भाकृअनुप
ICAR

VISION 2025

ICAR RESEARCH COMPLEX FOR NEH REGION

UMROI ROAD, UMIAM – 793103, MEGHALAYA

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FOREWORD

Indian agriculture must continuously evolve to remain ever responsive to manage the change and to meet the growing and diversified needs of different stakeholders in the entire production to consumption chain. In order to capitalize on the opportunities and to convert weaknesses into opportunities, we at the ICAR attempted to visualize an alternate agricultural scenario from present to twenty years hence. In this endeavour, an in-depth analysis of the Strengths, Weaknesses, Opportunities and Threats (SWOT) was undertaken to place our research and technology development efforts in perspective so that we succeed in our pursuit of doing better than the best. Accordingly, the researchable issues are identified, strategies drawn and programmes indicated to have commensurate projects and relevant activities coinciding with the launch of the 11th Five Year Plan.

ICAR Research Complex for North Eastern Hills Region was established in the year 1975 at Meghalaya with one regional centre in each of the 6 states of the region to provide technology backstopping for agriculture and allied sector development. The basic mandates were the development of agro-ecological zone specific farming system, screening and development of crop/ animal varieties, technology generation for organic farming, capacity building and providing training/ consultancy services.

Over the years, the Institute has developed and released several improved varieties of rice, tomato, turmeric, maize, brinjal besides developing 8 different farming system models and 6 models of intensive integrated farming system. In the Animal husbandry and fishery sector, the Institute developed a pig variety, introduced broiler rabbit and backyard poultry with improved breed. The Institute is in the process of developing organic food production packages.

The technologies developed in the Institute were disseminated through the 11 KVKs attached to it. Since the economy of the region is agriculture based, the Institute, keeping in view the strength and weaknesses of the region, developed a vision for comprehensive development of agriculture and allied sector.

It is expected that realizing the Vision embodied in the document would further ensure that the ICAR Research Complex for North Eastern Hills Region, Barapani continues to fulfill its mandate to make Indian agriculture locally, regionally and globally competitive. The efforts and valuable inputs provided by my colleagues at the ICAR Headquarters and by the Director and his team at the Institute level for over an year to develop Vision 2025 deserve appreciation.

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and
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March, 2007

Preface

Agriculture and allied sectors are the main sources of livelihood for the people of North Eastern region where rural population constitutes about 82% of the total population. Thus, any attempt to improve agriculture in the region shall have to be based on system wide regional planning keeping in mind judicious conservation and utilization of natural resources.

Over the last three decades the institute developed and demonstrated several farming system alternatives to *jhuming*, released location specific crop and animal varieties along with their management packages and designed ergonomic farm tools and implements for the local farmers. The institute also built capacity to produce desired number of fish fingerlings for identified cold water and ornamental fishes. Location specific intensive integrated farming system models were developed and replicated at similar sites. The Institute is in the process of developing organic food production packages. It has the capacity today to use molecular technique for animal disease and parasite diagnosis and development of transgenic in crop sector. On-farm demonstrations, kissan melas, institute village linkage programmes (IVLP), trainers training etc. were used to disseminate evolved technologies. To improve local competence, the institute also organized several training / skill development programmes for various client groups.

Out of the 4.0 million hectare net sown area in the NE region, nearly 1.3 million hectare suffers from soil acidity and about 1.6 million hectare area is under shifting cultivation. Agriculture is predominantly CDR type characterized by low cropping intensity, subsistence farming and monocropping. Land use pattern is relatively faulty causing loss of large volume of top soil. Farming is mixed type and predominantly rice-based. With the present production level, food grain deficiency in the region is around 1.6 million tones. Similarly, per capita availability of animal products are also very low in the region.

Since the economy of the region is agriculture based, the Institute, keeping in view the strength and weaknesses of the region, developed a vision for comprehensive development of agriculture and allied sector. While strategies for achieving food sufficiency have been pragmatically worked out, the institute also identified some of the newer areas of research *viz.* bio prospecting, water productivity analysis and conservation, precision farming, market intelligence and dynamics, crop diversification into wheat/floriculture, bamboo and fruit tree based agro forestry systems, preparation of soil health card, crop-weather monitoring modules, organic agriculture, action research on farming system, development of protocols for crop and animal disease diagnosis, establishment of grand parent stock based poultry farming, quality control issues like SPS, I/T led information dissemination and gender friendly agri-business based opportunities exploration programmes. The Institute also has developed HRD programmes together with Central Agriculture University to impart quality post graduate teaching in the areas of natural resource management.

Abbreviations used

EXECUTIVE SUMMARY

ICAR Research Complex for NEH Region established in the year 1975 at Meghalaya with 6 regional centers has been providing research back up to agriculture and allied sector development in 7 states on North Eastern Region including Sikkim. In the last 5 years itself, the institute gave the region 7 rice varieties, 3 tomato varieties and one turmeric variety. In addition, it has readied itself to deliver 2 varieties of rice, 4 varieties of maize, 02 of brinjal, 02 of tomato; one of pulse and one of french bean together with the crop varieties, agronomic packages for both developed and identified varieties were given. The institute also developed an effective management package for declined Citrus orchards in addition to identifying one acid lime variety for the region.

In the field of animal science and fishery sectors, the institute not only identified and popularized backyard poultry, artificial insemination in pig, economic rations for different livestock and poultry, ornamental fish wealth of the region, practices for cold water fish culture but also successfully started producing the seed material for the identified strains/varieties of animals and fishes. The institute also equipped itself with the facilities to conduct biotechnological and biochemical research in both crops and animals and utilizing this facility, it could develop rice variety through anther culture as well as deliver animal disease diagnostic services based on molecular technology having earlier perfected micro propagation technique of quality planting material through tissue culture.

Waking up to the challenge of natural resource conservation and the shift needed from chemo-centered to organic-based agriculture, the institute not only developed different farming system models to suit the varying agro-ecological situations of the region but also developed models of integrated intensive farming systems to benefit from the complementarities of crop-livestock-fishery systems both for household food and nutritional security and generating within farm resources so as to reduce the dependence on off farm inputs to promote organic agriculture. Together with this attempt, different agro-forestry models were also introduced to effectively utilize the wastelands.

Since the region has the involvement of around 48% women in agriculture and allied sector, the institute developed improved farm tools and implements to reduce drudgery of women as well as to make the production system energy efficient. As per the present day need of high value low volume crop production the institute, besides identifying high value crops, also introduced protected cultivation techniques based on low cost poly house design.

The institute did not confine itself to technology generation only but also disseminated the technological advantages to the client groups through a sound extension mechanism involving even the scientists in technology assessment and refinement programmes. The overall output of the institute both in terms of technology generation and its delivery during the period has been well recognized by the user groups in the region.

The various technologies and information generated by the Institute are disseminated to the farmers through various programmes like on-farm demonstration, kisan melas and Institute-village-linkage programmes. The various integrated farming system models which have been developed by the Institute are tested in the farmer’s field at various locales of the region through watershed development programmes. The institute has close linkages with the regional universities to accommodate post graduate level students to conduct their research in the

institutes farm and laboratories. The Institute also extends its facilities to Post-graduate and Ph.D. students working in various disciplines of agriculture and allied fields as a step to ensure Human Resource Development in the region. The Institute also has many collaborative projects with national and international agencies. Short-term training programmes as well as long-duration summer and winter schools are regularly organized for training various end users including farmers, researchers, officials of the line departments, NGOs, Self Help Groups (SHGs), students etc. for capacity building and skill development.

1.0. PREAMBLE

The idea to establish an ICAR Institute in the North Eastern Hill region was conceived at a seminar on 'Research and Training Needs in Agriculture and Animal Husbandry of the North East Himalayan Region' held in the Central Library Hall, Shillong on 23rd – 26th October, 1973. Organized by ICAR, the seminar was inaugurated on 23-10-1973 by the Union Minister of Agriculture, Late Fakhruddin Ali Ahmed and was attended by distinguished delegates from all over India. During the deliberations, the potentials as well as the long-felt need for research and development of **Agriculture, Animal Husbandry** and **Fisheries** in the North –Eastern Hill Region were highlighted. In the plenary session, under the Chairmanship of Dr. M.S. Swaminathana, the then Director-General, ICAR, New Delhi, it was concluded that an ICAR unit should be established at Shillong to take up research and development needs of the North Eastern Hills Region of the country comprising of Arunachal Pradesh, Manipur, Mizoram, Meghalaya, Nagaland, Tripura and the hill tracts of Assam like North Cachar and Mikir Hills.

The Government of India accepted the recommendations of the seminar and a project to establish Agriculture and Animal Science Research Centres in North Eastern states was included Council's IV Fiver Year Plan itself. However, the project could be implemented in V Plan only in the form of the ICAR Research Complex for NEH Region Shillong, which came into being on the 9th January 1975, when Dr. D.N. Borthakur joined as its first Project Director.

Soon after, Dr. M.S. Swaminathana, the then Director-General, ICAR New Delhi, visited the region from May 5 to 11, 1975 to assess and specify the agricultural research and training needs of the NEH region. He also extended his good office to finalize the locations and immediate infra-structural needs of the Centres. Regarding the role of Assam Agricultural University, Jorhat, he suggested that the University would train up students form NEH region and will also bear the administrative responsibility to establish the Research Centre in Karbi Anglong (former North Cachar and Mikir hills) district of Assam. Dr. Swaminathana also indicated the research priorities and strategy for different areas of the North-Eastern Hill region, which he summarized into three major groups as follows:

i. Development of alternative farming systems to replace the practice of *Jhuming* (shifting cultivation).
ii. Making up the gap in the food needs of different States/U.T.s by introducing improved and adaptable varieties of crops; efficient management of soil, water and pests and increasing the animal production by adopting scientific system; and
iii. Increasing the rural income and employment through developing high-value low-volume produce/products, which can be sold at a competitive advantage outside the region.

1.1. The Region and its Agriculture :

The northeastern region comprising eight states *viz*., Assam, Arunachal Pradesh, Meghalaya, Manipur, Mizoram, Nagaland, Tripura and Sikkim has a total geographical area of 262180 Km^2 which is nearly 8% of the total area of the country with more than thirty nine million populations. 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 2000mm accounting for around 10% (42.50 mhm) of the country's total precipitation of 420.00 mhm. 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 the influence of high rainfall. The soils are, however, rich in organic matter. The depth of the soil varies from shallow in inceptisols and antisols 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 (11%) 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 mhm out of 42.5 mhm 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 surface flow, 1.82% through surface lift and 0.14% through groundwater lift irrigation. Farmers also use an indigenous 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 base partly due to benefiting from the complementarities and partly due to meeting their animal protein requirement as most of the population (almost 100% tribal) is non-vegetarian. With this production practices, the region produces a total of 5.8 million ton of food grain against a

requirement of around 7.40 million tons. The deficiency is, therefore, around 1.6 million tons 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, 9.36kg, 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 have a base on system wide and eco-regional planning of agriculture sector 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, add value to the produce and their disposal /sale management shall be of paramount importance.

In the light of the above scenario, present vision document has been prepared keeping in view the Strength, Weaknesses, Opportunities and Threats to support the population dependent on agriculture and allied sector for their sustainability, profitability as well as poverty reduction.

1.2. An Analysis of the Strength and Weaknesses of the 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/beels : 1.43
    - Ponds : 0.41
    - Paddy cum fish culture : 0.03
    - 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 : 21.03 million
    (100% Mithun, 28.22% Pig and 24.61% Yak of the country)
  - Total Poultry : 36.46 million
  - Fish germplasm including Ornamental fish : 347 species
  - Agroclimatic zones : 06
    - Alpine zone : More than 3500 masl
    - Temperate and sub-alpine zone : 1500 – 3500 masl
    - Sub-tropical hill zone : 1000 -1500 m asl
    - Sub-tropical plain zone : 400 – 1000 m asl
    - Mild-tropical hill zone : 200 – 800 m asl

- Mild-tropical plain zone : 0 – 200 m asl

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 3-4 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 and Management.
- Agro-forestry intervention particularly in classified waste lands/marshy lands and permanent fallow.
- Conservation and utilization of bio resources through conventional and biotechnological interventions.
- 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.

1.3. Physiography of the Region:

Physiography of North East India can be divided into three regions *viz.* Meghalaya Plateau, the North eastern Hill and basin of the Brahmaputra Valley. The first two accounts for 78% of the region. Based on the topography, rainfall and temperature, the region has been divided into following three categories:

- Himalayan Hills comprising of Sikkim and Darjeeling district of West Bengal.
- NE Hills and plains comprising of Arunachal Pradesh, Hill districts of Assam, Meghalaya and Nagaland.
- Southern hills and valleys comprising of Manipur, Mizoram and Tripura.

1.4. Climate and Rainfall:

The region geographically comprises of extensive network of rivers, valleys and hills. The weather in the North Eastern region does not follow the pattern as observed in other places and show large spatial and temporal variability due to the presence of hill and mountain ranges on the synoptic system. The region is climatically classified as Sub-tropical Humid in general. The South West Monsoon is the most dominating factor due to which the region receives very high rainfall during the monsoon period. Average annual rainfall is 150-250 cm, which is almost 60-65% of the total annual rainfall. Because of high rainfall received, the climatic variability is less than 15% for the entire region. The region also receives considerable amount of rainfall during pre-monsoon (March –May) and post monsoon (October-November) periods due to localized low pressure belts and North East monsoon, respectively. The annual maximum temperature ranges from 10-20^{o}C during winter and 25 – 35^{o}C during summer season over different places. The annual minimum temperature ranges from 5 – 8 ^{o}C during winter and 15 – 25^{o}C during the summer months. The average bright sunshine hours received in the NE region is lowest in the country (2- 5 hours during monsoon and 7 -8 hours during winter). The range of average wind speed is 2 – 10km/h only. The average relative humidity of the region remains in the range of 60 -80% for most of the period of the year. The average annual potential evaporation is 140 – 160 cm over most part of the NE region.

1.5. Soil status :

Soils of north-eastern hill states have developed *in situ* on various types of rocks. The dominating parent materials are gneiss and granites, underlined with chlorite-quartz schist. Geologically the north-eastern region consists of sandstone, silt stone, shale conglomerates and limestones. In some places of Meghalaya and Arunachal Pradesh, granite, gneiss, phylites and quartzites are also common. Tripura has sedimentary rocks, which range in age from Miocene to loosely consolidated sediments of recent origin. The alluvial soils of Pasighat (Arunachal Pradesh) and Agartala (Tripura) are dominated by illite, kaolinite. Kaolinite and illite are dominant in the soil of Upper Shillong, Nayabanglow and Byrnihat of Meghalaya, which are developed on quartzite. Mica and chlorite with variable quantities of vermiculite, kaolinite, quartz and feldspars dominate the clay mineralogy of Sikkim soils.

The soils of the region are broadly represented by four groups, *viz. Inceptosols, Ultisols, Entisols* and *Alfisols*. Soils are usually rich in organic matter and are acidic to strongly acidic in reaction. It is now well documented that soil acidity leads to deficiency of some essential plant nutrients as well as creates elemental toxicity thereby adversely affecting the crop growth. The optimum pH congenial for nutrient availability to crop plants remains non-existent in acid soils. It is indicated (Fig. 1) that 95% of soils of NE states excepting Nagaland (77%) are acidic in reaction. Majority of the acid soils in the region have pH below 5.6 and remaining between 5.5 and 6.5. North East India has, in diversified climatic environs, the largest stretches (Fig. 2) of acid soils with a variation in pH from 4.0 – 6.8.

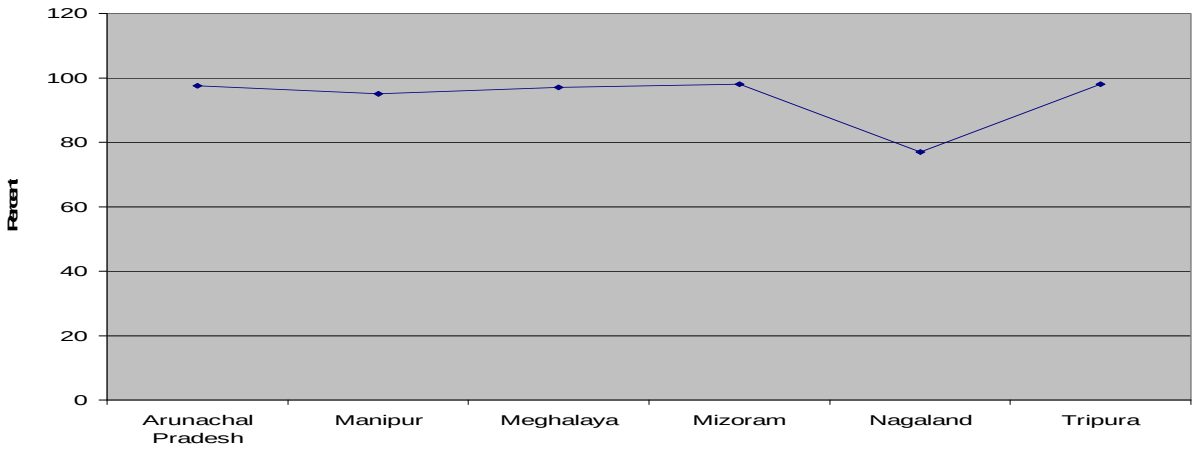


Fig. 1: Distribution (%) of acid soils

The soils of this region are rich in total N due to presence of high amount of organic matter. The content of organic matter and all forms of N and C:N ratio tend to increase with elevation. The soils are deficient in available phosphorous. The reason of low availability of P in the soils of NEH Region is high content of exchangeable aluminium.

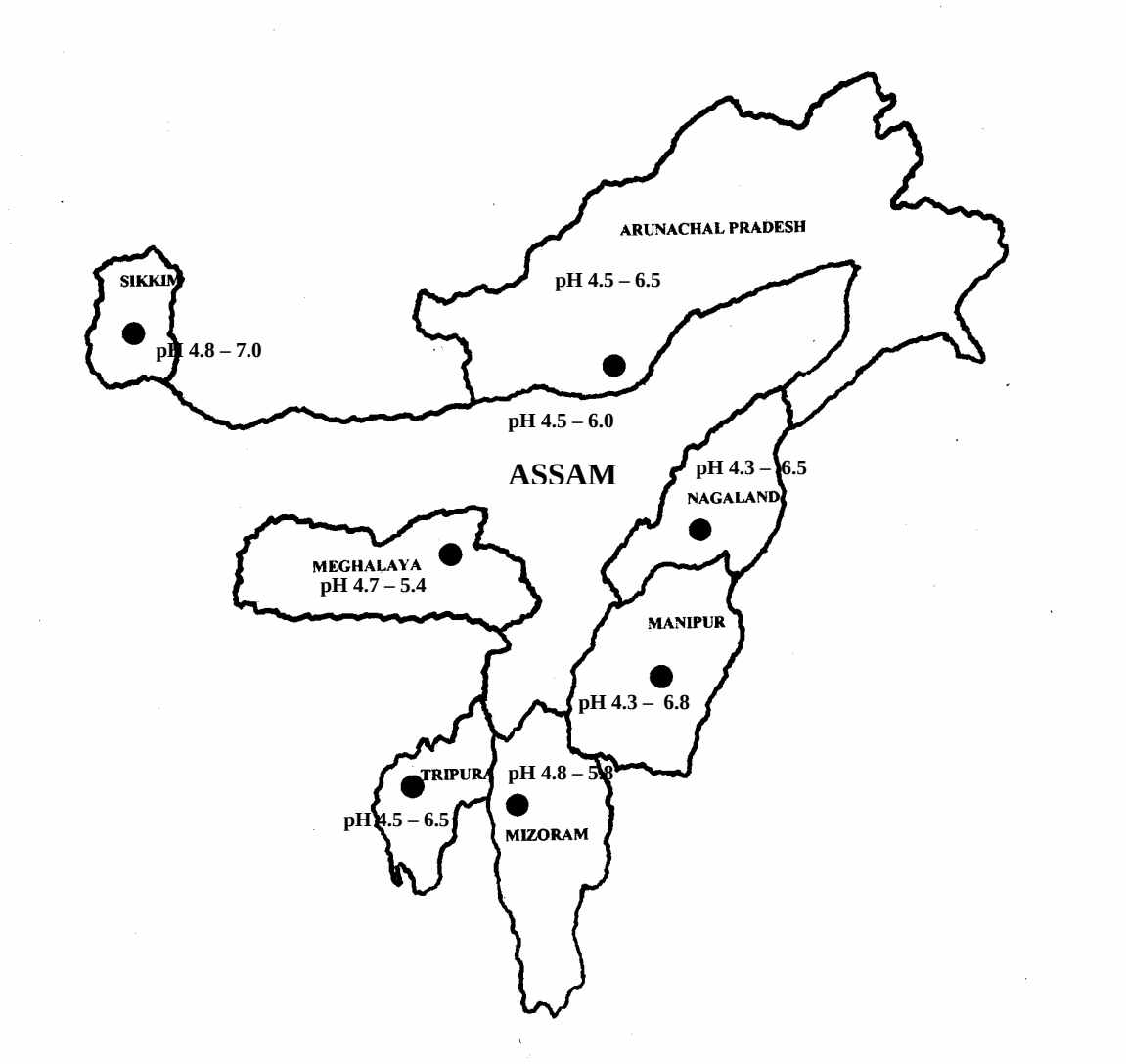


Fig. 2: Soil pH map of North east India.

1.6. Land Use Classification:

Statewise land use classification is given in Table 1. It will be seen from the Table that out of a total reporting area of 219.68 lakh hectare net sown area is 39.2 lakh hectare with a total of 44.70 lakh hectare area not available for cultivation.

Table 1. : Land Use Classification in N.E.R. 1996 & 1997-1998 (Thousand Hectares)

					Not available for cultivation			Other uncultivable land excluding fallow land				Fallow Land	
State	Geogra-phical area	Year	Reporting area for land utilisation	Forest area	Area put to non agricultural uses	Barren and uncultivable land	Total of col. (6+7)	Permanent pastures and other grazing land	Cultiv-able waste land	Others	Current Fallows	Fallow Land other than Current fallows	Net Area sown
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Arunachal Pradesh	8374	1996-97	5495	5154	$	48	48	(n)	(n)	44	28	36	185
		1997-98	5495	5154	$	48	48	(n)	(n)	44	28	36	185
Assam	7844	1996-97	7850	1930	1045	1448	2493	170	87	243	114	69	2744
		1997-98	7850	1930	1045	1448	2493	170	86	243	110	67	2751
Manipur	2233	1996-97	2211	602	26	1419	1445	(n)	(n)	24	-	-	140
		1997-98	2211	602	26	1419	1445	(n)	(n)	24	-	-	140
Meghalaya	2243	1996-97	2241	935	85	139	224	-	473	159	69	165	216
		1997-98	2241	932	86	141	227	-	482	161	68	164	207
Mizoram	2108	1996-97	2108	1598	-	65	65	-	174	-	-	162	109
		1997-98	1561	863	62	-	62	-	69	130	103	83	109
Nagaland	1658	1996-97	1538	863	61	-	61	-	70	129	105	85	225
		1997-98	1561	863	62	-	62	-	69	130	105	83	251
Tripura	1049	1996-97	1049	606	133	(i)	133	(n)	1	27	4	1	277
		1997-98	1049	606	133	(i)	133	(n)	1	27	4	1	277

Note : $ included under the head‘Barren and unculturable land’. (n) included under the head “ Land under miscellaneous trees crops and groves etc. (i) included under the head “ Area put to non agricultural uses” Source : Ministry of Agriculture, Deptt. Of Agriculture and Co operation (Directorate of Economics & Statistics)

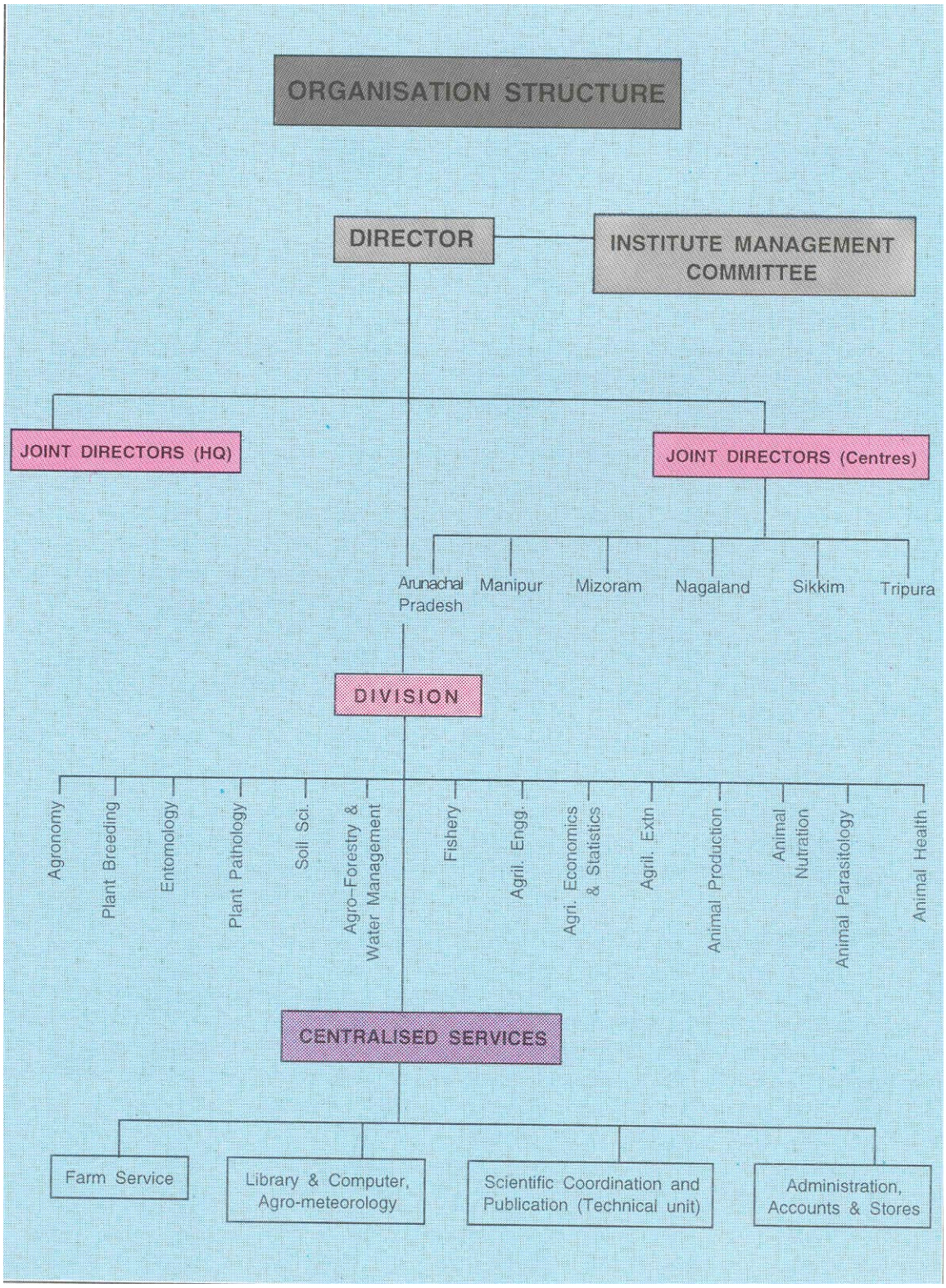
Table 2. : Area, production and yield of major food grains and decadal growth

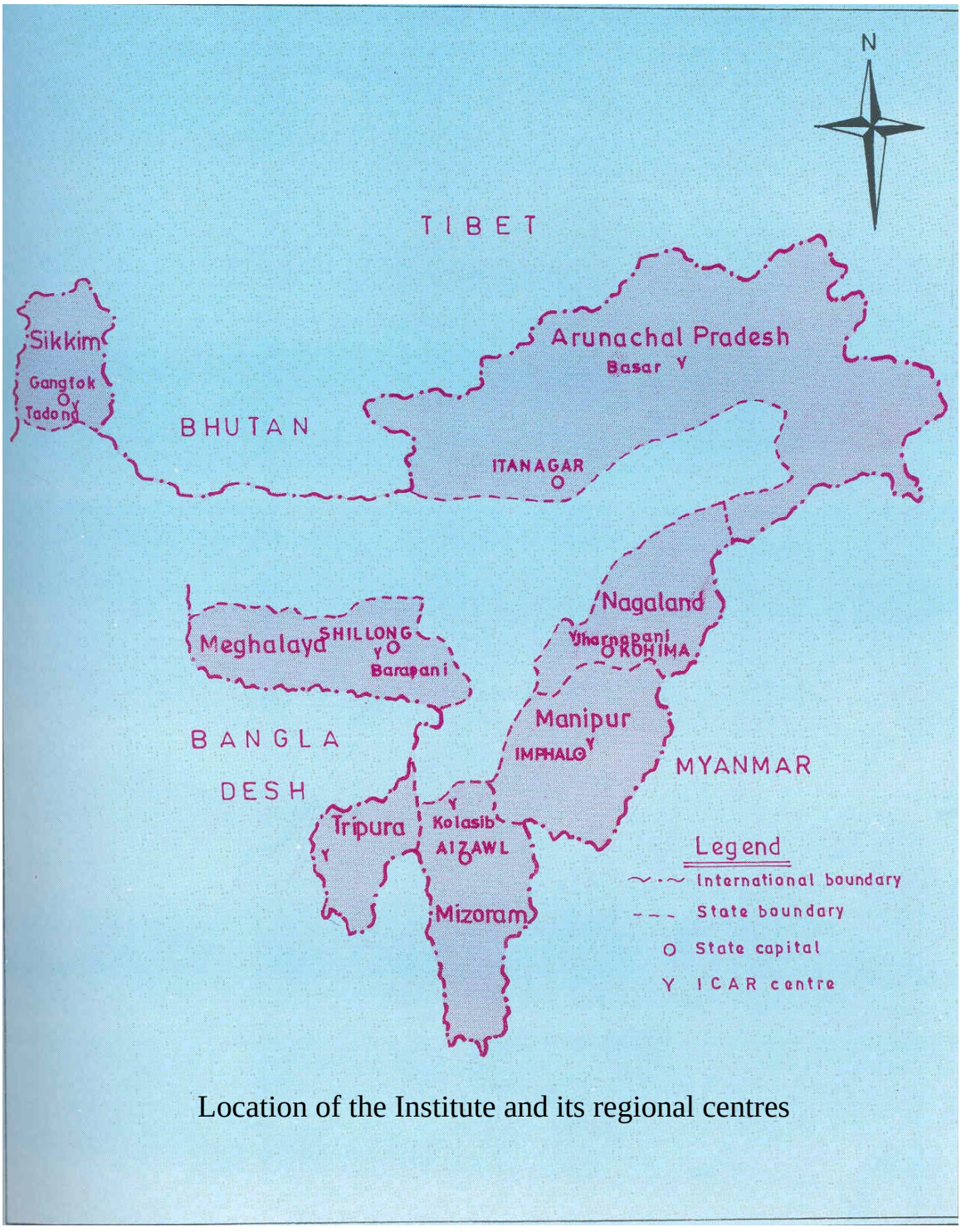
State	1980 – 81			1990 – 91			2000 - 01				
	Area (Lakh ha)	Produc-tion (Lakh MT)	Yield Kg/ha)	Area (Lakh ha)	Produc-tion Lakh MT	Yield (Kg/ha)	Area (Lakh ha)	Production (Lakh MT)	Yield (kg/ha)	Percent increase/decrease of production in 1990-91 over 1980-81	Percent increase/decrease of production in 2000-01 over 1990-01
Arunachal Pradesh	1.25	1.31	1051	1.83	2.14	1173	1.84	2.03	1103	63.36	-5.14
Assam	25.21	27.06	1073	27.19	34.42	1226	28.88	41.67	1443	27.20	21.06
Manipur	2.01	2.92	1449	1.62	2.85	1763	1.64	3.78	2305	-2.40	32.63
Meghalaya	1.24	1.55	1245	1.33	1.53	1147	1.31	2.03	1550	-1.29	32.68
Mizoram	0.33	0.35	1045	0.59	0.77	1296	0.61	1.24	2033	120.00	61.04
Nagaland	1.23	1.05	851	1.70	1.97	1161	2.11	2.77	1313	87.62	40.61
Sikkim							0.76	1.03	1355		
Tripura	2.98	4.03	1350	2.89	5.15	1783	2.54	5.23	2059	27.79	1.55
NE Total	34.27	38.26	1116	37.14	48.83	1315	39.69	59.78	1506	27.63	22.42
All India	1266.67	1295.89	1023	12.75.18	1762.30	1392	1197.83	1959.20	1636	35.99	11.17
%share of NE	2.71	2.95	93*	2.91	2.77	-77*	3.31	3.05	-130*		

1.7. The Institute

The institute is the first of its kind set up by ICAR, which encompasses all the disciplines of agriculture, horticulture, animal sciences, agricultural engineering, agroforestry, fishery and social sciences to cater to the research needs of the tribal areas of NEH Region including Sikkim. The headquarters of the institute is located in Meghalaya (Barapani), while its regional centres are located at Basar (Arunachal Pradesh) Imphal (Manipur), Kolasib (Mizoram), Jharnapani (Nagaland), Lembucherra (Tripura) and Gangtok (Sikkim). Besides, the Institute has twelve Krishi Vigyan Kendras (KVKs) attached to different centres for providing on/off campus training to the practising farmers, school dropouts and farm women in the field of agriculture and allied sectors. A Trainers' Training Centre has also been established at Jharnapani (Nagaland) to cater to the training needs of the entire region. Considering the entire NEH Region as one unit, the research centres have been so located as to represent the varying altitudes (60-1800m above msl) and agro-climates of the region. The research findings of the institute at different centres can thus be utilized for specific altitudinal range and agroclimatic conditions in component states. The headquarters at Barapani has now been housed in spacious new building with well-equipped laboratories and administrative wing.

The current organizational setup of the Institute is given in the next page:


ORGANISATION STRUCTURE
DIRECTOR
INSTITUTE MANAGEMENT COMMITTEE
JOINT DIRECTORS (HQ)
JOINT DIRECTORS (Centres)
Arunachal Pradesh
Manipur
Mizoram
Nagaland
Sikkim
Tripura
DIVISION
Agronomy
Plant Breeding
Entomology
Plant Pathology
Soil Sci.
Agro–Forestry & Water Management
Fishery
Agril. Engg.
Agri. Economics & Statistics
Agril. Extn
Animal Production
Animal Nutration
Animal Parasitology
Animal Health
CENTRALISED SERVICES
Farm Service
Library & Computer, Agro-meteorology
Scientific Coordination and Publication (Technical unit)
Administration, Accounts & Stores



Location of the Institute and its regional centres

2.0.MANDATE

The Institute when established had the following mandates

- To provide alternative farming system to replace *jhumming* (shifting cultivation) to improve its productivity.
- To develop each area according to its potentialities through research on food crops, fruits vegetables and other economic crops and animals.
- To collect indigenous, cultivated and wild germplasm in crops and animals – their evaluation and utilization for improvement and preservation.
- To raise the level of local competence to scientific manpower.

The mandate of the institute as approved by ICAR during VIII Plan

- To improve and develop sustainable farming systems for different agro-climatic and socio- economic condition of the region.
- To improve crops, livestock, fishery and to impart training for development of local competence for management of resources to enhance agricultural productivity.
- To maintain, analyze and project data base resources for perspective planning.
- To collaborate with the State Departments of the region for testing and promotion of improved farming technologies.
- To act as a repository of information on different farming systems of the region.
- To collaborate with national and international agencies in achieving the above objectives.
- To provide consultancy.

QRT for the period between …… and …… suggested incorporation of the following 2 mandates additionally which were also approved by the council.

- Research on organic agriculture (for Sikkim state)
-

3.0. GROWTH

INFRASTRCTURE

HEAD QUARTER

3.1.1.1. Laboratories: In the initial stages of its establishment, there were makeshift laboratories in rented buildings at all the centres and headquarter of the institute. With the completion of institute's own buildings, laboratories of all discipline were established. A Biotechnology laboratory equipped with sophisticated instruments for rice and horticulture was also added. The institute today has the following laboratories :

Crop Science	Animal Science	Others
Agronomy Agroforestry Soil Science Water Management Entomology Palnt Pathology Horticulture Plant Breeding	Animal Production Animal Health Veterinary Parasitology Poultry Science	Fisheries Agricultural Engineering Agricultural Economics Agricultural Extension Agricultural Technology Information Centre

3.1.1.2. Library: The library made a very modest beginning during its first year in 1975 with only 8 books and 24 Indian Journals. Today the library has a total of 19,213 books and it subscribes 102 Indian and 62 foreign journals. It also has 205 news letters and 11,052 back volumes of journals. To promote the Hindi language, the library procured 1506 Hindi books, 40 popular journals and 14 newspapers. The growth of the library budget rises to 20.0 lakhs in 2006 from Rs. 1,200 in 1975. Recently the library has acquired data bases like AGRIS from INSDOC. Reprints and reports published by the institute are supplied by the library on demand in addition to a regular clientele on the mailing list which is constantly upgraded. The library has been connected with NIC network recently. Besides providing SDI services to the scientists of the institute by accessing various national data bases, it is being equipped with e-journals.

3.1.1.3. Farms: When the Complex came into being in 1975, all the field experiments were conducted in State Govt. and private farms, till land at Barapani was acquired from the Govt. of Meghalaya in 1980. The 101 ha area of the farm (mostly hilly terrain) is about 22km away from Shillong city. The land has mild to steep hill slopes and flat valleys which provides almost all kinds of hill topography. After a topographical survey, development plans for areas for each discipline was

prepared so that the entire farm could come up on the scientific principle of watershed management. Bench terracing on mild slopes, contour bunds and half moon terraces on steep hills were developed for conservation of soil and water. Trenches and earthen dams were made to harvest the run-off water. All these development were completed by the end of 1981 and thereafter, all experiments and trials were shifted to the Barapani farm.

3.1.1.4. Buildings: The Complex Headquarters made a humble beginning at the rented buildings, and buildings provided by the State Governments. Private buildings had to be hired to accommodate the fast expanding laboratories and offices. In Shillong, as many as ten buildings had to be hired to meet the requirement. With the completion of the office-cum- laboratory buildings of the institute at Barapani, the entire activities of the Complex started functioning at its own buildings from 1992. Besides the office-cum-laboratory buildings, staff quarters have also been constructed to accommodate around 35% of the staff.. The Complex also has two spacious and well furnished conference hall for holding meetings, seminars etc. besides an engineering workshop, videoconferencing room, committee room, staff canteen and one ATIC building.

REGIONAL RESEARCH STATIONS

3.1.2.1. Basar, Arunachal Pradesh

Regional Research station, Basar is spread over 40.5 ha land at Gori research Farm. It has moderately furnished laboratories and staff quarters with a small library with more than 500 books and 18 journals. The center has 2 jeeps, 1 tractor, one truck and one power tiller . One KVK is attached to the centre to disseminate evolved and tested technologies to the user group.

3.1.2.2. Imphal, Manipur

The Regional Station, Imphal has its own campus at Lamphelpat comprising of residential quarters, laboratory buildings, KVK buildings and farms. The farm area is spread over 108 ha of land. The library of the center has more than 1200 books, 250 back volumes and 24 Indian and foreign journals. It has 1 bus, 2 jeeps, 2 tractors and 1 power tiller. The centre has almost all the equipments as per the strength of the scientists. It has common instrumentation centre where equipments like PCR, AAS etc. are used by the scientists. It also has a plant health clinic besides fish and poultry hatcheries.

3.1.2.3. Kolasib, Mizoram

The area of the farm at Mizoram Centre is 32 ha located at altitudes varying between 750-800 m. The whole set up with 16 quarters and an office-cum-laboratory buildings was handed over to the ICAR by Govt. of Mizoram in 1977. The library has procured about 300 books and subscribed 12 journals. It has 2 jeeps and a power tiller for agricultural operations.

3.1.2.4. Jharnapani, Nagaland

Nagaland ranges in altitude from 194-3840 m above msl and therefore, when the center was envisaged for the state, two different stations were planned one at Yiesmyoyng for taking up the problems of high altitude areas. However, due to lack of even the minimum facilities, the Yiesmyong station could not come up and, therefore, ultimately shifted to Jharnapani. The farm has an area of 84 ha. The station has now its own campus with office-cum-laboratory buildings, staff quarters and a trainees hostel. The library has the present stock of over 2000 books and more than 250 journals. The center has 2 jeeps, 1 bus, 2 tractors and 3 power tillers. The centre also has conference hall, guest house and the required equipments for the scientists.

3.1.2.5. Tadong, Sikkim

After the merger of Sikkim as a State of India, the center was established in 1976. The center has a farm area 21.2 ha in an altitude of 1200-1400 m. The station has well furnished office-cum-laboratory buildings, residential quarters and a scientists' dormitory. Other facilities included are a small library, one bus, two jeeps, audiovisual aids and a staff welfare club.

3.1.2.6. Lembucherra, Tripura

The center has a farm area of 48 ha comprising mostly of tilla land with only about 2 ha of low land. It has a good office-cum-laboratory building, some staff quarters, library, one bus, two jeeps, one tractor and two power tillers.

KVKS

Twelve KVKs are now attached with the Institute

KVK	LOCATION	STATE
KVK	Basar	Arunachal
KVK	Imphal	Manipur
KVK	Churachandpur	Manipur
KVK	Chandel	Manipur
KVK	Tamenlong	Manipur
KVK	Tura	Meghalaya
KVK	Barapani	Meghakaya
KVK	Jharanapani	Nagaland
KVK	Okha	Nagaland
KVK	Ranipool	Sikkim
KVK	Birchandramanu	Tripura
KVK	Hailakandi	Assam

3.1.4. ANY OTHER

The institute has a Scientific Co-ordination and Publication Unit for co-ordinating scientific and publication activities, a Medical Unit, Estate Unit, Instrumentation Unit,

Engineering Workshop, Vehicle Cell and Construction Cell for self reliance as far as possible.

3.2. BUDGET (IN LAKHS RUPEES)

Plan	Period	Plan	Non-plan	Others	Total
1.	V	78.18	-	-	78.18
2.	VI	1001.27	516.71	-	1517.98
3.	VII	861.00	1338.77	106.71	2306.48
4.	Annual [1990-91&1991-92]	526.00	882.00	68.00	1476.00
5.	VIII	1300.00	3839.00	556.55	5695.55
6.	IX	1869.00	5466.58	-	7335.58
7.	X	3270.50	6942.43	1888.63	12101.56
8.	XI	5000.00			
% increase		**4183.00 (7 over 1)**	**1344.00 (7 over 2)**	**1770.00 (7 over 3)**	**15479.00 (7 over 1)**

3.3. MANPOWER

The present approved discipline-wise scientific strength is given below:

Sl. No	Discipline	Main Institute				Centres				
		PS	SS	S	T.	PS	SS	S	T.	Total
1.	Entomology	1	1	2	4	-	1	8	9	13
2.	Pl. Breeding	1	2	6	8	-	2	7	9	17
3.	Pl. Pathology	1	1	2	4	-	3	9	12	16
4.	Soil Science	1	2	4	6	-	4	6	10	16
5.	Horticulture	1	1	6	8	-	3	12	15	23
6.	Agronomy	2	2	4	8	-	3	6	9	17
7.	Pl. Physiol.	-	1	1	2	-	-	-	-	2
8.	SWE	1	3	3	7	-	-	1	1	8
9.	FMP	-	1	1	2	-	-	-	-	2
10.	PHT	-	1	2	3	-	-	-	-	3
11.	Ag. Econ.	1	1	2	4	-	-	1	1	5
12.	Ag. Extn.	-	1	2	3	-	-	3	3	6
13.	Forestry	-	1	-	1	-	-	2	2	3
14.	An. Prod.	1	2*	4	7	-	2	6	8	15
15.	An. Health	1	1	3	5	-	2	4	6	11
16.	An. Nutrin.	1	1	2	4	-	-	4	4	8
17.	Vety. Para.	-	1	2	3	-	-	2	2	5
18.	Fishery	1	1	1	3	-	-	5	5	8
19.	Ag. Stat.	-	-	1	1	-	-	-	-	1
20.	Poultry	-	1	1	2	-	-	2	2	4
21.	Computer	-	1	-	1	-	-	-	-	1

22.	KVK	-	1	-	1	-	5	-	5	6
23.	TTC	1	-	-	1	-	-	-	-	1
Total		**14**	**26**	**49**	**89**	**-**	**25**	**78**	**103**	**192**

PS: Principal Scientist, SS: Senior Scientist, S: Scientist, T: Total.

Sanctioned staff strength is furnished below:

Plan period	Scientific	Technical	Administrative	A & S
1. V	186 (123)	179(89)	77(63)	67(64)
2. VI	244 (112)	349(89)	156(97)	229(127)
3. VII	251(113)	327(253)	167(118)	237(196)
4. VIII	192(92)	326(254)	167(120)	239(207)
5. IX	198 (141)	326(289)	150(126)	134(127)
6. X	202(118) + 4(0) KVK	353(289)	143(132)	129(128)
% increase (6 over 1)	8.6	97.2	85.7	92.5

4.0. SCENARIO

4.1. Regional Scenario

4.1. 1. Decadal Growth in Area, Production and Productivity of Major Food Grains:

It would be seen from Table 2 that area, production and productivity of major food grains in the region recorded a growth of 13.65, 34.00 and 25.89% between 2000-01 and 1980-81. Considering the fact that only 12% of the reported area is sown in the region, there is scope to increase the area under cultivation and thereby the food production.

Projection study on production and requirement of food grains in the coming decades in north eastern states was carried out to estimate the demand-supply gap of food grains. State-wise compound growth rates (CGR) of food grains production (includes rice, wheat, maize and pulses) were estimated by using time series data for a period of 1984-85 to 1997-98 (Basic Statistics of NER, 2002). Requirement of food grains was estimated by multiplying the recommended amount of per capita food grains with the population base at that point of time (say, 2010, 2015 etc.). The population base was estimated through CGR for which the same time series data was used (Table 3)

Table 3 : Population (2001) in lakhs :

Population	**States**							
	AP	**AS**	**MN**	**MEG**	**MIZ**	**NGL**	**SIK**	**TRP**
Male	5.74	137.87	12.07	11.68	4.59	10.41		16.36
Female	5.17	128.50	11.81	11.38	4.31	9.47		15.55
TOTAL	10.91	266.38	23.88	23.06	8.91	19.88		31.91
WORKERS :								
i) Cultivators:								
Male	1.37	26.61	2.77	2.50	1.28	2.71		2.21
Female	1.44	10.8	2.15	2.06	1.24	2.72		0.90
TOTAL	2.81	37.41	4.92	4.57	2.53	5.43		3.11
ii) Agril. Workers								
Male	0.10	8.49	0.53	0.90	0.13	0.18		1.63
Female	0.08	4.40	0.67	0.82	0.14	0.16		1.14
TOTAL	0.18	12.89	1.20	1.72	0.27	0.34		2.78

Total Population of North Eastern Region : 39.00 million
Total Population of India : 1252.51 million
% NE : 3.11%

Based on the present population and projected Cumulative growth rate (CGR), food grain production and requirement up to 2025 is presented in Table 4.

Table 4: Projected food grains production and requirement in North eastern states

States	CGR (Prod.)	Production*					Requirement*				
		2005	2010	2015	2020	2025	2005	2010	2015	2020	2025
Arunachal Pradesh	1.30	217	231	246	263	280	220	246	276	310	348
Asam	2.58	4733	5375	6105	6934	7876	5234	5703	6214	6770	7377
Manipur	1.96	416	459	505	557	613	486	554	630	718	817
Meghalaya	1.19	215	229	243	257	273	469	534	608	692	787
Mizoram	10.37	-	-	-	-	-	-	-	-	-	-
Nagaland	6.57	381	524	720	990	1360	443	565	720	917	1169
Tripura	2.25	584	653	730	816	911	620	667	717	771	829
All	-	6546	7471	8549	9817	11315	7473	8269	9165	10178	11326

* Thousand tons

4.1.2. Where the region stands?

(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)
Fruits	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	49.7
Milk	1.06	2.14	50.50
Egg (million nos.)	902.09	7027.21	87.20
Fish	0.21	0.38	55.26

4.1.3. Why such a situation ?

The above scenario is basically due to the following constraints:

(A) Environmental Constraint

- **Acidic soil-** low availability of P. Also has high concentration of Fe and Al and low Zn.
- **High rainfall and humidity-** Harbors pests, diseases and weeds.
- **Shifting cultivation-** Both strength as well as weakness.
- **Land tenure system-** Lack of sense of belongingness to the land due basically to absentee land ownership as well as allotment of land for cultivation on time scale basis.

(B) Technical Constraint

- **Seed and planting material.**
- **Disease and pest management.**
- **Farm mechanization.**
- **CDR type of agriculture.**
- **Constraints of Various Kinds in Transfer of Technology.**

(C) Physical Constraints

- **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.

(D) Economic Constraints

- **Lack of commercialization-** Leading to small-scale household production system.
- **Limited credit flow** - The farmers do not have easy access to credit flow as yet for which they are, many a times, compelled to continue small scale cultivation practices.

- **Market constraint -** Most of the places in the region do not have proper market to dispose off the produce. The result is that the farmers are forced to resort to distress sale of their produce.

4.1.4. Likely Scenario if the situation is allowed to be continued as above:

- Current loss of top soil @ 46.0 t/ha and water drainage @ 41.5 mhm, if not checked, shall limit the capacity of the land even to retain the current productivity pattern not to speak of increasing the productivity to bridge the demand – availability gap shown above.
- This will lead to loss of interest in agriculture especially among the youth with resultant increase in rural-urban migration as well as preference for non-farm sector.
- The region shall also remain dependent on other states of the country for food which might also record an increase in insurgency related activities.
- Unless the agriculture in the region is made remunerative, agrarian economy shall be shattered thereby increasing rural poverty.

4.2. National Scenario :

- Overall agricultural growth in the country has been showing a steady decline since 1980s and the growth in X Five Year Plan is expected to be only around 1.8%.
- The decline in growth is basically due to the fatigue in green revolution belt which has reached production plateu.
- In order to achieve 10% growth in economy, agriculture sector during XI and subsequent plan periods needs to grow at a minimum rate of 4% per annum.
- In order to achieve this, productivity in 63% rainfed areas of the country has to be doubled with concurrent steps to increase area horizontally, if possible.
- Regions like North-East, therefore, have to play a vital role to contribute its share to national food basket to ensure food security to the country.

4.3. International Scenario :

- In so far as North-East India is concerned, the region is going to be influenced by the agri-sector development in five of its neighbouring countries namely Bhutan, China, Bangladesh, Myanmar and Nepal.
- Opening up of East – West road link connecting these countries as well as opening up of trans-boarder trade with China through Sikkim has come as a challenge to the farming community and the people of North-East India to prepare themselves for quality food production keeping WTO measures in view to benefit mutually for which technological support has become even more relevant.
- India could be a beneficiary through its North-East territory if adequate measures are taken to augment the productivity of particularly the

horticultural and animal based enterprises including mass production of organic products for export purposes to the countries bordering North-East.

4.4. Steps to put NE region in agricultural development paradigm :

Capacity building of the existing institutions, while identifying some progressive NGOs for the same, in the following areas :

- Molecular genetics and crop / animal health protection measures.
- Post harvest handling, processing, value addition and packaging.
- Regional gene bank for conservation of available bio-diversity as well as to protect them from bio-piracy on account of international border.
- Increased capacity to develop human resources locally so as to prepare them to handle region specific issues for production optimization.
- Continuous gathering of reports on market intelligence including the shift in WTO world for production planning and information dissemination.
- In the areas of IT lead extension mechanism system.

Economic revolution through agriculture and allied sector in the following ways :

- Diversification into non-traditional sector like wheat, pulses and oilseeds for more income generation as well as for preparing the region as effective market partner.
- Popularising the concept of protected cultivation of high value low volume crops for off season sale to ensure increased income.
- Preparing artisans to manufacture farm implements.
- Preparing youth group for mass production of quality planting material / seed.
- Involvement of NGOs / SHGs in ornamental fish trade.
- Facilitating outlets at regional level for livestock vaccine production.
- Overall development of agri-business sector based on the strength of the region.

5.0. SALIENT RESEARCH ACHIEVEMENT

(for more details please visit www.icarneh.ernet.in**):**

A. Variety Development and release :

- 12 varieties of rice were developed and released for various ecologies of the region like high altitude, mid altitude, valley land and boro cultivation.
- 3 varieties of tomato with yield potential of 53.3 to 63.7 t/ha were released and also put under All India Vegetable Improvement trials.
- One variety of turmeric named as Megha Turmeric – 1 with yield potential of 30.0 t/ha and with curcumin content of 6.8% was released. The variety, due to its higher yield (30 t/ha against 15.5 t/ha from the existing ones), has become very popular.
- One crossbred pig variety with 87.5% exotic inheritance has been developed.

B. Varieties in the pipeline for release :

- Two genotypes of rice (RCPL1-10C & RCPL1-12C) are ready for release.
- 3 maize varieties, 2 composites (RCM1-1 and 1-3) and 1 popcorn (RCM1-2) are ready for release.
- One genotype of high altitude rice (RCPL1-10C) is ready for release.
- 2 genotypes of tomato (Megha Tomato 1 & 2) have been proposed for release.
- 2 genotypes of brinjal developed by the institute (RCMB – 1 & Sel – 5) are in the last year of AICVIP trial.
- 2 high yielding genotypes of ricebean, 2 of blackgram, 2 of pea and 1 of pigeonpea are under multilocational trials for release.

C. Development of Package of Production :

- Needed package support for production and protection of developed and screened varieties were developed.
- Citrus rejuvenation package was also developed to address the issue of citrus decline.
- Package of high density pineapple planting with 55,000 suckers / ha against the practice of 25,000 suckers / ha was developed.
- DNA-based animal disease diagnostic protocols have been standardized.
- Parasitic disease diagnostic kit has been developed.
- Six models of IIFS and eight models of FS developed.

D. New Programmes :

- Developed DNA-based protocol for sexing of ducks and chicks.
- Developed software for acid soil amelioration measures.
- Perfected artificial insemination technology in pig and popularized it at village level.
- Standardized fish breeding programme and addressed the issue of non-availability of fish fingerlings.

E. New Introduction :

- Strawberry was introduced in mid-hill situations in Meghalaya and Sikkim. In Meghalaya it is currently being grown by farmers leading to the opening up of scope for diversification.
- Passion fruit was introduced among farming community in Manipur, Nagaland and Sikkim.
- Kiwi fruit was popularized in Sikkim.
- Cole crops like broccoli was introduced.
- Multi-tier agroforestry system like MPT + Pineapple + Black pepper was introduced.
- Improved farm tools and implements were manufactured in the institute and introduced in the region.
- Introduced Vanaraja poultry breed in the region to promote backyard poultry.

F. Natural Resource Management :

- Farming system technology developed could check soil erosion from 46 t/ha earlier to the level of 8 – 10 t/ha and water retention in situ upto 93%.
- 3000 agri-horti crop germplasm were collected, screened and identified. 1400 of them preserved in gene bank.
- 185 ornamental fish species collected and identified from the region. Their captive breeding is presently being taken up.
- Developed bio-organics from weed flora as crop growth promoter.
- Jalkund concept of water harvesting for agriculture in non-rainy season at a cost of Rs. 0.14 per litter of water.

6.0. IMPACT ASSESSMENT

Overall impact of the programme of activities of the Institution on the production/productivity/profitability/sustainability of the relevant agricultural systems in operation in its area of responsibility:

6.1. Impact of Farming System Research

- The farming system models developed have been able to check the soil erosion to the extent of only 8 ton/ha against the average soil loss report of 46 ton/ha in the region besides being able to conserve water in situ up to 93%. The conserved water could also be utilized for life saving irrigation and maintenance of animal farm unit in the system. Observing these positive attributes of the system, farmers have started adopting the models to derive the benefit from these systems.

- The gradual process of conversion of the contour bunds into terraces over a period of 3-4 years achieved under the systems has also a positive impact on the farmers who have now resorted to this method because of the system being cost effective, labour saving and paying.

- The farming system models developed had also an impact on increasing the cropping intensity from the earlier average of 114% to 150% due to the cropping sequence followed in the system. Irrespective of adoption or otherwise of the systems, a visible impact on increasing the cropping intensity was observed at farmers' field with the result that around 25% of around 75% of land under current fallow, is now utilized for increasing the cropping intensity by the practicing farmers.

6.2. Impact of Screening and Development of Varieties

- Rice varieties developed by the institute for both valley land and upland ecosystem had a positive impact on increasing the production and productivity of rice in the region due basically to the coverage of around 30% rice growing areas in the upland areas in the states of Meghalaya and Manipur and around 35% area of the valley land ecosystems of states like Manipur. Since the varieties have been giving almost twice the yield compared to the existing varieties, the average productivity of rice increased from 1.8 ton/ha to 2.1 ton/ha. The record in Meghalaya state alone indicated per ha productivity increase from 1.4 ton/ha to 1.52 ton/ha. Another impact could be noticed from the certified seed production of the upland varieties by around 20 certified growers in the state of Meghalaya alone. Similarly, almost equal numbers of certified grower are producing the seed for valley land rice in Manipur.
- The impact of the turmeric variety on increasing the production and productivity of turmeric was assessed from the heavy demand/requisitions received from various Governmental agencies, NGO's and farmers.
- Impact of the technological revolution achieved in groundnut (average productivity being 2.3 ton/ha) was noticed from the demand of the farming community on creating the processing facilities for groundnut.

- In animal science sector, a positive impact was recorded by the economist team from NCAP, New Delhi who recorded the impact on farm income to have been increased from Rs. 35,000/- to Rs. 46,000/- from the improved pigs received from the institute besides increase in employment from 150 to 240 days per annum and an increase in pork availability from 1.7 to 2.3 kg per week.

- An overall impact from this programme was assessed to be an increase in rice productivity from 1.85 to 3.99 ton/ha, maize productivity from 2.2 to 4.3 ton/ha, and similar trend in case of crops like soybean, groundnut etc. Another visible impact was noticed in around 258 farmers who took up improved farm practices after assessing the benefits accrued to the farm families of adopted villages.

6.3. Impact of Agroforestry Programme

- After observing the benefit of agroforestry intervention, different state Govt. agencies and also the NGOs and farmers of the region have started developing the wasteland areas through agroforestry intervention.

- The Intensive Integrated Farming System Developed to reclaim the degraded lands had a positive impact on farmers field. Different NGOs and private farmers have adopted the models.

6.4. Impact of Fishery Sector

- Due to the successful breeding and production of fish fingerlings and also the demonstration of economic benefit from fish culture, both under integrated and pond culture system, the farmers of the region have been attracted towards aquaculture particularly because of an excess to fish seed as well as their production technology in the Institute. Fish production as a result, has gone up from around 1.9 lakh ton to 2.23 lakh ton.

6.5. Impact of Farm mechanization

- Impact of using improved farm tools and machineries as demonstrated by the institute could be assessed from the number of artisans who became interested in taking up the manufacturing of the implements. On an average, 23 artisans from each of the north eastern states came from training to learn the art of manufacturing of the farm implements demonstrated and recommended by the institute. The impact of the programme was also assessed from the demands placed by various agencies with the institute for the supply of farm implements like maize sheller, paddy thresher, wheel hoe etc.

6.6. Impact of Technology Dissemination

The impact of the programmes highlighted above are the result of a sound technology dissemination programme where not only the extension personnels but also the scientists of the institute were involved.

7.0. PERSPECTIVE

THE VISION

As per the projection the region is expected to produce 65.46 lakh tonne of food grain in 2005. Whether this is achieved is to be seen. Even if this is achieved, a food grain deficiency of 6.16 lakh tonne shall be experienced in 2015, which needs to be bridged so as to produce surplus production from 2020. The vision and strategy to achieve this is presented:

I. AMELIORATION OF ENVIRONMENTAL CONSTRAINTS :

Major environmental constraints limiting agricultural productivity are the acid soils, low phosphorous availability, low zinc and high concentration of iron and aluminium. Any attempt to increase production and productivity shall have to be adequately supported through appropriate amelioration of these constraints. One of the viable options to counter soil acidity is the application of lime. Another important environmental constraint is the high incidence of pest and diseases due to heavy rain fall and high humidity. Shifting cultivation, though considered as a constraint, has also the positive features to place the region in organic agriculture movement. Land tenure system which results into poor management of the soil health is another issue that needs to be addressed through the involvement of state governments.

NATURAL RESOURCE CONSERVATION :

The abundant natural resources available in the region in the form of water, soil, forest and bio-diversity shall be conserved both for short and long term use through both conventional and molecular means.

II. FOOD AND ENVIRONMENTAL SECURITY- RESEARCH ASPECT

A. Agriculture Sector

A.1. Making the region self sufficient in food :

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 39 million as in 2001. With a growth of 32.58% per decade, the projected population by 2015 is expected to be 5.80 million. With the current

production gap, expected deficiency by 2015 would be 2.81 million tones of food grain. First vision is to bridge this deficiency gap.

A.2. Bioresource inventorization and utilization :

Some of the important floral and faunal bio-resources which have withstood the process of natural selection and have potential production traits shall be inventorized and used through conventional and molecular breeding techniques for production of improved varieties.

A.3. 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/per boiled 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.

A.4. Addressing the constraints of deliverables :

In order to address the constraints like cold/heat tolerance, flood tolerance, disease and pest resistant varieties with higher production potential, adequate support through research backup shall be provided in the form of developing resistant/tolerant varieties, weather-based disease and pest forecasting models and molecular disease diagnostic systems for both crop and animals. .. The constraints of animal feed availability shall be attempted to address through the development of suitable feed formula based on locally available feed ingredients. Production constraint due to lack of improved farm tools and machineries shall be addressed through the development of improved tools and machineries by blending traditional and modern knowledge. The constraint of seed storage, post harvest handling and processing of the produce shall be addressed through development of appropriate technologies in a collaborative mode by partnering with the ongoing national /ICAR schemes.

Water scarcity problem particularly during winter shall be countered through the development of cost effective rain/roof water harvesting modules like '*jalkund*' and propagating the technology in a partnership mode with NABARD. Precise requirement of water and organic/inorganic fertilizers for different crops on per hectare basis shall be assessed through research on precision farming for facilitating spread of contract farming concept.

A.5. Managing the effect of global warming :

With a view to minimizing the slow but steady increase in global temperature which is predicted to rise by 1.4°C by 2030, research on carbon sequestration, reduced emission of greenhouse gases etc. from the agriculture and allied sector fields and commodities shall be undertaken.

A.6. Harnessing the benefit of plant, animal and fish biotechnology :

Application of biotechnology in the development of high yielding varieties of crops and animals with assured quality parameters, enhanced tolerance to biotic and abiotic stresses with increased nutritional parameters is envisioned. Also research on the production of biotechnologically effective vaccines (or vaccine candidates) for animals against some of the specific diseases of concern to the livestock growers is proposed.

A.7. Research on homestead farming and concept of crop cafeteria :

Considering the shrinking average land holding and also the requirement of *in situ* conservation of bio-resources, particularly the medicinal and aromatic plants and also some of the flower species, development of suitable technologies for homestead farming with a concept of encouraging the number of tertiary producers of such valuable bio-resources with far reaching utility through commercial means is envisioned.

A.8. 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.

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. Majority of the population is dependent on agriculture, horticulture and allied land based activities. The agriculture production system in the region is mostly rainfed, monocropped and at subsistence level. Slash and burn agriculture is still predominantly practiced in almost all the states, except Sikkim, on steep slopes with reduced fallow cycle of 2 to 3 years as against 10-15 years in the past.

B.1. Area, production and productivity of horticultural crops :

No systematic and accurate estimate of area and production of different horticultural crops in the North Eastern region is available. The estimates made by various sources also vary considerably. North Eastern Council used to compile the data available from different sources. According to Agricultural Research Data Bank ICAR 2002 the area under various fruit crops was 270.4 thousand hectare and production was 2337.7 thousand tonnes with average productivity of 8.65 tonnes per hectare during 1999-2000. However, the total area under fruit crops in the country was 3796.8 thousand hectare and total production was 45496.0 thousand tonnes with productivity of 11.98 tonnes per hectare during the same year (Table 5). Similarly, the total area under vegetable crops in the NE region was 367.9 thousand hectares and production was 4051.8 thousand tonnes with the productivity of 11.01 tonnes per hectare. While the area under vegetable crops in the country was 5993.0 thousand hectare and production was 90830.7 thousand tonnes with productivity level of 15.16 tonnes per hectare (Table 5). This shows that the productivity level of horticultural crops in the NE region is quite below the national productivity.

Out of the total area under different fruit crops in the NE region, the maximum area about 60.6 thousand hectare is under banana only. Area wise second most important crop is citrus, covering about 57.2 thousand hectare, while the pineapple occupies about 47.4 thousand hectare. Other important fruit crops of the region are papaya (11.4 thousand ha), litchi (9.9 thousand ha), apple (6.7 thousand ha), guava (6.4 thousand ha), mango (3.7 thousand ha) etc. (Table 6). No reliable estimate is available about the area under different vegetable crops but all the states of the region grow both tropical indigenous as well as exotic temperate vegetables to a limited scale. Out of total area under different vegetable crops, the maximum area of about 113.2 thousand hectare is under potato only. Potato is a very important cash crop of the entire region. Area wise second most important crop is cabbage, covering about 18.5 thousand hectares, while sweet potato occupies 17 thousand hectares. Other important vegetable crops from area point of view are brinjal (12.5 thousand ha), cauliflower (12.5 thousand ha), onion (7.9 thousand ha) etc. (Table 5)

Table 5: State-wise area and production of fruits and vegetables in NE region

Area-000 ha, Production-000 t, Yield-t/ha

State	Area production & yield	Fruits		Vegetables	
		1996-97	1999-2000	1996-97	1999-2000
Arunachal Pradesh	A	28.9	44.1	16.7	16.9
	P	87.9	93.1	80.5	80.9
	Y	3.04	2.11	4.82	4.79
Assam	A	102.9	106.1	223.2	255.9
	P	1229.0	1249.5	2074.1	3089.4
	Y	11.94	11.78	9.29	12.07
Manipur	A	22.7	24.6	8.0	9.0
	P	111.0	118.1	53.2	60.8
	Y	4.89	4.8	6.65	6.76
Meghalaya	A	24.8	26.9	41.8	29.2
	P	239.0	223.3	412.2	252.9
	Y	9.64	8.30	9.86	8.66
Mizoram	A	14.4	13.0	6.8	8.3
	P	66.0	40.7	49.6	56.3
	Y	4.58	3.13	7.29	6.78
Nagaland	A	13.6	19.4	19.3	20.9
	P	168.9	232.3	188.4	235.7
	Y	12.42	11.97	9.76	11.13
Sikkim	A	9.4	5.9	12.0	9.6
	P	12.5	8.6	54.0	43.0
	Y	1.33	1.46	4.50	4.48
Tripura	A	32.3	30.4	32.0	18.4
	P	400.9	372.1	358.5	232.8
	Y	12.41	12.24	11.20	12.65
NEH region	A	249.0	270.4	359.80	367.9
	P	2315.2	2337.7	3270.50	4051.8
	Y	9.30	8.65	9.09	11.01
India	A	3579.5	3796.8	5515.2	5993.0
	P	40458.4	45496.0	75074.6	90830.7
	Y	11.30	11.98	13.61	15.16

Source: Agril. Research Data Book ICAR-2002

Among spices maximum area is covered by chilli (29.7 thousand ha) followed by ginger (16.4 thousand ha) and turmeric (13.6 thousand ha). Ginger is the main cash crop for the tribals of Meghalaya, Mizoram and Arunachal Pradesh. In addition Assam also contribute substantial amount of ginger and thus the production of green ginger in the region may be much more than the figures indicated in the estimates (Table 6). Among plantation crops coconut and arecanut are the major crops of the region. Area wise, arecanut covers maximum area about 86.1 thousand hectares followed by coconut, covering an area of about 28.8 thousand hectares (Table 7). Apart from these, there are many other plantation crops like tea, coffee and rubber, cashew nut, walnut etc. which also cover a sizeable area in the region.

Table 6: Crop- wise area and production of spices in NE region (2000 - 2001)

	NE States			***India***		
Crop	**Area (,000 ha)**	**Production (,000 tonnes)**	**Productivity (t/ha)**	**Area (,000 ha)**	**Production (,000 tonnes)**	**Productivity (t/ha)**
Ginger	33.24	191.04	5.8	77.6	263.2	3.4
Turmeric	16.22	22.7	1.40	160.0	654.0	4.1
Chilli	31.0	36.0	1.16	908.0	970.0	1.07

Source: National Horticulture Board, 2002-Year Book.

Table 7: Area, production and productivity of plantation crops in NE states (1997-98)

Crop	**Area (,000 ha)**	**Production (,000 tonnes)**	**Productivity (t/ha)**
Coconut	28.8	20.0	0.7
Arecanut	86.1	79.7	0.9

Source: Directorate of Cashew nut Development, Ministry of Agriculture, GOI.

The state wise and commodity wise area and production of different fruit crops in different states are shown in Table 8. Arunachal Pradesh has sizeable amount of area under apple (6.5 thousand ha), citrus (8.0 thousand ha) and guava (1.0 thousand ha). Similarly Assam has maximum area under banana (41.9 thousand ha), citrus (14.4 thousand ha), pineapple (13.6 thousand ha), guava (3.7 thousand ha) and papaya (7.3 thousand ha) among the Northeastern states. Manipur has maximum area under pineapple (10.0 thousand ha) followed by papaya (1.9 thousand ha) among fruit crops. Similarly Meghalaya has maximum area under pineapple (9.3 thousand ha) followed by citrus (7.5 thousand ha) and banana (5.2 thousand ha). Mizoram has maximum acreage under citrus (8.8 thousand ha) followed by banana (3.2 thousand ha). Citrus, pineapple and banana are the major fruit crops of Nagaland. Citrus is also a major fruit crop in Sikkim. Citrus, banana, litchi and pineapple are major fruit crops of Tripura from area and production point of view (Table 8). However, passion fruit is becoming popular in most of the North

Eastern states due to its pleasant flavour and attractive natural colour and kiwi is becoming popular in Sikkim and Arunachal Pradesh due to its adaptability in these states.

Table 8: Crop-wise area and production of fruit crops in NE region (1998-99)

	NE states			India		
Crop	**Area (,000 ha)**	**Production (,000 tonnes)**	**Productivity (t/ha)**	**Area (,000 ha)**	**Production (,000 tonnes)**	**Productivity (t/ha)**
Pineapple	47.4	519.8	11.0	74.2	1006	13.6
Papaya	11.4	133.9	11.8	67.7	1582	23.4
Mango	3.7	21.8	5.9	1402.0	9782	7.0
Litchi	9.9	46.5	4.7	56.2	428.9	7.6
Guava	6.4	59.7	9.3	151.3	1801.0	11.9
Citrus	57.2	300.7	5.3	488.1	4575.0	9.4
Banana	60.6	744.6	12.3	464.3	15073.0	32.5
Apple	6.7	16.3	2.4	231.4	1380.0	6.0
Other	45.7	434.9	9.5	699.0	6664.0	9.5

Source: Agril. Research Data Book ICAR 2002

In case of vegetables Assam has maximum area under potato (75.3 thousand ha), cabbage (18.5 thousand ha), brinjal (12.5 thousand ha), sweet potato (9.4 thousand ha), onion (7.8 thousand ha) and cauliflower (12.5 thousand ha). Meghalaya has second largest acrage of potato (20.8 thousand ha) after Assam (Table 9). Meghalaya has sizeable area under cabbage, cauliflower, radish and chow-chow, which are also marketed out side the state. Similarly other states like Manipur has great potential in tomato & brinjal; Nagaland in brinjal, cabbage and bhindi; Mizoram in bhindi, brinjal and beans; Tripura in tomato, brinjal, sweet potato and dolichos beans and Arunachal Pradesh in pea and beans.

Table 9: Crop-wise area and production of vegetable crops in NE region (1997-98)

Crop	**NE states**			**India**		
	Area (,000 ha)	**Production (,000 tonnes)**	**Productivity (t/ha)**	**Area (,000 ha)**	**Production (,000 tonnes)**	**Productivity (t/ha)**
Potato	113.2	1048.3	9.26	1208.9	17652.3	14.6
Cabbage	18.5	227.5	12.3	218.4	3861.7	17.7
Sweet potato	17	70.4	4.1	128.8	1171.0	9.1
Tapioca	7.8	55.6	7.1	264.3	6681.9	25.3
Brinjal	12.5	187.7	15.0	434.2	6443.1	14.8
Onion	7.9	18.1	2.3	338.5	3142.8	9.3
Cauliflower	12.5	120	9.6	220.0	2474.0	11.3

Source: Basic statistics of North Eastern Region 2000, North Eastern Council, Shillong, Ministry of Home affairs, GOI.

As far as spices are concerned Meghalaya is the leading states in case of ginger (7.4 thousand ha) followed by Arunachal Pradesh and Mizoram. While the Assam has maximum area of chilli (14.3 thousand ha) followed by ginger and turmeric, Sikkim is highly suitable for large cardamon. In case of plantation crops Assam has maximum area of arecanut (74.1 thousand ha) & coconut (19.7 thousand ha). Meghalaya, Mizoram and

Tripura also have some area under arecanut. The data regarding ornamental crops is not available as it is confined to backyard of the houses and governmental institutions. But Assam, Sikkim and Manipur sizeable area under ornamental crops, as marigold is grown at large scale in Assam and Sirohi Lilly (endemic to Manipur), orchids are grown in Sikkim, Arunachal Pradesh and Meghalaya.

Considering the excellent climatic conditions, abundant rainfall and fertile soil (high organic content) of the region the productivity of different horticultural crops is quite low as compared to national productivity but horticulture bears the bright future in the region and it has every opportunity to be developed here as valuable processed food product and produce export quality fruits, vegetables, flowers and other horticultural products.

B.2. Research Infrastructure in Horticulture

The ICAR is carrying out horticulture research in the region through NEH Research Complex, Barapani (Meghalaya); National Research Centre for Orchids, Gangtok (Sikkim); Central Potato Research Station, Upper Shillong (Meghalaya); Central Plantation Crops Research Institute Regional Station, Kahikuchi (Assam). In addtion Assam Agricultural University, Jorhat and its research stations are contributing to horticulture research and development in Assam. Further, 11 research centers of All India Coordinated Research Projects on Vegetables, potato, Tuber Crops, Palms and Betelvine located at AAU, Jorhat, Tinsukia and Kahikuchi are conducting multilocational trials for identifying promising cultivars for the region. Twelve Krishi Vigyan Kendras (KVKs) in the region and one Trainers Training Centre (TTC) in Meghalaya are providing research back-up support towards popularization of improved technology and development of skilled manpower for various horticultural programmes.

Progress of Research

Concerted research efforts have been made to identify a large number of improved varieties and production technologies of fruits, vegetables and tuber crops including potato and plantation crops suitable for the region.

Fruits Crops: Based on survey conducted in Meghalaya, Arunachal Pradesh, Mizoram, Sikkim and Assam to ascertain the status of orange orchards, a large number of economic citrus species were collected and analyzed for physio-chemical characteristics. Manurial schedule was standardized. Penetration of taproots was found to be in the range of 65-95 cm with spread of lateral roots beyond the main root being 55-215 cm of the root system of orange orchards. Lucknow-49 and Allhabad Safeda were the suitable varieties of guava for mid hill situation. Agro-techniques for high density planting and fertilizer schedule for guava were standardized. Florodasun, TA-170 and Shan-e-Punjab were most suitable peach varieties for mid hills of Meghalaya. Tongue grafting in December and softwood grafting in August were the best propagation methods of peach.

Vegetable and tuber crops: Three tomato varieties namely Manileima, Manikhamnu and Manithoibi were released by State Variety Release Committee, Manipur and found

suitable for rice-based cropping system. Tomato varieties namely BT-2, Arka Alok, Arka Abha, and LE-79 were identified as bacterial wilt resistant varieties. Among the hybrids, the promising ones are Arka Vardhan, HOE 303, Swaraksha, S-7610, Avinash-2 and Rocky. Three pureline selections of French bean from the local germplasm were identified for multiplication. In brinjal, Pant Samrat and Arka Shirish and hybrid HOE 414 were the promising cultivars. Among the tuber crops, C-7 and TVM-293 in colocasia and S-162, Sonipat-2, X-69 and S-30 in sweet potato have been identified high yielding and most suitable varieties for the region. Turmeric and ginger are high remunerative crops for the farmers. Turmeric variety Megha turmeric-1 (earlier known as RCT-1) and ginger variety Nadia were found suitable for the region. Some F_1 hybrids of brinjal and tomato (OP) resistance to bacterial wilt are also in the advance stage of release at ICAR Research Complex, Umiam, Meghalaya.

Potato: Potato is an important vegetable crop of the region. The CPRI Station in Meghalaya has developed a number of improved varieties and appropriate management practices. The productivity is fairly high particularly in Tripura (17.1 t/ha) and the state has achieved distinction in producing TPS on commercial scale. Kufri Khasi Garo and Kufri Jyoti have been recommended for main and autumn season crops for the region. Among the recently developed cultivars, Kufri Megha and Kufri Giriraj, resistant to late blight, are widely under cultivation. A number of improved cultural practices have also been developed for the region.

Plantation crops: Coconut, arecanut, black pepper, ginger, turmeric, large cardamom and cinnamon have great potential in the region. Research work has been undertaken by CPCRI Regional Station, Kahikuchi for development of improved cultivars of different plantation crops. A profitable coconut-arecanut based cropping system involving spices and fruit crops has been developed for the region.

Biotechnology: Protocols have been developed for micro propagation of different citrus species used as rootstock for *C. reticulata* as well as Khasi mandarin. Successful and cheap acclimatization methods have been developed for acclimatizing micro propagated citrus plantlets.

Apart from above there are other promising varieties of fruits, vegetables, spices,tuber and rhizomatous crops, plantation crops and ornamental crops which were tested in the region, found suitable and recommended for commercial cultivation.

B.3. Vision (Horticulture)

B.3.1. 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 toatl 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.

B.3.2. 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 form the present production level.

B.3.3. 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 lease 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. Curcurmin content of turmeric in the region is very high (above 7% in Lakadong variety).

Main vision would be to increase production and explore processing, packaging and marketing both for domestic and export market.

B.3.4. 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.

Arecanut

- Development of dwarf hybrids using the Hirehalli dwarf as a parent for NE India in collaboration with CPCRI station at Kahikuchi.

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.

B.3.5. Floriculture :

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.

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.3. Important support services:

The institute also foresees the need to facilitate arrangement of necessary support services through the involvement of non-governmental and other agencies to support livestock sector in the region. The support services like providing health back up, input delivery like semen and A I, feed blocks etc are therefore planned to be arranged through public-private partnership. The area of promoting agri-business and veterinary clinics in the remote villages are also envisioned through such partnership.

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 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.

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.

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.

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 later 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

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.

D.6. Common issues to be addressed in Fishery Sector:

- 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.

III. Some common issues to promote agricultural growth

A. 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

B. 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.

C. 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.

D. Research on sanitary and phyto -sanitary 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.

E. 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.

F. 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.

G. 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.

H. 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.

I. National and International Collaboration :

In post WTO era, it has become absolutely necessary for every organization / country not only to assess its own strength and weaknesses but also the strength and weaknesses of the competitors and stake holders alike. National collaboration is required both for avoiding duplication as well as for benefiting from the complementarities of approaches so as to deliver the output in such a way that visible out come of the technologies at operational level is achieved. In order to achieve the same, it is proposed to develop effective collaboration of the institute with other national and international agencies working in mutually beneficial areas. Another objective for developing such collaboration is to place the institute in the information repository / information exchange list of the reputed R&D Institutions across the globe. Yet another vision is to facilitate development of externally funded R&D projects for the benefit of the farming and other communities that the institute represents.

8.0. ISSUES AND STRATEGIES:

Issues	Perspectives
1. Amelioration of environmental constraints	• Soils of the region shall be categorized on the basis of pH values and the standard dose of lime requirement as per pH of the given area shall be worked out. • Necessary software indicating the status of soil pH and the requirement of lime shall be developed. • Soil health card (SHC) shall be attempted to be issued to the farming community together with the needed measures to be applied. On the basis of the research study on the requirement of lime to enhance the capacity of the acid soil of the region for production optimization, a dose of 500 kg of lime per hectare has been found optimal. On the basis of this dose, the lime requirement for the total net sown area of 4.0 million hectare in the region shall be 2.0 million tones. Availability of this much quantity of lime in one go might be difficult. Therefore, the perspective is to : • Neutralize the acid soil at the rate of 33% of the area per year at a total lime requirement 0.67 million tones. This strategy shall contribute towards double productivity / hectare at the rate of 1.33 million hectare area / year and by third year of the operation, the capacity of the entire area of 4.0 million hectare hall be enhanced. • Together with this, integrated nutrient management package developed at various research institutes and universities shall be applied to counter the low availability of zinc and phosphorous. • In so far as addressing the issue of high concentration of iron and aluminium, plant biotechnology units are proposed to be strengthened to produce varieties tolerant to such soil conditions. It has been observed, particularly after the tsunami effect, that the climate in the region is showing a changing pattern particularly with respect to the rain fall which has been significantly low during past two years. It would, therefore, not be entirely incorrect to envision that further change in the climatic scenario shall be likely particularly in view of the increase in global temperature. It would, therefore be desirable that weather monitoring devices are put in larger areas of the region so as to monitor the climate change and its response to pest and disease problems. Medium range weather forecasting models shall be required to be placed together with the attempt to develop new age technology on integrated pest management using both chemical and organic means to take care of the major pests and diseases. The vision is to build the capacity of the existing research institutions so that appropriate technologies to manage the problems of pests and diseases are continuously developed using such technologies like bioinformatics,

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	biotechnology, semiochemicals and the like.
2. Natural Resource Conservation	Although the shifting cultivation mode of food production in the region has resulted in to barrenness in some of the areas due particularly to the non-adherence to the natural resource conservation measures and reduction of the cycle, the system has also the strength to place the region in organic food production map. The strategy shall be to develop suitable varieties of particularly rice and maize for shifting cultivation belt so as to increase production from this area popularizing the adoption of soil and water conservation measures, technologies for which have already been generated by the institute in the form of 08 farming system models. Agri-horti-silvi-pastoral model of farming system in particular is planned to be propagated in a partnership mode for effective land use, increasing productivity, checking soil erosion and retaining water *in situ*. A regional sensitization program on modifying the land tenure system currently in force in some states like Meghalaya is envisioned to be arranged particularly under the aegis of the Ministry of DONER involving the District Councils and State Governments.
Food and environmental security A. Agriculture Sector A.1.Making the region self-sufficient in food	**Rice :** Out of the present deficiency of 1.6 million tones of food grains, 1.0 million tonne deficiency is in rice alone. Main strategy would be to increase rice production through: • 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**. • 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.** • 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.** • 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 such seed. Youth groups/SHGs shall be constituted for seed production and delivery systems. • 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**

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	particularly of glutinous type. Thus, from the above strategy alone, food production shall be increased by 4.32 million tones **(1.4+ 1.12+1.0+0.8)** and together with the present production of 5.8 million t, total production by 2015 itself shall be 10.12 million t i.e. much more than the projected requirement of 8.61 million t. **Maize** M 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. Introduction of Quality Proteins Maize (QPM) at state Govt. farms and major maize growing areas. Replacement of low yielding traditional maize cultivars with high yielding varieties. Introduction of rabi maize in select states like Manipur, Sikkim, Tripura, Mizoram, etc. Horizontal expansion of area under maize. Promoting collaboration with Agriculture Technoligy Management Agencies(ATMA) and Krishi Vigyan Kendra for massive FLD programmes involving veterinary Deptts on bye back. From the intervention proposed an additional contribution of 0.5 million tones from the cereal group is envisioned to be made available. **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 department 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

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	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. **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.
A.2 Bioresource inventorization and utilization	• Survey of important existing species in all the states to append to information already available with the research institutes and Universities. Computerization of the data through specially developed software will be taken up for sharing the information at regional and national level and for development of data base for future use and protection of IPR. This will also help in disaster management by way of helping to select suitable crops to substitute main crops in case of natural calamities like flood or drought. The information collected will also help to develop suitable strategies for protection of fast diminishing bio resources and their judicious use. It is envisioned to develop a state wise bio resource inventory by the year 2015 and categorize risk level of various agriculturally important germplasm. • Integrated management of .resources especially for medicinal

Issues	Perspectives
	and aromatic plants, ornamental plants, lesser known food and horticultural crops, lesser known animals/birds/fishes which are endemic to the region is planned by 2015. • Molecular characterization of important bio-resources will be taken up for protection of IPR issues and to find out gene flow pattern in highly endangered species of agricultural importance. • It is envisaged to establish community bio-parks for some of the very important species. Such bio-parks will provide information to general public about conservation needs, judicious and diversified utilization and open up avenues for employment. • Development of infrastructure facilities for short-term conservation in each state is envisaged in a partnership mode. Training will be given to NGOs and SHGs for promoting natural resource conservation. Extension programmes and awareness meetings with general public with special emphasis on economic benefit of judicious utilization of bio-resources will be organized for increased awareness among general public for bio-resource conservation. The overall goal is to engage all stake holders like farmers, communities, scientists, NGOs, SHGs, policy makers and government machineries in a concerted manner so that the goal of bio-resource inventorization and protection of endangered species is achieved by 2025.
A.3. Placing the region in the organic food production map of the world	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 base 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.

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	• 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 insect, pest and disease management for 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. 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.
A4. Managing the effect of global warming	• Reducing number of unproductive/low productive animals to half and maintaining the current production levels by introducing high producing animals to reduce the methane production by 45%. This will serve a three-pronged purpose i.e. efficient utilization of feed resources, increase in the quantum of animal produce and reduction in methane emission. • Changing feeding practices by research focusing on altering the current feeding practices in the following lines : o Replacing part of grasses with legume forages o Reducing particle size of feeds by chopping, fine grinding etc. o Feeding complete diets to animals by mixing ground roughages and concentrates.

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	• Research on changing rumen microbial fermentation pattern by different methods like : o Addition of methane analogues/ionophores/saponins in the diet o Altering the quality and quantity of lipids in the diet o Development of vaccine against methanogens along with changes in the dietary compositions to counter the adversities that arise due to altered rumen environment etc. • Development of suitable water management practices in low land paddy fields to create intermittent aerobic conditions to reduce methane and N_20 production. • Anaerobic fermentation of excreta to yield biogas without sacrificing its manuring value so as to reduce the direct addition of CH_4 and N_20 to the atmosphere. • Reducing the use of nitrogenous fertilizers through IPNS system to check the nitrogen losses from the soil and N_20. • Controlling the biomass burning and proper measure of agricultural waste disposal and management. • Carbon sequestration through - o Conservation of *in situ* carbon by controlling deforestation and soil erosion o Reclamation and rehabilitation of degraded lands through agroforestry approaches o Controlling/improving jhum cultivation o Enriching the organic carbon in soil through crop residue incorporation, manure addition including green manuring, adopting conservation tillage practices and suitable crop rotations and growing cover crops.
A.6. Harnessing the benefit of plant, animal and fish biotechnology	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

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	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. • 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). • 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. • 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. • Production of disease free planting materials of fruits and ornamentals, through tissue culture for supply to growers for producing export quality fruits and flowers. • Molecular epidemiology of diseases of crops and animals in the region for prevention, control and developing forecasting system/early warning system.

Issues	Perspectives
	• Development of field level diagnostic kits for important crop/animal diseases of the region to provide better support in crop and animal health care. • Development of genotype (or serotype/strain) specific new generation vaccine candidates including those for edible vaccines for important diseases of the region. • Characterization and sustainable utilization of important microbes of the region in augmenting agriculture and livestock productivity. • Development of genetic database for crops, livestock, poultry, fish, microbes, pests including parasites and their utilization through bioinformatics. • Establishment of DNA, microbial and semen germplasm bank of the region for conservation, future use as referral library and protection of IPR.
A7. Research on homestead farming and concept of crop cafeteria	Homestead farming is a tradition in the North Eastern region. This farming is essentially a location specific crop cafeteria, which not only caters to day-to-day need of the family, but also serves as an excellent conservation strategy for many traditional/ folklore/ heirloom varieties. However, increasing demand of farm families and diminished economic returns are slowly causing these homestead farming system to disappear and there is an urgent need to improve upon these homestead farming systems not only to meet the requirement of individual families but also for employment generation and providing a viable means for on farm conservation. The following strategies would be adopted to achieve this goal. 1. Diagnostic survey and evaluation of existing homestead farming systems and research on their improvement through: • State-wise survey to append information on existing practices, crop and animal varieties, area under HFS, family size, species richness and diversity of the plant species, ITKs related to plant and animals management, source of water, inputs, production and productivity, economic returns, etc. • Evaluation of present HFS and crop cafeteria from the point of view of economics and conservation of resources and their documentation. 2. Development of Model Homestead Farming System (HFS) and Crop Cafeteria (CC) in each state of the region.

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	• Introduction of subsidiary source of income such as mushroom cultivation, apiculture, floriculture, vermin-culture, sericulture, rabbit rearing, new strains for crops, duck and poultry in existing HFS. • Quantification of water requirement and water use efficiency for integrated fish and livestock farming system in HFS. • Standardization of design of roof top water harvesting system and tapping of perennial streams. • Development of crop and animal calendar for their efficient management in HFS. • Skill enhancement through imparting training on preservation and value addition to the produce. 3. Replication of potential HFS and CC in participatory mode in different agro climatic zones of the region. Emphasis shall be given to include this programme in the ongoing schemes on watershed development and Technology Mission on Horticulture.
A8. Validating ITKs in agriculture and allied sector	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. 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. 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. 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.
B.	1. Gradual replacement of low producing varieties with high yielding

Issues	Perspectives
HORTICULTURE SECTOR B.1. Fruit sector development	varieties screened for different fruit crops for different areas. 2. Production of required number of planting material using techniques like tissue culture and other propagation methods both under field and protected conditions. 3. Arranging stake holder workshops / trainings to propagate orchard management packages to support production and maximize yield. 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 at Table 1, 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 is expected to be 118.52 lakh t by 2020 i.e. a gain of 95.15 lakh t. **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

Issues	Perspectives
	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.
B.2. Vegetable Sector Development	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 perspective as outlined in the fruit sector is envisioned.
B.3. Spices Sector Development	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 Agro-forestry programmes in high and low altitudinal conditions, respectively.

Issues	Perspectives
	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.
C. ANIMAL SCIENCE SECTOR C.1. Pig & Poultry Production aspects	• Cross bred pig variety already developed by the institute shall be made available to at least 3 states of the region for further multiplication under state government farms so as to address the constraint of quality pig germplasm availability. In addition to this, multiplication of pig shall be included in the 11th Plan Approach Paper being prepared by NEC so that necessary financial support to the state machinery is made available. • Similarly, one poultry breeding farm with grandparent stock of Vanaraja / Gramapriya is proposed to be established in the institute to serve the purpose of making available parent stocks to the state veterinary department for their multiplication so as to promote backyard poultry in the region. • Artificial Insemination technology in both pig and poultry is proposed to be propagated at village level since the efficacy of this technology particularly in pig has already been established by the institute. State veterinary officials and the para-vets are proposed to be trained on this aspect. The subject matter specialists now available in the KVKs are also to be engaged in this area so that quality pig / poultry production without having to rear the males is ensured. • Since pregnancy diagnosis in pig is a problem which leads to the enterprise being uneconomical, another vision is to develop pregnancy diagnostic kits for pig so that the pig growers do not have to wait for the repeat heat to know that the pig was not pregnant. • Feed formulae based on locally available ingredients are proposed to be developed for different categories of pig and poultry. Research on enrichment of the feed through mechanical, chemical and biological means are envisioned to be taken up. • Research on the development of complete feed blocks shall be undertaken to address the issue of non-availability of animal feed during lean season as well to mitigate environment related disasters. • Economic evaluation of livestock-centered enterprises is proposed to be carried out to assess the contribution of this sector towards poverty alleviation and employment generation aspects

Issues	Perspectives
Health aspects	• The molecular disease diagnostic protocols which have been standardized are proposed to be used in a systematic way to facilitate faster diagnosis of important animal diseases so that prompt curative/preventive measures could be taken to save the loss from both the morbidity and mortality. The animal health division of the institute is proposed to be elevated to a Regional Referral Laboratory with the support from other funding agencies like NEC, North East Development Plan of GOI etc. • Considering the threat from the emerging zoonotic diseases, research is planned to be undertaken on various aspects of livestock product quality control measures to protect the human health from the danger of meat etc. borne diseases. • The region being a high rainfall and high humidity zone, livestock suffer from various parasitic diseases leading to poor production. The parasitic disease diagnostic kit developed by the institute is proposed to be mass produced through genetic engineering technique for assisting the field veterinarians in prompt diagnosis of parasitic diseases. • In view of the fluctuating weather pattern in the region which has a direct co-relation with some of the animal diseases like gastro-intestinal parasites, another vision is to develop weather based forecasting models to fore warn the livestock growers about the preparatory measures to be taken . • Biotechnologically effective vaccines or vaccine candidates (strain specific) are proposed to be developed by 2025 so that the twin problems of non-availability of vaccines and the loss of potency over storage are addressed. • ITKs available in the region for treatment of animal diseases are proposed to be collected and the selected ones validated to establish their efficacy either in the present form or through the process of refinement by way of blending the ITKs with modern technological know how. Similar strategy shall be adopted for other animals namely goat, rabbit and cattle.
D. FISHERY SECTOR	• Replenishment of stock through appropriate ranching in rivers

Issues	Perspectives
D.1. Riverine fisheries	where population of natural stock is less. • 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. • Banning the fishing practices like poisoning, dynamiting etc. through a sort of village law to be enacted by the village council. • Creating facilities at least at district level for fish seed production.
D.2. Reservoir fisheries	• 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.
D.3. Beel Fisheries	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.
D.4. Pond fisheries	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

Issues	Perspectives
D.5. Rice – fish culture	sufficiency in quality fish seeds in large numbers. • Establishment of fish producer's 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. • 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.
III. COMMON ISSUES A. Intensive Integrated Farming System	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.
B. Precision Farming	• 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

Issues	Perspectives
	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.
C. Post-harvest handling of produce	• 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.
D. Sanitary and phytosanitary issues	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: 1. 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. 2. Establishment of an organic certification laboratory for • 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.
E. Strengthening	• Addressing lack of education, training, women specific technologies

Issues	Perspectives
knowledge base of women in agriculture	and Entrepreneurs among women by : 1. Establishment of rural schools for women in each village. 2. Arranging scientist-Extension agency- women interfaced to identify women related issues in agriculture. 3.Skill up gradation through training and demonstration. 4. 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.
F. Disseminating evolved technologies for enhancing production	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 2015. 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 up gradation 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.
G. Utilizing	1. Soil amelioration and fertility enrichment through utilization of

Issues	Perspectives
agriculture and other wastes	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 reside 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.
H. Using information technology in agriculture	• 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. • 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

Issues	Perspectives
	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. • 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. • 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. • 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. • 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.

9.0. PROGRAMMES AND PROJECTS

Programmes	Objectives
Soil Health Improvement	Preparation of soil health card and development of appropriate amelioration measures. Development of integrated nutrient management and software depicting the deficiencies and corrective measures shall be prepared. Collaboration with plant breeder for developing identified deficiency tolerant varieties.
Cereal Improvement	To develop demand driven varieties and packages for rice, maize and millets and explore possibilities for wheat cultivation. Participatory varietal evaluation programme to be undertaken. Both conventional and molecular means of breeding to be adopted.
Pulse Improvement	To screen and develop suitable pulse varieties together with methodologies for enhancing production through intercropping, relay cropping.
Oilseed Improvement	As for pulses. Tie-ups with other national programmes for increasing irrigation potential for all the crops.
Fruit Sector Development	To increase per hectare productivity, to produce quality planting material, to develop disease and pest management schedule and also to introduce fruit trees in forestation programmes in a participatory mode. Propagation of high value fruit crops like strawberry through KVKs and state departments. Technology generation for organic food production.
Vegetable Sector Improvement	Production enhancement of indigenous vegetables with simultaneous attempt to screen and develop high yielding varieties together with the needed agrotechniques to support higher production. Technology generation for organic food production.
Spices Sector Improvement	Technology generation to support mass production of turmeric, ginger and chilly.
Postharvest Technology	Capacity building to handle postharvest produce including necessary research to increase shelf life, add value and their storage and packaging with the needed protocol to maintain quality parameters.
Water Management	Efficient use of water resource through precision farming as well as development of modules for homestead water conservation.
Agronomy and Plant Protection Research	To develop agronomical packages and pest and disease management schedules for all the target crops to provide the needed backstopping.
Agro-meteorology	To develop weather-disease-pest relationship and forecasting models to forewarn the client group for preparedness and to adopt the suggested steps.

Farm tools and machineries	Prototype manufacturing of improved farm tools and machineries for increased production, energy saving as well as drudgery reduction of women workforce.
Weed management	In addition to developing suitable technologies for weed management, preparation of bio-extracts from weedy plants as growth promoters and disease/pest control agents shall be the major objective.
Pig, Poultry, Goat and Rabbit Improvement	Development of three-breed cross bred pig and propagation of already tested poultry breed in the backyard system together with the needed technologies to support enhanced production. Development of cheaper feeding schedule and also faster disease and parasite diagnostic system through molecular means as well as to attempt preparation of strain specific vaccines. Mass multiplication of pig, poultry, goat and rabbit seed in a participatory approach with state department and NGOs. Development of control measures against zoonotic diseases shall be another programme.
Fishery Sector Development	Technology up scaling for fish seed production, ornamental fish breeding, cold water fish culture, reservoir and riverine fish culture as well as to identify and prepare fish feed based on locally available planktons.
Agro-forestry	Collection and maintenance of MPTs and development of multi-tier agroforestry systems as well as development of technologies like intensive integrated farming for marshy / degraded lands.
Farming System Research	Assessment and refinement of already developed farming system for natural resource conservation and utilization for identifying the best model for system productivity.
Research on Bamboo	Identification of bamboo resources of the region, establishment of bamboo satum and development of technologies for bamboo product preparation.
Plant and Animal Biotechnology	Cataloguing of genetic resources through DNA fingerprinting to protect IPR, development of ecosystem constraint specific (acid, iron, aluminium etc tolerant) varieties, development of transgenics for biotic and abiotic stress tolerance and quality improvement, development of plant and animal disease diagnostic and also pregnancy diagnostic kits for animals using molecular means. Identification of new stress tolerance / quality improvement genes.
Organic Agriculture	Development of technological package, crop / animal wise, for the crops that have national and global demands and where the region has the competitive advantage to produce those crops.

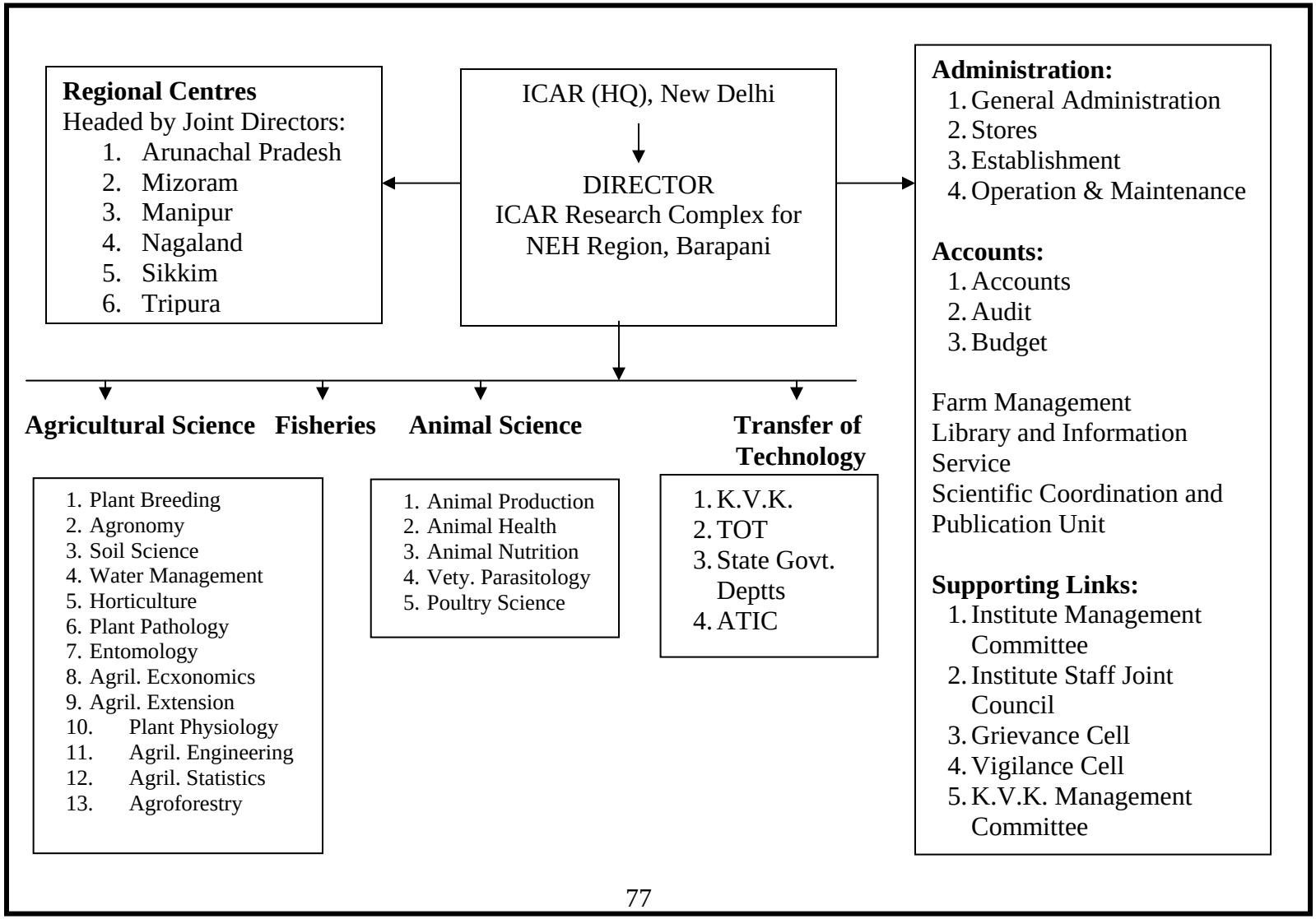
Development of Appropriate Extension Methodology	Methodologies like transfer of information together with the transfer of technology with focus on cluster / community are planned to be developed for a planned production system that will be market driven.
Patenting	To gear up the research activities in such a way that under each programme patentable process / products are developed.
Bio-prospecting	N.E. Region being the home of around 7000 agri-horti crop species and a host of medicinal and aromatic plants, prospecting analysis of particularly the later shall be carried out during XI and subsequent plan period. Capacity to handle this programme shall be strengthened with equipment and trained manpower.
Crop diversification	Research on the scope of diversification into high value crops depending on agro-ecosystem strengths shall be carried out and the potential systems demonstrated.
Shifting cultivation	Together with the research on developing farming system models as an alternative to shifting cultivation, a concurrent programme on improving the system through the development of suitable varieties and packages specific to shifting cultivation areas shall be undertaken.
Use of nano-technology in agriculture and allied sector	Capacity of the institute shall be built in terms of infrastructure, equipment and HRD to work on this emerging area as the technology is currently being tried in medical and other fields.
Market intelligence	Intelligence on rise and fall of markets for different commodities, likely demand of crops / commodities in regional, national and global markets, balancing of seed and planting material requirement etc. shall be gathered in a collaborative mode with state government and other agencies for issuing forewarning to the growers so as to avoid distress sell etc.
HRD Programme	In addition to developing the existing human resources in the institute through orientation programmes, the institute shall also take up post graduate teaching and research initially in collaboration with Central Agricultural University.
Technology backstopping	Eleven KVKs attached to the institute shall be used to demonstrate technological support to augment food production by adopting five villages under each KVK. They would also take up market led extension and training programmes

9.1. Time Frame

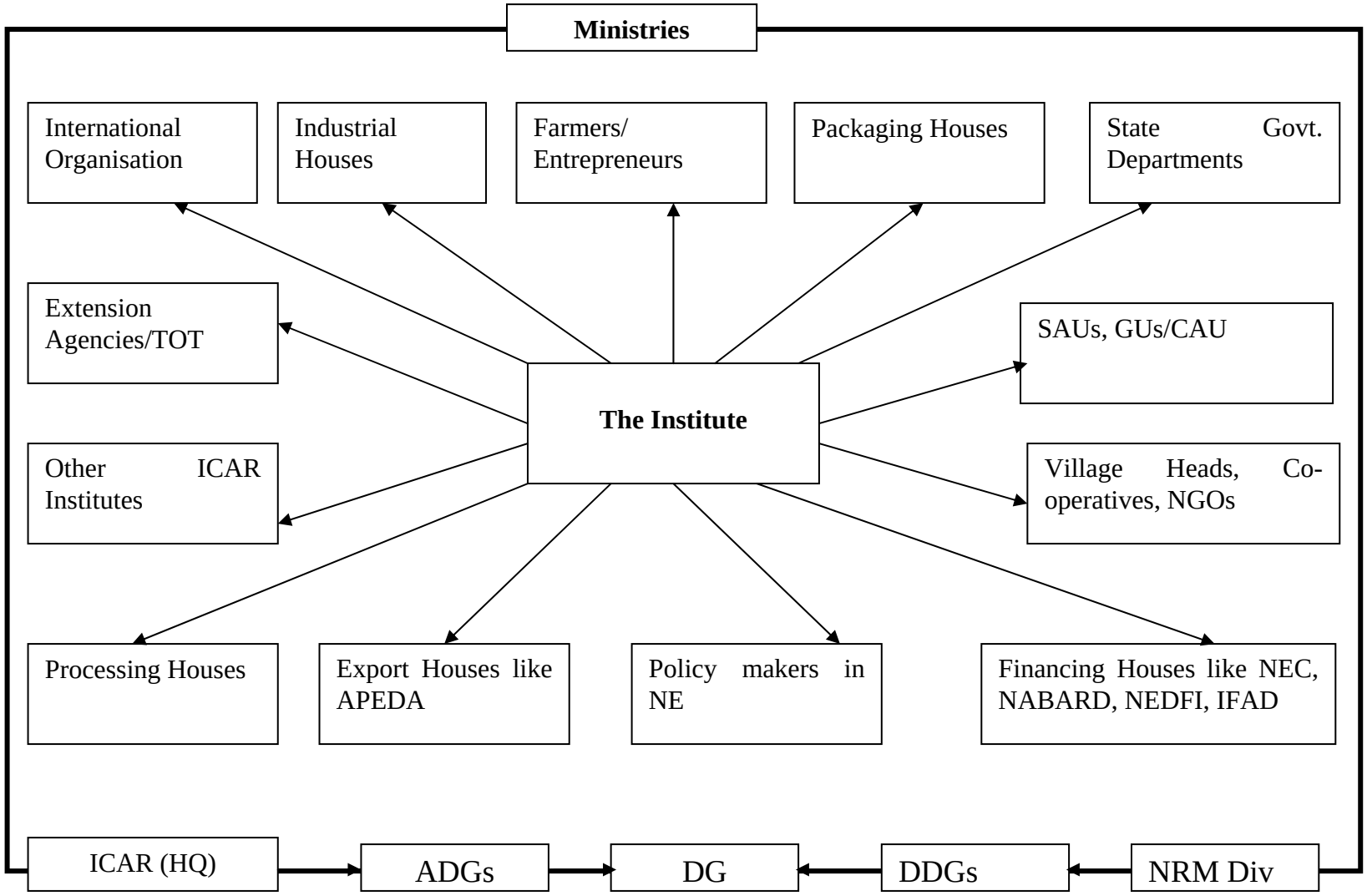
Programmes	2007-2012	2012-2017	2017-2025	XI Plan
Soil Health Improvement	XX	XX		
Cereal Improvement	XX	XX	XX	XX
Pulse Improvement	XX	XX	XX	XX
Oilseed Improvement	XX	XX	XX	XX
Fruit Sector Development	XX	XX	XX	XX
Vegetable Sector Improvement	XX	XX	XX	XX
Spices Sector Improvement	XX	XX	XX	XX
Postharvest Technology	XX	XX		XX
Water Management	XX	XX		XX
Agronomy and Plant Protection Research	XX	XX	XX	XX
Agro-meteorology	XX	XX	XX	XX
Farm tools and machineries	XX	XX		XX
Weed management	XX	XX		XX
Pig, Poultry, Goat and Rabbit Improvement	XX	XX	XX	XX
Fishery Sector Research	XX	XX	XX	XX
Agroforestry	XX	XX	XX	XX
Farming System Research	XX	XX	XX	XX
Research on Bamboo	XX	XX		XX
Plant and Animal Biotechnology	XX	XX	XX	XX
Organic Agriculture	XX	XX	XX	XX
Development of Appropriate Extension Methodology	XX	XX	XX	XX
Patenting	XX	XX	XX	XX
Bioprospecting	XX	XX		XX
Crop diversification	XX	XX	XX	XX
Shifting cultivation	XX	XX	XX	XX
Use of nano-technology in agriculture and allied sector		XX	XX	
Market intelligence	XX	XX	XX	XX
HRD Programme	XX	XX	XX	XX
Technology backstopping	XX	XX	XX	XX

10.0. LINKAGES

10.1. ORGANOGRAM
(Administrative and scientific links)



10.2. Linkages of the Institute with HQ, Universities, Line departments and other agencies



10.3. Coordination

Scientific Co-ordination and Publication Unit attached to the Director shall co-ordinate different activities, appraise the Director about the steps to be taken at divisional/regional centre levels who, in turn, shall co-ordinate with both forward and backward linking set up to ensure proper implementation of the programmes. Another set of coordinating group shall be the nodal officer of 11 Krishi Vigyan Kendras who would co-ordinate, in consultation with the Director, with the training and technology transfer aspects.

11.0. Critical Inputs :

12.0. Risk Analysis :

13.0. Project review, reporting and evaluation arrangements :

This shall be arranged through institutional mechanisms like

Divisional level project discussion
Staff Research Council
Research Advisory Committee
Quinquennial Review Team
Institute Management Committee
Monitoring Committee from the Subject Matter Division

14.0. Resource generation :

IXth Plan		Xth Plan		XIth Plan (Projected)	
Fund (in lakhs)	Resource generated (in lakhs)	Fund (in lakhs)	Resource generated (in lakhs)	Fund (in lakhs)	Resource generation (in lakhs)
1869.06	76.60	3270.51	135.01	5000.00	150.00

The institute shall generate resources through following means:

Consultancy services
Sale of products and processes
Patenting
Post Graduate Students (fees etc.)
Others

15.0. Output and expected outcome :

Technological package for agri-horti-animal-fish crops for facilitating enhanced productivity to not only bridge the current deficiency gap but also to produce marketable surplus shall be one of the major outputs. Development and delivery of organic package backup, putting in place suitable cropping sequence for different ecosystems, information on crop diversification options, resource analysis, conservation and utilization through

crop-animal-fish complementarities, development of a skilled manpower base to handle processing and value chain activities besides developing post graduates in the field of agriculture and allied sectors, bio-resource inventorization and characterization for IPR issues, introducing farm mechanization, improving shifting cultivation practices etc. shall be other major outputs.

Expected situation shall be a shift from mono to multiple cropping, technology shy to technology responsive farming community, small scale household production systems to semi-commercial/commercial system of farming, information hungry to information rich farmers groups, organic by 'de fault' to organic by 'process', natural resource degradation to natural resource conservation and its resultant use in a system mode, conventional to advanced mode of farming using molecular tools, insufficient inputs (seed/planting material/manures) to sufficient inputs production devices, local hut (market) oriented extension dissemination to market led extension etc Another situation shall be the placement of the region in organic map of the country/world, thereby paving the way towards evergreen revolution. Propagation of quality animals particularly the pig under the farming system approach at household level is expected to bring in a situation conducive of providing a meat revolution.