactre basis so that he not only can plan for its requirement but also create such facilities to store them in advance. The vision therefore is to :

- Research institutions shall be required to include precision farming in their research agenda initially on select crops on demand as per location specific strength.
- All necessary supports to be made available to these agencies to conduct such research at institute level including the facilities for weather forecasting devices, measurements of nutrient uptake by each crop and planning replenishment accordingly. Results of such research are to be made available by 2010.

Approx. Fund requirement : Rs 2.5 crore/ state = Rs 20.00 crore

E.3. Post Harvest handling of the produce

Post harvest losses of almost all the farm produce in the region is very high due to near zero facility for their handling, processing, value addition, packaging and even organized marketing. It is an irony that though the region produces best quality of turmeric, ginger, pineapple, orange, apple etc., there is no processing unit for any of these crops. Due to inaccessibility and transportation bottleneck restricting timely linkage between production site and the market, post harvest losses particularly for fruits and vegetable crops becomes very high ranging between 30 and 60%. Adequate measures therefore are very essential to reduce these losses which, if achieved, would add towards production enhancement.

The strategy to achieve this would be three folds:

- Skill up gradation of both public and private operators in post harvest processing in established institution.
- Setting up of small and medium scale processing units in the line of cottage industry at village level.
- Tie up with corporate houses engaged in processing and marketing of agri-horti products facilitating procurement of small scale produces from the farmers door and feeding the corporate houses in bulk quantities.

This is a sector where lot of employment opportunities for the unemployed youths exists.

Approx. Fund requirement : Rs 10 crore per state = Rs 80.00 crore

E.4. Research on sanitary and phytosanitary measures :

North Eastern region being relatively less equipped to carry out research on sanitary and phytosanitary measures – an important aspect to tap export market potential, establishment of referral laboratories particularly on animal health and organic certification need is planned.

Strategies to achieve the above goal:

North Eastern Region has several international borders through which import of animals, plants and their products take place. The region is less equipped as far as sanitary/phyto-sanitary monitoring is concerned. In addition, the region has vast potentials for organic farming which would require well organized certification facilities including sanitary/phytosanitary aspects. The vision is to provide these facilities through the following strategies:

E.5. Establishment of referral laboratory for plant and animal diseases.

- Monitoring of diseases and pests to prevent probable transmission from across the international borders during import of livestock and plants and their products and act as a support mechanism to quarantine establishment in the region.
- Monitoring of disease free zones, HACCP and GMP standards for export marketing.

Establishment of an organic certification laboratory :

- Chemical and antibiotic residue detection in produces, detection of hazardous chemicals and environment pollutants in soil, livestock and plant and their products.
- Developing methodology and protocols for monitoring of organic farms for certification.
- Training and awareness to promote organic agriculture.

Providing a mechanism for monitoring and surveillance of pathogens, input utilization mechanism, management practices, etc. for organic certification.

Note : These laboratories are preferably to be established under reputed institutions like ICAR Complex for North East and CAU

Approx. Fund requirement : As per proposal of Sub-Group V of Agro-Climatic Planning (to avoid duplication).

F. Strengthening knowledge base of women involved in agriculture:

In the North Eastern region, women work force in agriculture and animal husbandry constitute 48.1% against 35% in non-Himalayan region and 33% in the country. Women work force in the region is also the decision makers. However, advanced knowledge is normally given to the men work force for which the knowledge is left unutilized. By 2010, knowledge base of the women work force is planned to be increased through training and various other human resource development programmes. Research is also planned to be reoriented for addressing the women related problems in agriculture and allied sector with a view to increasing overall production by increasing the efficiency of women partners.

Addressing lack of education, training, women specific technologies and Entrepreneurs among women by :

Establishment of rural schools for women in each village.

Arranging scientist-Extension agency- women interfaced to identify women related issues in agriculture.

Skill up gradation through training and demonstration.

Formation of women SHGs in each village and building their technical competency.

Generation of anthropometrics data for local women of the region and study on drudgery perception in various agricultural practices and their refinements to reduce drudgery during the operation and make them ergonomically sound to improve the working efficiency and postural comfort of women.

Organising film etc. shows on success stories of women movement in agriculture.

- IT led information collection and use.

Action : Collaborative

Approx. Fund : Rs 0.20 crore per district X 78 districts = Rs 15.60 crore

G. Disseminating evolved technologies for enhancing production :

For assessment, refinement and dissemination of evolved technologies in a focused manner, one model village for each of the important crop and animal is also planned to be established to spread the message of the benefit from improved technologies. Each adopted village shall be facilitated by both public and private the extension machineries.

Strategies to achieve the above goal :

Although a number of viable agricultural technologies are available, their adoption has been at very slow pace, which needs to be accelerated to attain self-sufficiency in food production by 2011. To achieve this the following strategies will be followed :

1. Enhancing the pace of adoption of modern agricultural technologies:

- Concentrated efforts will be made to develop two model villages in each district of the NE Region through KVKs and other Extension Machinery for demonstration of modern technologies and for providing consultation to farmers for extracting maximum benefit from new technologies. Assessment and refinement of evolved technologies too will be carried out in a partnership approach to suit farmers' need. Research institutions and SAUs to take the lead.
- To facilitate the input and credit supply in agriculture and agro-based industries a platform for interface between farmers and financial institutions will be provided. Financial institutions will also be provided information about probable benefits of investing in frontline agricultural technologies for which the region has an advantage over rest of the country. Research institutions to take the lead.
- Skill upgradation on what to produce, how to produce, how much to produce, how to store, process and add value and how to market. IT led information delivery by extension agencies.

Approx Fund requirement : Rs. 0.20 crore/district X 78 districts = Rs. 15.60 crore

H. Utilization of agricultural and other waste :

Eco-friendly utilization of domestic, industrial and agricultural farm waste in a manner that they are converted into source of nutrients to the crop/animal through established and emerging systems of bio-conversion.

Strategies to achieve the above goal

1. Soil amelioration and fertility enrichment through utilization of agricultural/industrial waste-
 - a) Convergence efficiency of crop residues/domestic/animal waste through indigenous/ exotic earthworm species.
 - b) Standardization of techniques for nutrients enrichment of agricultural waste.
 - c) Changes in soil physico-chemical and bio-fertility as influenced by recycle waste material.
 - d) Quantification of waste compost requirement for various crops on cropping sequence basis.
 - e) Identification and quantification of waste material for amelioration of acidic soil.
2. Utilization of waste material to meet out the domestic energy requirement :
 - a) Identification of various waste material for biogas production
 - b) Screening and efficiency of various crop residue for making charcoal.
3. Recycling of agricultural waste for mushroom production
 - a) Testing of different crop residues for low cost mushroom production
 - b) Proximate analysis of mushrooms and spent substrates and compost to use as cattle feed, manure and vermicompost etc.
4. Use of crop and domestic waste as feed to livestock and bird
 - a) Survey and exploration of agricultural and domestic waste potential for their economical use as feed for animal and bird.
 - b) Nutritive values analysis of waste materials for enhancement/ support to animals and birds production.

Fund requirement = Rs. 15.60 Crore

I. Using information technology in agriculture

Studies on market dynamics and intelligence through IT-based technologies are planned to be carried out together with developing E-villages both for feeding market information, agricultural input services and weather-based information and produce delivery systems. Collaboration with Space Research Organization, Community Information Centres, marketing wings of State Govt.s and other financing bodies, NGOs and self help groups is planned to achieve this.

Strategies to achieve the above goal :

Infrastructural bottlenecks and poor information network has resulted in a vicious circle of subsistence farming in the north eastern region. There is a need to facilitate proper information flow through farmer's help line and a well-equipped communication network. The following strategies are envisaged to achieve this goal.

1. Enhancing farmer's knowledge base through development of suitable decision support systems based on technologies and resource analysis to help farmers in decision making. This decision support system will be a two part system. The first part, based mainly on market intelligence and resource availability information would help farmers to decide what to grow, when to grow, how much should be the production target and where to sell. In addition, it will also contain information on credit availability, source of seed/planting material/breed, insurance facilities etc. collected from various agencies. Financial institutions, suppliers, NGOs, SHGs will be consulted to develop this part of the system. The second part will be based on technical information like crop cultivation/animal husbandry decisions, health care, implements, storage systems, processing systems, etc.
2. Development of forewarning system for crop/animal/fish production by collecting and analyzing weather based information and dissemination of agro-advisories through mass media and communication network to minimize losses occurring due to natural calamities.
3. To strengthen the information flow among various players, collection of market information such as arrivals and prices of agricultural produce, input prices and availability and make them available to farmers after proper synthesis. Efforts will be made to develop a communication network in collaboration with NIC, ISRO, financial institutions, state and central agencies up to Block level in Phase I and at village level in Phase II. All 236 CICs developed by NIC can be utilized for this purpose. One model E – village in each state shall be created to monitor the impact and refinement of information dissemination system. Some persons from each model village will be trained to man systems in villages and SHGs will be created to extend benefit of the systems at village level.
4. A farmer's help line will be created under each research and educational (agricultural) institute for providing timely help to farmers in far flung areas.
5. A sound database on agri-horti-animal-fish and bio-resources of the north eastern region shall be developed. Information network through library automation and other means shall be widened for single window information delivery system. For example, if such a facility is created in say ICAR Research Complex HQ at Meghalaya, all the states of the region shall be benefited through its regional centres located in each state which shall in turn help in policy planning, trend analysis and forecasting.

Approx. Fund requirement : Rs. 20 crore

J. Development and support issues

Block level agri business centres

Agribusiness has facilitated movement of farm produce from neighbouring countries like Nepal and Bhutan to the capital city of the country. On the other hand, in North east, such movement is to a very limited scale between production site and the state capital. Disparities in prices of the commodities is mind boggling. For example, if ladies finger is available at production site at Rs.0.50/kg, the price of the same at capital township is around Rs. 15/kg. main reason for this scenario is the dominant role of middle man and lack of

information on prices etc. at village/block level. The vision therefore is to promote agri-businesses centre involving the unemployed youths who have become the soft targets for recruitment by the extremist organization due mainly to industrial backwardness and non lucrative business avenue in agriculture sector.

Strategy

- Youth groups at block/district levels are to be mobilized to take the benefit of various Central/ State Govt. schemes for agriculture and rural development.
- To organize skill up gradation programme and capacity building including development of master trainers on organic farming, productivity improvement, post harvest handling, processing, value addition and marketing.
- Establishment of rural godown for storage and processing of the produce to be collected from individual household paying prices comensurating with market price. Alternatively, such agri-business centres shall work as collection centres of farm produce.
- Establishment of agri clinic in this centres by unemployed agricultural/Veterinary graduates to provide door to door services for plant/animal health protection.
- Each centre is to be equipped with information technology backup for arranging information dissemination at block/village level through the concept of E-Chaupals (ITC).
- Each centre to be also equipped with facilities for seed/planting material production (green house technology), medium scale processing and packaging units and community training hall/centres.
- A small group of such centre shall be given specific responsibility to liaise with other departments/financing bodies for rural infrastructure development like road, community school and primary health centre.
- Yet another group of the centre shall take up the responsibility to create awareness among the masses on education, health, sanitary issues, WTO and IPR issues. this group will also maintain forward and backward linkages with experts and the client group, respectively.

Such agri-business centres, at least one in each block initially, are recommended to be established under the AIGES of some reputed NGOs having experience in similar lines. It has been tentatively estimated that depending on the number of blocks per state, a full time employment potential per state of around 30,000 unemployed persons could be achieved together with creating self employment opportunities for about 1 lakh people. This step would also help addressing the much talked about issue of marketing of agricultural produce in the region. If accepted, detail cost of the project shall be worked out for the support.

Action : NGOs, State Govt., Research Institute.

Approx. Fund : Rs. 10 Crore/State = Rs. 80.00 Crore

Development of HRD

For the overall development of agriculture and related sectors in the region, strong research base to support the developmental efforts will be necessary. Vastness of the area and geographical differences make it difficult for any institute in the region to cater to the needs of all the states. Thereafter ICAR Regional stations located in different states need strengthening with infrastructure and manpower. The trained manpower is not locally available and competent people from outside do not get attracted because of the disturbed

conditions. Therefore a suitable incentive to the employees on the lines of benefits given to the employees of All India services should be provided.

Vocationalization of education is necessary. In addition to the formal degree and post graduate programmes, short duration certificate courses on need based topics will ensure the empowerment of the farmers by enhancing their knowledge required for modern agriculture.

Infrastructure Needs especially for export and commercialization of commodities

Keeping in view Look East Policy, NE Zone need to have infrastructure for value addition and packaging of fruits and flowers. The encouragement on organic production under horticulture crop is need of the day so that the production can be easily exported in conformity with Look-East Policy.

Huge investment is required for promoting and maintaining the quality of horticulture produce from farm till the time it reaches the consumers in various forms. In its present approach followed for developing cold chain linkages, the govt. policies implemented by organizations like NHB NCDC APEDA, etc. primarily assist private entrepreneurs to set up Cold Chain facilities in their respective units. This approach has been followed by these organizations for the last one decade resulting in introduction of cold chain facilities amongst a number of units in the agro sector. However, a look at the performance of these units clearly indicates that the investment for cold chain linkages has not been found to be very viable.

It is recommended that the a strategy is adopted for providing facilities collectively for a region having potential strengths for production of horticulture crops throughout the year or for most of the year. This would mean enable the facility to be utilized throughout the year making the activity as economically viable. For cold chain and other areas of infrastructure & conversion of produce into marketable form the investment requirements have been formulated hereunder.

From the view point of complete supply chain, from farm to the market the infrastructure for all types of perishable horticulture produce I required at following levels:

(a) Small pre-cooling and/or zero-energy-cool chambers in the production areas where the field heat of the produce is to be removed at fast rate to bring down the temperature of the produce to the desired level before putting the product in the cold storages. The refrigerated transport units from the farm to the cold storages are also utilized as mobile pre-cooling units for this purpose.

(b) Collection Centre near to the farms.

(c) Medium to small cold storages having multi-product. Multi-chamber facilities are the

(d) Specialized cold storage with facility of built in pre-cooling high humidity and Controlled/Modified Atmosphere are required for storage of the produce for a longer period. These specialized storages are essential for extended shelf life of the produce and without these storages the requirement of storing the produce to meet the demand in the off season is not feasible.

(e) Other components like ripening chambers close to the markets and display cabinets at retail outlets.

(f) Linkages for conversion of fresh produce in other marketable forms.

(g) Integrated Pack Houses these centres may serve farms in a respective regions. Farms associated with each of the centres would collect farm produce and bring them to common cold storage centers where the se products would be given treatments such as washing,

sorting, grading and packaging. These products will then be preserved in the appropriate cold storage facility. The services of these centers will not only increase the value of the farm product but will also remove most of the unwanted biodegradable bio mass from the horticulture products which can be utilized as farm manure or even as cattle feed.

The Planning Commission has also setup a Working Group on Agriculture Infrastructure/Warehousing/Rural Godowns/Marketing/Post Harvest Management, Processing and Cold Storage, Trade and Export Promotion for formulation of the 11th Five Year Plan.

Linkages with stack holders:

The ICAR & CSIR institutes and SAUs in NE are expected to take up the needs of the farmers of the seven states of NEH region, it is necessary for them to have proper linkages in the state departments of Agriculture and allied sectors on one hand and have effective liaison with the national and international institutions dealing with agriculture, horticulture, animal husbandry, fisheries, soil conservation, agro-forestry and agricultural engineering through head quarters as well as directly. These institutions have also the responsibility of training and extension for which purpose liaison with farmers agencies or such voluntary as well as regional bodies/NGOs/Self Help Groups in cluster villages which are working for welfare of local farmers is essential. The Central and State Government institutions, especially ICAR Complex for NEH, Barapani, AAU and CAU should act as “Centres of Excellence” in all aspects of hill agricultural research including its role as (i) information repository on the use and development of land, water and livestock resources and (ii) focal point of his knowledge transmission/stack holders through publications, training and other are NGOs, Voluntary organizations, farmers associations, self Help Groups with cluster approach while NEC DTS, NDDDB, NEDFi, APEADA, NABARD, NHB, etc. for funding and promotional activities.

The Planning Commission has also constituted a sub working group under the chairmanship of Dr. C. Prasad (Ex-DDG) to formulate in detail action plan for extension linkages with stack holders of NE.

Funding

In order to address R & D needs of NE region, upgradation of scientific skills coupled with infrastructure of SAUs and ICAR institutes the first prerequisite to achieve the defined goals. Integration of research efforts through incorporation of major technologies can accelerate the development activity. Therefore inter institutional working groups will have to shape up as consortium so that multi disciplinary, multi commodity efforts on research, development and technology are harmonized into a mission mode initiative.

In addition to the funds received from the Government of India, consolidated fund, more funds may also be obtained by the concerned institutes, SAUs and State Departments from North East Council, Shillong, NABAARD etc. to execute the programmes envisaged in the XIth Plan.

It is understood that North East Council, Shillong now a statutory body has also formulated the fund requirement for ongoing activities and new projects of all the state of North East. Thus, the present working group will associate with the funds required by NEC for overall development of agriculture and allied sectors. Therefore, no separate attempt has been made to work out the funding in XIth Plan to avoid duplication.

TOTAL FUND REQUIRED = Rs. 1141.25Crore (excluding expenditure on organic farming proposal being presented by Sub-Group V to avoid duplication)

A. SCHEMES/PROJECTS TO BE CONTINUED WITH SUITABLE MODIFICATIONS

The ongoing projects in different states of the region which are likely to be spilled over to the 11th Plan along with new strategies for inclusion in the 11th Five Year Plan. The following on going programmes are needed to be strengthened further:

- Horticulture Technology Mission for North East
- Watershed Development Programmes like NWDPPRA
- Screening and development of agriculture, horticulture varieties to maximize quality yield by ICAR Institutes/SAU/CAU.
- Extension Programme by Zonal Coordinating units, ATMA programme in the state departments.
- HRD programme by CAU/AAU/NU and ICAR Institutes.
- ICAR and other funding agencies will continue like AICRPs and Adhoc Research Schemes in all SAUs and ICAR Institutes of N.E.

B. PROGRAMMES/ SCHEMES TO BE DISCONTINUED: NIL

C. SCHEMES/PROGRAMMES TO BE UPSCALED:

- Production of quality seed and planting materials
- Strengthening of floriculture industry
- Post harvest processing and value addition in establishing Mini Processing units at sites of production
- Cluster based cultivation programme, home stead to trench garden.
- IT based information to the farmers for extension management.
- Transfer of technology through ICAR/CAU and AAU.
- Regional Horticulture Mission
- Precision farming
- Intensive agricultural farming system
- Strengthening of biotechnology resource development programmes.
- Dairy Development programmes with fodder development programmes.
- Pig, fishery and quail farming as integrated programmes.

D. NEW INITIATIVES/SCHEMES

- Organic agriculture and Animal Husbandry
- Medicinal and Aromatic plants exploration
- Promotion of agro-techniques and superior strains of bio-diesel crops.

RECOMMENDATIONS AND CONCLUSIONS:

A. Recommendations emerging out of Sub-Group Meetings:

- Horticultural development, including the production of seed and planting materials.
- Making the state governments of the region to be more responsive for creating facilities for mother orchards for elite planting materials.
- Attending to the issues of credit facilities to the farmers.
- Addressing the most talked issue of shifting cultivation.
- Looking at the feasibility of increasing irrigation potential & power supply to farm sector.
- Exploring the possibility of diversification.
- Linking up rural employment with the national schemes like rural employment guarantee scheme
- Developing a proper mechanism for transfer of technology and training at different levels.
- Need to work on the Post harvest handling and processing particularly of horticultural crops for employment & income generation.
- Revamping state mechanism for effective delivery of agricultural inputs including technologies.
- Inventorisation/cataloguing and using the valuable bioresources including medicinal and aromatic plants.
- Exploring the issue of diversification. Oil seeds like groundnut and cereals like wheat etc figured during the discussion as the source of diversification in addition to livestock and fishes.
- Considering the shift in weather in the region observed during the last two years, the issue of monitoring weather parameters for understanding crop-weather response.
- Strengthening biotechnology resource development aspect.
- Development of ITC models in the villages in collaboration with the CICs wherever applicable.
- Provision for rain/roof water harvesting.
- Development of sound marketing network.
- Establishing small scale processing units in production site and cold chains in the urban areas near to capital city.
- Provision for special programme for the women in agriculture.
- Programmes for developing of dairy sector in plain zones of the region and piggery & poultry in the hill zones.
- Up gradation of capacities of the existing research institutes/universities/departments needs to be strengthened by way of support in terms of equipments/machinery etc to make the institute capable to take-up the upcoming issues of interest.

B. Recommendations emerging out of IAUA Vice-Chancellors' Conference

- In order to address the issue of technology delivery in the present day context, capacities of existing ICAR institutes and Universities located in NE Region be enhanced in terms of equipments and man-power.

- Regional referral laboratories needs to be established in CAU and ICAR NEH Region to promote organic agriculture/animal husbandry
- A regional consultative group needs to be established in the region to frame education and development agenda in a partnership mode so as to facilitate addressing farmers issues and propagation of intensive integrated farming system models developed for the region by ICAR Research Complex.
- North East Region imparts large quantities of animal products from outside the region. Besides, several other factors, the availability of higher cost of feed is the main limiting factor. The region is agro-climatically ideally suited to produce maize and soybean, the two important components of animal feed. It is recommended that cultivation of these crops should be popularized in a mission mode with forward and backward linkages.
- In order to improve the productivity and profitability of various components of farming systems like crop, animal, fishery, etc. the availability of quality seed, planting material, fish seeds, chicks, etc. should be ensured. The region lacks the basic infrastructure to meet the requirement. It is recommended that systematic planned programmes be undertaken and necessary infrastructure be created.
- Human resource development: Creation of awareness and development of technical skills in various aspects of production and rearing of various components of farming systems is a pre-requisite for improving the productivity of the system. The scientists of KVKs should be given required training to serve as master trainers.
- Research infrastructure in the region is extremely poor. It should be suitably strengthened.
- The region receives high rainfall but the benefit from such high rains are not reflected in the overall cropping patterns. Greater part in most of the states are monocropping, mostly rice, Rain water conservation for its better utilization in non-rainy or drought period will help in increased cropping sequence, cropping during rabi season.
- Soil and water conservation, especially terrace cultivation on the hill slopes is the most important scientific practice for realizing higher yields of crops with reduced soil and water loss.
- The region since blessed with high rainfall and water table depth is shallow, shallow water tube wells will do a miracle in valley areas, table land etc. making available irrigation water for the second crop in rabi and more than one vegetable crops during rabi/summer season.
- For improving the livelihood of the farmers and their farm income on year round basis, crop diversification and integration of crops with livestock and fishes as complimentary activity is considered to be the most sustainable practice. Separate models could be developed considering the need of the farmers and the resources available with him including socio-economic considerations.
- The North-East region in general and *jhum* cultivation area in particular should be targeted in promoting organic agriculture. Technology transfer and extension activities are important for promotion of agriculture.

- Subsidiary and allied activities like apiculture, sericulture, lac-culture, mushroom cultivation, agro-based handicrafts, family based minor food processing, etc. along with agriculture will help in improved livelihood of poor and small farmers.
- Promotion of some of the crops like maize, soybean, rice bean, forage and feed crops in the context of crop –livestock integration will be quite useful in the overall improvement of farm productivity.
- There is a need for formation of SHGs/farmers clubs with women empowerment and full back up in terms of training for post harvest processing, value addition and marketing. Thus, paradigm shift is needed in watershed based integrated farming approach for sustainable progress in agriculture following holistic activity wise steps.
- Extensive work on exploration, collection, evaluation and conservation of various crops of NE region is needed.
- More efforts are required for medicinal plants and for development of package of practices for their popularization and commercialization
- Indigenous livestock of NEH Region needs to be surveyed, characterized both at phenotypic and molecular level in particular Manipur Pony, Banpala sheep, Dam and Mali pig. Wild Asiatic buffalo which is progenitor of riverine buffalo and it needs to be conserved in-situ.

Conclusions:

The N.E. region is characterized by high rainfall (2000 mm) and suffers from soil erosion (1.3 m/ha) with annual loss of top soil (i.e. 46 ton/ha/annum) which is much higher compared to national average (16 ton/ha/annum). The region is also characterized by poor water harvesting measures, low irrigation intensity (20.74%), low cropping intensity (114%), predominantly rice based (except in Sikkim where maize is predominant crop) main cropping system with very low fertilizer consumption (11 kg/ha). The region has got greater biodiversity with highest forest cover 77% of the total area) with hilly, sloppy and plain lands in the valley. The region is also deficient in food grains, milk, meat, egg and fish.

The 11th Plan document for NE states envisions:

Making agriculture sector in the region food sufficient through production maximization, ameliorating environmental, physical, technical and marketing constraints for production enhancement.

- Remunerative to lure unemployed youth to the untapped Agri-based entrepreneurship and employment.
- Empowering the region to be a player in the emerging global organic food market and thus building its capacity to contribute to national food basket and export earning.
- Addressing the constraints of deliverables to ensure production optimisation.
- Skill up gradation and capacity building of each stakeholder.
- Facilitating cross border Agri-based trade in the areas of competitive advantage

Table 1. Agro climatic zones of N.E.H. Region*

Sl. No.	Zones	Altitude Range	Approx. geographical area (sq.km)	Annual Average Rainfall (mm)	Mean Temperature Max.	Min	Areas
1	2	3	4	5	6	7	8
1.	Alpine Zone	More than 3500 m	47068	750	17 ⁰ C	20 ⁰ C	Arunachal Pradesh: Gorichen Upper Tawang, Tulungla, Bumla, Sela pass areas of West Kameng District, Jidu and adjoining areas of Northern Siang
							Sikkim: Gnathong, Chhangu, Serrathong, Thangu, Yakthan, Zema Lachen, Heegyathang, Samsingeling, Cholemu, Lima, Nathula range
2.	Temperate and sub-alpine zone	1500-3500m	33564	2000	20 ⁰ C	11 ⁰ C	Arunachal Pradesh: Tawang, Dirang, Bomdila, Shergaon, areas West Kameng District, Dibang Valley, Northern part of East Siang, Upper Subansiri district, part of West Siang around Anini & North Eastern part of Lohit district
							Meghalaya: Upper Shillong, Mawphlang and Mairang of East Khasi Hills district
							Manipur: Mao & Maram areas of North district, Ukhrul and adjoining areas of East district
							Sikkim: Karponang, Bordong, Resi, Kangdin, Melli, Param, Lachen, Laichung, Hilley, Yoksum.
							Mizoram: Blue mountain, Halikhan, Tuipang, Nauzuarzo Tiang
							Nagaland: Tuensang and Zunhoeboto district, Vangkong area of Wokha district, higher areas of Mokokchung district.
3.	Sub-tropical hill zone	1000-1500m	29021	1600	30 ⁰ C	12 ⁰ C	Arunachal Pradesh: Changyak, Naga and Khonsa area of Tirap district, Basar area of Siang district
							Meghalaya: Jowai sub-division of Jaintia Hills, part of Nongstoin sub-division, Nokrek and Kailash area of West Garo Hills and Western part of East Garo Hills

							Sikkim: Namchi, Gayzing, Rongli, Rehnok, Mangan, Changthang, Uttre, Gangtok Mizoram: Whole State except lower valleys of Northern and Western part and area adjoining Cachar district and lower parts of Chhimtuipuii district Nagaland: Mokukchung district, Lower parts of Kohima, Wokha district and Mon district.
4.	Sub-tropical plain zone(valley area)	400-1000m	812	1375	27 ⁰ C	12 ⁰ C	Manipur: Imphal Valley Nagaland: Bhaghti & Longnak valley Meghalaya: Umkiang area of Jaintia Hills.
5.	Mild -tropical hill zone	200-800m	26349	1400	30 ⁰ C	12 ⁰ C	Arunachal Pradesh: Southern part of lower Subansiri district. Meghalaya: Southern part of Jowai sub-division adjoining Karimganj; Cachar and North Cachar district of Assam, Southern part of Nongpoh sub-division of Khasi Hills, Eastern part of East Garo Hills and West Khasi Hills. Manipur: Manipur West district including Jiribam area Churachandpur and Thanlon of South district. Moreh area of Central district. Sikkim: Rongpoh area of East district. Mizoram: Lower valley of Northern and Western parts of Chhimtuipuii district. Tripura: Jampui Hills. Nagaland: medziphema area of Dimapur sub-division.
6.	Mild -tropical plain zone	0-200m	29333sq	2000	33 ⁰ C	17 ⁰ C	Arunachal Pradesh: Pasighat area, Singphow area of Tirap district and lower parts of Lohit district. Meghalaya: Lower part of West Garo Hills district. Mizoram: Parts of adjoining Cachar district of Assam, and North Tripurs district. Tripura: Major part of Tripura excepting Jampui Hills Nagaland: Southern part of Dimapur sub-division excluding Medziphema area.

* Adopted from the Report of the ICAR Research Review Committee for N.E.H. Region, April, 1984 .

The major food crops in NER include:

1. Rice: the most important food crop occupying more than 65 percent of the total cultivable area in all the states.
2. Maize: Grown primarily in the hill district of the region
3. Other cereals: Wheat, finger millet, buck wheat etc. which are not of major concern
4. Pulses: Include, Black gram, Green gram, Soybean (used as pulse in hills)
5. Minor pulses: Field pea, Pigeon pea, Lintil
6. Oil seeds: The major oil seeds include Rape and Mustard, Soybean, Sesamum, Linseed, Sunflower, Groundnut and Castor are minor oilseeds
7. Fibre crops: Jute is the major fibre crop grown only in Assam, Meghalaya and Tripura other fibre crops of minor importance are Cotton and Ramie.

Area, production and productivity of major food grain crops (rice, wheat, maize and pulses) in the region recorded a growth rate of 13.65,34.00 and 25.89% respectively, between 2000-01 & 1980-81. considering the fact that only 12% of the reported area is sown in the region, there is scope to increase both the area under cultivation and the food production.

Horticultural Crops

Major crops

The major potential crops identified for the North, Eastern Region are as under:

- a) Fruits: Citrus fruits (mandarin orange and lemons), banana, pineapple, jackfruit, peach plum (low chilling types), passion fruit, Kiwi; apple (in rainshadow temperate belts).
- b) Vegetables: cabbage, potato, tomato, radish, carrot, cauliflower, beans, amaranths, pumpkin, chow-chow, and other tuber crops (tapioca, colocassia) and special focus on Off season production of vegetables.
- c) Spices: ginger, turmeric, large cardamom, chillies. black pepper
- d) Floriculture crops: orchids, gladiolus, anthurium; lillium and many foliage plants including climbers
- e) Plantation crops: Coconut, arecanut, cashew nut, tea, rubber and coffee
- f) Medicinal & Aromatic plants: Pachouli, Citronella. Besids, number of native species available naturally for commercial exploitation

INTERIM REPORT OF THE SUB-GROUP ON “VALUE ADDITION / INFRASTRUCTURE / ORGANIC FARMING” OF THE WORKING GROUP OF NATIONAL DEVELOPMENT COUNCIL (NDC) ON AGRO-CLIMATIC ZONAL PLANNING INCLUDING AGRICULTURE DEVELOPMENT IN NORTH-EASTERN INDIA FOR XI FIVE YEAR PLAN (2007-12).

By

**Dr. NAGEGNDRA SHARMA
Vice-Chancellor**

**Sher-e-Kashmir University of Agricultural Science and Technology
Jammu**

INTRODUCTION

Regaining agriculture dynamism, reversing deceleration in agriculture growth and there by addressing the problem of rural distress, we have to identify important challenges in 11th Plan. From the low level of 1% growth in agriculture in three years of 10th plan, we have to achieve 4% growth rate from farm sector in order to have overall 9% growth rate during the 11th plan. For that from cereal crops to non-cereal crops and from production to processing has to be given top priority. Hence, a “farm to fork” development strategy must incorporate to realize the maximum benefit from agriculture sector. How is that India is the largest producer of milk but not the milk chocolate ?, fruit but not the juice ?, cattle but not the meat products ?, sugar but not ethanol ?, cotton but not clothing ?. Agriculture to industry is a continuum dotted with agro based industries which are still in their infancy. Value addition and agro-based industry require nurturing and infrastructure support. The long supply chain from farmer to consumer is waiting to be harnessed for value, and this is where the right policy mix can spur growth. Infrastructure and human capital development is also essential for proper value addition. Potential bottlenecks have to be removed. Massive investment for value addition, infrastructure for production, processing, storage, marketing and training of human resources has to be given priority during the 11th plan investment.

CURRENT STATUS, PRESENT NEED AND GAPS EXISTING

Area, production and demand of agricultural commodities

Items	Year (2003-04)*		Year 2011-12** Projected production (mt)	Gap (mt)
	Area (m ha)	Production (mt)		
Food grain production	123.32	213.46	337.30	123.84
Rice	42.50	88.28	128.16	39.88
Wheat	26.58	72.11	130.45	58.34
Coarse Cereals	30.76	38.12	48.93	10.81
Pulses	24.45	14.94	29.76	14.82
Oilseeds	23.44	25.29	58.56	33.27
Potato	1.28	23.27	30.57***	7.30
Vegetables	6.18	91.08	120.22***	29.14
Fruits	4.74	45.70	60.32***	14.62
Sugarcane	4.00	237.31	679.64***	442.33
Cotton	7.63	13.87	18.20***	4.33
Jute & Mesta	1.02	11.23	14.78***	3.55
Milk	-	88.10	138.04***	49.94
Eggs	-	40,400 (mil. no.)	56.890 (mil. no.)***	16490 mil. no.
Wool	-	48.5 (m kg)	69.43 (m kg)***	20.80 (m kg)
Fish	-	63.99 lakh t	81.80 lakh t***	17.81 lakh t

* Statistics at a glance, 2005, Directorate of Economics and Statistics, Ministry of Agriculture, Govt. of India.

** Fertilizer statistics, 2002-03, the fertilizer association of India, New Delhi.

*** Calculated on the basis of previous available data.

Gaps in infrastructural facilities

S.No.	Infrastructure	2004 (Number)	Projection for 11 th plan (Number)	Gap (Number)
1	Wheat			
	Roller mills	750*	1100	350
	Chakki	2,66,000*	3,10,000	43,000
2	Rice and Dal			
	Huller	90,000*	96,500	6500
	Sheller	5,000*	6,200	1200
	Huller-cum-sheller	8,385*	8,600	215
	Modern rice mill	35,008*	39,000	3992
	Dal mill	20,000*	33,000	13,000
3	Fruits and vegetables (licensed) units	5,198*	6,300	1102
4	Sugar Mills	429**	550	61
5	Solvent Extraction Unit	725**	850	125
6	Meat			
	Meat Processing Unit	171**	225	54
	Integrated meat processing plants	18**	30	12
	#Slaughter house	3600**	6000	2400
7	Fish			
	Preservation, processing including freezing plant	372*	410	38
	Ice Making Plants	148*	170	22
	Cold Storages	450*	490	40
	Fish Meal Plant	15*	22	7
8	Milk Product Units	266**	325	59
9	Cold storage units	4,199**	19199	15000

Source: 1. *Central institute of agricultural engineering, Nabi Bagh, Berasia Road, Bhopal.

2. *Souvenir of international conference on emerging technology in agricultural and food engineering, held at IIT, Kharagpur during Dec. 14-17, 2004.

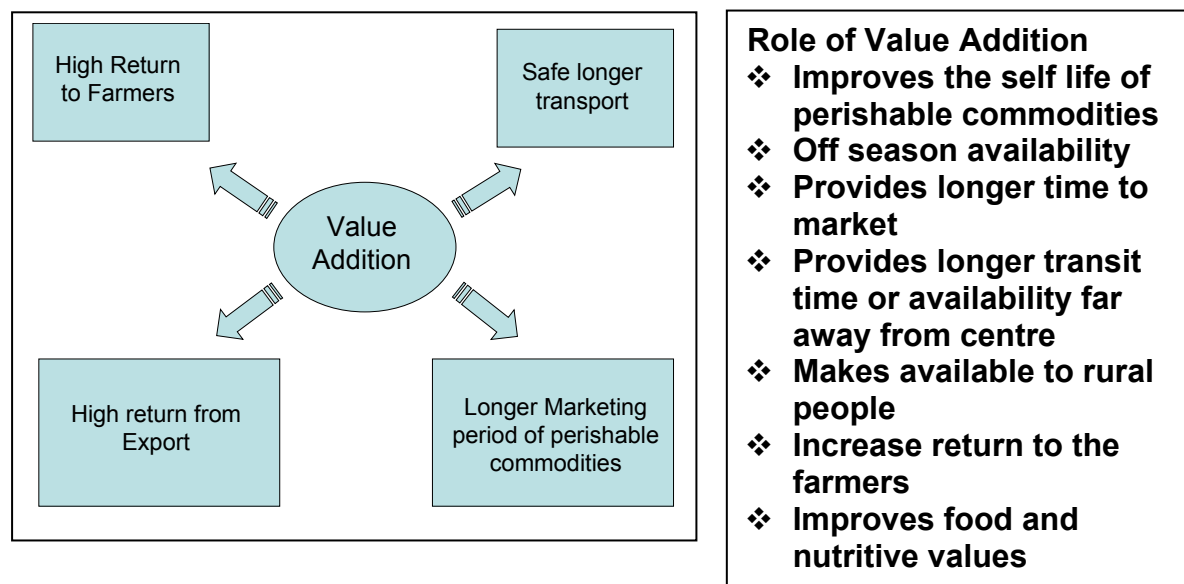
** Ministry of food processing and industry.

They are not in proper hygienic conditions.

PRIORITY AREAS

Conventional production system has resulted in deceleration in Agriculture Production. Many issues related to rainfed agriculture has not attained proper attention. Diversification in agriculture production system has become as pensive for improving the production/productivity to the income of the farmers but it still not clear how muul mantra of diversification be implemented in which form and for which commodity. If you we want to

come out of agriculture production saturation point the real challenge of risk minimization, however comes in high value agriculture like fruits and vegetables, dairy, livestock, and fishery. In India today, this kind of high value agriculture already contributes towards 45% of the total agriculture revenue. But the powers that be in the agriculture sector are still infatuated with food grains. The high value agriculture sector is highly perishable in nature and requires fast moving infrastructure and innovative institutions to link the farmers with the processors and the consumers. Value addition provides high returns to farmers, safe longer transport, high returns from export and marketing period for perishable commodities. This would help not only production of value added products either at production level or at processing level rather it will open new marketing and consumerism mechanism either for domestic market or export.



Suggestive approaches for value addition:

- ❖ Cost-effective production for reasonable prices to poor farmers.
- ❖ Climbing up in the value-chain by diversifying in value-added products.
- ❖ Sustained building of loyalty of customers.
- ❖ Facilitating reach to customers throughout the country by a strong chain of distribution outlets
- ❖ The investment in relationship with business partners

VALUE ADDITION (commodities wise)

Rice

Rice is a major food crop grown in diverse environments and meets food requirement for majority of the population in the world. Among various types of rice, basmati rice is more preferred due to its pleasant aroma and cooking quality which fetches high premium in the international markets and thus, offers a great potential for export.

After the introduction of semi-dwarf high yielding varieties in mid 60s, the world rice area and production has increased of which the India is no exception. India is making its efforts to sustain production, which is the challengeable tasks in new millennium. The Govt. Policy of buffering stocking the food grains is helping the food security. Besides, we have to open other areas where value addition of rice is to be prioritized. To meet the future challenges, it becomes imperative to increase the vertical productivity of rice, which can be met through golden rice development in which the beta-carotene which is a precursor for vitamin-A, has been trans-located in endosperm through genetic manipulations in case of Japonica rice variety: Tejpar-309. The efforts are on the anvil when such technique will be used in Indica rice in India which is at final stages. In order to compete with international markets, attempts has to be made in developing fine varieties through which we can reduce inputs either in terms of water fertilizer & energy and can fetch better bio-diversity and value for farmers e.g., Basmati rice in Tarai belts, R.S. Pura.

Rice bran is a valuable commodity which contains a moist inner oily layer that is heated to produce very healthy oil. Rice brisk is used mostly as a fuel for steam generation in rice mills and captive power generation in a few modern mills. A few mills also extract furfural from rice husk.

Paddy is first milled to remove the outer husks which creates brown rice. Further removal of the germ and the rest of the husk, called bran, creating white rice. The white rice then buffed with glucose or talc powder to produce *polished rice*, parboiled, or processed into flour.

The raw rice may be ground into flour for many uses as well, including making many kinds of beverages and sake. Rice flour is generally safe for people on a gluten-free diet. Starch basics: granule size, amylose and amylopectin: The size and distribution of starch granules is important for specific applications. Simple value-addition - including washing, centrifugation and pre-gelatinization -can pay huge dividends. Complex value-addition is represented by the wide range of chemically modified starches found in the food, paper and textile industries. There is also a great variety of value- added applications for starch in non-food industries like textile industry, paper industry, tissues paper preparations.

Wheat

Wheat is a major rabi crop of India grown from sea level to higher hills in temperate and cold desert region of :Leh. In wheat crop, the value addition can be made in three major species viz. *T. aestivum*, *T. durum* and *T. dicoccum*. *T. Aestivum* (Bread wheat) is grown throughout India and is primarily used for Chapati making and baking products. *T. durum* and *T. dicoccum* are the other two cultivated species used for macroni, semolina, noodles and pasta products. Both these species have tremendous potential for export to middle east and European countries.

Maize

Maize is emerging a potential future cereal crop in view of being staple food and a crop par excellence for various industrial uses and as an animal feed. Utilization of maize for specialized use is very rare in India. Main reasons behind this may be the unavailability of appropriate production technologies and lack of awareness among the farmers, traders, industrialists and policy makers regarding trade potential of the products derived from the value added grains of specialized corn. With the liberalization of trade under WTO regime, specialty corn offers a tremendous market potential not only in India but also in the international market as well. The various types of specialty corn viz. quality protein maize, baby corn, sweet corn, pop-corn, high oil corn, waxy corn offers huge potential for value addition and diversification in end user food and chemical industry. It appears-maize will

emerge future crop of economic importance in this country. It also has great potential for production of low fuel ethanol, besides having more than 3000 industrial uses.

Oil Seeds

Oilseeds are next only to food grains in acreage, production and value and form an essential part of human diet besides serving as raw material for a number of industrial products. Oilseeds are raw material for a number of industrial products other than oil. The value addition in different oilseeds and their products can directly increase their commercial value.

Sunflower

Industrial: Preparation of lubricants/varnish i.e. surface-active lubricants, spinning lubricants, reagents for drilling oil/gas wells and wood/metal varnish, anti-wear agent for engine fuel system, sealing liquid and additive promoting hydrocarbon combustion.

Pharmaceutical compositions: Hair growth agents, teeth/gum care composition, anti-soaring mixture, treatment of burn/skin diseases, decrease loss of tocopherols, oral drench mixtures for treating parasitic diseases and dietary supplement for animals to prevent shedding

Cosmetic compositions: Skin care creams {anti-wrinkling cream, nail cream, anti-ageing composition) and use in preparation of soaps, margarines etc. Use in food-stuffs: vegetable oil for stir frying, anti-adhering liquid for tortillas, slowing crystals for improving quality of condensed milk, fat substitute and as filter for low-fat sandwich cookies. Pesticides: insect control formulations

Peanuts

Foodstuffs and consumables: oil quality, butter, protein cake, nut spread with less stickiness and increased flavour, blended nut spreads and creamy chocolate, flavored nut spread. Pharmaceuticals: drug Industrial: lubricants/grease, coating material for removing colour from sugar. Cosmetic compositions: skin care creams, antibody against peanut agglutinin etc

Castor

Industrial: preparation of water proof plastic foams, coating material and foams, low viscosity polymer polyols, polyurethane resins, ink/dyes/paints, rubber, lubricants/grease, detergents. Pharmaceuticals: surfactant, solvating agent, as oil in water emulsion for soft gelati capsules, sustained release pharmaceutical tablets with termadol base, long acting injectabl formulations, for treatment of various skin/ear/eye disorders, promoting hair growth, cure of diabetes, cancer, HIV, arthritis and blood pressure, pharmaceutical medicants for coating of capsules. Personal care products: preparation of soaps, skin tanning, anti perspirant compositions Crop improvement/plant protection: pesticides/insecticides and for coating of fertilizers.

Soyabean

Food stuffs: Various soy foods such as soy flour, milk, sauce, soy concentrates, isolates and meat analogues. Pharmaceuticals: Isoflavones, phytosterols, tocopherols, phosphatidylcholine phophatodylserine. Industrial products: Soy-based inks, paints, lubricants, solvents, waxes, personal care products, bio diesel

Rapeseed and Mustard

Apart from edible uses characterized by low erucic acid ($> 2\%$), the oil can be used for different commercial and industrial settings. The oil with high laurate contents (40 %) can be used for industrial applications such as shampoos, detergents and food production i.e. chocolates. Oil having high content of pro vitamin A can be used for the treatment of Vitamin A deficiency. Brassicacea oils are relatively rich in saturated fats, have a lower pour or melting point and have better cold flow properties than other oils and hence can be better substitutes for diesel.

Non-cereals products

There is a vast potential of tree born oil seeds for exploitation as alternative source of bio fuel. The principal species are Jatropha, Simarouba, Karanja, Jojoba, wild apricot etc.

Fruits and vegetables

Presently value addition is done in some fruits, like mango, grape, litchi and apple through grading, packaging, and certain processed products like Jam, jelly, pickles, packed beverages. New products, which require to be exploited, are the fruit juice concentrate cryogenically frozen slices and aseptically packed fruit pulp.

The fruit preservation industry at present is able to utilized less than one per cent of total production for conversion into products like canned fruit, juices and their beverages, squashes, pulps, jams and jellies, pickles and chutneys.

Processing of fruits

Mango

Mango is fairly a good sources of carbohydrates, vitamin C and rich sources of vitamin A. sixteen carotenoids pigments were identified in the Alphonso mango and 60 per cent of total carotenoids was β - carotene. Luteexanthin and violaxanthin, which are seldom found in fruits, are reported to be present in significant amounts.

Green fruit is used to make chutney, pickles, curries, beverage and dehydrated products. Ripe mango are processed as canned and frozen slices. Mango beverage are prepared by mixing mango pulp, sugar and citric acid and water. Mangoes are also processed into concentrated products- Mango cereal flakes, strained baby foods, concentrated, aroma concentrates and dried products, like dry mango powder, mango leather, mango bars and mango custard powder.

Grapes

Nearly 90 per cent of the harvest are marketed fresh for table purposes and very little is processed into products like juice, RTS beverage, crush fermented beverage like wine and brandy, juice concentrate and raisins. Concord, Bangalore Blue, Black Champa, Culabi, Arka Shyam coloured variety and white varieties like Thompson Seedless and Ana-e-Shahi, Arka Shyam and Gulabi juice elicited over 70 per cent sensory score. Blending of juices of Bangalore, Blue, Arka Shyam and Gulabi yielded products much nearer to the desired type.

Guava

Guava is known for its intensive flavour, high vitamin contents and substantial qualities of B group vitamins calcium, iron and phosphorus. Only a small quantity of production is utilized for processing in the form of jelly, canned cups, juice and nectar,

cheese, toffee, bar, powder, flakes and strained baby fruit can also be prepared besides pulp RTS, concentrates and commercial pectin.

Banana

Various products of banana includes chips and flour from raw fruit and jam, canned slices, canned puree, juice, aroma from clarified juice and concentrates, dehydrated banana, banana powders and fruit bar from ripe fruit. The pseudostem contains upto 3 per cent starch which can be extracted and used to be edible purposed and fiber has been found to be use full in preparing paper pulp.

Citrus

Citrus fruits are rich source of vitamins, carbohydrates, minerals and possess special dietetic and medicinal values. A large number of products like Juice, Pickles, Marmalade, Squash, Cordial, Barley water, Candy, Frozen products, single strength canned juice, juice concentrates can be prepared from these fruits

Pineapple

Pineapple variety kew and gaint kew are considered the most important varieties for processing. Product such as slices and tidbits juice, pulp, jam Squashes and ready to serve beverage and other are prepared from pineapple fruit.

Papaya

The papaya fruit is fairly rich source vitamin C, pro-vitamin A and minerals. Papaya fruit is processed both in the raw as well as ripe stage to produce commercially important products. Raw papaya:- Different products are obtained from raw papaya like Papain, the most important commercial product prepared from raw papaya is papain which is a protein hydrolyzing enzymes. It is dried latex tapped from raw fruit and is being used for chill proofing of beer, meat tenderization, dehairing of skin, animal feeds, chew gum, pharmaceutical, Pectin, Papaya candy etc. Ripe Papaya fruits are consumed as fresh fruit and only a small quantity is processed into products like canned chunks in syrups canned puree, canned nectar, jam, osmo-air-dried chunks, fruit bar, cereals flakes etc.

Litchi

Litchi yet needs to be commercially exported from India. The fruit is fairly good sources of carbohydrates and vitamin C. varieties giving good canned products are rose scented, early large red and early seedless. Sahi and China varieties are good for developing dehydrated products

Pomegranate

Pomegranate yield 50 per cent of juice containing considerable quantity of tannin and fairly good amount of vitamin C. Pomegranate juice, blended juice, squash, syrup and jelly and some of the products that can be commercially produced. A sun-dried product called anardana used for culinary purposed, is produced from it.

Processing of Vegetables

Tomato

Tomatoes are very refreshing and appetizing. They are a good source of vitamins, particularly vitamin C and A. The most important tomato products manufactured in India are

canned tomatoes in natural juice mainly for supply to defence forces , juice , puree, paste, ketchup or sauce and soup. Many other valuable products which can be made include cocktail, chilli and hot sauce, powder, dried tomatoes, sweet pickle in vinegar. Especially there is good market and potential for tomato paste.

Potato

Potato, the most widely used vegetable, is a good source of minerals and carbohydrates. It also contains fairly good amount of vitamin C (17mg/100g), nicotinic acid, B (pyridoxine). In many countries, it is used as staple food. There are many value-added products like chips, dehydrated pieces, shreds, flakes, puffed, flour, granules, many varieties of snakes form potatoes.

Carrot

Carrot is a rich source of Vitamin A (2000 I.U/100g) along with other vitamins and minerals. Carrots can be utilized for value-added products like, dehydrated pieces and shreds, preserves, canned and in curried form, preserves, jam, compote, fruit pieces in syrup, pickle, bulk preservation in salt/acetic acid solution.

Beet Root

Beetroot is a good source of carbohydrates and minerals especially calcium, potassium and considered as a good liver tonic. It can be profitably utilized for making good quality beetroot sugar, which is made in one stage process from beets to crystallized form unlike cane sugar. Many other products like dehydrated dices, shreds (for use in soups), red colour beetroot juice, drinks, osmo-dehydrated cubes, can be made.

Cabbage

Cabbage is good source of vitamin especially vitamin A , minerals and crude fiber. Because it contains lactose, large quantity of cabbage is made into fermented product sauerkraut in western countries. This can be utilized for making products like sauerkraut, sauerkraut juice, dehydrated shreds , bulk preservation in salt/acetic acid solution.

Ginger

Ginger has many medicinal properties. It is good sources of minerals, vitamins and crude fiber. Fresh ginger can be processed into high value products like dried ginger, powder, dried shreds, ginger paste, preserve, ginger tonic, preserve (murabba), crystallized ginger pieces, osmo- dehydrated pieces, ginger tonic, pieces in vinegar etc.

Peas

Pea, a popular vegetable, can be processed into dehydrated peas, canned peas, and canned peas in curried form.

Garlic

Garlic has many medicinal properties and it is reported to lower the cholesterol level. Value-added products can be made from garlic include garlic paste, dehydrated garlic, garlic in vinegar, powder, etc.

Mushroom

Under prevailing circumstances, all possible sources of protein products will have to be exploited to save country from malnutrition. Mushroom powder can be incorporated with wheat flour, maize and millet flour to make chapaties, bread for daily consumption. Mushroom papads can also be made .The commercial bakery and confectionary industries

can also use mushroom powders to incorporate into their various confectionary like biscuits, bread, cakes etc. not only to enhance the nutritional quality of the product. Value added products like pickle, paste, chutney, ketchup etc. can also enhance its shelf life for more than a year with better sensory qualities.

Beekeeping

Honey as Food: About 10 per cent of the total production is used in Industry also. Some products that use honey are processed foods like cereals, ready-to-eat mixes, health foods and baby foods, and dairy products like yoghurts, milk sweetmeats, creams, fudges and ice creams. Pharmaceuticals: Much of the honey used in industry is for manufacture of medicines like cough drops, lozenges or syrups, tonics and other medical formulations.

Cosmetics: These days honey is increasingly used for manufacture of skin-care and hair-care products, as a natural therapeutic and medicinal ingredient. Besides all honey is also being used by Cigarette and perfumery industries. Bees wax is used commercially to make fine candles, cosmetics and pharmaceuticals including bone wax and polishing materials (particularly shoe polish)

Utilization of Fruit and Vegetables Waste :

The following products may be commercially manufactured from fruit and vegetables waste.

1. **Apple:** The pomace remaining after extraction of juice and removal of cores can be used for preparation of pectin, cider, vinegar, chutney.
2. **Apricot:** Kernels of white apricots are sweet and can be added to the jam after removing the seed coat to improve the colour and appearance. Oil can also be extracted from the kernels, and after refining it is like almond oil and can be used in pharmaceutical and cosmetic preparations. The oilcake is very rich in protein and can be used as cattle feed.
3. **Citrus fruits:** Peels are the most important waste products; other wastes are rags, seeds and sludge. Peels can be used for making candy and extraction of essential to used in confectionery. Pectin can be prepared from rags of galgal and orange. Rags can also be utilized in the preparation of marmalade, orange toffee and (after drying) as cattle feed. Orange and lime seeds can be used for extraction of seed oil used in several industries. Lime sludge is used for distillation of lime oil. Citrus acid can also be prepared from sludge. Orange residues can be fermented into fruit vinegar.
4. **Grapes:** Stems and pomace are the main waste products. The seeds and the cake used as cattlefeed. Pomace can be used for making jelly and chutney.
5. **Guava:** The most important product prepared from guava waste is guava cheese. It is prepared from the cores, seeds and peels left after extraction the juice and just like 'halwa'
6. **Jackfruit:** The thick rind and inner perigons can be made into high-class jelly. Pectin can be extracted from them. Seeds can be eaten after roasting or ground into flour.

7. **Mango:** 25 to 30 per cent of the fruit is wasted during canning. The peel can be fermented into vinegar. Kernels from the stones can be dried, powdered and utilized for edible purposes.
8. **Passion-fruit :** Pectin can be prepared from the thick ring and oil from seeds.
9. **Peach :** Oil can be extracted from the kernels for industrial use.
10. **Pear :** Peels and cores can be dried and used as an animals feed or can be fermented into perry or vinegar.
11. **Pineapple :** 40 -5- per cent of the fruit is wasted during canning. Juice extracted from the shells, trimmings and other wastes prepared from this juice as alcohol and vinegar by fermenting juice and the cake as cattlefeed. Pineapple tops and leaves mixed with molasses (1 per cent) and urea (0.2 per cent) can be used as cattlefeed.
12. **Papaya:** The latex of green papaya yields papain , a proteolytic enzymes which finds industrial application.
13. **Banana:** Banana stems wastes are utilized for growing food yeast. The residual fibers portion of the stem left over after extraction of starch can be used for the preparation of paper pulp. The central core of banana pseudo-stem constitutes 10-15 per cent of stem and can be candied or crystallized into a highly acceptable product, which resembles the tender bamboo shoot candy. The fresh material, commonly used as vegetables, can be canned along with potato and tomato as a curried product. the banana plant has 20-25 leaves at harvest time. The cut pieces of green leaves are used to serve to meals in India homes. Dried leaves of banana have be used as packing material. Cup and trays have been produced from banana leaves.
14. **Tomato:** The seeds can be used for extracting an edible oil and trimmings for preparing juice, sauce or puree.
15. **Other vegetables:** Wastes of potato, cabbage, cauliflowers, turnip, sweet potato, carrot, beet, beans, etc. can be used making cattle feed and preparation of vermin compost.

Plantation and spice crops

Plantation and spice crops are important in providing nutritional and health security besides providing social security and sustain ability.

Saffron

Due to anti oxidant properties in saffron value addition can be done by formulation of medicines, which are used as anti-carcinogenic and usage as coloring agent in food and beverages. Powdered saffron also fetches 11-18% higher price than whole saffron.

Coconut

Coconut has many uses as food, drink, edible oil, industrial oil for making various products, coconut milk, milk powder, desiccated coconut, etc. The timber, leaf petiole, shell, husk. etc. are useful for various purposes. Coconut palm also contributes about 6% of the safest

dietary oil requirement of the country. Because of its high lauric acid the oil is effective against HIV / AIDS virus and having anti carcinogenic properties.

Areca nut

Areca nut has many uses in pyurvedic and veterinary medicines due to its several alkaloids, but its utilization in this manner is negligible due to non-existence of viable technologies.

Palm Oil

It is the highest oil yielding perennial crop, which yields two types of oil. viz. palm oil and kernel oil. Palm oil is rich in vitamins A and E, and used to overcome vitamin A deficiency in children. Palm oil is a source of nutrition due to its high calorific value, readily digestibility and easy absorption. Palm oil contains equal proportion of saturated and unsaturated fatty acids. Refined palm oil is a rich source of vitamin E and related substances (tocopherols and tocotrienols). Unrefined palm oil is a rich source of β -carotene, an antioxidant and precursor of vitamin A.

Cashew nut

It is highly nutritious and supplies almost all essential nutrients including minerals and vitamins. Due to its balanced constitution of saturated and unsaturated fatty acids cashew nut is best fat source with no nutritional risk. Cashew apple fenni is a popular alcoholic drink in Goa. Cashew nut shell liquid is industrial oil.

Spices

Including seed species alongwith other products like spice oils and oleoresins as food ingredients and flavouring agents are fetching considerable export earnings.

Cocoa bean

Cocoa beans are largely used in the confectionery industrial sector for which demand is on increase. The high confectionery value of the cocoa beans derived after fermentation paves way for the manufacture of cocoa powder, which ultimately becomes the raw material for manufacture of edible chocolates, drinking chocolates etc.

Rubber

It provides the principal raw material required for manufacture of around 30,000 items of rubber products ranging from toy balloons to tyres, which are essential for human life.

Jute

For producing quality diversified products, the quality and standards of raw materials have to be improved be it fiber, yarn or fabric. Other intermediaries (Yarn and fabric) up gradation and modernization of technologies are also essential.

Wood substitute: Jute being a ligno-cellulosic material like wood, has emerged as a substitute of wood. Jute fibre can be processed for making semi rigid sheet and rigid board by incorporating adhesive chemicals. Packaging of mango, orange, grape and apple in boxes made of 0.6 or 0.8 mm thick sheets has been found suitable and transport worthy. Jute Oil can be used in industry or in domestic households. Phytomedicine: Jute, Mesta and their wild relatives are rich sources of various pharmacodynamic compounds.

Livestock products

Milk

India is the leading producer of milk in the world.

Different value added milk products

- | | |
|-----------------------|---------------------|
| ➤ Ghee | ➤ Butter |
| ➤ Paneer | ➤ Processed Cheese |
| ➤ Cheese spread | ➤ Mozarella cheese |
| ➤ Ice-cream | ➤ Flavoured Milk |
| ➤ Cream | ➤ Whole milk powder |
| ➤ Skim milk powder | ➤ Dairy whitener |
| ➤ Margarine | ➤ Condensed milks |
| ➤ Shrikhand | ➤ Curd |
| ➤ Chocolates/ candies | |

Suggestive approaches for value addition of Milk

1. Cost-effective production, including primarily, procurement of milk from dairy farmers, which in turn, assures poor farmers reasonable prices.
2. Climbing up in the value-chain by diversifying in value-added products, such as milk sweets, ice creams, pizzas, confectioneries, truly as a food company.
3. Sustained building of loyalty of customers.
4. Facilitating reach to customers throughout the country by a strong chain of distribution outlets. The investment in relationship with business partners: both farmer-based co-operatives and distribution networks for purchasing and selling functions respectively.

Meat

Meat processing technology and value addition in meat are integral components in making the meat industry prosperous and viable as the sale of fresh meat is not very profitable as an industry. There is genuine need to standardize ethnic meat products in states of the country.

Some of the potential value added meat products available in India are as under:

- | | |
|---|-------------------------|
| ➤ Sausages | ➤ Meat pickles |
| ➤ Meat loaves | ➤ Curry meat products |
| ➤ Meat nuggets | ➤ Meat samosas |
| ➤ Meat patties | ➤ Meat balls/meat kofta |
| ➤ Cured meat products | ➤ Meat burgers |
| ➤ Meat pickles | ➤ Tandoori chicken |
| ➤ Kashmiri dishes like Goshtaba, yakhni etc | |

Eggs

The value addition in egg is almost negligible. However some of egg powder plants have come up in the past. Potential value added products of eggs viz; Egg powder, Blended eggs products, Egg pickles, Bakery / confectionery

Yak

The good understanding and increased demand of “organic products” enlighten a great scope for very tender and juicy yak meat production. Yak meat lying in category of red meat without marbling is regarded as “green food or organic meat” because of its grazing in natural grassland. Till now yak meat is being used traditionally as dried meat, smoked meat and some time cooked fresh. There is great need to work on quality characterization of yak meat and processing of yak meat to value added products.

Wool

The annual growth rate in the last decade was just over 1.5% which is serious matter of concern. Wool is blended with different natural and synthetic fibers to increase its value. The optimization of different blends should be developed.

Slaughter-house by-products

Non-utilization or under utilization of by-products from slaughtered and fallen animals has been a major concern in developing countries, since this constitutes the source of economic returns by sale of animal based by-products. Potential uses of some slaughterhouse by-products

1. Bones- handicrafts, bone crushing units, mineral based industries, proteins based products, bone ash and one char
2. Blood- in medias, chemical analysis, nutrient supplements, semen diluents, industrial uses of blood as adhesives, paper/plastic industry, fire extinguishers, leather finishing etc.
3. Hairs-brushes, felts, testiles, carpets etc.
4. Intestines-casings, sutures, badminton rackets, collagen sheats
5. Horn and hoofs- feed meal
6. Rumen contents-fertilizers
7. Skin- leather industry

Fisheries

Traditional preparations like fish/prawn pickle, fish curry, battered and breaded products, fish mince ('Surimi) based products like sausages, cutlets, patties, balls, pastes etc., need to be promoted in ready-to-eat packs. The packaging should be such that ensures quality and hygiene as per international standards, with proper certification.

II) EXPORT

Export of Horticultural products may be another aspect, which needs attention because of fetching high value of crops and to create self-employment in this field.

EXISTING EXPORT ZONES

To promote exports of agricultural produce and its products, sixty agri-export zones have been established during 10th plan in 20 states of the country are as follows.

SL. NO.	STATES	NO OF ZONES	COMMUDITIES
1.	Andhra Pradesh	5	Mango Pulp, Fresh Vegetables, Grapes, Gherkins, Chilies
2.	Assam	1	Fresh Processed Ginger
3.	Bihar	1	Litchi
4.	Gujarat	3	Mango, Vegetables, Value added Onions, Sesame Seeds
5.	HP	1	Apple
6.	J and K	2	Apple, Walnut
7.	Karnataka	4	Gherkins, Rose, Onion, Flowers Vanilla
8.	Jharkhand	1	Vegetables
9.	Kerala	2	Horticulture, Medicinal Plants
10.	Maharashtra	8	Grape, Wine, Mango, Flowers Onion, Pomegranate, Banana Orange
11.	MP	5	Potato Onion, Garlic, Seed Spices, Wheat, Lentil, Gram, Orange
12.	Orissa	1	Ginger and Turmeric
13.	Punjab	3	Vegetables, Potatoes, Basmati Rice
14.	Rajasthan	2	Coriander and Cumin
15.	Tamilnadu	4	Flowers, Mangoes, Cashewnut
16.	Tripura	1	Organic, Pine Apple
17.	Uttar Pradesh	4	Mango, Vegetables, Basmati Rice, Potato
18.	Sikkim	2	Orchid, cherry, Pepper, Ginger
19.	West Bengal	6	Pineapple, Litchi, Potato, Mango, Vegetables, Tea
20.	Uttaranchal	4	Litchi, Flowers, Basmati Rice, Medicinal and Aromatic Plants
	Total	60	

Sixty eight export zones have been proposed in the 11th plan for eighteen states of the country.

PROPOSED AGRICULTURE EXPORT ZONES

S. NO.	STATES	No of Zones	COMMUDITIES
1.	Andhra Pradesh	6	Sorghum, groundnut, cotton, papaya, fish, meat products
2.	Assam	2	Pineapple, citrus
3.	Bihar	3	Rice (non basmati), potato, guava
4.	Gujarat	4	Groundnut, cotton, beer, cut flower
5.	Haryana	5	Beer, cut flower, wheat, fine rice, milk products
6.	Jharkhand	4	Guava, natural dye, lac based products and ethanol

			products
7.	J & K	1	Basmati Rice
8.	Karnatka	6	Sorghum, groundnut, cotton, fish, papaya, citrus
9.	Kerala	3	Coconut, cashew nut, spices
10.	Madhya Pradesh	3	Maize, chickpea, soybean
11.	Maharashtra	7	Sorghum, chickpea, groundnut, cotton, cashew nut, coconut, papaya
12.	Orissa	1	citrus
13.	Panjab	4	Wheat, sugar, kinoo juice, milk products
14.	Rajasthan	8	Chick Pea, millets, wheat, maize, soybean, cotton, ber, milk products
15.	Tamil Naidu	2	Banana and vegetables
16.	Tripura	2	Pineapple, jack fruit
17.	Utter Pradesh	6	Rice (non basmati), Maize, wheat, chickpea, sugar, guava
18.	West Bengal	1	Rice (non basmati)
	Total	68	

Potential major crops / fruits / vegetables / plants / livestock products etc. of different Agro-climatic zones of India

Agro Climatic Zones Of India	States	Major Crops and Live Stock	
1. Western Himalayan Region (39 Districts)	J&K (All 14), HP (All 12), Utranchal (All 13)	Food grain crops	Basmati rice, Maize,
		Fruit Crops	Apple, walnut, litchi,
		Vegetable Crops	Potato, Peas, Tomato, Cauliflower
		Flowering plant	Rose, marigold, Gladiolus and Tulips
		Spices	Kalazeera, Saffron, Ginger
		Medicinal and Aromatic plants	Himalayan Yew, ,Kuth, Kurroo, Dioscorea , Kutki, , Banafsha, Seabuck thorn, Lavender, Rose, Digitalis, Brahmi, Cedarwood, Harad
		Plantation crops	Jatropha, willow, cedar wood oil, silk
		Others (Mushroom & Honeybee)	White button mushroom, Honey
		Live stocks	Cattle, Sheep, Goat, Horse, Mules, Yak, Quail, Turkey, Fishery
2. Eastern Himalayan Region (79 Districts)	Sikkim (All 4), Arunachal Pradesh (All 13), Meghalaya (All	Food grain crops	Boro Rice, Lesser millets, etc
		Fruit Crops	Orange, lemon, Banana Kagzi lime, pineapple and papaya
		Vegetable Crops	Cauliflower, Cabbage

	7), Manipur (All 9), Mizoram (All 8), Assam (All 23), Nagaland (All 8), Tripura, (All 4) West Bengal (3)	Flowering plant	Orchids
		Spices	Black pepper, Ginger
		Medicinal and Aromatic plant	Cinchona, Chirayata, Himalayan Yew, Bhumi amla, Tejpata
		Plantation crops	--
		Others (Mushroom & Honeybee)	White Button , Oster, Paddy Straw Mushroom, Honey
		Live stocks	Pig, Mithun, Backyard poultry, Fishery
3. Lower Gangetic Plains Region (15 Districts)	West Bengal, (15)	Food grain crops	Rice, Wheat
		Fruit Crops	Mango, guava, litchi
		Vegetable Crops	Potato Brinjal, Tomato, Peas, Onion, Cucurbits, Chillies
		Flowering plant	Dahlia, tuberosa, Marigold
		Spices	Black pepper
		Medicinal and Aromatic plants	Kalmeg, Cinchona , Neem, Bael,
		Plantation crops	--
		Others (Mushroom & Honeybee)	White Button , Oster, Honey
		Live stocks	Cattle, Goat, Backyard poultry , Fishery
4. Middle Gangetic Plains Region (60 Districts)	Bihar (All 37), UP (23),	Food grain crops	Rice, wheat, maize, Lentil, etc
		Fruit Crops	Mango, guava, litchi
		Commercial crops	Sugar cane
		Vegetable Crops	Potato, Brinjal, Okra, Tomato, Peas, Onion, Cucurbits
		Flowering plant	Marigold, Gladiolus
		Spices	--
		Medicinal and Aromatic plants	Safed Musli, Makoy, <i>Berberis</i> spp, Gloe, Bael, Lemon grass, Khus, Neem, Jamun, <i>Mentha</i> spp,
		Plantation crops	--
		Others (Mushroom & Honeybee)	White Button, Oster, Honey,
		Live stocks	Cattle, Goat, Pig
5. Upper Gangetic Plains Region (40 Districts)	UP (40)	Food grain crops	Rice, wheat, pulses
		Commercial crops	Sugarcane, oil seeds
		Fruit Crops	Mango, guava, grapes, aonla
		Vegetable Crops	Peas, Tomato, Brinjal, Carrot, Onion, Cauliflower
		Flowering plant	--
		Spices	Coriander, Fennel
		Medicinal and Aromatic plants	Bael , Ashwagandha, Khus, Lemon grass,
		Plantation crops	--
		Others (Mushroom & Honeybee)	White Button, Honey
		Live stocks	Cross breed cattle, Poultry

6. Trans-Gangetic Plains Region (48 Districts)	Punjab (All 17, Haryana (All 20), Rajasthan (2), Delhi (All 8), Chandigarh (1)	Food grain crops	Rice, wheat, Pulses
		Commercial crops	Oil seeds
		Fruit Crops	Citrus, Guava, Grapes
		Vegetable Crops	Peas, Cauliflower, Potato, Tomato , Cucurbits
		Flowering plant	Rose. Marigold, Gladiolus
		Spices	Coriander, Fenugreek
		Medicinal and Aromatic plants	Safed Musli , Tulsi, Lemon grass, Khus,
		Plantation crops	--
		Others (Mushroom & Honeybee)	White Button, Oster, Milky Mushrooms, Honey
		Live stocks	Indigenous cattle, Sheep, Goat, Camel
7. Eastern Plateau and Hills Region (57 Districts)	Orissa (15), MP (3), Maharastra (4), Jharkhand (All 18), Chathisgarh (All 16), West Bengal (1)	Food grain crops	Maize, sorghum, pulses, etc.
		Commercial crops	Oil seeds
		Fruit Crops	Citrus, Guava, Mango, grapes
		Vegetable Crops	Potato, Garlic, Brinjal, Tomato, Cabbage, Onion
		Flowering plant	Tuberose, Gladiolus, Jasmine
		Spices	Ginger, turmeric, Coriander
		Medicinal and Aromatic plants	Sarp Gandha , Ashwagandha , , Glory lilly, Mulathi, Gudmar, Aloe
		Plantation crops	--
		Others (Mushroom & Honeybee)	White Button , Oster, Paddy Straw Mushroom, Honey
		Live stocks	Cattle, Goat, Poultry, Fishery
8. Central Plateau and Hills Region (57 Districts)	MP (30), UP (7), Rajasthan (20)	Food grain crops	Wheat, maize, bajra, pulses
		Commercial crops	Oil seeds, tobacco
		Fruit Crops	Mango, Guava
		Vegetable Crops	Tomato, Brinjal, Okra, Onion, Sweet Potato
		Flowering plant	Rose, Marigold, Jasmine, Gladiolus
		Spices	Ginger, Turmeric, Garlic
		Medicinal and Aromatic plants	Sarp Gandha, Ashwagandha, Safed musli,.
		Plantation crops	--
		Others (Mushroom & Honeybee)	White Button , Oster, Paddy Straw Mushroom, Honey
		Live stocks	Cross breed cattle, Poultry
9. Western Plateau and Hills Region (41 Districts)	Maharashtra (25), MP (15), Rajasthan (1)	Food grain crops	Maize, pulses
		Commercial crops	Oil seeds (soyabean & sunflower), sugarcane
		Fruit Crops	Citrus , Mango, Banana , guava , grapes
		Vegetable Crops	Chillies, Potato, Tomato, Onion, Brinjal
		Flowering plant	Marigold, Liliun, Gerbera and Gladiolus
		Spices	Garlic, Ginger, Turmeric

		Medicinal and Aromatic plants	Safed musli , Bael, Gudmar, Senna, Sandal wood,
		Plantation crops	Rubber, Cashew nut, areca nut, cocoa,
		Others (Mushroom & Honeybee)	White Button , Oster, Paddy Straw Mushroom, Honey
		Live stocks	Cattle, Sheep, Goat, Poultry
10.Southern Plateau and Hills Region (48 Districts)	Karnataka (21), TN (13), AP (14)	Food grain crops	Maize, Rice, Wheat
		Commercial crops	Tobacco, sugarcane, groundnuts etc
		Fruit Crops	Banana, Mango, citrus, guava, grapes.
		Vegetable Crops	Tomato, Brinjal, Okra, Onion, Chillies, Tapioca, Gherkins
		Flowering plant	Gomphrena, Crossandra, Jasmine
		Spices	Garlic, Ginger
		Medicinal and Aromatic plants	Sandal wood, Glory lilly, Senna, Ashok, Cinchona, ,
		Plantation crops	Rubber, Cashew nut, areca nut, cocoa, coconut, silk
		Others (Mushroom & Honeybee)	Cotton, White Button , Oster, Paddy Straw Mushroom, Milky Mushrooms, Honey
		Live stocks	Cattle, Sheep, Goat, Poultry, Fishery
11. East Coast Plains and Hills Region (43 Districts)	Orissa (15), AP (9), TN (15), Poundicheri (4)	Food grain crops	Rice, maize
		Commercial crops	Oilseeds & jute
		Fruit Crops	Banana, mango, citrus, guava, grapes papaya, pineapple
		Vegetable Crops	Brinjal, Okra, Tapioca, Sweet Potato, Onion, Chillies.
		Flowering plant	Tube rose, enthurium, Gompherina
		Spices	Black pepper, turmeric
		Medicinal and Aromatic plants	Coleus, Scented geranium,
		Plantation crops	Cashew nut, coconut
		Others (Mushroom & Honeybee)	Honey
		Live stocks	Cattle, Sheep, Goat, Poultry-duck, Fishery
12. West Coast Plains and Ghat Region (30 District)	Maharashtra (6), Goa (All 2), Kerala (All 14), Karnataka (6), TN (2)	Food grain crops	Rice
		Commercial crops	Sugarcane, oilseeds, etc
		Fruit Crops	Mango, citrus
		Vegetable Crops	Potato, Onion, Garlic, Tomato, Peas
		Flowering plant	Orchids
		Spices	Cloves, Cardamom, Cinamom, Black pepper, Ginger
		Medicinal and Aromatic plants	Asparagus, Glory lilly, Guggal, ,
		Plantation crops	cashew nut, areca nut, cocoa, coconut
		Others (Mushroom & Honeybee)	White Button , Oster, Paddy Straw Mushrooms, Honey
		Live stocks	Crass breed cattle, Poultry

13. Gujarat Plains and Hills Region (28 District)	Gujarat (25), Dadar and Nagar Haweli (1), Daman and Diu (2)	Food grain crops	Bajara, , pulses
		Commercial crops	tobacco, groundnut
		Fruit Crops	Mango, Banana, guava, papaya
		Vegetable Crops	Tomato, Chillies, Cucurbit, Potato, Onion
		Flowering plant	Aster, Spider lilly marigold chrysanthemum
		Spices	Garlic
		Medicinal and Aromatic plants	Isabgol, Guggal, Aloe,
		Plantation crops	Jatropha
		Others (Mushroom & Honeybee)	Honey
		Live stocks	Indigenous Cattle, Goat, Camel, Poultry
14. Western Dry Region (9 Districts)	Rajasthan (9),	Food grain crops	Bajara, maize
		Commercial crops	oilseeds
		Fruit Crops	Mango, guava,
		Vegetable Crops	Onion, Potato, Tomato, Cucurbits
		Flowering plant	Aster, Rose, Marigold, Gladiolus
		Spices	Coriander, cumin
		Medicinal and Aromatic plants	Isabgol, Senna, Aloe,
		Plantation crops	--
		Others (Mushroom & Honeybee)	Honey
		Live stocks	Indigenous Cattle, Goat, Camel, Poultry
15. The Islands Region (3 District)	Lakshdweep (1), A and N Islands (2)	Food grain crops	Rice,
		Fruit Crops	Papaya,
		Vegetable Crops	Chillies, Cucurbit, Brinjal, Okra
		Flowering plant	--
		Spices	--
		Medicinal and Aromatic plants	Khus,
		Plantation crops	Coconut
		Others (Mushroom & Honeybee)	Honey
		Live stocks	Goat, Poultry , Fishery

Major Agricultural commodities / products having export potential

Agro-climatic zones of India	States	Agricultural Commodities/Products
1. Western Himalayan Region (39 Districts)	J&K (All 14), HP (All 12), Uttranchal (All 13)	Basmati rice, apple walnut, litchi, olives, anardana, rose, marigold, gladiolus and tulips, saffron, black zera, Himalayan yew, kuth, kurroo, dioscorea, kulthi, banafsha, seabuckthorn, lavender, rose digitals, brahami, cedar wood, harad, merchella, mushroom, honey, willow, cedar wood oil, silk

2. Eastern Himalayan Region (79 Districts)	Sikkim (All 4), Arunachal Pradesh (All 13), Meghalaya (All 7), Manipur (All 9), Mizoram (All 8), Assam (All 23), Nagaland (All 8), Tripura, (All 4) West Bengal (3)	Pine apple, kagzi lime, fresh & processed ginger, orchids, Cherry, pepper, bamboo
3. Lower Gangetic Plains Region (15 Districts)	West Bengal, (15)	Rice, pine apple, litchi, mango, potato, darjeeling tea, jute mesta
4. Middle Gangetic Plains Region (60 Districts)	Bihar (All 37), UP (23),	Maize, sugarcane, mango, litchi, guava, vegetables,
5. Upper Gangetic Plains Region (40 Districts)	UP (40)	Basmati rice, wheat, potato, anola, mango
6. Trans- Gangetic Plains Region (48 Districts)	Punjab (All 17, Haryana (All 20), Rajasthan (2), Delhi (All 8), Chandigarh (1)	Wheat, peas, vegetables, potato
7. Eastern Plateau and Hills Region (57 Districts)	Orissa (15), MP (3), Maharashtra (4), Jharkhand (All 18), Chathisgarh (All 16), West Bengal (1)	Wheat, mango pulp, fresh vegetables, potato, onion, garlic, chilly
8. Central Plateau and Hills Region (57 Districts)	MP (30), UP (7), Rajasthan (20)	Soybean, lentil guava, chickpea, rapeseed mustard, orange, seed spices
9. Western Plateau and Hills Region (41 Districts)	Maharashtra (25), MP (15), Rajsthan (1)	Sorghum, groundnut, cotton oranges, grapes and grape vine, mango and mango pulp, pomegranate, banana, onion, marigold, lilium, gerbera and gladiolus, areca nut, cocoa, rubber
10. Southern Plateau and Hills Region (48 Districts)	Karnataka (21), TN (13), AP (14)	Mango, grapes, gomphrena, crossabudara, jasmine, vanilla, areca nut, cocoa, cassava, rubber, silk
11. East Coast Plains and Hills Region (43 Districts)	Orissa (15), AP (9), TN (15), Poundicheri (4)	Mango, cashewnut, onion, ginger, rose, tube rose, anthurium, gompherina, turmeric, jute
12. West Coast Plains and Ghat Region (30 District)	Maharashtra (6), Goa (All 2), Kerala (All 14), Karnataka (6), TN (2)	Cashewnut, coconut, onion, cloves, cardamom, cinamom, black pepper, ginger, asparagus, glory lilly, guggal, fresh vegetables
13. Gujarat Plains and Hills Region (28 District)	Gujarat (25), Dadar and Nagar Haweli (1), Daman and Diu (2)	Soybean, sesame, groundnut, rapeseed, cotton, mango, dehydrated onions, aster, spider, lilly, marigold, chrysanthemum, coriander, isabgol, guggal, jatrophia
14. Western Dry Region (9 Districts)	Rajasthan (9),	Millets, ber, cumin, tobacco
15. The Islands Region	Lakshdweep (1), A and N Islands (2)	Khus, coconut, honey

(3 District)		
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III) ORGANIC FARMING:

Organic farming (low cost and biological farming approach) with reference to North-East hill states of India

Organic farming is gaining wide attention among farmers, entrepreneurs, policy makers and agricultural scientists for varied reasons such as it minimizes the dependence on chemical inputs (fertilizers, pesticides, herbicides and other agro-chemicals) thus safeguards/improves quality of resources, and environment it is labour intensive and provides an opportunity to increase rural employment and achieve long term improvements in the quality of resource base.

North-eastern hill region comprise 7 states which are Arunachal Pradesh, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim and Tripura. Constituting more than 5 % of India's geographical expanse and a little more than 1% of population they are some of the most underdeveloped states in the country. The lack of infrastructural development, failure of government to meet the basic needs of the people by other means like distribution and the failure of the green revolution in settled farming effect the continual of the old method.

Proposed Action Plan for XI Plan for NE region:

Keeping the experiences of the Xth Plan regarding the organic farming practices in view, it is proposed that the following broader objectives needs to be underlined:

- To adopt low-cost and biological approach of farm production, which is economical for the farmers because products of organic farming command premium price. With increase in production, premiums will level out, but the market size will increase.
- To grow the products which are free of contamination with substances such as pesticides and heavy metal residues.
- To recycle biomass (weed, crops, trees etc.)farm waste compost through composting for supplementing nutrients which besides will reduce the weeds growth due to incorporation of plant biomass as a surface mulch.
- To apply nitrogen nutrient through compost, bio-fertilizers / liquid manures / Vermi-vash to the crop at any stage of growth thus eliminates the application of nitrogen produced through synthetic source.
- To devise/refine various crop production technologies under organic farming and encouraging natural enemies of crop pests for minimizing dependence on pesticides etc.
- In-situ biomass production and conservation strategies based on knowledge and experience.
- Value addition to the biomass to potentially meet crop nutrient needs, which can be achieved through;
 - (i) Encouraging use of traditional knowledge items known to contain agriculturally beneficial micro-organisms.
 - (ii) Market availability of high quality microbial inoculants found wanting in farmers field.
- In-situ production of botanicals to address the need of protecting crops e.g

gliricidia and neem etc. on field bunds, and cow dung and urine, thereby will overcome the problem of shortage of FYM and to exploit its futuristic research for efficiency and improvement.

- To build institutional support for better organic farming research through developing need based technologies and capacity building of manpower from Scientist to farmers Chain.
- To develop efficient monitoring mechanism, so that the overall goal for realizing qualitative eco-friendly and vertical crop production is achieved.

PROPOSED WORK PLAN ON ORGANIC FARMING

1. Benchmarking of sites and documentation of existing data:

A system is to set up for collection of data ongoing basis , disseminating useful information and feed back mechanism in the area. The data generated under this plan will help in site based farm design, quantify biomass source and its efficient utilization, help in ecological nutrient and soil management practices. Besides this it will help in designing composting methodologies (depending on the type of organic and animal waste available), Vermi-stabilization (a system of nurturing the local earthworms in the soil rather than applying vermin-compost), application of advanced organic farming techniques (through biodynamic preparations , bio-pesticides and plant tonic preparations from weeds, farm operations based biodynamic calendar and animal husbandry and farming-symbiosis.

2. Field Research for local activities

Its objective is confined to socio-economic technical and institutional baseline data and continued data collection for monitoring and evaluation, determining requirements for non-technical training and organizational needs functional unit size and group composition per operational area and identify most suitable groups and conditions for pilot and control groups. These are achieved by deciding base line data, selecting suitable indicators and prepare data collection forms and by establishing sociological, gender, environmental and economic assessments of stake holders.

3. Incorporation of farmer groups:

It will aim around organizing the most suited farmers for organic conversion of farms focusing on local farming system of NE regions., train farmer groups. This may performed by selecting farmers in consultation with local bodies at panchayat level at each site.

4. Local, National and Global Market Linkages:

It will be aiming to study the market for organically grown products in India and abroad on a continuing basis. Four to five long term customers per SHG/ fanners group needs to be identified and research the farm produce requirement of the local community and plan for production to meet demand and at farm gate prices. The market needs to be studied through data gathering, forecasting, pricing, competitive analysis, best practice costing and search for integration in to existing systems.

5. Support farmers group engaged in organic farming:

It will focus to identify research areas by interacting with the farmers, set up a system through which farming community plans and produces its own requirements, set up a system of sharing profits so that the farmers get an appropriate share of profit both at national and international level and to establish liaison with various organizations and programmes which

would help and utilize the products of organic farming. Besides creating an organizational structure manned by professionals to take over all responsibilities other than fanning from seed supply to sale of product and collection of money. It will also provide a single out let for provision of the inputs required by the farmers such as certified seeds, planting material etc.

This is proposed to be achieved through establishment and promotion of producer groups through concessions applicable to backward areas such as subsidized seed capital interest loans, tax holidays, electricity rates, transportation and sales tax etc. By canalizing rural and agricultural government schemes build local capacity in organization, financial management and marketing assistance in conversion from conventional to organic farming. Make estimation of initial requirement of assistance on farm infrastructure support (e.g., cows, cowsheds, farmyard manure, vermin-compost pits, and bio-pesticides etc.). Capacitate the groups through imparting training from seeding to marketing practices

6. Creating Institute or National Center:

This will cater the needs for research and development on organic agriculture that will take care for organic farming research's in the areas under hill-ecosystem besides will help in monitoring of plan performances through reports and other regulatory monitoring mechanisms.

7. Capacity Building Through Training Materials and Trainings:

This will aim in building the capacity of the research workers and grower groups through exposure of advanced training in established centers at national and international level, which in turn will establish training manuals for training of trainers, extension group agents and farmers in order to have best asses in biodynamic farming/ organic farming and organize site -based training workshops to cover the above subjects.

8. Product Certification:

It will aim to test the farmers organic produce for meeting the international quality standards of organic food. Therefore, set up of various organic farming testing laboratories to the level of international standards for organic certification at each productive site in NE regions is to be provisioned.

9. Product Identification:

Aiming to identify the most suitable range of products and crops fulfilling individually or as a whole the essential project requirements, including rotational and companion crops as applicable to the local areas. This can be achieved by describing the various characteristics essential and desirable for a species or combination of species to be selected for: a). collection / agro-forestry b) cultivation, by collecting and analyze information and select /prioritize species for the different sites etc.

10. Regulation Review for Each Site:

Its objective will revolve round to understand existing policies, laws, by-laws, regulations and institutional structures for organic farming with post harvest handling. This will be carried by reviewing existing regulations and legal frame work, which are beneficial and/ or obstructive to production, certification and marketing.

11. Awareness and Education Programme:

It objects to build mechanisms for transfer of knowledge, information of improved organic farming systems as applicable to each site into existing institutional and civic society systems, through support for school garden-based learning in primary and secondary education, and specialized subjects in vocational training in agriculture, in the project site areas. This done through preparation of resource material for teachers, TOT, and learners of organic gardening to support school garden based learning programmes and by awareness raising activities for general public and special interest groups.

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In Situ Production of Botanicals for the Need for Protecting Crop Plants

A. Diseases

Under the umbrella of IPM the role of botanical to minimize the pest / pathogens populations has attained greater significance in recent years. Plant extracts from the plant species such as Neem, Eucalyptus etc. are being exploited and tried in various combinations and schedules of IPM to reduce the over dependence on chemical pesticides.

Many plants species having the potential to manage the different diseases in crop plants that can be formulated and commercialized for the application to the crop plants. Important plant species that can be exploited for the said purpose are as follows.

S. No.	Common Name	Botanical Name	Target Pathogen/Disease
1	Neem	<i>Azadirachta indica</i>	Pea Powdery Mildew, Onion bulb rot, Bacterial blight of Rice, False truffle and mould in mushroom, <i>Fusarium solani</i> , Storage rot of Ginger
2	Ocimum	<i>Ocimum sanctum</i>	Seed born microflora of Paddy, Pea Powdery mildew.
3	Anagallis	<i>Anagallis arvensis</i>	Alternaria blight of mustard
4		<i>Prosopis julifera</i>	Seedborn microflora of Paddy
5	Pudina	<i>Mentha arvensis</i>	Seed borne microflora of Paddy, Black scurf of Potato, Stem end rot of Pear
6	Eucalyptus	<i>Eucalyptus globules</i>	Alternaria blight of Mustard
7	Ginger	<i>Zinziber officinale</i>	Pea Powdery mildew, Fruit rot of Grape
8	Datura	<i>Datura metel</i>	Alternaria blight of mustard, Bacterial blight of Rice, Sheath blight of Rice
9	Garlic	<i>Allium sativum</i>	Stem rot of Chilli (<i>Rhizoctonia solani</i>), Fruit rot of Pomogranate, Fruit rot of grape
10	Turmeric	<i>Curcuma longa</i>	Fruit rot of Pomogranate, Fruit rot of Grapes.

Thrust areas

- Identification of new molecules / botanicals from plants.
- Promotion of industries for large-scale production of botanicals.
- Large-scale prophylactic use of botanicals should encourage.
- Made more efficient formulations
- In-built stabilizers, antioxidants, UV protectants and surfactants to improve the shelf-life of formulated product

- The thrust should be to produce the formulations, which have the combinations of botanicals with biological control agents so that there is value addition in both the products
- For the cultivation of plants like neem, datura, eucalyptus etc. the waste lands abundantly available in the rural areas need to be exploited.
- The cultivation can be managed through NGOs and different development departments of the state Governments.
- In order to extract the botanicals it is very essential to promote the industrial units adjacent to the areas where the cultivation of these crops is done.

Insects

Strengthening the plant is the best protection against the pests through adopted cultivation methods and with good management of the ecosystem (beneficial organisms), infestations can be prevented or reduced. In some cases however, preventive measures are not sufficient and the damage by a pest reaches a level of considerable economic loss. Some commonly used botanical pesticides which are being used in traditional agriculture system are as below.

- | | |
|--|---|
| 1. Neem (<i>Azadirachta indica</i>) | 2. Dharek (<i>Melia azedarach</i>) |
| 3. Nicotine (<i>Nicotiana tabacum</i>) | 4. Chilli pepper (<i>Capsicum annuum</i>) |
| 4. Garlic (<i>Allium sativum</i>) | 6. Ginger (<i>Zingiber officinale</i>) |
| 7. Pyrethrum (<i>Chrysanthemum cinerariaefolium</i>) | |

Neem derivatives affect some 400 species of insects belonging to different orders viz., orthoptera, dermaptera, diptera, hetroptera, hymenoptera, isoptera, lepidoptera, phasmida, siphonaptera, thysanoptera, coleoptera and several species of mites and nematodes.

For the effective use of neem products the following strategy should be adopted:

1. Neem sheds should be developed in different parts, viz. east, and north central region of the country. These sheds would become centres of learning for the farmers and provide technical backup and material for promoting agro-based products for sustainable eco-friendly agriculture.
2. Development of improved varieties of neem trees containing higher *Azadirachtin* content through application of bio-technology undertaking extensive planting in the waste lands through establishment of Neem Sheds.
3. The existing production technologies would be studied and a more cost effective process developed based on which small scale production units would be set up at the village level. The various neem products to be developed would include pesticides, neem cake for use with urea as nitrification inhibitor, etc.
4. The active ingredients extracted from the neem seed kernels would be processed for the development of latest types of effective formulations including suspension concentrates, emulsions, water dispersible powder, etc.

Similarly following activities should be carried out along with formulation development to screen various formulations biologically for their stability for all botanicals

- a. Bioassay of different formulations for various bioactivities like anti-feedant, repellency, behavioral, insecticidal etc.
- b. Quality assurance test through bioassay technique
- c. Field testing at experimental farm
- d. Large scale field testing
- e. Bioassay and field testing against non-target pests
- f. Toxicological studies for registration purposes.
- g. Market recommendations

- h. Adoption of neem based formulation as seed protectant for seed storage (in warehouses) in Gene bank for long term storage of seeds free from pesticides, etc.
- i. Integration with other control methods for possible adoption in IPM system of important crops.

To adopt such technology by the industry would generate additional resources for the programme. To promote production, processing and use of neem based products, thereby aiding waste land development, generating rural employment and providing farmers with eco-friendly/ bio-degradable pesticides and producing neem based medicinal products. Setting up of collection and processing centres of neem kernels in the neem sheds through employment of local people under the aegis of the Panchayati Raj and the NGOs.

1. Neem sheds identification and development.
2. Increased use of waste land.
3. Increase in the number of eco-friendly and bio-degradable crop protection agents.
4. Proportional reduction in the use of hazardous chemicals.
5. Increased participation of women in the rural industry particularly in the collection of seeds and processing.

INFRASTRUTURAL NEEDS

Value addition is often understood in the context of adding value to the product. A new dimension from the consumer point of view is added to the existing understanding of value i.e. how a consumer perceives the value delivered to him through a bundle of product' services. This new approach of value addition through the consumer's mind needs special attention. All the activities now must be seen from the consumer point of view. In other words, consumer orientation is required in all spheres of agricultural sector. Keeping this approach in mind, there are four ways in which value addition to farm produce is possible:

Level 1 - *Pre-harvest level / At production level:*

Strategies:

Organic farming/contract farming

Farmers' HRD through institutional training / farm visits

Commercial production for selected crops like; Basmati rice, Durum Wheat, Off season vegetables, Fruit, Flowers, and Dairy Products / Quality Meat on cluster basis – project-based approach

Level 2 - *Post-harvest level / Primary Processing:*

Strategies:

The supply chain: growing-sorting / grading-packaging-storage transportation-processing-marketing

Level 3 - *Secondary Processing:*

Strategies:

Infrastructure for basic processing at nearer to production area.

Farmers training on primary and secondary processing and Packaging

Level 4 - High End Processing:

Strategies:

Organized farmers' groups, cooperatives on models / self-help groups, producer companies and other associations

Provision of collection centres and transportation to local markets

Provision for a network of cold chain storages / refrigerated vans all over the country in cooperative/private/ public sector

Training of farmers / entrepreneurship development

Need to provide infrastructure for local market, as NDDB type markets

Different markets in one location may continue to provide competition

Processing facilities to be set up in production clusters

Technology up gradation/ research required

APEDA approach be strengthened for export

Need for a Change:

The slow down in the Indian economy is of serious concern to every one, in the government, in industry, and in all the sectors of the economy. Today we are at less than 6% growth level, which is below the planned target. Even more worrying is the fact that the growth rate has been tending down for the last three years. Agricultural growth has dropped to 0.9% from the average of 3.9% in 1980s and 3.3% in the 90s. Many of the models show that the modest incremental growth of 3% in agriculture would lead to another 2.6% growth for manufacturing taking the overall GDP growth up by 1.7% - closer to 8% mark and above 10th plan ambitions.

Time has come when agriculture has to be run as agri-business rather than subsistence agriculture. The concepts of profit and loss are getting extended to the farms. Profits have to be achieved through judicious selection and application of inputs, higher productivity and improved quality. chain

Creation of a food starting from the farm gate to retail outlets is inevitable. In fact, *the chain should start from agricultural research institutions and laboratories to help farmers in scientific cultivation particularly to produce quality raw material for specific end-use, proper post-harvest management, storage, transportation and marketing.* There is also need for application of more and more mechanization and automation in post-harvest management and processing operations; utilization of agri-wastes generated during on-farm processing; agro-industrial systems development; and bio-process technology for conversion of raw agricultural produce to useful products.

World markets are undergoing a major transformation. Today, major markets are product-driven and less commodity-driven. To boost economic returns from farming, we must find ways for farmers to earn a greater share of the product sale revenue after adding value to their own produce. Strategies and organizational models to be adopted will vary from crop to crop and region to region and for meeting different technological and social needs.

We should focus on few selected commodities where (i) we have abundant production and consequently the storage problems, (ii) technologies for processing and/or value addition are available readily or can be generated with little modification on existing ones and (iii) national or international demand for such products exists.

Closer farmer-processor relationship is the core. This relationship needs to be a win-win type of relationship, with *reduction of intermediaries*. The producer should also be permitted to trade and the laws need to be amended for this.

Action needed for providing effective financial support, favourable government policies and laws, and linkages among producers, industry, R&D institutions and other partners.

- To meet the emerging challenges, agriculture must diversify in favour of high-value enterprises. The emphasis should be on production of high value commodities with enhanced quality and specific nutritional and processing characteristics, than increasing production per unit in past. Pricing policies also need to be changed linking it with the quality of the produce or a product is the basis for fixing per unit price, just as fat content in milk; higher protein quality/quantity in wheat; better aroma or cooking quality in rice and shelf-life of fruits and vegetables.
- Since marketing of products is more remunerative than raw commodities, farmer-processor linkages are needed to add value as per demands of the consumers. There is a great scope of developing some of our *traditional food items from cereals, fruits, milk and fish*. Appropriate and cost-effective packaging technology for these items is needed to ensure safety and prolonged shelf life.
- Agriculture is fast becoming demand driven from the earlier supply driven situation. For the food grains like wheat and rice, government support in the form of assured purchase as done in past will not be the same in years to come. Farmers will have to grow specific varieties needed for processing or add value to their produce. Policy and legislation must be reformed to allow processors to purchase their produce requirement directly from the farmers.
- Intermediaries in the food chain lock value and add to cost of the raw materials sometimes by even 80 to 100 percent. Effective linkages need to be built between farmers and processors on a mutually beneficial contractual agreement, particularly when a large number of small farmers are to be involved in contract farming.
- Self-help or common interest groups on the model of cooperatives should be encouraged to enhance the bargaining power of the farmers and negotiate effectively with the industry, just as is being done in Kerala and Punjab.
- Model of the Town and Village Enterprises (TVEs') of China is excellent for involving surplus rural labour in industrial activity by providing them alternative work at their doorstep. *This should be adopted with suitable modifications, for primary processing of the agricultural produce and effectively linked to urban units for secondary processing, product development and marketing.*
- *Location of food processing units should be strategically placed depending upon the raw material availability, labour, product utilisation and domestic and/or export marketing.* It should be nurtured to evolve on a natural course after initial nucleation, as done for IT industry.
- *Many times indigenous technologies are better suited for application than the imported ones.* There is an urgent need to have a scientific database of these technologies so that

one can compare the ones that are offered to us by others countries. There are nearly 200 major indigenous technologies for food processing which have been listed by CFTRI. NABARD or other financial institutions should finance this activity.

- There is an urgent need to have commodity-based management systems to advise the governments and R&D institutions to take steps proactively, based on continuous tracking of the demand, supply, consumer needs and prices both in domestic and international markets. The intelligent information collecting system should be networked with all user agencies and farmers in the country, using latest IT technologies and infrastructure.
- Processing of agricultural raw material generates a sizable amount of utilizable by-products, commonly termed as "waste". *Experimental protocols for converting these into usable co-products are available. These need to be developed into commercially viable technologies.* These ventures would be a success if main product manufacturing is undertaken in consonance with the by-product processing. Government regulations and policies must be suitably amended to facilitate this.

Rice and Wheat

- The varieties of wheat and rice grown now have been developed primarily for increased yield and lack the quality characters required for making products other than *chapatis*. R&D programmes should focus on *developing varieties for specific end-use and processing qualities*.
- The varieties grown at present, however, are more suited for making some traditional food items. The technologies for making these products are available with SAUs and labs of CSIR and ICAR. Their marketing potential should be explored and efforts made to make them into commercially viable propositions.
- *Processing units should be linked to areas/zones that should grow specific varieties for specific products.* Contract/Contact farming can meet this end. FAI laws must be amended and production/procurement policies must provide economic incentives to farmers to produce quality grain.
- Current post-harvest handling of grains results in high losses and leads to deterioration of quality. *Storage and handling technologies and infrastructure should be designed in a manner that losses are minimized and the produce retains its original quality.* Post-harvest care involving grading, storage and phyto-sanitation of the produce should meet the needs for export market.
- *Comprehensive processing units for developing products as well as bye-products should be set up.* For example, wheat flour mills can earn added benefits by undertaking wheat germ and oil production in consonance. Rice processing units should simultaneously handle de-husking and processing of bran for food, feed, oil and bio-chemicals, as is being done in many other countries. One such unit has recently come up in Punjab.
- *Separate boards for wheat and rice should be established* which should focus on all the activities from R&D to the production centres for quality grain, and from post-harvest handling to processing and marketing including image building in the national and international markets. Strategy formulation at the state and national level, development of infrastructure and facility for micro-level operators and intervention, wherein needed, should also be the role of these Boards.
- Although 1st green revolution ensured food sufficiency to the growing population but

over use of inputs like water resulted in long term adverse effects on sustainability of agriculture. Rice consumes almost 50 per cent water which is heading towards the threat of water crises in rice. Therefore, there is a need to develop and adopt technologies which will improve water use efficiency in rice by producing more crop per drop . In this regard there is need to develop efficient water management practices and to evolve aerobic type of rice variety which can grow with aeration or under non – flooded conditions. The aerobic rice can be grown with only 2-3 irrigations which can save 30-40% of water. System of rice intensification (SRI) can also save 30-40% of water with production of higher yields.

Removal of Restrictions on Sugar Industry:

Because of excessive production of sugarcane 10 million tons of extra sugar stocks have accumulated after meeting the annual requirement of the country. There are great possibilities of value addition in this industry. Unfortunately even today value addition in the sugar industry is made only in the form of sugar. On account of development of technique and technology in the sugar industry throughout the world, it has now become possible to have only 18 per cent value addition in the form sugar from sugarcane. The remaining 82 per cent value addition could be done through other commodities. The process of modernization and diversification has remained stagnant in this industry due to imposition of various licensing and other control systems. However, several restrictions still continue on distribution of molasses and other products of the industry based on sugarcane-including technical processing. Even today, molasses are being supplied at controlled rates to liquor factories and several other industries. It is possible to produce 27 valuable chemicals from molasses. Therefore, it is necessary to bring in modern technique to the sugar industry and remove all kinds of restrictions from it and its products.

Strategies for improving Jute production:

The canvas of jute indicates that it has the potentiality to become a fiber for the future if proper steps are taken in terms of research and development in both agricultural and industrial sector. For this we have to Check erosion of the market for traditional fiber product by making the items cost competitive with synthetics.

Develop new outlets for jute fiber, particularly through the development of new products. Improvisation in raw jute production technologies including development of more productive, and stress tolerant varieties with improved fiber quality as per requirement of new products. Development of modified retting/fibre extraction techniques to assure supply of good quality (Grade 1-3) fibre to the industry. Improve efficiencies of industrial production and processing so as to reduce costs and improve product quality and diversity Capitalize on superior environmental friendliness of jute over synthetics. Investigate ways to exploit jute plants for ingredients other than fibers and to utilize the unseables effectively

Fruits

Production Strategies-

- Commercial production for selected crops on cluster basis – project-based approach
- Micro irrigation
- Strengthening delivery mechanism for appropriate seeds / nurseries / nutrients/pesticides
- Establishment of plant health clinics (Tissue / Leaf analysis labs)
- Hi-tech farming/precision farming
- Research & extension on inputs/ farming systems/ technologies

Acreage Improvement Strategy:

- New gardens through development of wasteland / utilization of bunds / diversification from other crops
- Special thrust on Hill/ Island areas
- Appropriate inter-cropping
- Household gardening for vegetables and a few fruit trees for self-consumption
- Organic farming/contract farming
- Farmers' HRD through institutional training/farm visits/
- Appropriate media support/experts' visit to farmers' site
- Subsidy and credit at affordable rate of interest

Strategies- to Improve PHM

- The supply chain: growing-sorting/grading-packaging-storage transportation-processing-marketing
- It is indeed a web, not a chain

Interventions:

- Organize farmers' groups, cooperatives on models including NDDDB model, self-help groups, producer companies and other associations
- Provide for collection centres and transportation to local markets
- Provide for a network of cold chain storages/reefer vans all over the country in cooperative/private/ public sector

Strategies- to Improve Marketing

- Substantial gap between farmers' share in consumers' price
- A number of marketing practices
- Farmer – Consolidator – Trader – Commission Agent – Wholesaler –Retailer – Consumer
- 7307 markets regulated by APMCs
- NDDDB Bangalore model (transparency, cold chains, linkage with farmers)
- Need to provide infrastructure for local markets, help set up NDDDB type markets
- Different markets in one location may continue to provide competition

Strategies- to Improve Processing

- About 0.8% of production processed
- Processing capacity and distribution
- Processing facilities to be set up in production clusters
- Technology up gradation/ research required

Strategies- to Improve Export promotion

- APEDA approach to continue and be strengthened
- Marketing Intelligence through Ministry of Commerce
- Marketing research needed
- Standard development, testing facilities and enforcement mechanism required
- Training of farmers/ entrepreneurs

Floriculture:

Surplus production can be diverted for value addition and following areas are prospective:

- Production of essential oils, rose, jasmine, mahua, tuberose, kowera and maulshree can be used for the extraction of essential oils/floral fragrance
- Dehydration of flowers chrysanthemum, lotus, bougainville, cyeas leaves, pines leaves and cones etc. and wild plant parts can be used for dehydration purposes.
- Natural colourants- Marigold, balsam etc.
- Extraction of chemicals- pyrethrin from chrysanthemum and beta carotene from marigold can be used for chemical extraction.
-

Potato:

Potato varieties Chipsona-I and Chipsona-II match, or are even better than presently used international varieties for making chips and fries. These should be promoted among farmers and farmer-linked processing units.

- Since MH is known to inhibit sprouting of potato in storage, its import should be made easy.
- Technology for converting potato powder to high fructose syrup should be exploited at a commercially viable scale.

Beekeeping

The best known primary products of beekeeping are honey and wax, but pollen, propolis, royal jelly, venom, queens, bees and their larvae are also marketable primary bee products. While most of these products can be consumed or used in the state in which they were produced by the bees, there are many additional uses where these products form only a part of all the ingredients of another product. Because of the quality and sometimes almost mystical reputation and characteristics of most primary bee products, their addition to other products usually enhances the value or quality of these secondary products. For this reason, the secondary products, which partially, or wholly, can be made up of primary bee products, are referred to here as "value added" products from beekeeping.

Medicinal Plants:

There are vast potentialities of international trade in medicinal and fragrance giving plants and their products.

Protection of Indigenous Cattle wealth:

The quality of traditionally available breed like Jebu cow which has more resistance power to fight the diseases, capacity to give comparatively more milk with comparatively lesser fodder and animal feed and remarkable energy to withstand cold and hot seasons. For example, the average Indian cows' milk contains 5.5 per cent fat, buffalo's milk 7.75 per cent fat while the foreign and cross-bred cows contain 3.6 per cent fat in their milk. The foreign and cross-bred cows become pregnant only for five or at the most six times in total and become useless afterwards. Besides, these cows are infected with various kinds of diseases and cannot sustain in adverse climate. They are to be bathed twice every day during summer. On the contrary, for the maintenance of the indigenous breeds generally no medicine is required except the vaccine and; neither bathing nor fans are required. Therefore, the cost of their maintenance and keeping them disease-free is very less. Hence, it is essential to formulate a national programme for the protection of indigenous breeds, to bring about improvement in their breeds through selected breeding and to improve their health by nourishing food.

Milk and Dairy Products:

- Even though over 80 region-specific dairy products are known yet no scientific documentation of these products is available. Agencies and institutions concerned,

must urgently take up this work. Some of these traditional products, backed by R&D support for processing packaging could be elevated to commercially viable ventures for national and international markets (just as is being done for *Shrikhand and Rasogulla*).

- Attention must be paid to *develop nutritive foods using whey* that is rich in protein. One possibility is to supplement it with nutra-ceuticals, followed by gelling and suitably packaging to enhance its shelf life.
- Milk quality suffers from *high levels of pesticide residues and heavy metals* (which come through feed and fodder) and antibiotics mixed in feed or given for treating mastitis. This should be checked and monitored at the time of procurement to develop internationally competitive and pesticide free products.
- There is an urgent *need to develop low cost technologies for mechanization to hermetically pack milk products* as per needs of end users and involving the manufacturers of packaging material and equipment in an integrated manner.
- There are *natural anti-bacterial agents in milk of camel/goat/sheep, which has a shelf life of 8-10 days*. R&D efforts should be initiated for blending cow/buffalo milk with these milks, wherever possible. This will enhance shelf life and reduce handling costs.

Fish and Marine Products:

Traditional preparations like fish/prawn pickle, fish papar and fish curry, battered and breaded products, fish mince ('Surimi') based products like sausages, cutlets, patties, balls, pastes etc., need to be promoted in ready-to-eat packs. The packaging should be such that ensures quality and hygiene as per international standards, with proper certification.

Since India has a higher fish processing capacity than the total catch capacity. the idle workforce could be effectively engaged in making products based on “*Surim*” from low value/by-catch fish which otherwise fetch poor return to the farmers.

Sea weed farming should be commercialized and sea weeds used for preparation of nutritive foods and feed items. Post-harvest handling of fish and prawn catches must be done as per international standards of sanitation. This is essential if we are to compete in the global trade. It will require extensive cold-chain and appropriate storage infrastructure till the catch is processed or consumed.

Fisheries waste generated by the processing industry should be used for developing usable co-products like *chitin and chitosan from prawn shells* sutures from fish guts, the technology for which is available.

Biotechnology interventions

The research in this aspect may be carried through micro propagation and transgenics. Under micro-propagation the multiplication of elite lines in horticultural crops at rapid rate may be carried out besides, development of elite lines of low volume high value crops like Kalazeera, saffron, medicinal herbs and ornamentals may be adopted. Whereas in transgenic, the vegetable crops like tomato, brinjal etc. the quality of produce is hampered due to the attack of Napidoptri insects and virul fungus diseases. Transgenic varieties containing resistance to disease and insect pest will not only improve the quality but also reduce dependence on chemicals which otherwise are harmful to human health and environment. No BT tomato, brinjal, carrying resistance is available like wise coded protein genes for resistance to virul diseases as it is difficult to control through conventional means. Likewise genes for control of ripening and increasing shelf life are available tomato and other crop and

may be included for their value addition new areas of the research like phyto remediation and edible vaccines need to be explored for certain fruit crops.

Public Policies:

Policy and legislation must be amended *to enable the processors to procure cereals like wheat and rice directly from the farmers*. This will be cost saving and ensure the authenticity and traceability of material.

Policy reforms should be made so that cooperative units work as competitive units, self-supporting on their own strength, after a one-time initial financial support, on the lines of the TVEs of China. *State government should act as a facilitator of cooperatives and not as controller*, as is the practice now. These should be self-managed units, with appropriately defined independent dispute handling procedures.

Multiple taxation on value added products hinders development. The taxation laws should be simplified soon, as also envisaged in the draft National Food Processing Policy.

Special laboratories must be established in public and private sector for export certification of food consignments for the levels of antibiotics, pesticide residues, pathogenic organisms, heavy metals, impurities etc. as per Codex standards.

There should be time-bound commitment from the central and state governments to develop much-needed infrastructure like cold storages, CAS & MAS stores, warehouses, sorting, grading and packing at the farm level. Proper incentives should be provided for these ventures.

Involvement of Panchayats

In order to make agribusiness a profitable venture it is necessary to have a holistic approach to various activities inherent to it. In order to release the true potential it is necessary to establish efficient linkages between storage and marketing. In addition to providing sufficient storage capacity, it is also necessary to introduce a sound marketing system so as to minimize losses. The panchyats can help to develop the linkages. In addition to formation of linkages, through panchyats, self help groups (SHG) can help to extend micro finance as viable tool for extending credit to the poor farmers which in turn will help in risk management arrangements as a measure to improve profitability. Through involvement of panchyats, cold storages can be constructed on community basis. Panchyat can play role in organizing awareness camps through imparting trainings on value addition aspects.

Banking Support:

Technology generating institutions must help in developing the techno-economic project profiles, leading to bankable proposals for the prospective entrepreneurs.

Self-help women groups have successfully taken up some part time activities with support from NABARD and other institutions. These groups should be assisted in making traditional foods as per Codex standards, with proper training and financial back up.

Simplified credit facility should be provided to farmers and their cooperatives that wish to undertake value addition to their produce. First loss risk cover should be provided to these farmer-entrepreneurs.

Management Models:

Processing units adding value to agricultural produce should lay emphasis on *developing effective backward linkages with farmers*, to procure quality raw material.

Contract farming should be promoted in a manner that processing firms are not able to exploit an un-equal relationship with growers. Most contracts in the past have been tilted against farmers and also some farmers have diverted the produce to open markets.

The New Generation Cooperatives (NGC) model is ideal since it binds both farmers and processors to honour commitments and agreements. This should be applied in our cooperative enterprises. Contract farming involving small farmers should be promoted rather than involving a few big farmers.

Rural processing and value addition groups should be promoted. This will allow small and marginal farmers to be part-time farmers and work in rural enterprises for enhanced income and returns on their produce.

Small cooperative processing units should be promoted in rural areas. These could undertake primary processing, grading and cleaning of produce for adding value. The pattern of Town and Village Enterprises (TVEs) of China, could be used, with necessary modifications.

The Town and Village Enterprises (TVEs) of China represent a middle ground between private ownership and the state ownership- It has led to the emergence of rural entrepreneurs and enterprises at such a large scale and a rapid rate, which has not been experienced by any other country. TVEs are today a vehicle to increase rural income, absorb a large amount of surplus rural labour and check their migration to urban areas. Their growth has been critical to the success of transforming China to a market economy.

TVEs are industrial enterprises owned by local governments and citizens and generally produce consumer goods for domestic and foreign markets. They operate on a competitive-cooperative basis. Because the local governments can retain the revenues from TVEs, they have been managed efficiently and the loss-making ones are closed down. This created a domestic competitive environment. The TVEs are financed by local financial institutions and some even by foreign investors (World Bank, 1996).

Components of Infrastructure requirements for organic farming:

A. Enterprise:

Since the organic practices is a combination of various farm activities which include:

- Livestock: beef cattle, native cattle, dairy cattle, goat, coconut, fish etc.
- Fruits: apple, pears, grape, apricot, cashew nut, walnut etc.
- Others: Basmati, rice, vegetables, medicinal plants, bamboo, matrimony, vine, ginseng, mushroom etc.

The promotional activities of these enterprises may be enhanced

B. Infrastructure:

At each village there should be missionary planning for creation of tube wells, watershed approach for water harvesting techniques, lay out of metal farm roads, weir, dam, land reclamation mechanism, pumping station etc. Besides the infrastructure for the development of creation and establishment of no. of organic food testing and other allied laboratories for production of bio-agents at each farmers constituted group villages of international standards.

Development of more and more packaging centers and establishment of small and large-scale value added industrial units for processing of agricultural foods.

Creation of small-scale laboratories for research and development works either managed through authorized farming groups or by state agencies.

Financial support for commercial production units for production of organic inputs like fruits and vegetables waste compost, bio-fertilizer and establishment of vermin-culture hatcheries at large scale.

Allocation of funds for establishment for various location specific organic farming modules for impact analysis.

Construction for buildings at potential organically specified villages where all the activities for organic farming from seed to seed and marketing of the produce at retailer level will be monitored.

The creation of online facility for global information regarding the recent production and marketing trends (under information technology).

Promotion and establishment of organic vegetable and fruit markets at site specific places of the representative areas.

Infrastructure requirement in terms of man and material of establishment of centers for promotion and organization of organic farming activities.

C. Production facilities:

Vinyl house, plantation facilities, cold storage, horticulture plantation facilities, mushroom establishing unit facilities, and development for fish farm at each productive site.

D. Marketing facilities :

Agriculture co-operative warehouse, village warehouse, fruits warehouse, potato warehouse, wholesale market, processing mill etc.

Marketing and value addition related Bottlenecks in the development of zonal planning and to suggest measures to correct them

1. Lack of good quality raw material:

This is the most serious problem. In general, all the industries are facing a serious problem of non-availability of adequate raw material from the local area. The material is obtained from far off places resulting in high cost and transportation losses. This effect competitiveness of industry in other markets. The backward linkages of food processing industries with the farmers are inadequate

2. Processing machinery:

The establishment of most of the modern livestock processing plants requires high capital investment as most of the equipments/ machineries are imported ones. There is a strong need to develop cost effective indigenous processing equipments to reduce the capital cost for the establishment of processing plants. This will ultimately reduce the cost of production of livestock products and add to the profits.

3. Infrastructure:

Lack of available infrastructure has been well-recognized and most important constraint in the development of livestock processing industry. The connectivity in terms of transportation, communication and marketing channels is yet to be established, though it has been realized since long. Access to potable water and electricity are absolute necessity and should constitute an integral part of the strategy for infrastructure development.

4. Lack of cold chain system

Most of the livestock products are highly perishable commodities and need chilled or frozen handling during transportation, storage and exports. However cold chains including refrigerated/ frozen vans are not much developed in the country and thus danger of quality deterioration and public health risks remain high in our tropical climatic conditions. Irregular and poor quality of power supply has also been acting as a serious barrier to growth in cold storages. So, there is an urgent need to establish unfailing cold chains throughout the country connecting all major export points and processing units.

5. Inadequate Quality Assurance

Imposition of sanitary and phytosanitary measures is deemed important to protect human and animal health from pest and diseases arising out of foods of animal origin. Levels of pesticides, drug residues and other chemical contaminants should limit well below the recommendations to maintain market at domestic as well as international levels.

6. WTO agreements

External liberalization opens up new export avenues and seeks to integrate the economy with the global market. But it also poses threats of stiffer competition under a new world trade order with WTO agreements relaxing quantitative restrictions and non-tariff/sanitary barriers on importing countries. This exposes the Indian farmer to world market forces. Strategies to convert the potential disadvantage, on account of the new import regime, into advantage are needed. The inherent strength of high raw material production and large domestic market base has to be buttressed and energised by evolving the right international-level infrastructure and growing suitable raw material. This, coupled with operating processing units at optimum capacity levels as per economies of scale, would enable achieving a competitive edge over imported products. The food sector will be confronted by challenges of trade related Intellectual Property Rights, comprising patent laws, copyrights, trade links, etc.

7. Government policies

Taxes on processed food in India are among the highest in the world. No other country imposes excise duty on processed food. No country distinguishes between branded and unbranded food sectors for taxation. Several duties and taxes are levied by the Central/State/Local bodies on the processed products. India is the only country to have levied excise duty on machinery and equipment for processed foods. Indian consumers are very price-sensitive and cost reductions are imperative to raise demand and consumption of food products. Since the net effect of various taxes falls directly on the price, the off-take of processed food items remains low.

8. Disaster Management

The Asia-Pacific region experiences nearly 60 per cent of the world's natural disasters. India, on account of its geographical position, climate and geological setting, is the worst-affected theatre of disaster in the South Asian region. Drought and floods, earthquakes and cyclones, are devastating the country with grim regularity year after year. They are spiraling out of control, increasing in frequency, causing more and more injury, disability, disease and death. Livestock owners in India are at serious risk of losing animals to natural and human-caused disasters. The threat of disasters always put a sense of insecurity for the processing industries because of unavailability of adequate raw material, delayed transportation, instable markets etc. Though the country is periodically stuck by some or other disasters, the efficient plan for their management still needs to be formulated.

9. Lack of Effective Extension Programmes

Commercial R&D activities in the food industry have remained confined to only a few areas. R&D activities have scarcely emerged from the laboratory to be extensively adopted on the field. Different agencies have been set up for extension programmes with the purpose of transfer of latest know how to the farmers and common man in different fields or

sectors. Also with the advent of time, the processing technologies for different livestock products are also coming up in India. However the majority of country population still does not respond well to processed food products especially from the livestock sector and still prefer to purchase milk and meat in the fresh form. The price realization for the processed foods is also very poor. The extension organizations need to be more effective in educating consumers about the advantages of the processing of livestock foods.

10. Lack of Organized cooperatives

Cooperatives and other semi-government organizations are weak and people's participation, either through Panchayati Raj institutions, NGOs, farmer organizations or industries' associations in food sector remains extremely inadequate. However, the only effective Indian cooperative in livestock industry till now i.e. AMUL has achieved international repute.

11. Religious Taboos

Religious and ethnic groups are also of major concern for the development of livestock especially meat industry by their agitational approach. Negative propaganda of some social groups against meat exports, establishment of slaughter houses and promotion of non vegetarianism is seriously affecting meat trade. This need to be countered with facts and developmental requirements.

12. Poor backward and forward linkages:

- The contract farming should be promoted to
- i) Ensure regular supply of raw material for the processor.
 - ii) Avoid incidence of distress sale and ensure remunerations price to farmer.
 - iii) Promote cultivation of processable variety of farm produce.
 - iv) Prevent wastage of surplus farm produce and increase its shelf life through processing.
 - v) Commercialization of agriculture through contract farming.

13. Lack of HRD: Lack of awareness of recent technologies prevalent at global level is the key in hampering technology development is refinement. Hence HRD component through trainings in international institutes of repute is needed.

Corrective Measures

The present scenario has resulted from the lack of cohesive and integrated planning of the industry, keeping in mind specific needs of various regions, their produce and special industries, which could be energized to work at optimum capacity. The policy initiatives thus far have gone by the assumption that this industry has high risk and low return and that seasonalities of produce dictates the levels of capacity utilization; that any multi-line projects will become unviable, for there is paucity of marketing outlets and lack of other infrastructural facilities. These problems cannot be viewed in isolation nor can they be tackled by a single department/ministry. It is important to adopt a holistic approach in formulating any viable policy for this nascent sector. The planning should be bottom up and not top down, for in India, the initiative has to come from the rural sector constituting 70% of the population.

Infrastructure development

Infrastructure in the shape of cold chain, packaging centres, value added centre, modernized abattoirs, quality control and testing infrastructure, inefficient supply chain. Improvement in general infrastructure would be a booster to energize this sector.

Highest priority should be attached to the expansion of physical infrastructure for facilitating prompt growth of food processing industries in XIth plan.

Govt. has already implemented the scheme for infrastructure development comprising the following components.

- a). Food park scheme.
- b). Packaging centres.
- c). Integrated cold chain facility
- d). Value added centres.
- e). Irradiation facility.
- f). Modernized abattoirs
- g). Upgradation of infrastructure

Good quality raw material

Since the quality of product is primarily dependant upon the type of raw material used, it is of utmost importance that adequate supply of quality raw material should be ensured through out the year. The linkage between producer and processor is essential to encourage material of appropriate quality. The incentives for the quality produce will also encourage farmers. Besides this, R & D of ICAR and SAUs should clearly come with area based breeding and production practices.

Proper Marketing Strategies

The number of intermediaries operating between the farmers/processors and the consumers, resulting in high cost to the latter and low return to the former needs to be reduced. The low cost of processed products certainly will result in increase in demand of products.

Effective Extension Programmes

Transfer of technology is also one of the major requirements for bringing up processing industry in livestock products. The farmers, processors and consumers need to be educated about technologies available, advantages of processing and value addition. The adoption of processed livestock products can be substantially increased only with the help organized and efficient extension programmes.

Establishing Disease-Free Zones for Rearing Animals

India is now fortunately free from most of the trade related diseases listed at List 'A' of the Office International des Epizooties (OIE), namely, Rinderpest, Contagious Bovine Pleuropneumonia (CBPP), etc. India has also not reported Bovine Spongiform Encephalopathy (BSE – Mad Cow Disease). However, Foot and Mouth Disease (FMD) is still prevalent in an endemic form in some States in India. The Government of India has established three Zones with 56 Districts to control FMD in the Tenth Five Year Plan. These Zones are in the North, Central and Southern zone where most of the EOU plants are located.

Hopefully, in another 2 – 3 years, OIE recognized FMD free zones with vaccination would be established in the country, which will further boost meat export. The Project has started with 100% financial assistance from the Central Government. Training of the Veterinarians and purchase of vaccines have been completed. The mass vaccination has started from October 2003.

Standardization and upgradation of indigenous products

The Indian meat and milk delicacies are being relished through out the world. Meat pickles, kababs, tandoori chicken, gostaba, rishta, tikka are some of traditional Indian meat products with very high popularity. The preparations of these products do not require use of costly machinery. Many times indigenous technologies are also better suited for application than imported ones. Scope of these technologies should be looked seriously.

Proper marketing strategies

Inadequate proper marketing is also one of the important causes for non popularity of processing and value addition of livestock products. Though modern marketing techniques are common in India but promotion of livestock processed products is negligible. Intermediaries in the food chain lock value and add to cost of products sometimes by even 80 to 100%. So effective linkages need to built between farmer and processor on a mutually beneficial contractual agreement

Quality Assurance

Strict quality control of raw and processed products is essential to establish and maintain demand and market. Referral Laboratories in the area of pesticide residues, meat and meat products, fishery and needs established in the country, and will be the bulwarks of quality assurance for agricultural export products and domestic markets.

State-wise Details of Cold Storage and Food Processing and Training Centres Assisted by MFPI during 10th and proposed for 11th plan

S. No	Name of the State	Cold Storage Units Assisted during 10 th plan and proposed for 11 th plan			Food Processing and Training Centres Units	
		10 th Plan	11 th Plan		Assisted for 10 th Plan	proposed for 11 th Plan
			Modified Atmosphere / Cold storage	Metal silos		
1	Andaman & Nicobar Islands	-	-	-	-	1
2	Andhra Pradesh	1	7	-	-	1
3	Arunachal Pradesh	-	-	6	-	1
4	Assam	-	8	-	-	1
5	Bihar	-	-	5	01	1
6	Delhi	1	-	-	-	1
7	Gujarat	3	5	-	01	1
8	Goa	1	-	5	-	1
9	Haryana	1	7	-	02	2

10	Himachal Pradesh	-	10	10	-	1
11	Jammu & Kashmir	-	15	-	-	2
12	Karnataka	-	-	10	-	1
13	Jharkhand	-	-	-	1	1
14	Kerala	1	10	-	-	1
15	Lakshadweep	-	-	-	-	1
16	Maharashtra	3	5	5	01	3
17	Madhya Pradesh	-	7	7	-	2
18	Manipur	1	2	2	01	2
19	Mizoram	-	2	2	-	1
20	Meghalaya	1	2	2	-	1
21	Nagaland	-	1	1	-	3
22	Orissa	-	3	3	3	2
23	Punjab	-	10	25	-	2
24	Rajasthan	-	7	5	01	3
25	Tamil Nadu	-	3	3	06	4
26	Tripura	-	-	-	-	1
27	Uttar Pradesh	1	8	15	12	10
28	West Bengal	-	-	-	03	6
29	Uttaranchal	-	5	5	03	5
	Total	14	117	111	35	62

Funding requirement

Proposed budget outlay for infrastructure during 11th plan for value addition & organic farming

- | | |
|---|------------------------|
| 1. For infrastructure & human capital development | 1210 crores |
| 2. Commodities wise for different agroclimatic zones of India | 4053 Crores |
| 3. For organic farming (NE region) | 370 Crores |
| Total | Rs. 5633 Crores |

1. Proposed budget outlay for infrastructure & human capital development

S. No	Scheme	10 th Plan (Rs. in Crores)	Proposed for XI th Plan (Rs. in Crores)
1	Scheme for infrastructure development a) Food Park b) Packaging centre c) Modernized abattoirs d) Integrated cold chain facilities e) Irradiation facilities f) Value added centres	180.00	310.00
2	Scheme for technology upgradation, Establishment/ Modernization of Food Processing Industries. Processed	295.00	370.00

	food industries in general		
3	Scheme for backward and forward integration and other promotional activities. a) Backward linkage b) Forward integration c) Generic advertisement d) Promotional activities such as participation in exhibition / fairs / supporting seminars / workshops / studies and surveys. e) Preparation of short films and material for different meetings. f) Strengthening of Directorate of Food and Vegetable Processing g) Strengthening of Industry Associations h) Fortification of wheat flour	30.00	110.00
4	Scheme for quality assurance, Codex standards and R and D a) Food safety and quality assurance mechanisms. b) Bar coding system c) Strengthening the Codex cell d) Continuous R&D e) Setting up/upgradation of quality control laboratories	50.00	185.00
5	Scheme for Human Resource Development a) Setting up of FPTC b) Imparting training to update skills c) Entrepreneurship Development Programme d) Facilitating Universities/Institutions for running degree/ diploma courses and extension services e) Foreign Exposures	65.00	135.00
6	Scheme for strengthening of institutions a) Strengthening of Agro-processing Research Centre b) Strengthening of State nodal agencies c) Meeting expenditure of pay and allowances for Plan posts. d) Information Technology.	30.00	100.00
	Total:-	650.00	1210.00

2 Proposed budget outlay for Commodity wise infrastructure for different agro-climatic zones of India. (Rs. in Crores)

-+

Agro Climatic Zones Of India	States	Commodities	Budget Outlay
1. Western Himalayan Region (39 Districts)	J&K (All 14), HP (All 12), Uttranchal (All 13)	Food grain crops	13.02
		Fruit Crops	55.62
		Vegetable Crops	31.64
		Spices	65.36
		Medicinal and Aromatic plants	0.84
		Plantation crops	-
		Others (Mushroom & Honeybee)	3.0
		Live stocks	68.72

		Total	238.20
2. Eastern Himalayan Region (79 Districts)	Sikkim (All 4), Arunachal Pradesh (All 13), Meghalaya (All 7), Manipur (All 9), Mizoram (All 8), Assam (All 23), Nagaland (All 8), Tripura, (All 4) West Bengal (3)	Food grain crops	20.84
		Fruit Crops	48.94
		Vegetable Crops	31.64
		Spices	65.36
		Medicinal and Aromatic plants	0.84
		Plantation crops	-
		Others (Mushroom & Honeybee)	3.0
		Live stocks	68.72
		Total	239.34
3. Lower Gangetic Plains Region (15 Districts)	West Bengal, (15)	Food grain crops	18.10
		Fruit Crops	63.82
		Vegetable Crops	31.64
		Spices	-
		Medicinal and Aromatic plants	0.84
		Plantation crops	11.50
		Others (Mushroom & Honeybee)	3.0
		Live stocks	68.72
		Total	197.12
4. Middle Gangetic Plains Region (60 Districts)	Bihar (All 37), UP (23),	Food grain crops	27.12
		Commercial crops	126.68
		Fruit Crops	63.82
		Vegetable Crops	31.64
		Spices	-
		Medicinal and Aromatic plants	0.84
		Plantation crops	-
		Others (Mushroom & Honeybee), Sugarcane	3.00
		Live stock	68.72
		Total	321.82
5. Upper Gangetic Plains Region (40 Districts)	UP (40)	Food grain crops	19.90
		Commercial crops	33.74
		Fruit Crops	79.06
		Vegetable Crops	31.64
		Spices	-
		Medicinal and Aromatic plants	0.84
		Plantation crops	-
		Others (Mushroom & Honeybee)	3.0
		Live stocks	68.72
		Total	336.90
6. Trans-Gangetic Plains Region (48 Districts)	Punjab (All 17, Haryana (All 20), Rajasthan (2), Delhi (All 8), Chandigarh (1)	Food grain crops	19.90
		Commercial crops	7.06
		Fruit Crops	79.06
		Vegetable Crops	31.64
		Spices	-
		Medicinal and Aromatic plants	0.84
		Plantation crops	-
		Others (Mushroom & Honeybee)	3.0
		Live stocks	68.72
		Total	203.16
7. Eastern Plateau	Orissa (15), MP (3), Maharastra (4),	Food grain crops	11.52
		Commercial crops	7.06

and Hills Region (57 Districts)	Jharkhand (All 18), Chathisgarh (All 16), West Bengal (1)	Fruit Crops	95.06
		Vegetable Crops	31.64
		Spices	-
		Medicinal and Aromatic plants	0.84
		Plantation crops	-
		Others (Mushroom & Honeybee)	3.0
		Live stocks	68.72
		Total	217.84
8. Central Plateau and Hills Region (57 Districts)	MP (30), UP (7), Rajasthan (20)	Food grain crops	29.22
		Commercial crops	11.06
		Fruit Crops	18.20
		Vegetable Crops	31.64
		Spices	6.80
		Medicinal and Aromatic plants	0.84
		Plantation crops	-
		Others (Mushroom & Honeybee)	3.00
		Live stocks	68.72
		Total	169.48
9. Western Plateau and Hills Region (41 Districts)	Maharashtra (25), MP (15), Rajsthan (1)	Food grain crops	11.52
		Commercial crops	133.66
		Fruit Crops	95.26
		Vegetable Crops	31.64
		Spices	6.84
		Medicinal and Aromatic plants	0.84
		Plantation crops	64.00
		Others (Mushroom & Honeybee)	3.00
		Live stocks	68.72
		Total	415.48
10. Southern Plateau and Hills Region (48 Districts)	Karnataka (21), TN (13), AP (14)	Food grain crops	26.42
		Commercial crops	136.60
		Fruit Crops	131.06
		Vegetable Crops	31.64
		Spices	6.84
		Medicinal and Aromatic plants	0.84
		Plantation crops	64.00
		Others (Mushroom & Honeybee)	3.00
		Live stocks	68.72
		Total	469.12
11. East Coast Plains and Hills Region (43 Districts)	Orissa (15), AP (9), TN (15), Poundicheri (4)	Food grain crops	14.72
		Commercial crops	16.56
		Fruit Crops	154.00
		Vegetable Crops	31.64
		Spices	6.84
		Medicinal and Aromatic plants	-
		Plantation crops	60.00
		Others (Mushroom & Honeybee)	3.00
		Live stocks	68.72
		Total	355.48
12. West Coast Plains and Ghat Region	Maharashtra (6), Goa (All 2), Kerala (All 14), Karnataka (6), TN (2)	Food grain crops	5.7
		Commercial crops	133.66
		Fruit Crops	26.68
		Vegetable Crops	31.64
		Spices	6.84

(30 District)		Medicinal and Aromatic plants	-
		Plantation crops	139.16
		Others (Mushroom & Honeybee)	3.00
		Live stocks	68.72
		Total	415.40
13.Gujarat Plains and Hills Region (28 District)	Gujarat (25), Dadar and Nagar Haweli (1), Daman and Diu (2)	Food grain crops	12.5
		Commercial crops	11.0
		Fruit Crops	70.04
		Vegetable Crops	31.64
		Spices	-
		Medicinal and Aromatic plants	2.00
		Plantation crops	2.00
		Others (Mushroom & Honeybee)	3.00
		Live stocks	68.72
		Total	200.90
14.Western Dry Region (9 Districts)	Rajasthan (9),	Food grain crops	9.02
			7.06
		Fruit Crops	18.20
		Vegetable Crops	31.64
		Spices	-
		Medicinal and Aromatic plants	2.0
		Plantation crops	-
		Others (Mushroom & Honeybee)	3.00
		Live stocks	68.72
		Total	139.64
15. The Islands Region (3 District)	Lakshdweep (1), A and N Islands (2)	Food grain crops	4.00
		Fruit Crops	16.00
		Vegetable Crops	31.64
		Spices	-
		Medicinal and Aromatic plants	-
		Plantation crops	10.00
		Others (Mushroom & Honeybee)	3.00
		Live stocks	68.72
		Total	133.36
		Grand Total	4053.24

3) Proposed Infrastructure and budget outlay for organic farming for NE Region

S. No	Schemes	Proposed plan (Rs. in crore)
1	Schemes for Infrastructural Development: a). Organic food testing and other laboratories for producing bioagents (for product certification etc. b). Packaging centers c). Infrastructure for farmers group centers d). Others	90.00
2	Schemes for technology upgradation, Establishment/ Modernization of organic farming centers	35.00

3	Scheme for backward and forward integration and other promotional activities: a). Backward linkage b). Forward integration c). Generic advertisement d). Promotional activities such as participation in exhibition / fairs /supporting seminars / workshops / studies and Bench mark surveys e). Preparation of short films and material for different meetings f). Strength centre for organic farming activities g). Financial support for commercial production units for production of organic inputs like:- Fruits and Vegetable waste compost; Bio-Fertilizer production; and Hatcheries for vermin-culture Promotion and extension of Organic Farming.	80.00
4	Scheme for quality Assurance, Codex standards and R&D a). Food safety and quality assurance mechanisms b). Strengthening of organic farming Associations c). Setting up / upgradation of testing laboratories	55.00
5	Scheme for Human Resource Development a). Capacity building through service providers b). Setting up of FPTC. c). Imparting training to update skills. d). Facilitating NE Universities / Institutions for running / diploma courses and extension services. e). Foreign Exposures	50.00
6	Scheme for Strengthening Institutions a). Strengthening of state nodal agencies b). Meeting expenditures of pay and allowances for plan posts. c). Information technology	70.00
	Total	370.00

Total proposed budget outlay: 1 + 2 + 3 (1210 + 4053 + 370) = Rs. 5633 crores

SUMMARY

The production of various crop commodities has increased substantially over the various Plan periods. The food grain production increased to a level of 213.46 mt in 2004 from 89.36 mt in 1964 – 65 and require 337.3 mt by the end of 2012. Production of oilseeds, cotton, sugarcane fruits vegetables, and milk also increased appreciably. Value addition is one of the potential areas which can uplift rural economy because value addition to raw food material in India is only 7% while it is 23,45 and 188 % in China, Philippines and UK, respectively (as per National Food Processing Policy, Draft Document, 2000). We process less than 2% of fruits and vegetables as compared to 30% in Thailand and 80% in Malaysia (PIB Feature, 2001). The high value agriculture sector is highly perishable in nature and requires fast moving infrastructure and innovative institutions to link the farmers with the processors

and the consumers. Value addition provides high returns to farmers, safe longer transport, high returns from export and marketing period for perishable commodities. This would help not only production of value added products either at production level or at processing level rather it will open new marketing and consumerism mechanism either for domestic market or export.

To promote exports of agricultural produce and its products, sixty agri-export zones (AEZ) have been established during 10th plan in 20 States of the country. The potential crops for exports have been identified and steps taken to promote exports of good quality raw material and processed products. Sixty eight export zones have been proposed in the 11th plan for eighteen states of the country.

Value addition is often understood in the context of adding value to the product. A new dimension from the consumer point of view is added to the existing understanding of value i.e. how a consumer perceives the value delivered to him through a bundle of product' services. This new approach of value addition through the consumer's mind needs special attention. All the activities now must be seen from the consumer point of view. In other words, consumer orientation is required in all spheres of agricultural sector.

There are four ways in which value addition to farm produces possible

- Level 1 - *Pre-harvest level / At production level* : Value added commodities / high value crops like; Basmati rice, Dicotyledonous wheat, Durum wheat, Broccoli etc..
- Level 2 - *Post-harvest level / Primary Processing*: Proper cleaning, grading and packaging e.g. vegetables, potatoes, fruits etc.
- Level 3 - *Secondary Processing*: Basic Processing, packaging and branding e.g. packed *atta*, *suji*, rice, etc.
- Level 4 - *High End Processing*: Supply chain management, modern processing technology, packaging of processed foods, branding, marketing e.g. potato chips, breakfast food, noodles, macaroni etc.

Time has come when agriculture has to be run as agri-business rather than subsistence agriculture. The concepts of profit and loss are getting extended to the farms. Profits have to be achieved through judicious selection and application of inputs, higher productivity and improved quality chain

Creation of a food starting from the farm gate to retail outlets is inevitable. In fact, *the chain should start from agricultural research institutions and laboratories to help farmers in scientific cultivation particularly to produce quality raw material for specific end-use, proper post-harvest management, storage, transportation and marketing.* There is also need for application of more and more mechanization and automation in post-harvest management and processing operations; utilization of agri-wastes generated during on-farm processing; agro-industrial systems development; and bio-process technology for conversion of raw agricultural produce to useful products.

The eco friendly inputs viz., vermin-compost, organic manures, biological control agents can be produced in small scale at village level by developing cottage industry, which would offer lot of employment opportunities and income generation in rural areas.

Domestication of economically suitable medicinal and aromatic plants also has a potential of employment generation as it involves range of entrepreneurship activities like cultivation, processing, extraction, product formulation and fractionation. Estimated employment generated in terms of man days by cultivation and post harvest processing of some crops is: *Artemisia* (1.1 crore), *Chlorophytum* (1.3 crore), *Rauvolfia* (1.35 crore), *Aloe*

(1.57 crore), *Rose* (0.9 crores) and *Ocimum* (0.4 crores). By setting up of different fruit and vegetable processing industries will offer lot of employment opportunities and income generation in rural areas.

Some marketing and value addition related bottlenecks in the developments of zonal planning are Lack of good quality raw material, Processing machinery, Infrastructure, Lack of cold chain system, inadequate quality assurance, WTO agreements, government policies, disaster management, lack of effective extension programmes, lack of organized cooperatives, religious taboos, poor backward and forward linkages, lack of HRD. In order to overcome these difficulties highest priority should be attached to the expansion of physical infrastructure for facilitating prompt growth of food processing industries besides good quality raw material, proper marketing strategies, effective extension programmes, establishing disease-free zones for rearing animals, standardization and upgradation of indigenous products and quality assurance.

The outlay of funds for such scheme has been increased from Rs. 235 crore in 9th plan to Rs. 650 in 10th plan i.e. almost three times. There is a need to increase this allocation to strengthen R&D pilot scale infrastructure in SAU's / ICAR institutes. The allocation of research grant to institutions had been meager. The total outlay should be increased to Rs. 1210.00 crores in XIth Plan. Also emphasis should be laid on foreign training of human resource. About 4053 crores are required for infrastructure for commodities besides 370 crores for organic farming in region. The total proposed budget outlay for 11th plan for value addition/infrastructure & organic farming requires **Rs. 5633 Crores**.

Appendix – I

Proposed infrastructure to be provided during 11th plan for different Agro-climatic zones of India

Rs. In Lakhs					
Sl. No	Agricultural commodity	Value added Products	Plant Capacity	Cost of Plant and Machinery / unit	Total Capital Investment / unit
1	Banana	Wafer	100 kg / day	2.85	17.82
		Banana Floor, Dehydrated Banana, Clarified Banana juice, Banana Powder	40 MT / day	1329.00	1791.67
2	Mango	Mango fruit bar	200 Kg / day	21.70	31.84
		Mango Juice	2 MT / day	96.00	120.0
		Mango pickles	1000 Kg / day	16.00	71.08
		Mango Processing (Jam Jelly), Mango Pulp & Slices, Mango Papad, Mango Powder	2500 kg / day	24.30	177.70
		Canned Mango Pulp	5000 cans / day	32.00	133.00
3	Litchi	Juice	2 MT / day	9.0	37.00
		Pulp	2500 kg / day	24.3	177.7
		Canned Pulp	5000 cans / day	32.00	133.0
4	Guava	Juice	2 MT / day	96.0	120.0
		Concentrated Pulp, Jelly & Jam	2500 kg / day	24.3	177.7
		Osmo-dehydrated	5 TPD	59.00	78.45
5	Grapes	Juice	2 MT / day	96.0	120.0
		Beverages	1000 Lts / Day	50.00	110.00
		Beverages (Tetra Packs)	3,00,000 Packs / Day	1000.00	1400.00
		Concentrates	1 TPD	650.00	800.00
		Resin	1 TPD	120.00	350.00
		Wine industry	75000 Lts / Month		130.00
		Canned Fruits	10000 cans / day	50.00	133.00
6.	Papaya	Dehydrated	5 TPD	450.00	650.00
		Jam	1500 Kg / Yr	30.00	40.00
		Ready to Serve	1000 Lts. / Day	50.00	110.00
7.	Pine apple	Juice	2 MT/day	9.0	37.00
		Jelly	2500 kg/day	24.30	177.00
		Canned pulp	5000 cans/day	32.00	133.00
8.	Apple	Juice, Concentrates and Beverages	1 TPD	650.00	800.00
		Dehydrated	5 TPD	450.00	650.00
		Canned	10000 cans / day	50.00	133.00
		Jam	1500 kg/yr	30.00	40.00
9.	Citrus	Juice, Concentrates	1 TPD	650.00	800.00

		and Beverages			
10.	Apricot	Osmo-dehydrated Product	300 MT / Yr	300.00	350.00
		Jam	15000 Kg / Yr	30.00	40.00
		Pulp	8 TPA	200.00	290.00
		Beverages	3,00,000 ltrs/Yr	40.00	60.00
11.	Walnut	Walnut oil	22 MT/day	325.00	678.00
12.	Oil Seeds	Refined oil	12 MT/day	325.00	353.27
13.	Pulses	Milling	6000 MT/year	110	125
14.	Vegetables	Dehydrated Vegetables	5 TPD	180.00	230.00
		Frozen Vegetables	900 MT / Yr.	300.00	325.00
		Pickles	9500 Kg. / Yr	30.00	34.00
		Canned Vegetables	5000 Cans / Day	65.00	133.00
		Tomato paste, Puree, Ketchup	150 TPD	60.00	85.00
		Frozen Veg. Puree	30,000 MT / Yr	370.00	775.00
15.	Areca nut	Pan Masala etc.	150 MT / Yr	98.00	100.00
16.	Spices	Ground and Packaged Spices	40 MT / Day	2549.00	2700.00
		Packaged Spices	500 Kg / Day	53.00	60.00
		Chillies Processing and Grinding	1 TPD	30.00	36.00
		Drying of Chillies	3,47,100 Kg / Yr	45.00	50.00
		Ginger oil	40 Kg / Day	158.00	282.00
		Oleoresin	15 MT / Yr.	77.01	140.00
17.	Coconut	Powder	200 Kg / Day	545.00	741.00
		Feni	5000 Bottles / Day	240.00	360.00
18	Sugarcane	Sugar plant	10,000MT of sugarcane crushing /day	50.00	6200.00
		Sugar juice preservation	12,00,000 ltr/yr	32.00	40.00
		Sugar cubes	1000 tones/yr	45.00	56.00
		Sugar candy	900 MT/yr	32.00	38.00
19.	Cashew nut	Cashew beverages & squashes	21 lakh Bottles / Yr.	125.00	140.00
		Cashew feni	1000 Bottles / Day	100.00	115.00
20.	Rice	Poha	10 MT / Day	145.00	170.00
		Milling	5 MT / Day	25.00	30.00
21.	Wheat	Automatic bread/ biscuit plant	600 Kg / Day	155.00	185.00
		Macroni products	50,000 Packets / Day	350.00	400.00
		Extruded products	10 MT / Day	100.00	120.00
22.	Maize	Corn flakes	300 MT / Yr	65.00	80.00
		Popcorn	50 Pkts of 100 Gm / Day	5.00	8.00
		Corn oil	1 MT / Day	85.00	176.15
		Maize starch	100 MT / Day	110.00	187.00
23.	Soya bean	Soya bean Milk & paneer	400 MT / Day	43.00	65.00
		Soya bean meal	2 MT / Day	81.00	102.55
		Soya bean oil	22 MT / Day	325.00	677.74

		Ice-cream	600 Tonns / Yr	32.00	44.00
24.	Honey	Honey processing & packaging	50 Kgs / Day	5.00	10.00
		Solvent extraction plant	15 MT / Day	448.00	550.00
25.	Small millets	Flour plant	10 MT/day	150.00	229.00
		Biscuit	300 mt/yr	76.00	126.00
		Alcoholic beverages	10,000 ltr/day	350.00	487.00
26.	Jute	Jute bag making	200 bags/day	250.00	330.00
		Jute batching oil	100 mt/day	50.00	70.00
		Jute ropes	1,000 kg/day	28.00	35.00
		Laminated jute bags	5,50,000 bags/yr	35.00	40.00
27.	Cotton	Cotton seed oil (Extraction and Refined)	100 mt/day	3200.00	3500.00
		Surgical cotton	129 mt/yr	27.00	30.00
		Absorbent cotton	150 tons/yr	18.00	23.00
		Cotton yarn plant	7 lath ft. of yarn 1 month	180.00	195.00
		Cotton Garments	9000 dozen/yr	7.00	10.00
28.	Mushroom	Cultivation, processing & canning	1000 kg	116.00	135.00
29.	Medicinal & aromatic plants	Fractional distillation of essential oil & medicinal plant	1 TPD	35.00	42.00
30.	Milk	Milks products, Pasteurized milk, butter, cheese & ghee	30,000 lts./day	940.00	1505.00
		Milk cheese	350 kg / day	45.37	63.49
		Milk powder	250 kg / day	17.00	38.00
		Chocolate	500 kg/day	36.00	45.00
		Butter	500 kg/day	16.00	19.00
		Pasteurized milk & cheese	3000 ltrs, milk for process	345.00	504.01
		Paneer (Cheese)	500 kgs / day	5.00	20.00
		Skimmed milk powder	1 ton/day	73.00	102.62
31.	Meat	Broiler chicken	20,000 mt/yr	173.00	185.00
		Buffalo meat processing	5 TPD	143.00	150.00
		Meat extraction	600 tons / yr	63.00	75.00
		Mutton processing	1.5 mt / day	58.00	60.00
		Pork processing	5 tonnes / day	132.00	148.00
32.	Fish	Dehydrated	1 mt / day	130.00	147.00
		Canned	6 lakhs pack of 1 kg dehydrated / yr	32.00	40.00
		Farming	6,00,000 kg fish / yr	78.00	110.00
33	Egg	Egg powder	1 TPD	210.00	225.00

Appendix II

Value added products

Food grain crops	
Rice	Rice Flakes (Poha, Avalakki), Puffed, Flour, Starch (for Textile, Paper and Food Indusry), Rice Bran Oil, Ready to Eat Rice (Retortable Pouches), Papads
Basmati Rice	Area Expansion and Strict Quality Control for Export
Wheat	Flour (Used in Bakery and Confectionary), Pasta Products and Extruded Products
Maize	Monohydrates, Dextrin, Modified Starch, High Fructose Corn Syrup Sorbitol, Furfurol (used in Textile and Pharmaceuticals Industries), Corn Oil.
Small Millets	Flours, Biskits and Other Bakery Products, Malt Foods, Alcoholic Beverage and Starch
Soya-bean	Soya-milk, Yogurt, Ice cream, Paneer, Bread, Oil, Cookies, Pan Cakes, Flour and Granules
Vegetable Crops	
Vegetables	Dehydrated Vegetables, Frozen Vegetables, Canned Vegetables, Pickles, Soup, Ketchup, Paste, Ready to eat vegetables (Retortable Pouches)
Fruit Crops	
Mango	Fruit Bar, Concentrates, Dry Powder, Mango Pickles, Juice, Pulp, Flavour, Kernel Oil, RTS, Frozen Products and Mango Leather
Litchi	Pulp, Juice, Concentrates, Canned Litchi and RTS
Banana	Wafers, Pulp, Flour (Rich Source of Calcium, Iron and Minerals thus used as infant food), Dehydrated Ripe Banana (Figs), Clarified Banana Juice, Powders (used in Ice Creams and Bakery Products)
Guava	Juice, Concentrate Pulp, Jelly, RTS Osmo-dehydrated Fruits
Papaya	Toppings for Bread, Ice creams, Pastry, Custard, Shrikhands etc. Dehydrated, Jam, Papin, and RTS
Grape	Juice, Beverages, Concentrates, Resins, Wine Industry, Canned Fruit
Citrus	Juice, Concentrates, Powders, Oils, Flavours and Citric Acids
Apricot	Dried, Jam, Pulp, Beverages
Walnut	Dried Kernel (used in Confectionary, Bakery and Snacks) and Kernel Oil
Apple	Jam,Juice, Concentrate, Beverages, Frozen Apple & Dehydrated

Flowering plant	
Flowers	Cut Flowers (Domestic and Export), Perfume Industry, Rose oil, Rose water, Gulkand, Beverages and Dies and Colour Industry
Spices	
Spices	Powder, Spice Oils, Oleoresins, Dies and Colour Industry, Food Industry, Pharmaceuticals, Preservatives, Body Care
Medicinal and Aromatic plants	
Medicinal and Aromatic plants	Pharmaceuticals, Dies and Colouring Industry
Plantation crops	
Coconut	Dried Coconut, Coconut Powder, Milk, Cream, Confectionaries, Chips, Oil, Sweets, Vinegar and Coconut Coir Fiber
Cashew Nut	Juice Beverages, Wine Manufacture Fenny, Dry Kernels, Confectionaries and Food Industries, Sweets Making
Areca Nuts	Pan Masala, Leather Industry, Die And Colouring Industry
Rubber	Ribbed Smoked Sheet, Concentrated Latex, Specified and Raw Natural Rubber and Technically Specified Rubber
Others (Fiber Crops, Mushroom & Honey)	
Jute and Mesta	Yarn and Fabric, Packaging and Paper, Fire Fighting Cloths Handlooms And Handicrafts, Wood Substitute, Jute Oil, Phyto- Medicines
Cotton	Fiber, Oil, Animal Feed and Soil Amendments
Mushrooms	Powder, Pickles, Canned, Soup Powders, Chemical Extractions, Cosmetics and Pharmaceuticals
Honey	Cosmetics and Pharmaceuticals