CONTENTS

Chapter-1

A. ACTION TAKEN REPORT ON THE MAJOR RECOMMENDATIONS OF THE 20TH MEETING OF THE REGIONAL COMMITTEE ZONE – III, HELD AT UMIAM, MEGHALAYA ON 5-7 MAY 2011

SN	Recommendation	Action taken
1.	In view of the importance of climate monitoring in the region, ICAR, through VC, AAU, shall facilitate establishment of a NE Regional Climate Forum involving all the stakeholders as the region is more fragile and vulnerable to effects of climate change **[VC AAU, Jorhat/ DDG (NRM)].**	• Vice Chancellor, Assam Agricultural University discussed the matter with Hon. Chief Minister, GoA who suggested that Honble Minister, DoNER, GoI would be the right person since he can take it up in NEC meeting. Accordingly, Honble Minister, DoNER was requested. The proposal of Honble Minister, DoNER heading the forum is understood to be under consideration. (**VC, AAU**) • ICAR-RC NEH is a partner of the National Initiative on Climate Resilient Agriculture.
2.	Formation of regional bio-diversity boards be pursued through National Bio-diversity Authority, as many states do not have bio-diversity boards to take care of documentation and conservation of bio-diversity. **[Director NBPGR/NBA]**	• Establishment of State Biodiversity Boards (SBDBs) is in the purview and control of the National Biodiversity Authority (NBA). State Biodiversity Boards have already been constituted in 24 States and UTs in India. NBPGR is helping in providing technical support to the SBDBs through PGR experts, as member in the particular State Boards. For example, two NBPGR scientists, one each from NBPGR Regional Station Shimla and Hyderabad, are members of Himachal State and Andhra State Biodiversity Boards, respectively. Director NBPGR is also represented in special expert committees constituted by NBA from time to time. (**Director, NBPGR**) • Being proposed under the ICAR Research Complex for Eastern Region (under the 12th five year plan)
3.	The possibilities of establishing a cell be explored with post-quarantine facilities in one of the regional universities or research institutes, to monitor trans-boundary crop and	• BSL-3 facilities has been created at AAU, Khanapara, Guwahati, which is being strengthened during XII plan as agreed in the last meeting **[DDG (AS)].**

	animal diseases, considering exposed border of NE region to many other countries **[DDG (AS)].**	
4.	Establishment of a research centre for wetland areas of the region be explored by ICAR in XII Plan. Programme for effective utilization of marshy land in Assam be undertaken **[DDG (NRM); DDG (CS); VC AAU, Jorhat].**	• It is understood that the Honble Chief Minister, Assam had sent a proposal to Honble Agriculture Minister, GoI for a full-fledged research institute on wetland agriculture in Assam. The VC, AAU also received the communication from the earlier DDG (NRM), ICAR about his comment on establishing such a centre in Assam and the VC had given his comment supporting the proposal of Hon'ble Chief Minister. Further progress is, however, not known. Meanwhile, the VC, AAU had also requested for considering the establishment of at least a regional centre on wetland agriculture under ICAR Complex for Eastern Region, Patna. This is also understood to have received the consideration of the QRT for that institute. ICAR is requested to convey its approval in this Regional Committee Meeting to set up the same, if not a full-fledged institute. (**VC, AAU**). • NBSS&LUP, Regional Centre, Jorhat as a member of the committee formed under the Chairmanship of Vice-Chancellor, AAU took part in identification of the site for the "Research Centre for wet land areas" near Guwahati, Assam.**(NBSS&LUP)** • A centre is being proposed under ICAR Research Complex for Eastern Region under the 12th five year plan. **(DDG, NRM).**
5.	In order to address the issue of non-availability of swine fever vaccine, ICAR together with DAHD&F, shall make necessary attempt to establish one swine fever vaccine production centre at AAU, Khanapara. Meanwhile, NRC-Pig, Guwahati shall make arrangements to store the swine fever vaccine after collecting from IVRI to meet the large scale	• As per advice of RCM and the Council, NRC Pig will take necessary steps towards procurement and storage of swine fever vaccine at the Institute in the 12th Plan. In order to implement this, the Council is hereby requested to provide additional budget and staff in the 12th plan. However, till this stop-gap arrangement is completed, the state AH & Vety Departments are advised to procure the vaccine directly from IVRI or AAU or Biological Products, Government of India. **(NRC Pig).** • The Institute till date is not having any pending demand of swine fever vaccine from any state of the country. However, the required doses of swine fever vaccine may be supplied against advance payment if communication is made at least three months in advance. It is therefore requested that the State AH & Vety Departments may kindly be intimated that the

	demand and for timely availability. The need for FMD vaccine in Arunanchal Pradesh was also projected. It was mentioned that respective State Govt. should submit their demand to IVRI, immediately **[VC AAU, Jorhat; DDG (AS); DDG (NRM); Director NRC (Pig); Director IVRI].**	demand along with advance payment may kindly be made to the institute. **(IVRI)** • The recommendation has been communicated to VC, AAU for requisite action • Initiation has been made to keep minimum quantity of swine fever vaccines at campus of NRC Pig. Already vaccines have been supplied to CAU, Imphal; ICAR Research Complex, Umiam and its Jharnapani Centre. According to Director, IVRI, sufficient quantity of swine fever vaccines are available at IVRI, Bareilly. Also, Directors of AH & Vety of the NEH region have already given indent for supply of swine fever vaccines to IVRI (**NRC Pig**)
6.	Establishment of AICRP units on Pig, in Manipur and Arunachal Pradesh may also be explored in XII Plan by ICAR. Similarly NRC Mithun may be expanded during XII plan. The cultivation of QPM Maize in NEH region be promoted to enhance availability of nutritional feed to Pigs **[Director NRG Pig; Director NRC Mithun; DDG (CS); Director DMR, New Delhi].**	• During the last EFC meeting of Animal Science institutes held at Guwahati on 24-25 December, 2011, DDG (AS) has approved the creation of two new AICRP centres at Arunachal Pradesh and Nagaland in the XII plan. For Manipur, one new centre of mega seed project on pig has been earmarked for XII plan. NRC Pig does not have sufficient land for cultivation of QPM maize. However, necessary steps to produce QPM maize through KVKs and mission mode project on 12^{th} plan will be taken up. **(NRC Mithun)** • During the lst six monthly review, it was informed by the Director, NRC on Pig that there was a proposal for closing AICRP in the XIIth plan. Instead, a mega-seed project and project on artificial insemination would be operative. The mega seed project will be handled by the state department while the other project would be handled by the research institutes and universities. • A regional centre at Arunachal Pradesh will be proposed in the 12^{th} plan • The ICAR RC NEH has initiated introducing (TOT) QPM in the region. Training on single cross hybrid maize to entrepreneurs initiated. **(ICAR RC NEH)**
7.	For production of quality semen, facilities at AAU should be strengthened by State Govt./ ICAR. Import of superior bulls may be undertaken **[DDG (AS)].**	• Steps have been taken to produce quality semen at College of Veterinary Science, Guwahati. Infrastructure has been completed with support from RKVY. The bulls are now being procured. (**VC, AAU**)

8.	Opening of a research centre on Duck in the region be considered during XII plan under CARI, Izatnagar. Three major missions on Pig (NE region), Duck (Eastern region) and Goats (in central region) should be given emphasis during XII plan **[Director CARI; DDG (AS); Director NRC (Pig); Director CIRG].**	• NRC Pig is drawing a proposal for initiating a new mission mode project on pig in the 12th plan. (**NRC Pig**) • Although a regional centre of CARI, wholly devoted to ducks, is already functioning at Bhubaneswar, an additional regional centre can be proposed in principle for inclusion of the same in the 12th plan EFC proposals. **(CARI)** • A concept note on Mission on Goat to be undertaken in the XII plan has been prepared and the same will be included in the XII plan EFC of the institute. (**CIRG)**
9.	Considering the need to introduce peri-urban agriculture concept in the region, ICAR may consider funding such project for Guwahati and the proposal for the same may be submitted by AAU, Jorhat **[VC AAU, Jorhat; DDG (NRM).**	• The project on peri-urban agriculture for Guwahati and Jorhat city is prepared and submitted to Dy. D.G. (NRM), ICAR for funding. Action on the proposal from ICAR side is awaited. **(VC, AAU)**
10.	Some final year students of the universities be also exposed to leading Institutions abroad and budget provision for this purpose be made during XII plan. The HRD programme during XII plan be strengthened **[DDG (Edn.)].**	• The issue to be taken up in the 12th plan EFC of Education Division **[DDG (Edn.)].**
11.	One Veterinary college at Nagaland may be established by ICAR as soon as the necessary formalities are completed **[DDG (Edn.)].**	• The territorial jurisdiction of the existing CAU, Imphal will include State of Nagaland after reorganization following creation of new CAU at Barapani **[DDG (Edn.)].**
12.	The scientific man power in NE region may be	• While the scientific manpower in animal sciences has been filled in KVK system, the AAU, authority has already

	filled on priority basis by the universities and ICAR. in NE region. The SMS from animal science sector should be increased in view of the known potential of livestock sector in NE region **[VC AAU, Jorhat; VC CAU, Imphal; Dean Medziphema; DDG (AS); DDG (AE)].**	approached the State Government for required permission for filling the vacancy position in animal sciences and other disciplines in various Faculties of the University. The position will be filled up immediately after receipt of Government clearance.(**VC, AAU**) • Action has been taken up for filling scientific manpower in the university. (**VC, AAU**) • Recently at the College of Post-Graduate Studies, Professors positions were filled up, one each in Agronomy, Entomology and Agricultural Economics. One Associate Professor for Entomology has been selected for the college. Action has been initiated by the CAU for filling up of other vacant post. (**VC,CAU**)
13.	On the issue of establishing Central University in NE region, it was felt to have various options including deemed to be university/ university status to ICAR Research Complex located at Umiam, Meghalaya. A policy decision involving all state Governments be taken in their regard. The Meghalaya Govt. shall take necessary action for providing land for expansion of P. G. College, as requested earlier **[VC CAU, Imphal; Govt. of Meghalaya; Director ICAR Research Complex for NEH, Umiam; DDG (Edn.)].**	• DPR for establishment of new college of Agriculture in Meghalaya under CAU, Imphal has been prepared (**DDG, (Edn)).** • Deemed university status to ICAR Complex has not yet been granted. The matter would be taken up again. As regards to providing land to PG College, the matter has been approved but physical hand over is yet to take place. Land is in the position of the Govt. Of Meghalaya for new C.A.U. and will be ready any time to hand over. **(ICAR RC NEH)** • (i) The issue of the second Central Agricultural University is being taken up by the Department of Agricultural Research and Education **(DARE)**. • (ii). During the recent meeting of the Dean, College of Post-Graduate Studies with the Chief Secretary on **22/03/2013** alongwith the Director, ICAR, Research Complex for NEH, Umiam; the Chief Secretary, Govt. of Meghalaya has assured that the Government will clear the encroachment problems and hand over the additional land of about 20-22 Acres to CPGS as soon as possible.(**VC, CAU**)

14.	In view of the opening up of East-West corridor through NE Region, a need to build competitiveness in Agro-Food Processing and value addition was felt and accordingly, strengthening of this sector in existing universities and ICAR Institutes was needed **[Director CIPHET; DDG (Engg.); VC AAU, Jorhat; VC CAU, Imphal].**	• Activities for orchid packaging and preparation of pineapple powder in the CAE&PHT, CAU, Ranipool is in progres • The facility has been strengthened to some extent. However, additional facilities will be required which is being tried in XII plan. (**VC, CAU**) • Having improved the processing facilities, training programmes to build competitiveness has been planned (**VC, AAU**).
15.	ICAR Research Complex together with other universities shall take up research on Bird eye Chilli; evaluate good varieties of grape for wine making and diseases of Anthurium for Mizoram State **[Director ICAR Research Complex for NEH, Umiam; DDG (NRM); DDG (Hort.); VC CAU, Imphal].**	• Wide collection of bird eye chilli germplasm has been done and experiments on the performance evaluation are in progress at ICAR Complex, Mizoram center at Kolasib. Project on the disease management of Anthurium proposed by scientist of Mizoram has been approved in IRC. Research is being undertaken by ICAR Research Complex, Mizoram centre in collaboration with NRC Grapes for development and evaluation of varieties for humid and heavy rainfall conditions of NE region. **(ICAR RC NEH)** • More than 20 germplasm of Bird's eye chilli have been collected and are being evaluated. **(ICAR RC NEH)** • A set of 53 different chilli geno types from North East India have been evaluated based on morphology, 50 SSR markers and pungency locus Pun1Locus. One of the samples was Bird eye chilli of Meghalaya.(**VC, CAU**) • Bird eye Chilli: Steps will be taken for development of high yielding varieties in Bird eye Chilli (Capsicum) with tolerance / resistance against leaf curl virus, chilli mosaic virus, chilli veinalmotle virus, anthracnose fruit rot and phytophthora root rot in collaboration with ICAR Research Complex for NEH Region, Shillong. **(IIHR, Hessaraghatta, Bangalore)** • Grape Wine Varieties: Evaluation of Grape Wine Varieties already is in progress at NRC Grapes, Pune. **(IIHR, Hessaraghatta, Bangalore)** • Anthurium: Bacterial blight disease caused by *Xanthomonas difenbachia* is a serious disease of Anthurium. Management of

		this disease will be undertaken in collaboration with ICAR Research Complex for NEH Region, Shillong. **(IIHR, Hessaraghatta, Bangalore).**
16	Acid soil amelioration measures should be taken up in an integrated manner by proper combination of locally available organic and inorganic amendments. The problem regarding acid soil amelioration needs to be addressed, with feasible technological options that are to be immediately disseminated to the farmer's field **[VC AAU, Jorhat; VC CAU, Imphal; Director ICAR Research Complex for NEH, Umiam; DDG (NRM)].**	• Assam Agricultural University has already taken up measures for acid soil amelioration through involvement of scientists and KVK personnel in different districts of the state. **(VC, AAU)** • The Soil Science section of NRM division took up demonstration programme in the farmers' fields on liming acid soils (integrated use of lime+50% Recommended dose on NPK+Vermicompost @ 1t/ha) during 2011-12 for increasing the productivity of maize, potato and groundnut crops. The programmes were conducted in collaboration with the Nagaland Centre of ICAR RC for NEH Region and KVK, Ri Bhoi district of Meghalaya. Under Nagaland centre, 10 ha area was covered under the demonstration programme in maize covering Wokha (Ralan village) and Dimapur (Bade village) Districts. In Meghalaya, demonstrations were conducted in East Khasi Hills district (Mawpyrshong village) and Ri Bhoi district (Liarbang and Lumroman village), in potato, maize and groundnut crops, covering 10 ha area. The integrated use of lime, fertilizer and vermicompost with HYV seed (Kufri Jyoti) increased the yield of potato (30.3 t/ha) to the tune of 128% over farmers practice (local variety of seed and fertilizers, yield 13.3 t/ha), while in other crops the increased in yield was found to vary between 20-25% (maize var. DHG-849, yield under lime+INM= 35.9 q/ha, farmers' practice 29.8 q/ha; Ground nut var. ICGS-76, pod yield under INM+lime23.9 q/ha as against 18.7 q/ha under farmers' practice). Around 100 farmers were benefited from the programme. • Research on the role of different organic sources of manures *viz.* pig manure, poultry manure, FYM, vermin-compost and compost as acid soil ameliorant to replace agricultural lime is being conducted. Study under controlled conditions revealed that application of these organic sources of manures @10 t/ha was effective in controlling the acidity. Due to application of these manures, the soil pH (initial 4.85) increased by 0.56-0.74 unit recorded at the harvest of the crop. The increase in soil pH was highest in case of pig manure (0.74 unit) followed by poultry manure (0.71 unit), FYM (0.63 unit), vermicompost (0.57 unit) and compost (0.56 unit). Application of manures increased the ground nut (var. ICGS-76) yield to the extent of 18-99% as compared to lime amended soil. The effectiveness

		of different organic manures in increasing crop yield fall in the order: poultry manure> pigmanure> vermicompost> FYM=compost. To study the effect manures under field conditions, experiments with different doses of organic manures (2.5 and 5.0 t/ha) have been initiated. • The institute obtained 60 t of paper mill sludge from Nagaon Paper Mill, Jagiroad, Morigaon district, Assam during February 2013 and this sludge will be demonstrated among the farmers as alternative source of agricultural lime for amelioration of acid soils of the region. Demonstration programme on use of paper mill sludge as acid soil ameliorant has already been initiated using Maize as test crop in Dimapur district of Nagaland and East Khasihills and Ri Bhoi districts of Meghalaya. **(ICAR RC NEH).** • ICAR-RC NEH continues to work on acid soil amelioration and integrated farming system models are being disseminated . • Work has been carried out at CPGS, Umiam for evolving acid and cold- tolerant rice varieties. The results are given below. i. Generation of a physical map of tolerant genes and quantitative trait loci (QTCs) for acidity and cold tolerance in rice. ii. Marker assisted generation of mini-core (about 70) collection for acidity and cold tolerance, which will serve as part of the reference set for acidity and cold tolerance has been completed. For acidity tolerance, sequence data generation across genic regions like STAR1, STAR2 and PTF1 have been generated and important sequences deposited in Gene Bank**. (VC, CAU)**

17.	Concept of Agri-incubators be gradually introduced by the universities and ICAR Research Institutes in the region. The agro-entrepreneurship be encouraged in the Research institutes and universities of the region **[ADG (IP& TM); VC AAU, Jorhat; VC CAU, Imphal; Director ICAR Research Complex for NEH, Umiam].**	• Agri-entrepreneurship in the areas of bio-input production, fish seed production, floriculture and bakery and confectionery have been developed. **(VC, AAU)** • At ICAR Research Complex, a proposal for agri-incubator is under development in collaboration with ZTMC. For entrepreneurship development some technologies were licensed to the local entrepreneurs. For some more technologies advertisements have been put up. **(ICAR RC NEH)** • A model training course on Strategies for Entrepreneurship Development towards vegetable growers of the north eastern region was held on November, 17-24, 2012. In this Trainers Training Programme, 20 officials of the line departments from Assam, Meghalaya and Mizoram participated**.(VC,CAU**) • No specific activity is so far been taken up for development of agro-incubators under CAU, Imphal. However, ATIC centre of the university may serve to some extent on this line. **(VC, CAU).**
18.	Package of practices for different crops to be grown organically be developed by the research institutes and universities of the region. Production of quality seed and planting material be also given emphasis **[VC, AAU, Jorhat; VC CAU, Imphal; Director ICAR Research Complex for NEH, Umiam].**	• Action has already been taken to develop package of practices for organic cultivation of some important crops under selective AICRP projects and researches have been taken up in RARS and commodity research stations of the university. **(VC, AAU)** • Development on the package of practices on organic farming for some important horticultural crops including spices like ginger and turmeric are being taken up by the College of Horticulture and Forestry, CAU, Pashighat, Arunachal Pradesh**.(VC, CAU)** • ICAR Research Complex has already developed package of practices in organic farming of rice, maize, ginger, turmeric, French bean, rajmash, chilli, groundnut and Assam lemon. Cucumber, peach, guava, soybean are in the process. **(ICAR RC NEH)** • Regarding quality seed production- about 500 quintals of TLC seeds of CAU-R1rice variety is targeted during kharif, 2012**. (VC, CAU)** • AICRPDA is developing package of practices involving organic, inorganic fertilizer doses for rice and toria. • AINP on Soil Biodiversity-Biofertilizers studied the impact of biofertilizers as components of INM in sali and boro rice**.** • Azotobacter and PSB increased `toria' yield by 26%. • Azospirillum and PSB as seed treatment enhanced fibre yield of jute by 20.4 % with B:C ratio of 1.9.

		• Application of enriched compost (@10 t/ha) increased fresh yield of hot chilli, `Bhut jolokia' in Assam. • Production of vermicompost by utilizing weed biomass such as *Ipomea carnea, Eichhornia crassipes, Mikania mikarantha, Cassia occidentalis, Cassia tora, Mimosa invisa, Lantana camara, Chromolaena odorata, Ageratum conyzoides*, and mixed weed biomass recommended. • The Cooperating centre of the network Project on Organic Farming (Umiam) developed package of practices for important crops such as rice, tomato, French beans and carrot. • ICAR RC Complex for NEH Region developed organic package of practices for ginger, turmeric, french leaves, chilli, maize etc**.**
19.	Agriculture is not boundary specific but climate specific. Therefore, institutes/ centers located at similar altitude need to find out appropriate technologies instead of establishing new research centers in each state **[Director ICAR Research Complex for NEH, Umiam; VC AAU, Jorhat; CAU, Imphal].**	• Collaborative research with VPKAS (Almora), DRR, DWM, NBSS&LUP, CRIDA, CIPHED, CIAE, CTCRI, IIPR DCFR, Bhimtal, IVRI Center, Mukteswar, NRCs in the NEH Region etc. are already in progress. Appropriate technologies on conservation agriculture/climate smart agriculture, NICRA etc are being developed. **(ICAR RC NEH)** • The matter has been taken up as a research policy of the university (**VC,CAU)** • Micro rain water harvesting structure - Jalkund - for hill tops developed. • In-situ residue management for carry over soil moisture in maize-toria system developed.(**ICAR RC NEH)** • At Jorhat, improved practice of 6 cm irrigation at flowering stage in rapeseed grown after kharif rice produced 54% higher yield over farmers' practice. • NBSS&LUP, Regional Centre, Jorhat is working on 'Integrated Farming System' for livelihood security. • Research on trans-boundary disease on animals and fisheries has been initiated. NICRA has been initiated by the Council on capacity building, Technology transfer and Research. • NBSS&LUP, Regional Centre, Jorhat is working on 'Integrated Farming System' for livelihood security in Agro-ecological Subregions 15.4 under 'TSP' project. (**NBSS&LUP)**
20.	In order to address the issue of high altitude research, ICAR may consider strengthening the	• Sikkim centre has been strengthened by posting new scientists. In the XIIth plan, a flagship programme on temperate horticulture is being proposed for Arunachal and Sikkim. Research on high altitude cold tolerant rice is going on at

	research base at Sikkim or in any other suitable area. Research on high altitude cold tolerant rice need to be strengthened **[DDG (CS; DDG (NRM); VC CAU, Imphal; Director ICAR Research Complex for NEH, Umiam].**	upper Shillong farm and has been extended to Sikkim also. Ten ha area is under demonstration. (**ICAR RC NEH)** • A total of 176 rice genotypes were collected from different parts of the North Eastern Hill Region including 170 landraces and 6 improved genotypes for different altitudes in NEH region of India and evaluation is carried out as a pre-breeding activity in the University. 106 rice genotypes for high altitude has been collected and crop improvement programmes with 63 segregating populations are being carried out**.(VC, CAU)** • A coordinating centre of AICRP on Irrigation Water Management at Sikkim is proposed to address the complexities of water management in high altitude areas of the north-eastern hilly region**.** • Centres of AICRP on Integrated Farming System and the Network Project on Organic Farming are also proposed at Gangtok during the 12th five year plan**.** • Temperate horticulture is a flagship project of ICAR - RC NEH**.** • CITH, Kashmir, proposes to establish a regional station at Dirang, Arunachal Pradesh on temperate Horticulture**.** • The College of Post-Graduate Studies, Umiam is involved in characterization of cold-tolerant rice accession. **(VC, CAU).**
21.	Stakeholder workshop on "Jhum Cultivation" be arranged with focus on addressing the issues related to enhancing the productivity and alleviating farm income and suggesting alternatives **[Director ICAR Research Complex for NEH, Umiam].**	• A workshop was organized at Nagaland centre on 29-30 June 2011. Based on the deliberations, a flagship programme on Jhum for the NEH states has been proposed in the XIIth plan. **(ICAR RC NEH)** • Agroforestry technologies based on Multipurpose Trees and Shrubs, fodder, fuel wood and fruit trees have been developed as an alternative to jhum cultivation**.** • A project on 'Soil Nutrient Mapping of Nagaland' is proposed in which soil samples in Jhum cultivated areas (6.1%) to be collected at an interval of 500 m**.** • ICAR- RC NEH has a flagship program on Jhum cultivation improvement. • Studies on the cropping system, crop sequencing, crop diversity, crop rotation along with identification of suitable crop species and varieties for different jhum fields through the application of the principles of conservation agriculture are being taken up by the College of Agriculture, CAU, Imphal for increasing productivity under jhum cultivation. **(VC, CAU)** • NBSS&LUP, Regional Centre, Jorhat has started a project on

		'Soil Nutrient Mapping of Nagaland' in which grid soil samples in Jhum cultivated areas (6.1%) to be collected at an interval of 500m. They will be analysed to study the fertility status of the area for stable agriculture. **(NBSS&LUP).**
22.	ICAR Research Complex, Tripura centre may strengthen research to evaluate early season mango varieties, high yielding rice varieties and also develop suitable INM Packages for pineapple. The viable agro-forestry options and ways to enhance coconut production in Tripura may be suggested **[Director ICAR Research Complex for NEH, Umiam; DDG (NRM); DDG (Hort.)].**	• ICAR Research Complex, Tripura centre has developed plantations of 18 mango varieties to evaluate early season mango; programme on high yielding rice varieties are in progress and the centre has released three high yielding rice varieties (Gomati Dhan, TRC-2005-3 and Naveen). As the centre does not have any scientist specializing in coconut, the research on this crop is yet to be taken up in collaboration with CPCRI**. (ICAR RC NEH)** • About five early season mango varieties are being evaluated. Three rice varieties of rice have been released for kharif and boro rice. Water and nutrient management is being worked out for pine apple. • Mango: Collection, evaluation and characterization of some of the mango varieties collected from Tripura region has already been taken up at this Institute. However, the furthering of this work will be initiated in collaboration with College of Agriculture, Tripura and ICAR Research Complex, Tripura Center. **(IIHR, Hessaraghatta, Bangalore)** • Pineapple: Pineapple being one of the important fruit crops, the required Integrated Nutrient Management packages suitable for the region will be taken up in collaboration with ICAR Research Complex for NEH Region, Shillong. **(IIHR, Hessaraghatta, Bangalore)** • Training on 'improved coconut production technology' was given to progressive farmers from Tripura on 7th, 15th and 19th September 2011 at AICRP on Palms, Kahikuchi centre. Demonstrations on important cultural practices of coconut as well plant protection measures were also given to them to increase coconut production in Tripura. **(CPCRI, Kasaragod)** • It is planned to impart training and demonstration on 'Improved coconut production technology' at farmers' field in Tripura in the following years. **(CPCRI, Kasaragod)**
23.	Central Potato Research Station at Shillong may take up the issue of generating sufficient quantities of Kufri Megha	• CPRS Shillong has started the production of basic material for quality seeds of Kufri Megha through micro propagation and mini tuber production. Side by side CPRS has also taken initiative for expansion of infrastructures like expansion of tissue culture laboratory, construction of aeroponic unit and

	Potato seeds required for the region **[DDG (Hort.); Head CPRI Research Station, Shillong].**	net houses for production of sufficient quantity of Kufri Megha and other potato varieties required by the region **(CPRI, Shimla).**
24.	Fisheries Division of ICAR Research Complex, at Umiam, Meghalaya be strengthened further to take up research on indigenous small and endangered fish species, fish processing and packaging studies **[Director ICAR Research Complex for NEH, Umiam/ DDG (Fy.)].**	• Fisheries discipline at present has very less number of scientists with only one scientist (Principal scientist) at the headquarters. Requisition for filling up the vacant post has already been given. Proposal to have a full fledged fisheries division has been recommended by the present QRT. • ICAR complex could successfully introduce indigenous Indian minor carp for hill aquaculture. Standardized the seed production technique of exotic ornamental fish. Due to shortage of scientific manpower, the work on packaging and processing is yet to be taken up. **(ICAR RC NEH)** • A research project on indigenous small and endangered fish species is being implemented in Manipur**.** • Processing and packaging unit established at the centre in collaboration with CIFT Cochin **.**
25.	The hostel facilities at CAU be enhanced to accommodate more number of students, in view of growing demand. The CAU may also have its central Instrumentation facility **[VC CAU, Imphal/DARE].**	• At present the hostel facilities at CPGS, Umiam is found to be adequate. In future, if the student's strength increases, construction of additional hostel building may be considered provided the additional land of 22 Acres is handed over to the CPGS by the Government of Meghalaya**.(VC, CAU)**
26.	Extensive utilization and popularization of farm tools and implements should be initiated among the farmers in various states of the North East region. Storage facilities also need adequate attention **[Director ICAR Research Complex for NEH, Umiam; DDG (Engg.)].**	• For popularization of farm tools, license for production of two farm tools have already been given to private companies. Negotiations for the others are in progress. • Developed household seed saving storage (bamboo/ cane) at ICAR RC Manipur Centre. Training has been conducted. **(ICAR RC NEH).**
27.	Research on paddy-cum-fish culture may be taken up by CIFRI/CIFA	• Training program was conducted by DCFR, Bhimtal in association with NRC Mithun, Jharnapani, Nagaland and ICAR Research Complex for NEH Region, Nagaland for the

	centers located in the region and field demonstrations be also undertaken. These institutes along with DCFR Bhimtal may take necessary measures to address various issues related to Fisheries in NE region **[Director CIFRI/CIFA/DCFR/DDG (Fy.)].**	state fisheries officers of Nagaland and other NEH region. 20 trainees participated in the program for a period of 5 days during 27 Feb.-2 March 2012 for the program entitled "Intensive grow out practices of Golden and Chocolate mahseer for Himalayan region". • Training program was also conducted at KVK, Tirap, Arunachal Pradesh for the fish farmers on integrated fish farming in mid Himalayan region for 30 farmers. • Breeding of rainbow trout was carried out in Sikkim and Arunachal Pradesh and approximately two lakh fry of rainbow trout were produced. A new trout hatchery is procured for the installation at Shergaon trout farm, Arunachal Pradesh. Breeding of brown trout was also carried out successfully. • The development of brood bank of mahseer is going on in the premises of Eco-camp, ABACA, Nameri, Assam and infrastructure created for the brood bank development. • The rearing of Champa-1 & 2 is going on in Sikkim, Assam and Meghalaya to evaluate the comparative growth of the fishes in different thermal regimes. • A workshop was also organised at IIBM, Guwahati during 24-25 March, 2012 on "Sustainable Utilization of Mountain Fisheries Resources for NEH Region". Two hundred dignitaries participated in the workshop from all the states of NEH region as well as from Uttarakhand, J&K and other states of India. A recommendation was made during the planery session for the action to be carried out by DCFR, Bhimtal in association with ICAR/SAU/KVK/Universities and other stakeholders for the overall development of the sector in this region. (**Director, DCFR**). • The institute has initiated demonstration programmes on paddy-cum-fish culture. It is operating a project entitled "Development of livelihood through freshwater aquaculture for the tribal people of North-Eastern states". This project coordinates research and development activities in freshwater aquaculture of the NEH region. The following activities were conducted • Dr. A.K. Sahu, HoD, APED and Dr. Kuldeep Kumar, Pr Scientist participated in the workshop organised by NFDB on "Starategies on enhancement of productivity of IMC and species diversification with special reference to magur, murrel, chitala, pabda, anabas, mahseer and others in NE states" held at Guwahati during 8-9 July 2011.

		• Training programme on Breeding and hatchery management of carps for participants from Meghalaya (30.7.2011-8.8.2011) • Workshop on popularization of murrel culture and other economical species in Assam (11.9.2011) • Workshop on BMP for murrel and other economical species in Assam (12.9.2011) • The institute is looking for some locations in NE region for initiating research programme on paddy-cum-fish culture **(Director, CIFA).** • CIFRI, Barrackpore, through its Regional Centre at Guwahati, Assam, has already conducted a rapid survey to identify the scope and prospects of paddy-cum-fish culture in NE States, as practiced traditionally in Arunachal Pradesh. It has been observed that the Arunachal Pradesh model, though traditional, is a good practice, which needs to be replicated in other NE States. Taking a cue from the Arunachal Pradesh model CIFRI has developed a package of practice for the sustainable utilization of seasonably flood wetlands with rice as the major crop and demonstrated the same in Assam and West Bengal for increasing the per unit water productivity. The model thus developed is ready for transfer in other NE States. Guwahati Regional Centre of CIFRI is working on inland open water fisheries to address various issues in wetlands and rivers in NE region **(Director, CIFRI)**.
28.	The programme KIRAN (Knowledge Innovation Repository in Agriculture for Northeast) an exclusive hub for knowledge transformation and dissemination to various stakeholders related to agriculture and allied sectors programme launched during the RCM be nurtured and supported by all concerned **[Director ICAR Research Complex for NEH, Umiam].**	• KIRAN is already operational at *www.kiran.nic.in* and is being regularly updated after getting information from the regional centres, other institutes and stake holders. **(ICAR RC NEH)**
29.	ZPD office should preferably have a station	• After conducting a meeting with the Zonal Project Director, ICAR Zone-III, CIFRI has already provided 1000 sq feet in the

	at CIFRI, premises Guwahati for easy access and co-ordination **[Director CIFRI; ZPD Zone III; DDG (Fy.)].**	fourth floor to the ZPD during 2011 itself, adhering to the action point of the XX meeting of ICAR Region-III for creating their window at the CIFRI premises Guwahati.
30.	In view of the need to have Jt. Director at ICAR Research Complex, Umiam, Meghalaya, the placement of the Jt. Directors in Centers be reviewed and a policy decision taken. The centres where the number of scientist is inadequate, the need for having Jt. Director be reviewed. The extent of original and adaptive research which needs to be carried out by ICAR research Complex and its Centres in NEH region be defined **[Director ICAR Research Complex for NEH, Umiam/Director (P)].**	• Requisition for JD (Research) & HoD's at the head quarters has been given to the council. **(ICAR RC NEH)** • Action is being initiated.

31.	VCs and ICAR Institutes Directors/Regional Heads are required to undertake six monthly reviews to assess implementation process of the decisions taken in the regional committee and feedback given in this meeting. The above committee shall also deliberate on "complimentary Agriculture, Speciality Agriculture and Secondary agriculture for the region. The Director ICAR Complex for NEH region at Umiam shall take necessary actions, accordingly. The scientists should also visit various sub-centres and build up net work to address regional problems. Location specific and Viable research options should be exercised after mutual discussion [Director ICAR Research Complex for NEH, Umiam/VC AAU, Jorhat/VC CAU, Imphal/All Regional Heads/DDG (Edn.)/ DDG (NRM)].	• The Committee had its three meeting so far under the Chairmanship of Vice Chancellor, CAU, Imphal wherein Directors of ICAR Institutes and the Regional Heads in the NEH Region were invited and reviewed the actions on the decision of the Regional Committee Meeting wherever necessary; efforts were made to solve difficulties expressed by the participants **(DDG, Edn).** • Six monthly review committee meetings have been convened and so far three meetings were organized where the status of implementation of decisions have been taken up. (**VC, AAU**) • Research thrust area for XIIth five years plan (2012-17) and Prioritised focussed researchable issues for the year, 2012-13 of different Colleges/Directorate under CAU as per the **(CAU)** • Noted for compliance. • Meetings of the Vice Chancellors and Directors of all Regional institutes in NE are held regularly (every six months). Action taken on the recommendations of the Regional Committee Meeting has also been reviewed by the committee. • Mid term Review has been conducted. **(ICAR RC NEH)**

B. ACTION TAKEN ON RECOMMENDATIONS AND ACTION POINTS EMERGED THROUGH INTERACTION WITH KVKS DURING 20TH RCM (ZONE-III) HELD AT BARAPANI (5-7 MAY, 2011)

SN	Recommendation	Action Taken
1.	Foundation course must be organized in NAARM for newly joined Programme Coordinators and Subject Matter Specialist for orientation about mandates and activities of KVKs. *(Action to betaken by Division of Agri. Extension,ZPD-II/ and Host Institutes).*	• The Zonal Project Directorate, Zone-Ill has taken up the matter of providing foundation courses for newly joined Programme Coordinators and SMSs of KVKs at the divisional level. However, host institutes and ZPD are regularly conducting orientation and HRD programmes for newly joined Programme Coordinators and SMSs of KVKs in the region. Altogether 16 orientation and HRD programmes were conducted during 2011-12 by ZPD in collaboration with different host institutes for KVK staff. During 2012-13 (up to February, 2013), a total of 13 HRD programmes were conducted for PCs and SMSs of KVKs by this directorate in collaboration with different organizations.
2.	Filling up of vacant positions in all the KVKs. The State Government of Meghalaya and Tripura should fill up all the posts within 3 months. *(VCsof CAU/AAU, Directors of ICAR Complex Barapani, Director Agri/ Veterinary, Government of Meghalaya/ Tripura/Arunachal/Nagaland/ anipur.)*	• The vacant post of staff of KVKs under Department of Agriculture, Govt. of Tripura and Meghalaya were partly filled up and all the host institutes were requested to fill up the vacant posts on priority. A total of 993 staff are presently in position out of the total strength of1184 in 74 KVKs in the region as on 1st February, 2013. The remaining16.13% vacant posts are in the process of recruitment by different host institutes. • Action has already been taken. However, due to movement of KVK scientists and staff to other organizations, vacancies keep coming up which is taken care of through filling up of those vacancies periodically.(**VC, AAU**)
3.	Construction of approved infrastructures of KVKs should be completed during 11th Five year plan. *(VCs of CAU/AAU, Directors ofICAR Complex Barapani, DirectorAgri/Veterinar, Government of Meghalaya/Tripura /*	• During XI plan, 39 administrative buildings of KVKs were completed/ available, 19 are ongoing and 16 are proposed in the 12th plan. Staff quarters in 32 KVKs were completed, 7 ongoing and 35 proposed. Farmer hostel of 24 KVKs were completed and 31 were proposed. There are 108 nos. of functioning demonstration units and 48 proposed. While fencing of 14 KVKs were completed/ ongoing and fencing for 60 KVKs were proposed in the 12 th Plan. • Efforts have been taken to expedite the construction works. However, fund flow for KVK activities is requested to be made faster. (**VC, AAU**)

	Arunachal/ Naga/and/ Manipur.)	
4.	Director of ICAR Institute, Zonal Project Director, Directors of Extension Education of SAU and CAU should visit KVKs frequently for proper monitoring and feedback collection. *(Director I ZPDI DEE)*	• Zonal Project Directorate regularly monitoring and reviewing the activities of the KVKs. During 2011-12, 119 nos. of visits were made to KVKs by the ZPD and scientists from the directorate for monitoring and review of KVKs mandatory activities and programmes including organization of Annual Zonal Workshop and state-wise Annual Action Plan workshop. Similarly, Director of Extension Education of AAU and CAU and their scientists made 134 nos. of visits to different KVKs for monitoring and review of KVK activities during 2011-12. • Monthly monitoring of KVK activities is going on in AAU. Such meetings are held in different locations to take the stock of activities pursued in different KVKs.(**VC, AAU**)
5.	Feed back about technologies generated by ICAR institutes, SAUs and other Research Institutes should be provided for modification/ refinement required in the technologies. *(DEEs I ZPDIDirector, ICAR)*	• KVKs are providing feedback to the concerned host institutes regularly based on assessment and refinement of technologies in agriculture and other allied components. The results of the assessment of the technologies generated by ICAR institutes and SAUs are reported in the individual KVK annual report that was presented during the Annual Zonal Workshop of KVKs. During 2011-12, a total of 196 technologies were taken up on different areas of crop enterprises by the KVKs for their assessment and to identify location specific technologies under local farming situations with 867 nos. of trials. While 59 technologies with 190 nos. of trials related to livestock enterprises during the period. • The feedback obtained from different corners and also from the field functionaries are regularly taken to concerned scientists so that such feed back is duly incorporated in developing new technologies**.(VC,AAU)**
6.	Technological back stopping should be provided to NGO KVKs by the ICAR institute and Director of Extension Education of CAU/AAU *(Director, ICARI DEE)*	• ICAR institutions and DEEs of SAU/ CAU are regularly providing technologies to the NGO KVKs of the region by attending SAC meetings, providing quality seeds and planting materials, technical inputs/ publications as well as organisation of collaborative programmes sponsored by different organisations including State Governments. • Technologies developed by AAU are always available to NGO KVKs. As and when necessary the University is providing the needed back stopping**. (VC, AAU)**
7.	KVKs should consult the nearby institute SAU/CAU/ICAR organizations for	• KVKs are visiting the nearby institutes/SAUs for technology backstopping and also participate in the various HRD programmes organized by SAU/CAU/ ICAR institutes in the region.

	technology backstopping. *(All the KVKs)*	
8.	Administrative approval for changing site for 3 KVKs of Assam i.e. Dhubri, Darrang, Morigaon has to be approved from Site Selection Committee. *(VC, AAU, ZPD)*	• Actions for Change of site of KVK Dhubri in Assam from Chirakuta, Jamaduar to Rangamati, Bahalpur as proposed by AAU have been initiated at the Council level for which this directorate has already submitted. i) Land allotment Order from Asstt. Settlement Officer, Chapar, ii). Land possession certificate in favour of AAU, iii). Non encumbrance certificate and iv). Land map duly signed by competent authority as desired by the Council. Similarly, the change of site from Gelaidingi village to Bengabora Chuburi as proposed by AAU for KVK Darrang was also in the process for which details of information received from AAU have been submitted to the Council. While for KVK Morigaon, requested all concerned Host Organisations including Assam Agril. University to submit fresh/ new proposal in prescribed format for establishment of KVK in Morigaon district of Assam. • Owing to land related problems the sites of three KVKs had to be shifted. Efforts are on in obtaining necessary approval of Revenue Department of the state.**(VC,AAU)**
9.	Staff of KVK Wokha should shift to KVK Site (Lonsachung) within a month i.e. June 2011 *(KVK Wokha)*	• The staff of the KVK, Wokha has already shifted to the KVK site (Lonsachung) and performing mandatory KVK activities.
10.	SAC meeting should be conducted regularly in addition to interface meeting with SAU/CAU/ICAR and other Agri and Allied organizations. *(All the KVKs)*	• Host institutes of KVKs under Zone-Ill are requested to conduct SAC meetings of KVKs under their administrative control regularly. During 2011-12, a total 63 number of SAC meetings were held and 9 interface meetings out of 16 nos. of HRD programmes were conducted in collaboration with different host institutes during the same year.KVKs are also organizing collaborative and sponsored programmes with different line departments and input and funding institutions. • Action has already been initiated**.(VC,AAU)**
11.	Studies on impact assessment of KVK activities should be conducted for last 10 years. (ZPD/KVKs)	• The Zonal Project Directorate is presently undertaking an institute research project entitled- "Impact assessment of KVKs activities in North East" to study the impact of various KVK activities in the region. The project is at the stage of compilation and analysis after completion of data collection from the intended respondents. In annual action plan of KVKs also, impact studies of major technologies have been included. • Those KVKs that completed 10 years have been instructed to carry out impact studies and accordingly KVKs are pursuing

		such activities.(**VC,AAU**)
12.	KVKs should also take-up programmes on Acid soil Management, Resource conservation Technology and Agri-Intelligence. *(All the KVKs)*	• Considering the manpower the activities, viz., acid soil management, resource conservation technologies have been proposed in the KVKs action plan. Some of the KVKs already demonstrating FLDs on liming and zero tillage in major crops of the region.
13.	Due importance should be given on livestock, fodder production and fisheries while assessing and demonstrating technologies *(AllKVKs).*	• KVKs in the region are as mandatory conducting assessment, refinement and demonstration of technologies on livestock, fodder production and fisheries etc. in farmers' field. During 2011-12, a total of 1663 demonstrations on livestock, 61 on fodder production and 94 on fisheries were conducted by the KVKs in the region.
14.	The Host Institutes should ensure the placement of SMS in Animal Science and should release the funds in time. *(All the Host Institute)*	• Host institutes are requested to ensure the placement of SMS (Animal Science) and funds are released on regular basis.
15.	Exploring the possibility for establishment of Women KVK in the region *(ZPD)*	• Initiative has been taken to explore the possibilities for establishment of women KVKs in the region in consultation with different host institutes. However, till now no formal proposal has been received from any host institute for establishment of KVK exclusively with women staff. • AAU would like to propose at least two KVKs exclusively staffed by Women.(**VC,AAU**)
16.	Submission of application for the Best KVK Award (Zonal Level) within 15 days *(ZPD, All the KVKs)*	• Submitted the proposals for the Best KVK Award (Zonal Level) and KVK East Sikkim was awarded the Best KVK Award (Zonal Level) for the year 2010-11. While KVK West Tripura begged the Best Zonal KVK Award, 2011-12.
17.	Ensuring for proper maintenance of land records of KVKs(AII KVKs/Host institutes/ZPD)	• All host institutions have been requested to maintain the proper land records of KVKs and to submit the same to ZPD for office records. This directorate is keeping in contact regularly with host institutes of KVKs in this regard.
18.	Establishment of Crop cafeteria and Technology Park for bringing more visibility of technologies. *(All the KVKs)*	• 10 KVKs in the region have been proposed for establishment of Crop Cafeteria in the form of technology Information Unit during 12th plan for bringing more visibility of technologies.

C. ACTION TAKEN REPORT ON RECOMMENDATIONS OF THE MID-TERM REVIEW MEETING HELD ON 10TH SEPTEMBER, 2012 AT UMIAM, MEGHALAYA (TO REVIEW THE ACTION TAKEN ON THE RECOMMENDATIONS OF THE 20TH RCM HELD ON 5-7 MAY, 2011

SN	Recommendations	Action taken
1.	In view of the importance of climate monitoring in the region, ICAR through VC, AAU shall facilitate establishment of a NE Regional Climate Forum involving all the stakeholders in the region is more fragile and vulnerable to effects of climate change (VC, AAU, Jorhat /DDG(NRM)	• 17 KVKs under Zone-III are presently involved in NICRA project. Some of the outcomes due to KVKs' interventions are- • In-situ moisture conservation was practiced with mulch plastic, biological wastes etc. and half moon terracing in horticultural crops to retain run of water which could benefit 231 farmers and covered an area of 48.48 ha of land • Water harvesting and recycling for supplemental irrigation with Jalkund, rain water harvesting ponds, farm ponds, ring well and community bands which are very useful for the farmers as during lean season for life saving irrigation were provided from the harvested water which help improved crop and water productivity. This could benefit a total of 214 farmers. • Conservation tillage with zero tillage which benefit 15 farmers covering 53.25 ha land. • Water saving irrigation methods with water pump set, diversion channel, sprinkler irrigation and drip irrigation could benefit 173 farmers in 27.5 ha of land. • Introduction of flood/ drought/ temperature tolerant varieties of rice, maize, black gram, soybean, turmeric, ginger, okra, French bean, potato, cauliflower etc. could benefit a total of 1068 farmers which could cover 112.16 ha of land. • Location specific intercropping systems with high sustainable yield index with Potato+ Pea, ground nut + Maize, Maize + Soybean benefitted 63 farmers covering 13.4 ha land. • Use of community land for fodder production during drought/ floods like annual fodder (Maize+ Cow pea), perennial fodder (Hybrid Napier), green fodder cultivation of Oat, var. Kent could benefit 64 farmers covering 17.59 ha land.
2.	Formation of regional bio-diversity boards be pursued through National Bio-diversity Authority, as many states do not have biodiversity boards	• The KVKs in the region are successfully collecting information on different types of unique germplasm of fruits, vegetables, medicinal plants etc. in a specially prepared format. 13 KVKs in the region had already contributed information in the format to the regional station of NBPGR, Umiam. KVKs in Manipur, Nagaland, Arunachal Pradesh and Tripura are extending support and expert assistance to the member of NBPGR.

	to take care of documentation and conservation of biodiversity. [Director NBPGR/NBA].	
3.	The possibilities of establishing a cell be explored with post-quarantine facilities in one of the regional universities or research institutes, to monitor trans-boundary crop and animal diseases, considering exposed border of NE region to many other countries [DDG (AS)].	• KVKs located at the boarder areas have been requested to take up extension activities related to awareness of communicable diseases like swine flu, FMD etc. in animals from across the boarder and their precautions and control measures through different training and demonstration programmes on regular basis. Consequently, KVKs have taken up vaccination and rehabilitation programmes in affected areas of their concerned districts in the region.
4 (6).	Establishment of AICRP units on Pig, in Manipur and Arunachal Pradesh may also be explored in XII Plan by ICAR. Similarly NRC Mithun may be expanded during XII plan. The cultivation of QPM Maize in NEH region be promoted to enhance availability of nutritional feed to Pigs [Director NRG Pig; Director NRC	• As many as 50 KVKs in the region are undertaking QPM maize production and promotion programme through supply of inputs and demonstration in farmers field since 2009-10. Different training and demonstration programme on production and management of QPM maize have been conducted by KVKs for farmers particularly in hilly areas.

	Mithun; DDG (CS); Director, DMR, New Delhi).	
5 (29).	ZPD office should preferably have a station at CIFRI, premises Guwahati for easy access and co-ordination [Director CIFRI; ZPD Zone ill; DDG (Fy.)].	• As part of the action taken of the recommendation of 20th RCM held on May 5-7, 2011, this directorate has written a request letter to the DDG (Fisheries), ICAR, New Delhi vide Office F. No. ZPDIII/ Estt/2009-10/760, dated 11th July, 2011 for kind consideration and further necessary action for a station of the Zonal Project Directorate, Zone-Ill at CIFRI Regional Centre, Guwahati. Further, the Zonal Project Director, Zone-Ill had a meeting with the Head, Reservoir & Wetland Fisheries Division, CIFRI, Barrackpore and Head, CIFRI, Guwahati on 14th September, 2011 at CIFRI, Guwahati to examine and discuss the allotment of space to ZPD, Zone-Ill for establishment of a sub-station at the same premises. The proceedings of the meeting has been submitted to the DDG (AE), ICAR, New Delhi vide this office letter F.No. ZPD-1I1/ Sub-station/2010-11/1316, dated 20th September, 2011 with a request for necessary instruction to us for early start of functioning at the centre. Once the approval is received, further actions will be initiated for early inauguration of one sub-station at CIFRI Regional centre, Guwahati for easy access and co-ordination of KVK activities in the region.

Chapter-2

PRODUCTION AND REQUIREMENT OF FOOD GRAINS AND OTHER COMMODITIES

The region III of ICAR including Assam requires a total of 8125.11 thousand tones of foodgrains for a population of 46.3 million in 2012. During the past two years 2010-11 and 2011-12 substantial increase in production and productivity of foodgrains has been achieved, reducing the deficiency of foodgrains from 23% in TE 2010 to 8.33% in TE 2012. During the last ten years rice production of this region increased by 21.28% (from 5396.2 thousand tones in TE 2003 to 6544.4 thousand tones in TE2012) with a compounded growth rate of 3.16% over the last five years. The increase in production and productivity of foodgrains is being achieved because of replacement of high yielding varieties and quality seed materials and timely supply of improved seeds. Among the NE states Tripura achieved highest productivity of foodgrains (2.62 tones/ha) and highest cropping intensity (184%). Similarly, in organic farming Sikkim is leading among all other states specially in spices crops. The package and practices of organic farming for different crops provided by the ICAR, SAUs, CAU and state agricultural research stations has given better nutrient status in organic food.

The National Horticultural Mission/ Technology Mission in horticulture have played an important role in increasing fruits and vegetables production. Introduction of superior variety and hybrids of different fruit and vegetable crops with package of practices in Hill Agriculture, all the states have increased their fruits production significantly. Fruit production increased from 2839.7 thousand tonnes in 2007-08 to 3955.89 thousand tonnes in 2011-12 with an annual compound growth rate (CGR) of 3.39%. In case of vegetables including Assam, the production in 2007-08 was 5670.6 thousand tones and in 2011-12 the production is 4787.77 thousand tones. This indicates the market complexities in remote areasrequiring special attention.. However excluding Assam, vegetable production production increased from 1196.4 in 2007-08 thousand tones to 1742.2 thousand tones in 2011-12 with CGR 4.04%.

Fish production has increased from 246.69 thousand tonnes in 2006-07 to 259.7 thousand tonnes in 2011-12 though the region is still deficient (57.63 percent). Egg production has been increased from 9894 Lakh No. in TE 2010 to 10099.41 Lakh Nos. in TE 2012. Milk production has increased from 1144 thousand tonnes in 2007-08 to 1201.35 thousand tonnes in TE 2012. Meat production of this region has increased from 206 thousand tonnes in TE 2010 to 220.78 thousand tonnes in TE 2012 (72.48% increase). Except Tripura (-82.12%) and Sikkim (-22.36%), all the other states have increased meat production substantially particularly, Nagaland (164.06%) and Arunachal Pradesh (132.04%).

Table 1: Production and requirement of foodgrains, fish, milk, egg and meat in NE Region in 2012

States/Human Population in 2012 (Estimated)	Commodity	Production(Triennium from 2001 to 2003) in '000'tons	Production(Triennium period from 2010 to 2012) in '000'tons	% increase in production during 2001 to 2012	Requirement in '000 tones as per 2012 population	Surplus/ Deficit in '000 tones	Percent Surplus/ Deficit
Arunachal Pardesh	**Rice**	**134.00**	234.93	75.32	220.76	14.17	6.03
1406115	Total Cereals	227.20	325.27	43.16	222.17	103.10	31.70
	Pulses	7.40	9.77	31.98	25.66	-15.89	-61.94
	Total Food grains	234.70	335.03	42.75	246.42	88.61	26.45
	Fish	2.40	2.51	4.58	18.28	-15.77	-86.27
	Milk	49.00	27.20	-44.48	153.97	-126.77	-82.33
	Eggs	86.00	401.80	367.21	2109.17	-1707.37	-80.95
	Meat	9.20	21.35	132.04	15.47	5.88	27.54
Assam	**Rice**	**3905.00**	4529.59	15.99	4976.77	-447.17	-9.87
31699149	Total Cereals	3921.00	4605.89	17.47	5008.47	-402.58	-8.74
	Pulses	63.20	67.75	7.20	578.51	-510.76	-88.29
	Total Food grains	3984.00	5020.03	26.00	5555.28	-535.24	-10.66
	Fish	159.80	184.21	15.27	412.09	-227.88	-55.30
	Milk	751.00	780.67	3.95	3471.06	-2690.39	-77.51
	Eggs	5067.00	4674.60	-7.74	47548.72	42874.12	-90.00
	Meat	22.40	33.54	49.71	348.69	-315.16	-90.38
Manipur	**Rice**	**378.00**	477.53	26.33	434.58	42.95	8.99
2768025	Total Cereals	375.70	514.14	36.85	437.35	76.79	14.94
	Pulses	3.00	19.42	547.22	50.52	-31.10	-61.56
	Total Food grains	378.70	533.56	40.89	485.10	48.46	9.08
	Fish	15.50	17.52	13.05	35.98	-18.46	-51.30
	Milk	77.00	78.00	1.30	303.10	-225.10	-74.27
	Eggs	902.00	1146.08	27.06	4152.04	-3005.96	-72.40
	Meat	22.00	24.31	10.48	30.45	-6.14	-25.27

Meghalaya	**Rice**	**184.00**	210.06	14.16	473.26	-263.20	-55.61
3014395	Total Cereals	225.20	238.74	6.01	476.27	-237.53	-49.87
	Pulses	3.40	3.64	7.06	55.01	-51.37	-93.38
	Total Food grains	228.50	242.38	6.08	528.27	-285.89	-54.12
	Fish	4.70	3.61	-23.26	39.19	-35.58	-90.80
	Milk	75.00	78.77	5.02	330.08	-251.31	-76.14
	Eggs	902.00	1008.39	11.79	4521.59	-3513.21	-77.70
	Meat	35.60	37.67	5.81	33.16	4.51	11.97
Mizoram	**Rice**	**99.30**	55.69	-43.92	174.20	-118.51	-68.03
1109561	Total Cereals	127.10	59.78	-52.97	175.31	-115.53	-65.90
	Pulses	4.50	5.97	32.74	20.25	-14.28	-70.50
	Total Food grains	131.60	72.83	-44.66	194.45	-121.62	-62.55
	Fish	2.90	2.88	-0.80	14.42	-11.55	-80.06
	Milk	16.00	10.73	-32.92	121.50	-110.76	-91.17
	Eggs	289.00	382.39	32.31	1664.34	-1281.95	-77.02
	Meat	8.70	9.92	14.04	12.21	-2.28	-23.02
Nagaland	**Rice**	**199.00**	334.69	68.19	316.24	18.45	5.51
2014272	Total Cereals	354.00	461.07	30.24	318.26	142.81	30.97
	Pulses	30.40	35.25	15.96	36.76	-1.51	-4.28
	Total Food grains	384.40	496.32	29.12	353.00	143.32	28.88
	Fish	5.00	5.79	15.87	26.19	-20.39	-77.88
	Milk	67.00	78.92	17.79	220.56	-141.65	-64.22
	Eggs	540.00	811.28	50.24	3021.00	-2209.72	-73.15
	Meat	26.20	69.18	164.06	22.16	47.03	67.97
Sikkim	**Rice**	**22.40**	22.06	-1.52	97.03	-74.97	-77.26
618018	Total Cereals	92.10	100.07	8.65	97.65	2.42	2.42
	Pulses	6.30	10.22	62.28	11.28	-1.06	-10.32
	Total Food grains	98.40	110.26	12.05	108.31	1.95	1.77

	Fish	0.10	0.16	60.00	8.03	-7.87	-98.01
	Milk	49.00	43.72	-10.78	67.67	-23.95	-54.79
	Eggs	97.00	133.57	37.70	927.03	-793.46	-85.59
	Meat	4.00	3.11	-22.36	6.80	-3.69	-54.31
Tripura	**Rice**	**535.50**	686.94	28.28	586.15	100.79	14.67
3733439	Total Cereals	574.10	691.50	20.45	589.88	101.62	14.70
	Pulses	5.40	5.23	-3.09	68.14	-62.90	-92.32
	Total Food grains	579.50	696.73	20.23	654.29	42.45	6.09
	Fish	29.30	43.69	49.11	48.53	-4.84	-11.09
	Milk	89.00	103.34	16.11	408.81	-305.47	-74.72
	Eggs	607.00	1541.31	153.92	5600.16	-4058.85	-72.48
	Meat	128.00	22.88	-82.12	41.07	-18.19	-79.48
Total NE	**Rice**	**5396.20**	6544.39	21.28	7278.99	-734.60	-11.22
46362977	Total Cereals	5896.10	6996.45	18.66	7325.35	-328.90	-4.70
	Pulses	123.70	157.26	27.13	846.12	-688.87	-81.41
	Total Food grains	6019.80	7500.03	24.59	8125.11	-625.08	-8.33
	Fish	219.70	255.34	16.22	602.72	-347.38	-57.63
	Milk	1173.00	1201.35	2.42	5076.75	-3875.40	-76.34
	Eggs	8305.00	10099.41	21.61	69544.47	-59445.05	-85.48
	Meat	128.00	220.78	72.48	509.99	-289.22	-56.71

Table 2: Compound Growth rate of fruits and vegetables productions over the period from 2007-08 to 2011-12.

Fruits Production (000'tons)						
STATES	**2008**	**2009**	**2010**	**2011**	**2012**	**CGR%**
Arunachal	107.9	108	107.9	107.9	107.93	0.01
Assam	1410.8	1574.8	1575.5	1763.5	1851.7	2.89
Manipur	273.7	341.9	281.9	286.3	405.85	2.68
Meghalaya	235.2	294.8	294.8	241.9	300.424	1.27
Mizoram	219.6	123.1	328.3	211.5	275.712	4
Nagaland	53	151.3	223.7	151.3	347.68	4.42
Sikkim	13.9	15.7	18.5	25.8	**22.24**	**6.43**
Tripura	525.6	477.2	573.8	643.9	644.348	3.11
NE	2839.7	3086.8	3404.4	3432.1	3955.89	3.39
Vegetables Production (000'tons)						
Arunachal	37.3	110	38.5	70.87	83.5	2.47
Assam	4474.2	2916.7	4569.9	2925.5	3045.56	-3.27
Manipur	113.7	174.3	221.8	236.5	200.32	6.44
Meghalaya	352.5	415.8	415.8	356.5	385.011	0.09
Mizoram	95.9	114.4	179.1	115.6	221.101	7.57
Nagaland	63.5	78.3	78.3	79.4	222.626	11.57
Sikkim	110	98	147.7	120.9	**77.10**	-2.15
Tripura	423.5	294.7	446.9	532.3	552.55	4.99
NE	5670.6	4202.2	6098	4437.57	4787.768	-1.17

Chapter-3

AGENDA ITEMS

STATES OF NEH REGION

A1- ASSAM

DIRECTOR OF AGRICULTURE:

1. Considering the upcoming importance of organic agriculture in the state of Assam, ICAR may kindly consider setting up of a full fledged research centre on organic agriculture including animal husbandry in Assam
2. The state has a sizable area under wet land. Technological packages for this kind of ecosystem are not available locally. ICAR therefore may consider opening up of a sub center on wet land agricultural research.
3. No major attempt in the state of Assam has been taken to promote production of millets though the state has enough potential for this. It is therefore proposed that ICAR considers extensive research support on millets including crops like Buck wheat either by strengthening regional research station under AAU or by way of projects like AICRP/Network on millets.
4. It is understood that AICRP projects on Integrated Farming System is in operation through AAU. Considering the present importance of a farming system for nutrition, additional support to undertake such research on multi-locational basis may be considered.
5. Presently the Government of Assam is going ahead with procurement and storage of paddy for which massive research support to manage storage grain pest is proposed.

DIRECTOR OF DAIRY DEVELOPMENT:

1. Dairy Development, Assam is in acute shortage of Dairy Technologist since for almost last 15 years. No one has undergone the course of B.Tech. (Dairying). Hence, the ICAR should make provision of seats in ICAR affiliated institutions in the country so that Diary Development activities in the state could be managed by Dairy Technologist

DIRECTOR OF FISHERIES:

1. **Standardization of commercial breeding technology of live fishes:** The State is abundant with live fishes such as magur (*Clarias batrachus*), singhi (*Heteropneustusfossilis*), koi (*Anabustestudeneus*), cuchia (*Monopteruscuchia*); snake heads such as sol (*Channastraitus*), sal (*Channamarulius*), goroi (*Channapunctatus*) etc.; feather backs such as chital

(*Chitalachitala*), kanduli (*Notopterusnotopterus*). But commercial breeding of these consumers preferred and high priced species are yet to reach the farmers and subsequent development of farmers friendly package of practice.

2. **Development of College of Fisheries, Raha:** College of Fisheries, Raha is the first institution for fisheries education in the NE Region. The college is celebrating its Silver Jubilee, but the level of education, infrastructure and overall status remains more or less same. ICAR may intervene in development of the College to a state-of-art educational institute equipped with all modern tools, manpower, infrastructure and other facilities so that quality education both at graduate and post graduate level.
3. **Demonstration of pen & cage culture:** Considering the varied and vast water resources of the state, pen and cage culture are very potential non-conventional methods of fish culture. These methods are to be demonstrated not only for seed rearing but also for enhancement of fish production on large scale in wetland, open water fisheries and tributaries where feasible. A module may be developed with community participation in coordination with implementing Agency.
4. **Standardization of commercial breeding of indigenous ornamental fishes:** Assam is gifted with abundant and diversified aquatic resources, especially fishes, many of which fetch very high demand even in the international market. Standardization of commercial breeding technology of these high demand species is the need of the hour.
5. **Introduction of organic fish farming:** Assam has many pockets which are still virgin with scope of organic fish farming; but farmers are ignorant of this important aspect. Steps may be taken to introduce organic fish farming, initially covering main fish producing districts in the state on demonstration/ pilot basis.
6. **Identification of locally available raw materials as fish feed:** Fish feed is one of the major hurdle in increasing fish production in the state. Procuring feed from the neighboring state is also not cost effective. Hence, identification of locally available raw materials for utilization as fish feed ingredients may lead Assam to become a self sufficient state in fish feed production.
7. **Alternative to mustard oil cake:** Mustard oil cake is an integral part of traditional fish feed in our state. But due to low productivity/ less area coverage or any other reason, this component is not available to be utilized as fish feed. Emphasis must be laid down for production of ground nut oil cake/ soybean etc to get sufficient raw material as source of protein rich fish feed.
8. **Standardization of Integrated Fish Farming Practices in Assam's condition:** Integrated Farming of Paddy cum Fish Culture, Pig cum Fish Culture, Fish Cum Horticulture may be expanded for sustainable economic return of marginal and small farmers for which package of practice in local situation may be updated.
9. **Linkage with KVKs:** Establishment of a strong linkage (both way) between KVKs & Fishery Department at district level and the Department & Assam Agricultural University in state level is very necessary for overall development of the sector. Fishery Experts are to be recruited in

all KVKs and an effective mechanism for proper coordination need to be introduced for the purpose.

A2- ARUNACHAL PRADESH

COMMISSIONER (AGRI./HORT.):

I. Crop Production:

a) Evolve suitable strategy for alternate to shifting cultivation.

b) Release of glutinous high yielding Rice Variety.

c) Genetic manipulation of indigenous cultivars of field/fruit & Medicinal & aromatic crops.

d) Standardized Package of Practices for Agro ecological zone specific Integrated Farming System approach.

II. Research:

a) Establishment of Regional Research Centre for Temperate Horticulture as recommended by High level Roving team.

b) Project on Control of Apple scab & Rejuvenation of Senile Apple orchards.

c) Establishment of R&D Centre for Fruits & Medicinal Plants.

d) Setting up of a Regional Pig Breeding Farm & a Goat Research Station.

III. Human Resource Development:

a) Establishment of College of Agriculture and a College of Veterinary Science under CAU, Imphal.

b) Up-gradation of existing ICAR, Arunachal Centre into a Directorate with agro-ecological zone wise Field Trial/ Research Stations.

c) Establishment of KVKs in Anjaw, Dibang Valley, Kurung Kumey & Longding districts.

d) Strengthening of KVKs with multidisciplinary Subject Matter Specialist (SMS), Supporting manpower, adequate funding for Research & Extension, Other logistics like residential & non- residential accommodation.

e) Pay & allowances for KVK staffs under administrative control of State govt. at par with KVK staffs under ICAR.

DEPARTMENT OF AHV & DD:

1. **Extension unit of NRC (pig) Rani (Assam)**: One Extension/Network unit of NRC (Pig), Rani, Assam, may please be provided to Arunachal Pradesh, in the form of AICRP on (pig) to cater the high demand of Piglings and other Research/ technical input supports to farming Community of the state.

a. This proposal is raised considering the bottle necks in transportation of Pig/ Piglings from neighboring states to cater the local needs of Piglings in the state.

2. **Sub-Centre of NRC (Mithun), Medziphema (Nagaland):** OneSub-Centre of NRC (Mithun), Medziphera (Nagaland) may be established in Arunachal Pradesh, nearby Itanagar, considering the state possessing highest Mithun population (78.7%) and for the benefit of Mithun rearers.
   a. This proposal has been raised since 2009 Regional Committee Meeting held at Gangtok, Sikkim, but not materialized yet.

3. **Infrastructure Development at KVK, Papumpare:** No adequate fund has been provided for infrastructure development at KVK, Papumpare, except for one Administrative building, 860 running meter boundary fencing at Karsingsa and one horticulture demonstration Unit so far. Though, this KVK has been functioning in full swing with full strength since Feb, 2008 till date without proper infrastructures.

4. **One College of Veterinary Science for Arunachal Pradesh:** Establishment of one College of Veterinary Science in Arunachal Pradesh, under Central Agricultural University may be considered on priority.

   Further, the existing 5 seats for BVSc & AH at C.V.Sc Aizwal (CAU) may be increased to 10 seats, and additional 10 seats in C.V.Sc, Khanapara, Assam Agril. University, may be provided till the establishment of veterinary college in the state of Arunachal Pradesh.

   This proposal is raised considering the large number of aspiring students and requirement of professional manpower in the state of Arunachal Pradesh. At present there is no veterinary college in the state.

A3- MANIPUR

DEPARTMENT OF AGRICULTURE:

1. There are no released varieties from the Agriculture Department, Manipur.
2. Suitable package of practices including soil health, nutrient management, plant protection for hill agriculture.
3. Efficient technology for reclamation of acid soils and water logged soils are needed.
4. Farm mechanization with appropriate machineries and equipment are required for the state.
5. Efficient extension education mechanism is needed for the state for dissemination of agricultural technology.
6. Various improved package and practices including latest technologies for increasing agricultural production.
7. To develop sufficient number of HYV paddy varieties suitable for high altitudes and cold tolerant.
8. To establish a High Altitude Crop Research Station for the state to take care of research.
9. Suitable improved agricultural improvements for hill agriculture.

10. To establish a Krishi Vigyan Kendra at Jiribam under the administrative control of Agricultural Department, Manipur.

DEPARTMENT OF HORTICULTURE & WATER CONSERVATION

1. Suitable tomato varieties for green houses are to be identified.
2. Package of practices is needed for green house cultivation of crops especially for tomato.
3. Agronomical practices which are less labour consuming and help in holistic management need to be evolved for horticultural crops.
4. Standardized package of practices for king chilly cultivation.
5. Standardized package of practices for *Allium* sp. cultivation.
6. Easily adoptable technologies to increase the shelf life of horticulture produces.

A4- MEGHALAYA:

1. **Quality planting materials of strawberry:** As the cost of importing hybrid plating materials is very high, the state government would like to get the materials from ICAR if they are available.
2. **Central Agricultural University:** Since the land for the proposed Central Agricultural University is ready for transfer, the Govt. of Meghalaya wants that the University may be established at the earliest.

A5- MIZORAM

DEPARTMENT OF FISHERIES:

1. Creation of one fishery scientist post at ICAR, Mizoram Centre for initiation of fisheries research in the State. The State is having tremendous scope for establishing aquaculture based integrated farming system models, development of cage culture in the state owned hydrel projects. The State is endowed with lots of water bodies and indigenous germplasm of fishes including ornamental fishes.

DEPARTMENT OF AH & VETY:

1. Establishment of Rural Animal Health Mission in Mizoram state for increasing production and productivity of meat, milk and egg in the state.
2. Research in production of low cost feeds of animals using locally available feed materials and also provision of subsidy in animal feeds by the Government of India.

DEPARTMENT OF HORTICULTURE:

1. **Trial of different Varieties of Grape for Mizoram condition:** Grape issuccessfully cultivated in the state, where more than one lakh bottle Red port wine is being produced annually and still increasing in upward trend each year. The present Grape variety being grown is Bangalore Blue which is good for Read port wine. But, superior variety for red wine i.e. "Tempranillo" (Spanish variety) is being introduced for better quality wine and gradually the present variety will be replaced in due course of time. Further, two varieties from IARI i.e. Pusa Navrang and Pusa Urvashi (table and wine variety) and two varieties from Taiwan i.e. Muskat (Black Queen) and Kyoho had also been introduced in the state and is being trial in various departmental centres. Hence, for producing better Red port wine or table Grapes, it is necessary to do adoptive trial on different varieties of grape so as to find out the best suited varieties in Mizoram Condition.
2. **Trial of temperate fruits like peach, pear and plum in Mizoram condition:** The unique climate condition of Mizoram is suitable for cultivation of various kinds of Horticulture crops ranging from tropical, sub-tropical to semi-temperate fruits, The success of grape `Red Port Wine' is being achieved in the state. However, temperate fruits like Peach, Plum & Pear can also be processed into wine and other purpose. In order to find out the best suited var/crop, adoptive trial may be taken on these crops fro Mizoram conditions.
3. **Trial of different harvesting season for year round production of M. Organge:** M. Orange is one of the most important crops in the state and has been successfully grown in the state for about hundred years back. The crop is harvested from November – January in the state. Since, it is very much preferred by the consumers, production period enhancement has become very important. In order to increase the harvesting period and to get year round production, trial of staggered harvesting of M. Orange may be conducted in the state.

DEPARTMENT OF AGRICULTURE:

1. Opening of Regional Center of Directorate of Oil Palm Research (including establishment of Oil Palm Seed Garden) in Mizoram to cater the problem of quality planting materials and also research needs of Oil Palm in the state as well as other States of North East covering 13056 Ha., with three processing Centres of 5MT/hr Capacity each.
2. Posting of Scientist in the disciplines of Plant Breeding and Agronomy in ICAR, Mizoram Center for conducting research in improvement of location specific HYVs of Rice and Maize, nutrient management and conservation Agriculture and maintenance of indigenous varieties of crops.
3. Creation of three Senior Scientist posts in the disciplines of Soil Science, Plant Breeding and Agronomy for meeting the challenges of climatic change Soil acidity and food security in the State.

Director of Agriculture (Research & Education)

1. This Directorate is acting as a host Department for 7 KVK of Mizoram. It would be very beneficial for the poor farmer if provision for creating of various Agril. Scientist post is made to monitor local KVK within the state.
2. Meagre Release of Fund for KVK: The fund release during 2012-2013 for contingency fund is only Rs 3.0 lakhs for each KVK's whereas there is Rs. 9.0 lakhs for contingency fund in the Revised Estimate for the year 2012-13. Under this situation, it is very difficult to have good achievement and earnestly requested to allot more fund under contingency head.
3. Strengthening of ICAR Research Complex, Kolasib: As we have heard from a reliable source, the total number of scientist's sanction post is 10 only, which we feel very much necessary to increase at 15-20 sanction posts for achieving higher outcome for the benefit of Mizo farmers.

A6- NAGALAND

DEPARTMENT OF AGRICULTURE:

1. Establishment of KVKs in Kiphre and Peren Districts.
2. Creation of research facilities for high altitude agriculture.
3. Creation of facilities for seed production and processing.

DEPARTMENT OF HORTICULTURE:

1. Management of Passion fruit diseases.
2. Development of package of practices for chow-chow (*Sechium edule*).
3. ICAR to provide mother plants for Rootstock block and Scion block of various horticultural fruit crops
4. Detail study for declining Passion fruit plantations in Nagaland.

VETERINARY & A.H. NAGALAND, KOHIMA.

1. To expedite the process of setting up of Veterinary College under CAU in Nagaland as assured by the Director General, ICAR at the 19th meeting of the ICAR Regional Committee No. III at Gangtok, Sikkim on 23rd-24th October 2009 and also at the XX ICAR Regional Committee meeting of Zone -1II held at [CAR Research Complex for NEH Region, Umiam, Meghalaya, 5-7th May 2011.

2. Grass root level oriented technology for utilisation of locally available feed resources in livestock & poultry production by AICRP on improvement of feed resources and nutrients A.A.U., Khanapara.
3. ICAR Centre at Jharnapani, Nagaland be facilated for testing chemical residuals in meat that are being sold in Kohima, Dimapur etc in collaboration with the Department of Veterinary & A.H. Nagaland, Kohima with a view to create awareness and also to provide wholesome meat to the consumers.

DEPARTMENT OF FISHERIES:

1. To establish an updated laboratory so as to identify and treat fish diseases.
2. To assist the Department to procure fund so that the ICAR and the Deptt. can work hand in hand with the latest technologies know-how.
3. To take up research/culture on Murrel in wet terrace field, Frog cultures and Mollusc cultures.
4. Consultant for preparation of DPR on the above may be made available from ICAR.

A7- SIKKIM

DEPARTMENT OF AGRICULTURE:

1. Formulation of packages of practices for various crops under organic farming system.
2. Identification and exploitation of some important indigenous crop. As such, establishment of package of practices for the above indigenous crops needs to be developed by ICAR.
3. To develop sufficient number of HYVs of paddy suitable for the high altitudes and which are cold tolerant.
4. Suitable improved agriculture implements for hill agriculture.
5. Research work in finding proper/suitable organic seeds which can grow in moisture stress and upland areas particularly rabi crops.
6. Conservative Agriculture.

DEPARTMENT OF HORTICULTURE:

1. Organic pest and disease management protocols for specific crops – focus on flowers.
2. Large cardamom – specific management of colletotricum fungus.
3. Organic management of mould during transit (shipping to outside countries for export).

A8- TRIPURA

DEPARTMENT OF AGRICULTURE:

1. Establishment of Krishi Vigyan Kendra in newly constituted 4 no districts viz; Unakoti, Gomti, Shipahijala & West Tripura.
2. Establishment Agricultural University in Tripura ICAR has established University of Agriculture and Technology in the states except few NE states. Since last 6 years Tripura Government is running College of Agriculture and College of Veterinary (4 yrs) out of state fund which are affiliated Tripura University. In addition Fishery College is running for more than 10 years under Central Agriculture University. Tripura would like to draw attention of ICAR for establishment of "Tripura University of Agriculture & Technology" comprising all the existing 3 colleges for imparting better education in Agriculture and allied discipline as the basic social characteristics are agrarian.
3. Establishment of Crop and Cropping system Specific Research Station in Tripura by ICAR especially for Rainfed Upland Ecosystem, Fruit and Plantation Crops and Tuber Crops.
4. Placement of Scientist to ICAR Research Centre for Tripura located at Lembucherra, Agartala at least up to already sanctioned strength of the centre.
5. Crop diversification modules both in lowlands and uplands of Tripura with maximization of economic return to farmers.

DEPARTMENT OF HORTICULTURE:

Fruits & Plantation Crops

1. Identification and improvement of best quality local varieties of jackfruit including round the year types and standardizing their cultivation practices.
2. Identification and improvement of local fruit varieties of Carambola, Custard, apple, Loquat, Beet, Banana etc.
3. Maintenance & supply of nucleus mother plants/culture of important local varieties of fruits.
4. Developing protocol for micro propagation of banana var. Sabri through tissue culture.
5. Standardization of agro-techniques for high density cultivation of Citrus, Guava, Mango, Pineapple & Banana for Tripura.
6. Identification of specific casual organism/reason for poor size, shape of Coconut which is largely seen throughout the state.
7. Introduction of new early and mid season varieties of Mango suitable for Tripura condition.

Vegetable crops:

1. Identification of new H.Y.V varieties of Sweet Potato, Xanthosoma, Colocassia suitable for Tripura.
2. Maintenance & supply of nucleus seed materials of important local vegetables.
3. Identification of suitable HYV/Hybrids for cultivation during off season.
4. Low cost techniques for cultivation of indeterminate types of Tomato.
5. Standardization of low cost protective structure for cultivation of vegetables round the year.

Spices:

1. Identification of standard suitable for monoculture of Black Pepper out of locally available and easily multipliable plant species.

DEPARTMENT OF ANIMAL HUSBANDRY:

1. Posting of Scientist in the Discipline of Animal Health in the local ICAR Unit with effective monitoring and surveillance of Animal diseases particularly trans-boundary diseases.
2. Policy formulation in upgradation of milch cattle with an approach to increase milk availability in Tripura.
3. Establishment of AICRP on Piggery Development programme.
4. Strengthening of rural poultry production systems under low input supply acceptable by farmers.

DEPARTMENT OF FISHERIES:

1. Diversification in aquaculture with special emphasis on production of minor fishes in Tripura.

A9. AGENDA ITEMS FROM AGRICULTURAL UNIVERSITIES/ICAR INSTITUTES

A9.1- ASSAM AGRICULTURAL UNIVERSITY:

1. **Reservation of seats for students from Assam in B.Tech (dairying) and MSc (dairying) at NDRI**

   The students aspiring to undergo education in Dairy science from the state and the Region are finding it difficult to get admission at NDRI because of All India Test system that too without any examination centre in the Region. The Region also does not have any Dairy science College locally. The issue of some kind of a reservation of some seats at NDRI was discussed with the Director NDRI recently who expressed his willingness to create such a provision with the permission from ICAR. It is therefore, proposed that ICAR may kindly grant permission to NDRI to create the provision of 10 additional seats for the students of North Eastern Region with 4 seats for Assam and remaining 6 @ 1 each for other states excluding Sikkim since they have a centre close by at Kolkatta. Similarly, 3 seats in the College of Agricultural engineering at Sikkim is proposed for the students from Assam.

2. **Provision for skill increasing attachment of Post-graduate students in advanced labs**

   MSc/ MBA/ MVSC/ MFSC and PhD students need exposure and hands on training on advanced equipments etc in fore-runner universities/ institutions in India for which a specific budget provision for the PG students of AAU is proposed. This will also encourage knowledge and expertise exchange among the students. An amount @ Rs. 12,000/ per student per annum for around 300 students per batch for remaining 4 years of the plan period i.e Rs. 144.00 lakhs is proposed.

3. **Developing a model for Complementary Agriculture in the area of Sericulture**

   Sericulture is an old and prestigious sector of agriculture in Assam which produces Eri, Muga and Mulbery silk. The sector where around 2.6 lakh people depend is suffering from quality seed crisis, particularly P-2 level seed. One of the factor hindering quality seed production is the massive expansion of small tea garden areas where substantial amount of pesticide etc are used. One of the likely solutions is to produce the seed in the neighbouring states of Assam like Arunachal Pradesh, Nagaland and Meghalaya. It is therefore, proposed through ICAR that the available infrastructure/ land etc in its Institutes in these states or the areas available under state departments of those states are utilized for production of silkworm with a buy back arrangement of the seeds by the state department of Assam. AAU shall take the responsibility of training the personnel in seed sector together with Central Silk Board utilizing a portion of the ICAR development Grant.

4. **Modification and restructuring of existing B. Sc. (Agri) programme**

   The present curricula of B.Sc. (Agri), implemented after 4th Deans Committee report in 2007 has reduced the on-campus regular classroom courses to 3 year duration with the introduction of Experimental Learning Programme (ELP), along with continued implementation of

RAWEP. As a result, some courses have been withdrawn while some had to be clubbed with some other courses without concomitant increase in the credit hours, if a comparison is made with the course carricula followed after 3rd Deans Committee recommendation. As a result, it has become difficult for the teachers to adequately cover and explain the course content to a level needed for an average student. Again, the erstwhile elective courses were observed to be beneficial in guiding them for higher studies, as those courses served as basis to post-graduate course in a discipline.

It is, therefore, proposed that the 3 years (6 semesters) regular on-campus should be extended to 3 years 6 months (7 semesters) duration. The elective courses in all disciplines should be introduced. The ELP and RAWEP should be clubbed together for operation in 8th semester to complete whole B.Sc. (Agri) programme in 4 years.

5. **Exposure visit of faculty members to abroad**

Continued working in same environment may dampen the spirit of self improvement and innovation which severely affects quality teaching and research. Engagement in a well-planned study tour process should provide faculty with opportunities to network and share information, explore topics of common interest, experience the best of the research/ extension methodology followed, and engage in the kinds of learning that they are expected to practise with their students' etc.

It is, therefore, proposed that the faculty members may be facilitated, through special provision, for short term visit to abroad and best national institutes to keep them abreast with the new developments in agricultural teaching, research and extension and enhance their professionalism.

A9.2- CENTRAL AGRICULTURAL UNIVERSITY

The states are requested to make available land for:

a) College of Agricultural Engineering in Sikkim

b) College of Agriculture in Arunachal Pradesh

A9.3-DIRECTOR, NRC (YAK), ARUNACHAL PRADESH:

1. To provide infrastructure at ICAR_RC for NEH Region, Sikkim Centre, Tadong to facilitate training. This will also facilitate in organizing necessary training for the purpose.
2. Shortage of manpower/vacant post in NER institute to be filled up on priority basis.

A9.4-NRC FOR ORCHIDS, PAKYONG, SIKKIM

- State Govt. of Sikkim acquired 1.84 ha of land for ongoing airport. No substitute land has been given to NRC orchids. Further, no fund has been given for acquiring of Two building and wall and polyhouse **(as per arbitration)**
- Community *ex situ* orchid conservation centre or park can be developed by joint collaboration with State Forest and Horticulture Department for promotion of ecotourism.
- Due to non-availability of sufficient service providers for outsourcing farm and laboratory work, recruitment of skilled technical staff are required.

A9.5- NRC ON PIG, RANI

1. **Central Pig breeding farm in the North Eastern states, India:** Pig farming in the North Eastern (N.E.) states, India is playing a very important role for socio-economic upliftment and livelihood generation amongst the rural poor. Due to increasing demand for quality pig germplasm both for production and breeding purposes, the ICAR National Research Centre on pig and its AICRP and Mega seed centres in the N.E. Region is unable to meet up the requirement. Therefore, the Central Pig Breeding farm in different States be strengthened in the XII plan.
2. **Policy for banning illegal migration and trading of live animals across the International borders:** North Eastern Region of the country shares more than 95% of the International borders and there are porous International borders. In view of the emerging threat of transboundary animal diseases in the region there is an urgent need to evolve policy guidelines and legislation to prevent the illegal migration of animals particularly from Myanmar,Bhutan, Nepal and Bangladesh.
3. **Strategy to evolve regional coordination for animal disease control programme in N.E. region, India**: Diseases more particularly the epizootic diseases of animals are the major factors for retarding the growth of livestock industry in the N.E. region in particular and the country as a whole. For controlling the diseases strong regional coordination with the Asian countries is needed. Therefore, it is important to evolve a strategy for regional cooperation so that economically important diseases of livestock in the country can be controlled effectively.
4. **Establishment of quarantines at the porous international borders**:To reduce the chances of emergence of transboundary animal diseases in the N.E. Region in particular and the country as a whole there is a need to establish quarantines having animal disease diagnostic facilities . Therefore, Animal Husbandry and Veterinary Department of each of the N.E. states should set up priority for establishing such centre.

A9.6-NATIONAL BUREAU OF SOIL SURVEY AND LAND USE PLANNING, NAGPUR

1. Soil Fertility Mapping of Nagaland and Sikkim State: Soil samples are to be collected at 1 km interval and parameters like pH, Organic carbon, Available N, P and K and Micronutrients (Fe, Mn, Cu & Zn) are to be analysed and mapped.
2. Detailed Soil Survey will be made on the Wet Land to be identified by the core committee constituted by Vice Chancellor, AAU, Jorhat.
3. The Land Use Planning under rainfed ecosystem (Johat district of Assam) will be linked with Decision Support System.
4. Land Resource Inventory for Farm Level Planning of Dimapur district of Nagaland (1:12,500 scale) will be carried out.

A9.7-REGIONAL RAINFED LOWLAND RICE RESEARCH STATION, GERUA

1. Collaborative efforts in research for the development of short duration, high yielding, medium slender-grained rice varieties for for early *ahu* (pre-flood) and late *sali* (post-flood) seasons
2. Collaborative efforts for the development and evaluation of hybrid rice technology for resource poor farmers
3. Interface for popularization of integrated rice-fish farming system.

A9.8- CIFRI Regional Station, Gauhati

1. Ecosystem based fisheries management in wetlands of northeastern states.
2. Demonstration of enclosure (pen and cage) culture in wetlands and reservoirs of the Northeast.

C2- ZPD, ZONE III, MEGHALAYA:

1. **Filling up of vacant posts in KVKs and ZPD on priority basis.** A total of 993 staff are presently in position out of the total strength of 1184 in 74 KVKs in the region as on 1st February, 2013. The vacant post of KVK staffs under Department of Agriculture, Govt. of Tripura and Meghalaya were partly filled up and all the host institutes were requested to fill up the remaining 16.13% vacant posts on priority basis as early as possible.

2. **Non-receipt of proposals from host institutes for establishment of new KVKs in Assam, Meghalaya and Arunachal Pradesh.** This directorate has invited all concerned host institutes for submission of new/fresh proposal for establishment of KVKs which have been

approved during XI plan for the districts of North Cachar (Dima Hasao) and Morigaon in Assam, South Garo Hills in Meghalaya and Dibang Valley and Kurung Kumey districts of Arunachal Pradesh. However, till now this directorate has not received any proposal from any host institute for establishment of KVK in the said districts.

Chapter-4

STATUS OF AGRICULTURAL RESERCAH, EDUCATION AND EXTENSION ACTIVITIES

B-1. STATUS REPORT OF AAU, JORHAT

Assam Agricultural University, Jorhat, established in 1969 has grown to a premier institute, not just for the North East Region, but also for the country as a whole. This year, in a survey of Outlook Group of Magazines (Career 360), the University has been rated as fifth best among the agricultural universities and one among the 100 top ranking universities and deemed universities of the country. The University has played an important role for the growth and development of the region with significant contribution towards fulfilling its mandates of imparting education, furthering advancement of research and undertaking extension in agriculture and allied sciences like animal husbandry, fishery and home science. It has four faculties with 6 constituent colleges *i.e.* three in Agriculture and one each in Veterinary, Fishery and Home Science Faculties for imparting education; 6 Regional Agricultural Research Stations and 5 commodity research stations for conducting location specific research and 20 Krishi Vigyan Kendras (KVK) and 1 Extension Education Institute (EEI) to undertake extension activities of the university. The University has already been accredited by the ICAR. Brief information on the salient achievements of the University under its mandates during 2011-13 is given below.

1. Education

The College of Agriculture, AAU, Jorhat offers courses viz. B. Sc. (Agri), M. Sc. (Agri), MBA in Agribusiness and Ph.D. degree. Altogether 18 Departments offer various degree programmes in the college. The faculty has introduced the new curriculum as recommended by the 4th Deans committee on Agricultural Education in India. Masters degree programme in Agri-business Managenent was introduced during the year 2002. Ph.D. in Agricultural Biotechnology has been proposed under course-curriculum system. Certificate and diploma courses, ranging in duration from two weeks to one year, for providing self-employment and income generation opportunities have been proposed. During 1996, the Rural Agricultural Work Experience Programme (RAWEP) was introduced for which another 20 credits have been earmarked for one semester.

a) Students admitted in College of Agriculture, AAU, Jorhat during 2008 – 2013

Year of Admission	Total students Admitted	Male students	Female students	No. of students passed out
2008-09	143	55	88	106
2009-10	165	70	95	105
2010-11	171	65	106	122
2011-12	185	79	106	122
2012-13	179	78	101	99

b) Performance of students in U.G. level

Fellowship/Award received

Year	Particulars of Award			
	JRF	SRF	DBT	ICAR NET
	No. of students	No. of students	No. of students	No. of students
2008-09	7	-	-	12
2009-10	9		5	11
2010-11	8	-	-	10
2011-12	9	3	4	12
2012-13	11	1	4	-

c) Students' Placement during 2007-12

Sector	No. of students placed
Public Sector	32
Private Sector	73

d) Performance of teachers

Faculty winning international, national and state Awards/Recognition during 2007-2012	8
No. of faculty invited, period spent and purpose as Guest faculty, Adjunct, faculty and Faculty exchange	11

e) Number of Research/Conference/Seminar Paper published from different departments

Year	Research Paper	Conference/Seminar/ Workshop Paper
2008-09	58	63
2009-10	36	86
2010-11	61	31
2011-12	61	31
2012-13	95	43

f) Niche Area of Excellence:

Discipline: Soil Sciences

i) Production of Bio-fertilizer Enriched Organics for sustainable agriculture.
ii) Facilities developed costing more than 10 lacs: Construction of l compost pit.
iii) Impact :

a) 18 M.Sc. and 5 Ph.D. students and Ph.D. students and faculties are utilizing the facility for their research.
b) Hoested method of Azolla cultivation developed and popularized.
c) Hybrid Azolla, capable of producing 3 times more biomass than non-hybrid *Azolla*, was developed.
d) An amount of Rs.13.35 lakh was generated by selling biofertilizer, enriched organics and mother culture.
e) Successful development of entrepreneurship in three sites.

g) ELP Activities

As per recommendations of the Fourth Dean's Committee on Agricultural Education of India, ICAR, New Delhi, the following 7 packages of Experiential Learning Programme for the 4th year (2nd semester) B.Sc.(Agri.) students is running as given below.

Package no.	Title	No. Of students
Package – i	Crop protection	20
Package – ii	Post harvest technology	6
Package – iii	Agri- business management	15
Package – iv	Commercial horticulture	20
Package – v	Commercial agriculture	16
Pakcage - vi	Social science	12
Package – vii	Tea production and processing technology	10
	Total :	**99**

h) RAWE Programme :

As per guidelines of the Indian Council of Agricultural Research, New Delhi under the new course syllabus, Rural Agricultural Work Experience Programme (RAWEP) is offered to the students of the Faculty of Agriculture. The students admitted to B.Sc.(Agri.) degree programme have to complete one semester of RAWEP with the host farmers in the villages. However, the students opting for specialization in Tea Husbandry and Technology shall undergo Tea Industrial Work Experience Programme (TIWEP) in lieu of RAWEP.

i) E-learning :

Live lecture capture is going in the College of Agriculture and they are published in the U-Tube for augmenting the learning process of the students of Faculty under the Agricultural Innovation Progamme (AIP), a collaborative programme with the Cornel University, USA. This e-learning technology is unique and is being done first time in India. To supplement the teaching learning process the course contents are uploaded through Online Learning and Teaching (OLAT) Software in the University Server. These e-learning technologies have broken the class room barrier and the students can learn their lessons anytime, anywhere.

2. Research

The research activities in agriculture are being undertaken in different departments of the constituent colleges as well as in 6 Regional Agricultural Research Stations (RARS) and three Commodity Research Stations (CRS) *viz.*, Citrus Research Station, Tinsukia; Sugarcane Research Station, Buralikson and Horticultural Research Stration, Kahikuchi. The research activities in veterinary and fisheries are conducted primarily in the departments of the constituent colleges. There are, however, two research stations to conduct research in livestock and one centre for research in fisheries. Almost all the KVKs have the manpower and facilities to conduct participatory and on-farm research in these fields. The research programs in home science are carried out by the Departments as well as through the KVKs. The research stations and the departments of the constituent colleges have reasonably good laboratory and field facilities for executing the research activities.

2.1 Agriculture

At present, a total of 118 research projects including 44 ICAR sponsored All India Coordinated Research Projects (AICRP)/All India Network Project (AINP) and 74 ad-hoc projects sponsored by different agencies like ICAR, DBT, DST etc. are in operation in the Faculty of Agriculture.

Research achievements

The University has so far developed more than 80 crop varieties which include the promising varieties like Ranjit, Bahadur, Prafulla, Gitesh, Lachit, Luit, Dishang, Jyotiprasad, Bishnuprasad, Kanaklata, joymati, Aghoni bora, Bhogali bora, Keteki joha in rice; Pratap in greengram; TS-36, TS-38 and TS-46 in toria; Dhansiri, Lohit Nambor, Kapilipar and Doiyang in sugarcane; Tarun in jute; JC-1 and JC-2 in brinjal; etc. The rice varieties with very short duration, submergence tolerance and the sali rice varieties with suitability for staggered planting with aged seedlings are significant contribution of the university to the farmers of flood affected areas of the state.

The University has established itself as one in the elite club of universities/institutes to exhibit its capability in gene technology. The university has successfully generated the transgenic Bt-chickpea lines resistant to pod borer and transferred the same to M/S Mahyco, India's leading Seed Company, for further testing and commercialization.

The university has identified/developed/updated/perfected volume of technologies and information and recommended to the farmers from time to time in the form of 'Packages of Practices of Kharif Crops' 'Packages of Practices of Rabi Crops' and 'Packages of Practices of Horticultural Crops'.

The most significant research achievement of the year 2011-12 is the recommendation of altogether 17 crop varieties by the State Seed Sub-Committee for their notification by the Central Seed Sub-Committee. The varieties include 9 in rice, 2 in wheat, 1 in jute (Apeswaree), 1 in sugarcane (Doiyang), 2 in coconut (Assam green tall and Kahikuchi hybrid-1), 1 in rice-bean (Shyamalima) and 1 variety in colocasia (Ahina Kochu).

One more accomplishment of significance was the establishment of AAU-DBT Centre with funding of Rs 35 crore from DBT to promote research in the frontier areas of science.

Few among the important accomplishments during 2011-12 and 2012-13 are as follows:

Rice

- The breeding line TTB 103-21-1 (Mulagabharu - derived from Jaya/Mahsuri) with 135 days duration and tolerance to blast, brown spot and sheath blight diseases has been found promising for growing in double cropped areas.
- Four rice varieties viz. TTB 303-18-3 (4.76 t/ha), TTB 303-2-23 (5.11 t/ha), TTB 303-1-26 (4.66 t/ha) and TTB 303-1-42 (4.84 t/ha) exhibited significant promise for water logged situation of Assam and have been recommended.
- With a yield of 51.22 q/ha rice variety Kmj 3-1-3 exhibited promise for shallow water situation.
- On farm testing of advanced breeding line TTB 404 (135 days) exhibited better promise over the recommended variety Basundhara and other varieties of similar duration in terms of yield performance.
- Swarna Sub1 exhibited maximum elongation percent of 88.5% on physiological studies on Near Isogenic Lines for submergence tolerance. The lowest reduction in grain yield due to submergence stress was recorded in cvs. Purnendu (3.10 t/ha) and IR64 Sub1 (3.08 t/ha),

thereby registering the highest partitioning efficiency (HI) of more than 25% under submergence stress.

- Long term application of 100% NPK @ 40 kg N, 20 kg P_2O_5 and 20 kg K_2O/ha along with $ZnSO_4$ (20 kg/ha) + 5 t FYM could sustain stable yield of rice crop over the years (22^{nd} year) and improve soil fertility. In rice-based cropping system, application of this treatment once in a season led to positive growth of plants and increased nutrient accumulation, improved nutrient status and higher organic carbon in soil.
- With the best management practices (Irrigated, Application of FYM @ 5 t/ha + 150% RDF NPK,+ 25 kg $ZnSO_4$, alternate wetting and drying, incorporation of weed bio-mass, line planting with 20 cm × 20 cm, pest-management) rice variety *Ranjit* could produce an average yield of 5.56 t/ha as against 3.89 t/ha with farmer's practices (Rainfed, imbalanced fertilization, continuous flooding, random planting no. of hills/m2- 17-21, pest control following ITK).
- Different irrigation schedules did not show difference in grain yield of *boro* rice. However, 5 cm irrigation at 3 DADPW resulted in considerably higher water use efficiency of 73.3 kg/ha and led to water saving to the extent of 42.3 per cent over the farmers' practice.
- In relay cropping of pea after rice, increase in number of irrigations increased the p^H value significantly while reverse trend was recorded in respect of Soil Microbial Biomass Carbon (SMBC). Organic carbon, available N, P_2O_5 and K_2O did not differ significantly due to the influence of irrigation levels. Residual data (gain/loss) calculated based on initial chemical properties revealed that both irrigation schedules and organic manures improved pH, organic carbon (%), available N, P_2O_5, K_2O (kg/ha) and SMBC (µg/g) to the tune of 0.30, 0.04, 24.73, 11.41, 18.32 and 22.25, respectively.
- Application of flubendamide 3.5% + hexaconazol 5% WG could effectively reduce the infestation of sheath blight disease and attack of leaf folder, DH and WEH and could increase grain yield of rice.
- In a farmer's field of 100 hectare area, BIPM technology had shown better performance in reducing Green Leaf Hopper and rice stem borer infestation with an increase in yield of 6.08 per cent over the chemical control.
- Application of Buprofezin + Acephate (20+50) % @ 800 ml/ha could effectively suppress the infestation of rice stem borrer, whorl maggot, leaf folder and gundhi bug.
- Application of vermicompost @ 2.5 t/ha could lower the incidence of stemborer, gall midge and gundhi bug and could increase the grain yield up to 4790 kg/ha.
- Bamboo internode pieces (15.46 gm/day) are the best bait station followed by banana pseudostem (14.00gm/day), while banana leaf exhibited poor performance with lowest bait consumption (12.20 gm/day).

Pulses

- In blackgram, application of lime @ 200 kg/ha increased grain yield by almost 80 kg/ha over the control with the BC ratio of 2.04.
- Treatments with different biofertilizers recorded significantly higher grain yield in blackgram than no seed inoculation. There was no significant variation in grain yields under Rhizobium and PSB when inoculated separately while in combination inoculation could record significant increase in grain yield and BC ratio.
- In greengram-wheat sequence, greengram equivalent yield (GEY) of the sequence was significantly higher under 40 kg P_2O_5/ha + seed inoculation with PSB (Bacillus megeterium) @ 50 g/kg seed of greengram than all other P2O5 levels applied to the first crop. Application of 60 kg P_2O_5 /ha to wheat produced significantly higher GEY of the

sequence than application of the lower doses. Combinations of 40 kg P2O5 /ha + seed inoculation with PSB @ 50 g/kg seed of greengram and P_2O_5 @ 30 (B:C ratio 1.72) and 60 kg /ha (B:C ratio 1.70) applied to wheat resulted in significantly higher GEY of the sequence.

- In lentil, application of 10:20:15 kg N:P_2O_5:K_2O/ha along with vermincompost 1 t/ha or FYM 2 t/ha as basal + seed inoculation with *Rhizobium* and PSB each @ 50 g/kg seed of lentil was found to significantly increase yield.
- The bio-efficacy of seven biopesticides, *viz*. Neemazol, Neemgold, Multineem, Nimbicidine, Achook, *Beauveria bassiana* (Biopower) and *Verticillium lecanii* (Verticel) were evaluated against insect pests of lentil. All the insecticides were found effective in suppressing pests population and consequently increase in yield. Nimbicidine @3ml/l was found most effective followed by neemazol at the same dose.
- In lathyrus, seed inoculation with *rhizobium* and PSB besides application of 5 kg N, 13 kg P_2O_5 at sowing and 5 kg N, 13 kg P_2O_5 and 15 kg K_2O/ha at rice harvest recorded the highest grain yield (1035.56 kg/ha) and was significantly higher than those under all other treatments except application of N and P_2O_5 at 2 equal splits at sowing and rice harvest (@ 7.5 kg/ha and 17.5 kg P_2O_5/ha) along with K_2O @ 15 kg/ha at rice harvest (1001.11 kg/ha). Two sprays of 2 % urea at branching and pod initiation recoded significantly higher grain yield (1002.04 kg/ha) in comparison to no spray.
- In field pea, Adoption of IPM module (Seed treatment with Imidacloprid 600FS + Carbendazim2 3g/kg + Removal of rogued plants + Sprays of NSKE 5% at 40 days + Install yellow sticky trap (1mx1m) @ 8/ha + Spray of Spinosad @ 60 a. i./ ha at 50% flowering stage) has resulted in 17.26% increase in yield over farmers' practice (FP). The cost-benefit ratio was calculated as 1.89 in the respective year.

Rapeseed and Mustard

- In rice–toria sequence, 50 % RD of N and P with 100 % K and 1 t of enriched compost (for both the crops) produced rice and toria yield of 3.99 and 0.85 (t/ha) with corresponding B:C ratio of 2.21 and 1.39. This treatment combination showed higher yields, improved chemical and biological properties as well as better B:C ratio. Incorporation of the enriched composts with consequent reduction of mineral fertilizer exhibited greater MB-C (318.93-428.47µg/g) and dehydrogenase (314.69-367.44 µg TPF /g/ 24h), phosphomonoesterase (466.05-623.42 µg p-nitrophenol/g/h) and fluorescein diacetate (11.89-13.20 µg fluorescein/g/hr) activities
- In rice – linseed sequence, the highest rice and linseed yield was recorded in 100 % NPK. Rice – Linseed crop sequence yielded significantly higher LEY when rice was fed with 100 % NPK and linseed with 75 % NP + Azotobacter + PSB + 100% K. The highest Gross Monetary Return along with highest B:C ratio was recorded with 100% NPK applied both in rice and linseed.

Jute and Allied Fibers

- Among 27 breeding lines derived from the crosses of oletorious jute, few lines such as NHPOC 27, NHPOC 2, NHPOC 26, NHPOC 21, NHPOC 12, NHPOC 23, NHPOC 20, NHPOC 22 with plant height of 164 to 186 cm were found promising. All the plants in each of the crosses were free from incidence of stem rot, root rot and anthracnose diseases.
- Retting was completed in 15 days when treated with CRIJAF microbial consortium against 21 days without microbial consortium (natural). The fibre was brighter in CRIJAF microbial consortium treated jute plants than non-treated plants. On the other hand, with

application of the bacterial consortium of Shillongani retting was completed within 17 days while the retting in the control (untreated) tank was completed within 20 days. The fibre extracted from the treated tank was of better quality and lustrous than the fibre extracted from the controlled (untreated) tank.

Fruits

- Three local cultivars of banana *viz*, Bhutmonohar, Bharatmoni and Kachkol were evaluated as promising cultivars in regards to plant height, girth, number of leaves. However, Barjahaji is the best among the cultivars in regards to yield and yield attributing characters.
- Reduced disease and increased fruit yield were observed on application of three bioagents *viz*., *Trichoderma viride, Trichoderma harzanium* and *Pseudomonas fluorescens* followed by foliar spraying of Al-phosetyl. The reduction in disease severity of 46.14% was achieved with the spraying of Al-phosetyl alone, while, 48.32% reduction in disease severity was recorded when all three bioagents were added to the soil.
- For management of citrus canker, alternate application of COC (0.3%) + streptomycin sulphate (100 ppm) and NSKE 5% found effective (72.64%) when compared to NSKE 5% (49.82%) and COC (0.3%) + streptomycin sulphate (1g/10lit) (48.56%) separately.

Vegetables

- A large number of brinjal varieties were tested over seasons and across locations. From the evaluations, three brinal varieties - two round type and one long type were found to be suitable for consideration for recommendation to the farmers with high yield, good taste and consumer preference palatability.
- Experiments were conducted to develop organic package of practices in several crops including cabbage and tomato.

Flowers

- A large number of flower cultivars were tested. Among the cultivars tested, the promising cultivars were Prajwal in tuberose; Pusa Kiran in gladiolus; Aeropolish, Fire, Tropical and Calora in anthurium andRed Gem and Classic Beauty for open condition and Battayia, Gussi, Basic, Nayri, Sangria and Rosalin for protected condition in gerbera.

Honeybee

- Stingless bees were collected or received from different parts of India. Taxonomic study was made and based on characteristics such as colour morph, chaetotaxy, structural variation and morphometrics six species have been identified as *Trigona conifrons, T. iridipennis, T.laviceps, T. ruficonis, T. atripes and T. ventralis.*

White Grub

- Field and laboratory investigations on different aspects of *L. mansueta* confirmed the biennial life cycle of *L. mansueta*, which was reported for the first time from North East India. Biology and feeding behavior of the pest including its host range etc. have been studied thoroughly.

Ornithology

- 96 species of birds belonging to 31 families were recorded in agricultural landscape of Assam of which Eurasian Tree sparrow (*Passer montanus*) and House sparrow (*Passer*

domesticus) were the only two dominant sparrow species recorded in agricultural landscape of Assam.

- The low cost nest boxes designed for beneficial omnivorous birds were mainly occupied by House sparrow, Eurasian Tree sparrow, Great Tit, Magpie Robin and Spotted owlet. Eurasian Tree sparrow and House sparrow readily occupied earthen nest box and nest box made of shoe box (70% occupied), while 30 per cent Nest Box made of wood occupied by spotted owlet. Magpie Robin preferred mud pot (40 per cent) and Common Myna in old biscuit tin.

Biofertilizer

- Five indigenous phosphate solubilizing bacteria (PSB) based on their potential phosphate solubilizing abilities (13.00-59.25% P dissolved from RP in 30 days) were evaluated in field condition taking rice as test crop for three years. Three years pool analysis of data clearly indicated the excellent performances of indigenous PSBs in increasing rice yield (3.84-3.88t/ha) and enhancing the phosphomonoesterase activity. These PSBs are preserved and will be utilized for biofertilizer production.

2.2. Home Science

- Four research projects including the AICRP on Home Science with 5 components are in operation in the Faculty of Home Science.

Research achievements

- Few significant research accomplishments have been - development and commercialization of Assam mix – a promising weaning food, nutritional fortification of several traditional recipes, development of women-friendly farm-tool "Kuhuna" for drudgery reduction and standardization of methods for extraction of natural dyes from locally available plants etc. Few of the significant achievements during the period under review are as follows:
- Ergonomic evaluation of parboiling of rice with conventional tool was assessed. The working heart rate and energy expenditure of the farm women using conventional tool were found to be 104 b.min-1 and 7.70 kJ/min respectively. The activity was categorized as a "moderately heavy" activity based on average heart rate and energy expenditure values. Ergonomically designed hand tool along with improved work station will reduce drudgery and enhance the work efficiency of the farm women.
- Weaving chair for fly shuttle weavers was ergonomically designed with provision of back support and drawer underneath for keeping weaving accessories. The working heart rates while weaving in conventional seat and improved chair were found to be 98.36 $b.min^{-1}$ and90.44 $b.min^{-1}$respectively indicating reduction of physiological workload and hence enhancing comfort as well as efficiency of the fly shuttle weavers.
- Laboratory scale production of rice beer was standardized and suitable varieties were identified.
- For Value addition of under-utilized non-degradable natural resources, Polyethylene Laminated fabric and for the under utilized degradable farm waste, Banana fiber were used for making folders, note books, visiting cards, etc. for entrepreneurial development.

2.3 Veterinary

Currently, a total of 31 research projects including 8 ICAR and DBT sponsored AICRP/AINP projects are in operation in the Faculty of Veterinary Science.

Research achievements

The University developed improved pig breed with 87.5 % Hampshire inheritance, goat breeds with 75 % beetal blood, developed DNA fingerprinting of Swamp buffalo to establish its closeness to riverine buffalo, standardized MOET (Multiple Ovulation Embryo Transfer) protocols and developed Cell culture vaccine for Swine Fever which is now being mass produced in PPP mode among many important accomplishments. Few of the significant achievements during the period under review are as follows:

- In buffalo, Vitrification of immature bovine oocytes using 10 % Ethylene Glycol +10 % Dimethyl Sulphoxide for equilibration and 20% EG+20%DMSO with 0.6M sucrose as vitrification solution yielded acceptable *in-vitro* maturation rate of 74.20± 1.88% and successfully isolated Cx43 (Connexin 43) and PAP (Poly A Polymerase) genes in vitrified in vitro matured bovine oocytes.
- A package of rations for pre weaned piglets, grower and lactating sows have been developed by combining different ingredients and chemicals for optimum growth and the cost price per kg of feed is calculated as Rs. 62.85/-, 38.15/-, 23.55/-, 20.85/- and 19.16/- respectively in Pre-stater, Starter I, Starter II, Grower I and Lactating sows.
- Microsatellite based characterization of indigenous pigs, goats is in progress.
- Cell culture adapted lapinized vaccine virus at different passage level and 43 CSF virus isolates from Assam and other N.E. states were lyophilized and kept in the virus repository.
- Production and characterization of monoclonal antibodies against CSF virus antigen was done for the first time in the country.
- Among the various extracts of *Esholtzia communis.*, *Elsholtzia communis* ethanol water extract exhibited potent adaptogenic activity in various models of adaptogenic study. The extract showed the presence of diterpenes, phenolics, steroids, triterpenes, flavonoids, tannin. The phenolic content of the extract is 0.081±0.012 mg tannic acid/g of dry plant material and flavonoid content of the extract is 0.011±0.010 mgquercetin /g of dry plant material. The extract showed the maximum *in vitro* anti-oxidant activity at the concentration of 0.05 mg/ml .Likewise, among the various extracts of *Gnetum gnemon.*, itsethanol extract showed potent adaptogenic activity in various models. The extract showed the presence of diterpenes, phenolics, glycosides, triterpenes. The phenolic content of the extract is 0.148±0.025 mg tannic acid/g of dry plant material and flavonoid content of the extract is 0.011±0.006 mgquercetin /g of dry plant material. The extract showed maximum *in vitro* anti-oxidant activity at the concentration of 0.05 mg/ml. While comparing the nutritive values of both the plants, *Esholtzia communis* exhibited higher level of crude protein and carbohydrate.

2.4 Fishery

There are altogether 8 research projects in operation in the faculty.

Research achievements

Few important accomplishments in fishery research have been development of crop-fish-live-stock based integrated farming system models, seed production of Cat-fish magur (Clarias batrachus), development of low cost fish-feed under the trade name “Sushama”. Some of the salient research findings under these projects are as follows:

- Studies on culture and breeding of three small fish species viz. *A. mola, N. notopterus, M. Vitatus* under small pond condition revealed that *N. notopterus* was the most suitable one for culture under small pond condition.

- Different integrated fishery based farming systems have been developed and demonstrated at FRC farm for the benefit of the fish farmers of N.E. Region visiting the Centre.

3. Extension Education

The Directorate of Extension Education (DoEE), a constituent unit of Assam Agricultural University, Jorhat aims at raising the farm level production/ productivity through the efficient transfer of need based and demand driven technologies emphasizing on entrepreneurship development and capacity building of stakeholders engaged in the development of the agricultural sector. The mission of Directorate of Extension Education is "Reaching the Unreached and Touching the Untouched" for agricultural development in the state. There are 20 KVKs and one Agricultural Technology Information Centre (ATIC) under this Directorate. The Directorate acts as the facilitator and provides guidelines, monitors and evaluates the extension programme of KVKs. The process of establishment of KVKs in rest of the five districts is on.

The Directorate conducts advanced training programmes for scientists/ officers in specialized fields and also organizes workshops, exhibitions etc. One certificate course on Apparel Designing and Construction was completed in 2012. The Directorate publishes AAU Newsletter quarterly and the farm magazine '*Ghare Pathare*' fortnightly. The Agricultural Technology Information Centre (ATIC) provides facilities of information technology for dissemination to the farmers as a single window delivery system. This service includes both providing solution of location specific problems and making available all the technological information along with technology inputs and products. In the last five years 11071 farmers visited the ATIC.

The Directorate has taken up various extension activities like training, FLD, OFT etc. through the KVKs to develop knowledge and skill on improved agricultural technologies among the farmers. During the last five years 115543 farmers/ farm women/ rural youth and extension fuctinoaries were trained up through 4334 nos. of training programmes. One hundred and thirty six (136 nos.) of vocational training on nursery management, fruits and vegetable preservation, repairing of farm implements, mushroom cultivation, apiculture, dairy, poulty, piggery, fishery, tailoring, sericulture etc. were organised. Besides training, 1001 FLDs and 653 OFTs were conducted in the farmers fields. Area expansions under HYV of rice, toria, lentil, blackgram, pea and jute have increased overall production. Due to enhanced seed production by AAU, seed replacement rate has increased from 10% to 60% in rice in the XI Plan period.

AAU has launched an ambitious programme named 'Technology Showcasing' through KVKs in 2010 with the objectives to showcase the latest cost effective production technology in farmers field to produce quality seeds of cereals, oilseeds and pulses in a participatory mode with the farmers in an attempt to bridge seed requirement gap. In the last two years the seeds produced under this programmes were as follows:

Year	Area(Ha)	Seed Production (MT)
2010-11	1100	Rice: 6000, Toria: 90
2011-12	1200	Rice: 6250, Toria: 280

The programme has brought visibility of KVKs as well as the University as a whole in the state. The impact of this programme is reflected in a recent decision of the Finance Dept. of Govt. of Assam that the state should procure HYV seeds only from AAU when it is in a position to supply the same.

In 2012, the state of Assam was ravaged with three flood waves resulting into a loss of paddy seedlings in the affected areas. The KVKs located in the flood affected districts of Assam raised fresh rice seedlings for second planting to cover around 225 hectare of flood damaged areas.

Collaborative Projects

National Initiative on Climate Resilient Agriculture (NICRA):

The site specific technology packages for adoption to current climate risks under the project NICRA have been demonstrated in the farmers' field of 4 different villages of Dibrugarh, Sonitpur, Cachar and Dhubri with an objective to enhance the resilience of agriculture of the selected villages to climate variability and climate change through application of improved production and risk management technologies and to generate information on location specific climate resilient practices and its performance in farmers' field. Considering the major contingencies of the selected villages, the four KVKs are carrying out the technology demonstration component with 4 different modules-natural resource management, crop production, livestock & fishery and institutional intervention. Movement of fish during flood can be restricted by placement of nylon nets along the periphery of fish ponds and renovation as well as raising the height of dykes of ponds. The KVKs are also striving to introduce integrated rice-fish and poultry farming to help the small farmers to cope with the losses due to flood.

DBT Project on Biotechnology Led Organic Farming in North Eastern Region

Organic farming aims at low input farming thus reducing dependence on inorganic fertilizers, herbicides and plant production chemicals. The project on Biotechnology Led Organic Farming in NER has been in 5 (five) KVKs of Assam viz., KVK, Lakhimpur, Jorhat, Golaghat, Karbi Anglong and Kokrajhar. Organic farming technologies of fruits (orange, pineapple), vegetables (tomato, frenchbean), spices (ginger, turmeric, blackpepper, chilli) focusing on non chemical use for plant nutrition and plant protection and other organic farming requirements have been assessed and refined through these KVKs. Some of the concluded demonstrations have showed encouraging performance which would definitely help in development of much desired standards for export promotion of high value horticultural crops of the state.

Other Programmes

1) Farmers' Participatory Action Research Programme on toria, potato, tomato, other crops sponsored by Ministry of Water Resources, Govt. of India.
2) Collaboration in NAIP.
3) Demonstration units on integrated farming system under Rashtriya Krishi Vikash Yojana (RKVY).

Other Extension Activities

Besides the mandated activities, KVKs are conducting other extension activities for development of farming community as enlisted below:

Extension Activity	**No.**	**Extension Activity**	**No.**
Field day	253	Phone in/ help line programme	121
Kissan Mela	14	Exposure visit	58
Exhibition	20	Function of self help group	19
Awareness programme	95	Extension literature	397
Radio talk	454	TV Programme	75
Press Coverage	819	-	-

Extension Publications (Numbers)

Particulars	2007-08	2008-09	2009-10	2010-11	2011-12	Total
Extension Bulletin/ Literature	47	102	134	103	112	***498***
Scientific Paper/ Popular Article	58	176	233	269	259	***995***

E-Learning Material for Farmers

1. Development of AAU Web Portal (http://portal.aau.ac.in) having up to date AAU information, details of technologies in agriculture, veterinary, home science, fishery etc, agro-met advisory services , weather forecasting, e-bulletins, news letters, current agricultural knowledge and information etc. for use of farming community.
2. Innovative farmers friendly, the first of this kind in North East, India agricultural website "http://briddhi.aau.ac.in" with content both in Assamese and English for use of farming community having details of Crop Production, Package and Practices, news-letters, bulletins, photo gallery, video gallery etc. related to agriculture and allied sector.
3. Service of Kisan Call Centre (KCC) to address farmers problem by expert team of Assam Agricultural University
4. Disseminating farm information/ technology, management options through e-mode of extension by KVKs using short-message-service (KMAS) by mobile phones to the farmers.
5. Dissemination of Current commodity Price/ Market information/ Futures contract etc through Electronic Ticker Board installed at various KVKs and ATIC, Assam Agricultural University.
6. Agricultural websites for 19 KVKs uploaded in ARIS Cell, AAU have been developed with user friendly content, information, production and protection technologies, other interactive services etc through KVKs.
7. One Rural Knowledge Centre, with a farm knowledge portal in Jorhat district of Assam has been established by KVK Jorhat with support from NABARD, Assam having information on agricultural and allied sector, demonstration on recent production technologies, digitized phone directory, agro advisory services and other interactive services for benefited the farming community.
8. Development of Farm technology packages using multimedia for farmers under respective KVK.
9. Interactive learning systems with image and video gallery, video conferencing have been developed.
10. Web based programmes like digitized package of practices of major crops of Assam for farming community has been developed and published through AAU Web Portal, RKC for better reach.
11. HRD information package of technical expert of AAU in the field of agriculture and allied sectors has been developed so that farmers can take better advantage as and when required.
12. Developed e-learning training materials like CDs, Software, animation tools etc.

Recognition

1. Since its inception, Krishi Vigyan Kendra, Chirang has been trying sincerely for overall agricultural development in both Bongaigaon and Chirang districts of Assam. It is all about the works of KVK scientists, for which the Zonal Coordinating Unit (Zone-III), Umium has recognized and appreciated as one of the best performing KVK of NE Region in the year 2007.
2. KVK, Kamrup was awarded second position in the exhibition of 3rd Regional an 14th State level Annual Agri-Horti show from 10th to 14th February, 2008.

3. KVK, Kamrup was awarded first position in the exhibition of 17th state level Annual Agri-Horti show from 9th to 13th February, 2011.
4. The technology on Diffusion of Early Ahu rice var. Luit in social system was disseminated and popularized by KVK, Nalbari was recognized as one of the best technology of KVKs by ICAR in 2010.
5. AAU has bagged 3rd prize in the Tableau competition in connection with the Republic day celebration at Jorhat Court Field in 2009.
6. AAU stall was awarded 3rd prize in the exhibition organized in connection with the Asom Sahitya Sabha session, Dergaon in 2010.
7. AAU stall received 3rd prize in the exhibition organized in the NE Regional Agri Fair held at ICAR Research Complex, Barapani.
8. KVK, Dhubri was selected as one among 12 best NICRA project centres in the country by ICAR in 2012.
9. AAU has bagged special prize for attractive exhibits at First Mega Agri-Horticultural Exhibition, 2013 organised by Directorate of Horticulture and Food Processing, Guwahati, Assam.

B-2. CAU, IMPHAL

The Central Agricultural University (CAU) was established in the year 1993 under the Central Agricultural University Act, 1992 of the Parliament (Act No. 40 of 1992). The act authorized CAU to establish need based Agricultural Education Institutions in the North-Eastern Hill (NEH) Region of India. At present, the Central Agricultural University has seven constituent colleges *viz.*, the College of Agriculture (Iroisemba, Imphal, Manipur), Fisheries (Lembucherra, Agartala, Tripura), Home Science (Tura, Meghalaya), Horticulture & Forestry (Pasighat, Arunachal Pradesh), Veterinary Science & Animal Husbandry (Selesih, Aizawl, Mizoram), Agricultural Engineering & Post Harvest Technology (Ranipool, Gangtok, Sikkim) and Post Graduate Studies, (Barapani, Meghalaya) to empower the agriculture research, education and extension in the NEH Region.

1. University at a Glance

The university headquarters is situated at Iroisemba, Imphal West, Manipur. The picturesque campus of CAU is spread over 704.90 acres *viz.*, 287.20 acres in Manipur, 170.60 acres in Mizoram, 56.25 acres in Tripura, 45.0 acres in Meghalaya, 135.25 acres in Arunachal Pradesh and 10.63 acres in Sikkim in the North Eastern Hill Region of India. The state of Manipur, Mizoram, Meghalaya and Tripura fall under the Indo-Burma Biodiversity Hotspot while the state of Arunachal Pradesh and Sikkim belong to Eastern Himalayan biodiversity hotspot.

2. Constituent Colleges of the University

The university has established seven (7) colleges in different hill states under the jurisdiction of the university in the NEH Region as follows:

3. HIGHLIGHTS OF ACADEMIC ACHIEVEMENTS, 2012-13

4.1. Academic activities

- The University is fully residential.
- Admission to UG programmes is through nomination by respective states of NEH Region and ICAR/VCI, based on entrance test conducted by them.
- Admission to PG/Ph. D. programmes is on the basis of merit in entrance examination conducted by CAU and through nomination by ICAR.
- ICAR/VCI model academic regulations and syllabi are strictly followed.

Table 1: Students allocation in UG programme during 2012-13 from different states of North-Eastern Hill Region

		Arunachal Pradesh	**Manipur**	**Meghalaya**	**Mizoram**	**Nagaland**	**Sikkim**	**Tripura**	**ICAR/ VCI**	**Total**
1	B.Sc. (Agri.)	12	16	14	09	0	09	16	13	**89**
2	B.Sc. (Home Science)	05	06	07	03	0	03	05	05	**34**
3	B.VSc.&A.H	05	09	09	12	04	06	11	09+02*	**67**
4	B.Sc. (Horti)	07	07	06	06	02	06	07	03	**44**
	B.Sc. (Forestry)	04	05	03	04	0	03	04	03	**26**
5	B.Sc.(Fisheries)	04	09	03	03	0	03	09	05	**36**
6	B.Tech. (Agril. Engg.)	06	08	06	05	0	05	08	04	**42**
	B. Tech. (Food Processing Engg.)	02	04	02	02	0	03	04	03	**20**
	Total	**45**	**64**	**50**	**44**	**06**	**38**	**64**	**36**	**358**

Table 2: Intake capacity, admitted and passed out students for the academic session, 2012-13
A. Undergraduate programme

SN	**Name of the Constituent College**	**Name of the Course**	**Intake Capacity**	**No. of Student Admitted**	**No. of Student Graduated**
1	College of Agriculture, Imphal, Manipur	B. Sc. (Agri.)	89	67	60
2	College of Vety. Sc. & A.H., Selesih, Mizoram	B.V.Sc. & A.H.	67	49	48
3	College of Fisheries, Lembucherra, Tripura	B.F.Sc.	36	24	33
4	College of Hort. & Forestry, Pasighat, Arunachal Pradesh	1. B.Sc.(Hort.) 2. B.Sc.(Forestry)	44 26	39 13	15 15
5	College of Home Science, Tura, Meghalaya	B.Sc. (Home Sc.)	34	15	13
6	College of Agril. Engg. & PHT, Ranipool, Sikkim	1. B. Tch. (Agril. Engg.) 2. B.Tch. in process & Good Engg.	42 20	34 07	24 _
7	College of Post Graduate Studies, Barapani, Meghalaya	-	-	-	-
		Total	**358**	**248**	**208**

B. Post graduate programme (2012 – 2013)

SN	Name of the Constituent College	Name of the Course	Intake Capacity	No. of Student Admitted as on 30/9/2012	No. of Student Graduated as on 20.10.12
1	College of Agriculture, Imphal, Manipur	M. Sc. (Agri.)	48	27	21
2	College of Vety. Sc. & A.H., Selesih, Mizoram	M.V. Sc.	55	13	07
3	College of Fisheries, Lembucherra, Tripura	M.F. Sc.	20	13	12
4	College of Hort. & Forestry, Pasighat, Arunachal Pradesh	M.Sc. (Hort.)	10	06	04
5	College of Home Science, Tura, Meghalaya	-	-	-	-
6	College of Agril. Engg. & PHT, Ranipool, Sikkim	-	-	-	-
7	College of Post Graduate Studies, Barapani, Meghalaya	M.Sc.(Agri.)	48	27	19
		Total	**181**	**86**	**63**

C. Ph. D. Programme (2012 – 2013)

Sl. No.	Name of the Constituent College	Name of the Course	Intake Capacity	No. of Student Admitted	No. of Student Completed
1	College of Agriculture, Imphal, Manipur	Ph.D.	04	03	_
2	College of Vety. Sc. & A.H., Selesih, Mizoram	Ph.D.	06	02	_
3	College of Fisheries, Lembucherra, Tripura	_	-	_	_
4	College of Hort. & Forestry, Pasighat, Arunachal Pradesh	_	-	_	_
5	College of Home Science, Tura, Meghalaya	_	-	-	-
6	College of Agril. Engg. & PHT, Ranipool, Sikkim	_	-	-	-
7	College of Post Graduate Studies, Barapani, Meghalaya	Ph.D.	08	07	19
		Total	**18**	**12**	**_**

4.2. Academic performance

Incessant efforts have made to improve the range and quality of teaching and research at Central Agricultural University, Imphal. The CAU teachers, scientists and SMSs have actively participated in Symposia, Seminars, Workshop, etc., held in India and abroad.

Academic Performance of Undergraduate Students of CAU during the last four years

SN	Particulars	Year			
		2009	2010	2011	2012
1.	No. of students appeared for CET of ICAR	122	146	173	184
2.	No. of students qualified for counselling	118	129	136	165
3.	No. of students admitted in national Institutes (IARI, IVRI, NDRI, CIFE, IIT, NIFT & IFRI)`	26	20	34	42
4.	No. of students admitted to post-graduate programme	68	78	98	126
5.	**No. of students selected for ICAR Junior Research Fellowship**	**23**	**21**	**26**	**25**
6.	**All India ranking in JRF Examination**	**5th**	**6th**	**2nd**	**4th**

HIGHLIGHTS OF RESEARCH AND DEVELOPMENT, 2012-13

The university has a separate Directorate of Research to coordinate, supervise, monitor and evaluate all the research activities under the university. The research of the university aims at developing technologies which can bring about a far reaching impact on production, productivity and profitability of crops, animals and fishes through sustainable and eco-friendly technological approaches for socio-economic upliftment of the people of N.E.H. Region. In order to fulfill the research objectives of the university, a numbers of need based location specific internally and externally funded basic, strategic and applied research projects are being taken up in all the constituent colleges and the Directorate of Research of the university. At present, university has 43 ongoing internally funded research projects under the name "Intramural Research Projects (IRP)" as on 31.3.2013. During the financial year 2012-13, 12 IRPs were sanctioned by the Directorate of Research to the constituent colleges of the University. Further, the university is also conducting 106 numbers of externally funded projects from ICAR, D.A.C., D.S.T., D.B.T., MoFPI, etc. during the year 2012-13. A total of 26 numbers of externally funded projects were sanctioned during the year 2012-13 alone to the university by various funding organizations.

Status of Intra-mural Research Projects (IRPs) under University Funded Research Programmes as on 31.3.2013

SN	Directorate/ College	No. of IRP Completed	No. of IRP ongoing as on 31.03.13	Total no. of IRP
1.	Directorate of Research, CAU, Imphal	1	1	**2**
2.	College of Agriculture, CAU, Imphal, Manipur	13	9	**22**
3.	College of Vety. Sc. & A.H., CAU, Selesih, Aizawl, Mizoram	33	7	**22**
4.	College of Fisheries, CAU, Lembucherra, Tripura	22	7	**40**
5.	College of Horticulture & Forestry, CAU, Pasighat, Arunachal Pradesh	26	3	**29**
6.	College of Home Sciences, CAU, Tura, Meghalaya	19	6	**25**
7.	College of Agril. Engg. & Post Harvest Technology, CAU, Ranipool, Gangtok, Sikkim	14	4	**18**
8.	College of Post Graduate Studies, CAU, Umiam, Meghalaya	4	6	**10**
	Total	**132**	**43**	**175**

Status of Externally Funded Research Projects (EFRPs) as on 31.3.2013

Sl. No.	Directorate/College	No. of EFRP completed	No. of EFRP as on 31.03.13	Total no. of EFRP
1.	Directorate of Research, CAU, Imphal, Manipur	Nil	**10**	**10**
2.	College of Agriculture, CAU, Imphal, Manipur	3	**13**	**16**
3.	College of Vety. Sc. & A.H., CAU, Selesih, Aizawl, Mizoram	1	**16**	**17**
4.	College of Fisheries, CAU, Lembucherra, Tripura	6	**11**	**17**
5.	College of Horticulture & Forestry, CAU, Pasighat, Arunachal Pradesh	10	**24**	**34**
6.	College of Home Sciences, CAU, Tura, Meghalaya	1	**7**	**8**
7.	College of Agril. Engg. & Post Harvest Technology, CAU, Ranipool, Gangtok, Sikkim	NIL	**9**	**9**
8.	College of Post Graduate Studies, CAU, Umiam, Meghalaya	1	**16**	**17**
	Total	**22**	**106**	**128**

The University also took up, from time to time, the contingency research projects which are of great concern and need immediate attention, related to crops, animals and fishes in the region.

As an outcome of these research endeavours, the University was successful in developing location specific deliverable technologies, recommendations and research findings on Agriculture and Allied Disciplines for the farmers and agri-entrepreneurs of the N.E.H. Region.

Deliverable location specific CAU technologies, recommendations and research findings:

Sl. No.	Discipline	No. of technologies
Deliverable Location Specific Technologies on Agriculture and Allied Disciplines for NEH Region		
1.	Agriculture	**4**
2.	Horticulture & Forestry	**2**
3.	Veterinary Sciences & Animal Husbandry	**1**
4.	Agriculture Engineering & Post Harvest Technology	**3**
5.	Home Science	**-**
	Sub Total (A)	**10**

Location Specific Recommendations and Scientific Findings on Agriculture and Allied Disciplines			
1.	Agriculture	Plant Genetic Resources and Crop Improvement	**16**
		Natural Resource Management and Crop Production	**20**
		Microbial Resources and Crop Protection	**5**
2.	Horticulture & Forestry	Horticultural Plant Genetic Resources and Crop Improvement	**5**
		Natural Resource Management and Horticultural Crop Production	**7**
		Microbial Resources and Horticultural Plant Protection	**9**
3.	Veterinary Sciences & Animal Husbandry	Veterinary Medicine and Surgery	**3**
		Livestock Production and Management	**5**
4.	Fisheries	Fish genetic Resources and Fish Breeding	**3**
		Fish Production and Processing	**1**
		Fish Health Management	**1**
5.	Home Science	Family Resource Management and Home Science Extension	**2**
		Clothing, Textiles and Handicrafts	**2**
		Human Development and Nutrition	**1**
6.	Agriculture Engineering & Post Harvest Technology	Farm Mechanization and Renewable Energy	**7**
		Post Harvest Technology and Value Addition	**3**
		Sub Total (B)	**90**
		Total (A+B)	**100**

Major Research and Development Achievements of the University

1) CAU-R1 a semi glutinous medium duration high yielding rice variety for wetland rice ecosystem of Manipur and similar situations of N.E.H. Region

"CAU-R1" a semi glutinous medium duration (130 days) high yielding rice variety for wetland rice ecosystem of Manipur and similar situations of NEH region was developed from a cross between *Leimaphou* (KD-2-6-3) as female parent and BR-1 as male parent. CAU-R1 was released in the name of ***Tamphaphou*** on 24-2-1999 by State Variety Release Committee with 72% brown rice recovery and an average rice yield potential of about 6.00 tonnes/ha. The variety with a plant height of about 100 cm was also found to be drought tolerance during flowering time and submerge tolerance during tillering stage as well as tolerant to low phosphorous content. CAU-R1 was notified during 2009 by Government of India vide notification No. 449(E) dated 11-2-2009 and thereafter enter in seed multiplication chain. Among the high yielding inbred rice varieties, CAU-R1 was recommended by Government of Manipur as a rice variety suitable for cultivation under SRI.

2) CAU-R3 a very early high yielding rice variety as contingency rice crop for wetland rice ecosystem of Manipur and similar situations of N.E.H. Region

"CAU-R3" a very early high yielding rice variety was developed from a cross between RCM-7 and V20B. The variety with duration of 100 days and plant height of 90 cm was entered in IET of All India Co-ordinated Rice Improvement Project with IET No. 22833 during *kharif* 2011. CAU-R3 having a rice yield potential of 4 tonnes/ha was released in the name of ***Mangalphou*** on 24/10/2012 for Manipur by State Variety Release Committee as a contingency crop which can be sown as early as 1st March and as late as 1st August where there is frequent natural calamity like flood and drought situations in Manipur Valley.

3) CAU-R4 a tall lodging tolerant high yielding rice variety suitable for low lying semi-deep water rice ecosystem of Manipur and similar situations of N.E.H. Region

"CAU-R4" a tall lodging tolerant high yielding rice variety was developed from a cross between *Moirangphou khokngangbi* and *Leimaphou*. The variety with duration of 145 days and 145 cm tall was entered in IET of All India Co-ordinated Rice Improvement Project with IET No. 22469 during *kharif* 2011. CAU-R4 having a rice yield potential of 3.5-4 tonnes/ha was released in the name of ***Eenotphou*** vide Memo No.23/31/94-Agri. dated 9th November, 2012 by the State Variety Release Committee for general cultivation to low lying semi-deep water ecosystem, sometimes known as *Patlou* in Manipuri and as a component Paddy variety for paddy-cum-fish farming.

4) CAU-R2 a promising extra early rice variety for *jhum* fields of Manipur and similar situations of NEH Region.

CAU-R2 is a selection from the cross between V20B X RCM-7 with an extra early duration of 95-100 days and 75-80 cm plant height under rainfed upland direct seeded conditions of Manipur. The line/genotype was included in a screening programme for identification of promising rice cultivars under real *jhum* field conditions of Baruni hills, Andro village. A total of 223 rice land races/genotypes collected from the N.E.H. states and promising rice breeding lines for hill rice eco-system were included in the study. Out of the total genotypes studied, CAU-R2 recorded the highest yield of 3.0 tonnes/ha while the best local check varieties *Phouoibi* and *Mohar* yielded only 2.1 tonnes/ha thereby showing a rice yield advantage of about 30%. The genotype is recommended for FLD in Manipur hills under *jhum* rice ecosystem.

5) CAU-RH1 a medium duration semi dwarf and semi glutinous hybrid rice genotypes for wetland rice ecosystems of Manipur valley and similar situations of NEH Region

CAU-RH1, a semi-dwarf medium duration (130 days) semi-glutinous hybrid rice genotype for general cultivation under Manipur Valley conditions or similar situations of N.E.H. States was successfully evolved from the 3 line hybrid rice breeding programme of the CAU, Imphal (Manipur). The hybrid rice genotype CAU-RH1 has recorded a yield potential of 12.64 tonnes/ha as paddy under field experimental conditions of Andro, Imphal East (Manipur) showing a yield superiority of 13.26% and 9.98% over the best inbred rice check variety CAU-R1 and hybrid rice check variety PAC-801 respectively. The CAU-RH1 is recommended for FLD under wetland rice cultivation areas of Manipur valley.

6) Standardized rain water harvesting and cultivation technologies of *rabi* pulses and oilseeds in rice fallow of Manipur valley and similar situations of N.E.H. Region

A technology was designed to evaluate suitable *rabi* crops as a second crop after *kharif* rice through exploration of rain water harvesting as farm adaptive trial. Among the *rabi* crops, the yield of pea as well as the income was higher as it was harvested as green pod. For easy comparison, the yields obtained were converted into pea equivalent yield and the highest yield income was obtained from pea followed by lathyrus, lentil and rapeseed. The following conclusions were drawn from the trial:

- It is practically feasible to grow a *rabi* crop in rice fallows by developing facilities for rain water harvesting
- Among the four *rabi* crops tested, pea gives the highest return but benefit cost ratio is the highest in lathyrus.
- Irrigation water use efficiency is higher under twice irrigation but economically thrice irrigation is more profitable.
- Lathyrus and rapeseed have higher tolerance capacity to water deficit and hence better under rainfed condition.
- For giving thrice live saving irrigations by adopting sprinkler irrigation, approximately 1/10 of the field area has to be reserved for digging water harvesting ponds to a depth of 2.5 m.

7) Standardised Agro-Horti-Sylvicultural farming system for sustainable production for Manipur hills

Sustainable pineapple farming in agro-horti-silvicultural farming system module was attempted by the College of Agriculture, CAU, Imphal at Thoubal district of Manipur under IFAD fund. This system was found to be more sustainable in regards with soil and water conservation as well as soil fertility status than the traditional system of pineapple cultivation practice in the hill tract of Manipur. If properly designed, a sustainable income flow of the farm can also be maintained. The salient findings of the developed system are summarized as under:

A. Controlling soil erosion

Soil loss was studied from both the newly designed farm area as well as from the traditional farm area, which was specially kept for comparison.

The summary of the results based on 4 years study clearly indicated that soil loss can be reduced from 140-170 t/ha/yr under traditional farm lands to only 15-27 t/ha/yr under the newly designed farm land. This is a good indication of being sustainability of the system with regard to soil deterioration.

B. Natural terracing

Due to continuous inter-cultivation, the inter space between the pineapples rows were converted flat within 4 years just like the shape of terrace. Thus, the hill slope was converted to terrace land naturally by following the system .This will help in controlling soil erosion and agricultural operation was also made easier.

C. Sustainable income flow

The income flow of the newly designed farm started from 4-6 months onwards from the field crops grown in the interspaces of pineapple with a mean extra earning of ` 4000/ha in the first year. From second year onwards farmers started introducing many more crops likes ginger, turmeric, *Calocasia* etc. which further enhanced their extranet earning from intercrop up to ` 6700/ha in the third year. From fourth year grafted citrus started giving an extra income of ` 3500/ha. The income flow is expected to multifold from seven years onwards from *Citrus macroptera* & *Autocarpus heterophyllus*. Thus, the income flow of the pineapple farmers started from a early period, enhancing further and further with the progress of time while, in case of traditional pineapple mono-cropping, during the first year income was negative as pineapple started fruiting from 16^{th} months onwards and economic life span was also very short due to excess soil moisture and nutrient erosion and started declining from fourth year onwards as seen in table below:

The introduced system also helped in extending the economic lifespan of the pineapple due to soil moisture conservation and improvement of fertility from the legume intercrops. Income under traditional farming was sharply declined from 4th year onwards while under modified farm the income was found further increasing from first year onwards.

8) Standardised drying systems of spices and vegetables using forced convection solar dryer for small farmers and households in N.E.H. Region

A portable type of forced convection multi sack solar cabinet dryer was developed in the Dept. of Engg., COA, CAU, Imphal. The maximum temperature achieved in the chamber was 65% with an average drier efficiency of about 23%. The speed of the blower ranges from 1.2-2.0 m/s and can give solar insolation of 75-100 mw/cm2. This system was used to dry spices and ve discolouration, charring or fungal growth was observed. The dryer was cost effective and will be useful for NEH Region.

9) Standardised orchid cut flower packing technology for increased shelf life up to 3 weeks for long distance marketing

- A package design for *Cymbidium* orchids was developed and its self life was studied.

- The packaging was done in the corrugated paperboard cartoon lined with silver paper and bamboo based material. The shelf life of packaging with corrugated paperboard was found to be at least 21 days i.e. 3 weeks. The packaging technology needs to be demonstrated to local entrepreneurs for commercialization.

10) Sustainable quails farming technology for income generation for Mizoram farmers and similar situations of N.E.H. Region

A quail is a small bird that belongs to pleasant family. They are fairly disease resistant as compared with other poultry. Their meat and eggs are nutritious and contains various vitamin and minerals. Hatching of quails required heat, therefore 100W electric bulb should be provided for 2-3 weeks. The newly hatched quails should be kept separately. Broiler and layer ration can be given to the

chicks. The housing of the chicks should be airy and be able to received morning sunlight. It can also be raised in cage of suitable size.

11) Standardised techniques for production of virus free planting materials in Khasi mandarin

Seventy one orchards along the Basar region of Pasighat was thoroughly studied for detection of Citrus *Tristeza clostero virus* (CTV) and Citrus *Exocortis viroid* (CEVd). The detection of CTV was done by bioassay of CTV with indicator plant, enzyme, linked immunosorbent assay (ELISA) and diagnostic strips and CEVd by bioassay of CEVd and
RT-PCR. Seeds from virus free citrus plants were sown and budded with the bud collected from selected virus free mother plants. Then, the certified budded planting materials were supplied to the state horticultural department as well as farmers of NEH Region.

12) Standardized process and product development technology of pineapple juice powder for developing pineapple based Agro-industries in the N.E.H. Region

Pineapple production in North-East India is 40% of the total production of the country but due to insufficient market facilities, high bulk and less price (less than Rs. 5/piece), lack of storage infrastructure, improper transport facilities, most of the produce are spoiled/wasted. In this regard, a process and value added product development of pineapple juice powder was standardized using pineapple produced in the region for better storability and wider markets.

13) Oilseed varieties adapted to foot and mid hills of Manipur and rice fallow of Manipur valley and similar situations of NEH Region

a. *Kharif* oilseeds

Groundnut:

- Groundnut Variety "ICGS 76" developed from the cross between TMV X Chico (an early maturing line) by bulk pedigree method was found to be promising under Manipur conditions and similar situations of NEH Region. The variety matures in 115-125 days with an average yield of 1600-1800 kg/ha with 64-66% shelling percentage and 42-44% oil content. It has a yield advantage of 337 kg/ha over the national check TAG -24 under low input rainfed conditions.

Soybean

- Soybean variety JS-335 (Jawahar Soybean 335) developed from the cross between JS 78-77 and JS 71-05 is recommended as the best adapted variety under foothills and uplands of Manipur with about 28% increase in yield over the National check var. Bragg. The average yield was 1557 kg/ha with crop duration of 105-110 days and plant height of 50 cm under local conditions of Manipur.

b. *Rabi* oilseeds

Rapeseed-Mustard

- The toria variety "M-27" evolved from RRS, AAU, Shillongani, Assam was found to be a promising variety under zero tillage cultivation of rapeseed under Manipur valley conditions with seed yield potential of 1000 kg/ha. The variety matures in 105-110 days with the oil content of 43-44%.

14) Four Tier Runoff Water Harvesting Model for Hill fisheries based Farming System in NEH Region

A location specific four tier runoff water harvesting model for fish based farming system for the hilly terrains of Tripura has been developed without disturbing the natural contour of the hills and tested on farm for the last three years. The novelty of this model is as hereunder:

- The runoff water is channelized through vegetative channel to prevent soil erosion.
- The ponds at the higher elevation lined with polypropylene sheet are seasonal being used for the rearing of fish fries during breeding season and also acts as recharging pits for sustainable supply of water to the perennial pond at lowest elevation and gullies being used for grow out fish.
- The entire catchment area can be used for the integration of Horticulture, Animal Husbandry and Agriculture by using the harvested water judiciously.
- This model is being effectively replicated in the farmers' field under NAIP for the last three years.
- This model can be replicated elsewhere in NEH region with minor location specific modifications, if needed.

Achievements of CAU quality seed production

Visualizing the need of quality seed production in N.E.H. Region, the Central Agricultural University has started quality seed production in the XIth Five Year Plan (2007-08 to 2011-12) with limited achievements. However, University is planning to achieve more in the quality seed production of different crops for food security and livelihood improvement in the XIIth Five Year Plan.

Achievements of quality seed production programme during the year 2012-13:

Particulars	**NS (kg)**		**BS (q)**		**FS (q)**		**CS (q)**		**TFL seed (q)**	
Seeds	**T**	**A**	**T**	**A**	**T**	**A**	**T**	**A**	**T**	**A**
Cereals										
Rice var. CAU-R1, CAU-R3 & CAU-R4	10.00	10.00	20.00	15.00					500.00	1000.00
Sub-total	**10.00**	**10.00**	**20.00**	**15.00**					**500.00**	**1000.00**
Pulses										
Urdbean									5.00	2.00
Sun-total									**5.00**	**2.00**
oilseeds										
Soybean									5.00	4.00
Groundnut									5.00	2.00
Mustard var. Ragini									10.00	10.00
Sub-total									**20.00**	**16.00**
Total	**10.00**	**10.00**	**20.00**	**15.00**					**525.00**	**1018.00**

NS = Nucleus Seed, **BS** = Breeder Seed, **FS** = Foundation Seed, **CS** = Certified Seed
TFL = Truthfully Labelled Seed, **T** = Target, **A** = Achieved

Dissemination of Location Specific CAU Technologies, Recommendations and Research Findings

All the deliverable location specific technologies, recommendations and research findings achieved by the university are disseminated through the following scientific publications:

1. CAU Research Newsletter, ISSN 2319 – 3042 (Half yearly)
2. CAU Annual Research Report (Yearly)
3. CAU Location Specific Deliverable

Technologies, Recommendations and Research Findings (Plan wise publication)

4. Highlights of Extension Education Activities, 2012-13

Dissemination of information through field days, fairs, training programmes are the significant expertise to popularize any new pioneer technologies to the farming community. The university has made efforts to organize and execute certain important events at various colleges to have a technological interaction between scientists, stakeholders and farmers in the form of major events.

CAU Agri Fair 2012 and NE Agri Fair 2013 were organized from January 19-21, 2012 at College of Fisheries, Lembuchera, Tripura and from 19-21 March, 2013 at College of Home Science, Tura Meghalaya, respectively. Further, transfers of technologies in farmers' field are being taken up through the following projects:

- Under Agriculture Extension Project entitled, "Augmenting Rapeseed-Mustard Production of Tribal Farmers of NE States for Sustainable Livelihood Security" in collaboration with
- Directorate of Rapeseed-Mustard Research (DRMR), Bharatpur under Tribal Sub-Plan during 2011-12, 172 farmers were benefited with a net profit of Rs. 24,000/ha from an average yield of 10.0 q/ha. During *rabi* 2012 the project covered 1010 ha in 50 villages under 4 districts of Manipur and benefitted 1419 farmers with average yield of 6.0 q/ha under dry situation without getting any rain during the crop period.
- Livestock based integrated farming system has been taken up by Krishi Vigyan Kendra, Imphal East from 2009 for better utilization of natural resources and generating sustainable income at the instructional farm of KVK. The farm has a total area of 0.5 ha and consists of piggery, duckery, poultry, turkey and fishery units and started accruing income of Rs. 2.5 lakh upto December, 2012.
- The university is taking up extension activities on rain water harvesting through farm ponds for cultivation of *rabi* crops in rice fallows. So far the University has constructed 3(three) big water harvesting structures with micro irrigation facilities covering a total area of 0.56 ha with 14,697 cum of harvested water and irrigable command area of 48 ha. In addition 15 farm ponds and 10 jalkunds have also been constructed in farmer's field for giving live saving irrigation to *rabi* crops.
- ICAR launched project on "National Initiation on Climate Resilient Agriculture (NICRA)" has been in operation by the KVK, Imphal East to make the farmers aware of the climate change and its consequences with suitable mitigation and adaptation strategy. Flood tolerant rice variety "Taothabi", short duration rice variety "Pari phou" and cold tolerant rice variety "RC-Mani Phou-7" were introduced in farmers field during aberrant weather conditions and gave average yield of 3.12 t/ha, 4.48 t/ha and 4.56 t/ha, respectively. New crops like, lentil and lathyrus have

been introduced in rice fallow under zero tillage. New enterprises like water reed-cum-fish culture, mushroom, poly house for protected cultivation of high value off-season crops, vermicompost, have been introduced in farmers field.

A project on "Biotechnology led organic farming in NEH Region funded by the Department of Biotechnology is under progress. Under this project, French bean (var. Arka Komal), Ginger (var. Nadia) and Turmeric (var. Megha turmeric -1) are cultivated in 5 ha and gave average yield of 361 q/ha (green pod), 214 q/ha and 220 q/ha respectively. The farmers received Scope Certificate for producing the above crops organically *(Certificate No. ORG/SC/1204/000688)*.

- Central Agricultural University, Imphal produced 100 tonnes of quality seeds of rice variety CAU-R1 under farmers' participatory mode for widespread distribution in Manipur and neighbouring states.

CAU Extension Publications

CAU Farm Magazine is published quarterly in seven different languages (English, Hindi, Bengali, Manipuri, Mizo, Khasi and Garo). The magazine carries information on different technologies and scientific recommendations/refinements related to agriculture and allied sciences particularly relevant to the farming community of the NEH Region.

B-3. ICAR RESEARCH COMPLEX FOR NEH REGION, UMIAM, MEGHALAYA

Background

The ICAR Research Complex for NEH Region, a unique Institute of the ICAR, encompasses agriculture, horticulture, animal sciences, agricultural engineering, agroforestry, fishery and social sciences to cater to the needs of the NEH Region. The institute headquarters is located at Umiam (Barapani), Meghalaya, whereas its regional centres are located at Basar (Arunachal Pradesh), Imphal (Manipur), Kolasib (Mizoram), Jharnapani (Nagaland), Lembucherra (Tripura) and Gangtok (Sikkim). The institute efforts are supported by centralized Services, such as farm services, library and computer services, technical cell and administration, accounts and stores. Besides these regional centers, the Institute has fourteen Krishi Vigyan Kendras (KVKs) for providing on/off-campus training to field functionaries of agriculture and allied departments, NGO's, farmers, school dropouts and farm women. Scientists working in the KVKs are also involved in providing feed back to the scientists about the recommended technologies through on-farm evaluation and field demonstrations. The regional research centres have been located to represent the varying altitudes (60-1800m above mean sea level, amsl) and agro-ecologies of the NEH region. The research findings of the institute at different centres can thus be utilized for specific altitudinal range and agro-climatic conditions in different states.

The present mandate of the institute is to:

- Develop and improve sustainable farming systems for different agro-climatic and socio-economic conditions of the region.
- Improve crops, livestock and fishery and to impart training for development of local competence for management of resources to enhance agricultural productivity.
- Maintain, analyze and project data based resources for perspective planning.
- Collaborate with State Departments of the region for testing and promotion of improved farming technologies.
- Research on organic agriculture.
- Develop local human resources through post graduate teaching and research.
- Act as a repository of information on different farming systems of the region.
- Collaborate with national and international agencies in achieving the above objectives.
- Provide consultancy.

Out of the eight Divisions (16 disciplines) of the Institute (proposed to be 10 divisions by present QRT), six divisions are engaged in post graduate teaching and guiding of CPGS (CAU) besides research and extension activities. The Institute also has an IGNOU programme study centre, and 10 courses are already activated. Besides scientists of the Institute are also engaged in guiding students from various Universities such as Silchar University, Bisva Bharati, SASRD, IVRI etc.

The Institute has 59 competitive and externally funded projects of NAIP, NFBSFARA, DST, DBT, NHBs etc. Besides 12 AICRP projects are also operated by the Institute. The number of Institute funded projects are 124. Recently strategic research for climate resilient agriculture has been initiated under **NICRA Scheme**. The Institute presently has 14 KVKs attached to it (including newly established KVK at Longleng, Nagaland) in different parts of the NE region. The Institute has well established farming system models, germplasm blocks, agroforestry models, water

harvesting structures besides well developed experimental fields, laboratories, infrastructure facilities and equipments.

The Institute is under NRM Division but has a good coordination of projects in all other Divisions under ICAR such as Horticulture, Crop Sciences, Agricultural Engineering, Animal Sciences, Fisheries, Education and Extension. The Institute has developed **good linkages** with universities (CAU, AAU, MU, NEHU, SASRD etc.), State Government Departments (Agriculture, Horticulture, Soil and water Conservation, Animal Sciences, Fishery etc.), NGOs, including International Institutes (ILRI, IWMI, IRRI, SARC, ICRISAT, ICRAF etc.) within and outside the region and country and working in convergent mode for disseminating various improved technologies to the farmers' field.

The Institute is in the process of developing **state of art infrastructure** in frontier areas to handle major researchable issues on climate change, biotic and abiotic stress for which the facilities such as Free Air Temperature Enhancement (FATE), CO_2 and Temperature Gradient Chamber (CTGC), Biochar, Environmental Control Chambers, Phenomix, Weather Forecasting facilities, etc.

Some projects such as NICRA, NAIP, NHM, TSP, Mega seed prgramme on pig and poultry has enabled the Institute to disseminate technologies to the farmers in the region to a great extent enhancing productivity and production of food.

The EFC document for 12 FYP and vision 2050 envisioned food security and efficient management of natural resources and strive to attain research excellence in sustaining hill agriculture. Post harvest and marketing facilities are the bottlenecks in the region. Hence, secondary agriculture, speciality agriculture, organic farming, agri-incubators, conservation agriculture, health food, seeds, water, nano technology, molecular breeding, bio-fortication, agro-biodiversity, phyto-chemicals and high value compounds, farm mechanization etc. will be undertaken in collaboration with ICAR and other Universities/Institutes as consortia or platform research. Action has been initiated by the Institute to undertake programmes under FARMERS FIRST policy as envisioned by the Council. Attracting & Retaining Youths in Agriculture (ARYA) will be another focus programme to develop entrepreneurship in the region.

Based on the challenges and needs of the region, **3 major flagship programme** for the Institute has been initiated and efforts to integrate in-house projects on these viz., Jhum improvement programme, Temperate horticulture Transboundary diseases

Major achievements and Impact

During the review period, the Institute has focused on efficient natural resource management, especially soil & water management, developing stress tolerant and high-yielding crop/livestock varieties/breeds for various ecosystems, including shifting cultivation areas, integrated farming system & conservation agriculture for food and nutritional security of small and marginal farmers. To address the issue of climate change and associated risks NICRA programme was initiated in the Institute along with few identified KVKs with focus on strategic research, technology transfer and capacity development in various aspects. Under TSP programme alone about 32,500 farmers were covered during 2010-12, and the major focus was on making available improved varieties of crops, horticultural planting materials, including live stocks and fish to the farmers.

The salient research and extension achievements of the Institute are as follows-

CROP IMPROVEMENT

Rice

The varieties released during last two years are-

- Two upland varieties, Bhalum 3 and Bhalum 4 were released in 2010. Bhalum 4 is tolerant to stem borer, leaf folder and gandhi-bug. Yield potential is 4.2 t/ha and duration ranges from 140 – 150 days. Yield advantage over Bhalum 1 is about 20%.
- RC Maniphou-11, resistant against blast disease and brown plant hoppers, was centrally released and notified in 2011.
- TRC 2005-1 and TRC 2005-3 for wetland ecology, released for Tripura in 2011
- Naveen, a wetland variety, was released for Tripura in 2011
- TRC 2005-1 (Gomatidhan) was released by Tripura State in 2012
- RC Maniphou 7 (RCM 9) has been found tolerant to submergent conditions for up to 13 days after transplantation.

Maize

- Developed three composites of 100-110 days duration, RCM-75, RCM-76 and DA 61 A, for the NE Hills with a yield potential of 5.0-5.5t/ha.
- Identified one OPV maize genotype showing QPM character (tryptophan 0.86, lysine 3.87g/16gN)

Pulse and Oilseed Improvement

- Field pea variety TRCP-9 was released for Tripura in 2011.
- Seven photo insensitive lines (1.5 – 1.7 t/ha) of rice-bean identified and two genotypes suitable for spring season developed.
- Eight urd-bean genotypes suitable for upland condition had been identified. Superior genotypes were KU 527 (9.9 q/ha) and Pahelo Dal 4 (7.5 q/ha).

Vegetables:

- Tomato: Megha tomato 3, which is high in lycopene content, having high yield potential (600 q/ha) and suitable for poly house cultivation was released for Meghalaya in 2010. RC Manikhamenashinba- 1 has been released by the state variety release committee, Govt. of Manipur in October 2012.The variety, RC Manikhamenashinba- 1 is tolerant to leaf curl, bacterial wilt, fruit borer and cracking.
- Brinjal : TRC Bholanath (dark purple oblong oval shaped) released for irrigated upland condition, resistance to bacterial wilt and has high yield potential (400-450 q/ha).
- Brinjal : TRC Singhnath (dark purple, long cylindrical shaped), released for irrigated upland condition, resistance to bacterial wilt, suitable for year round production and high yield potential (400-450 q/ha).

Varieties in pipeline for release

- Guava cultivars RCGH 1, RCGH 4, RCGH-7 and RCGH 11 are in pipeline for release.
- In Tripura, Papaya cultivar RCTP 1 tolerant to ring spot virus is in pipeline for release.
- Two genotypes of tomato (Megha Tomato 1 & 2) have been proposed for release.
- Two genotypes of brinjal developed by the institute (RCMB 1 & Sel 5) are in the last year of AICVIP trial.

- One genotype of frenchbean (RCFB 1)
- Two genotypes of ash gourd (RCAG 15 and RCAG 28) are in the process of releasing.

Registration of germplasm lines: RCM-23 (IET 20810) registration no INGR 10153 as a source of neck blast and Phougak (registration no- INGR 101154) for multiple spikelets in single cluster were registered with NBPGR, New Delhi in the year 2011.

Identification of Germplasm lines with high nutritional value: Some rice lines with high nutritional quality traits ware identified from the local collections. Those are Taothabi for high lysine (8.41g/16gN), Moringphou for high methionine (9.36g / 16gN), Chahou amoba for high iron (19 ppm), Moringphou for high calcium (30mg / 100g).

BIOTECHNOLOGY

- Physical and nutritional quality analysis of popular rice varieties and germplasm of NE region were taken up. Promising genotype for different amino acids and essential elements are given below:

Genotype	Amino acid/element content
Taothabi	Lysine (8.41g/16gN), higher than normal
Moringphou	Methionine (9.36g / 16gN), higher than normal
Chahou amoba	Iron (19 ppm), higher than normal
Moringphou	Calcium (30mg / 100g), higher than normal

- Characterized 600 germplasm and developed catalogued 400 of them.
- StandardizedIn vitro screening protocol for aluminum toxicity, heat cold tolerance at different growth stages of rice.
- Screened about 600 rice germplasm for aluminum toxicity, heat and cold tolerance, and identified core genotypes for each stress.
- Developed 28 hyper variable SSRs for rice-bean.
- Used 105 SSRs for cross species amplification in Vigna radiata, Phaseolus vulgaris and Cajanus cajan.
- Diversity analysis of chilli using 32 SSR markers led to identification of unique genotype from Mizoram with morphological similarity to king chilli, but genetically different.

AGRICULTURAL ENTOMOLOGY

- Improvised and validated ITK (attraction of gundhi bug towards rotten crabs) for the control of rice gundhi bug (Leptocorisa acuta). It gives 70% control at par with chemical control.
- A novel ready to use card was developed against most destructive pest, Pieris spp., of cruciferous crops. The product has been submitted for patenting.
- Synthetic diet for rearing citrus trunk borer larvae was developed and applied for patent.
- Hammering at oviposition sites and blocking the larval tunnel with imidacloprid (0.5 mL per L) and mud was found most effective in reducing emergence of adult citrus trunk borer.
- IPM technologies with pheromone trap, clipping of infested/infected shoots and branches, and sanitary measures were developed for the management of brinjal fruit and shoot borer (*Lucinodes orbonalis*). Films on this technique was made in Khasi and Bengali languages and telecasted through DD Tripura and Meghalaya.

- Surveyed 67 districts in eight states of NE India from which 42,000 insect specimens belonging to twelve taxonomic orders were collected and 1140 insect species identified and catalogued.
- Beauveria bassiana, Metarhizium anisopliae and Verticillium lecanii (1x109 cfu/ml each) were isolated, evaluated and found effective @ 6 ml/litre of water against rice leaf folder, white grub and white back plant hopper.
- Maize hybrid Vivek-15 was found resistant to maize stem borer.
- Aqueous extract of Melia azedarach (5%) showed ovicidal action against cabbage butterfly causing 48% egg mortality and 46 to 65% mortality of different instar larvae 72 hours after treatment.

PLANT PATHOLOGY

- Eighteen new reports of fungal plant pathogens were reported from this region using Scanning electron microscopy and molecular techniques (PCR, Sequencing and Phylogenetic analysis) e.g.Verticillium epiphytum on Mucuna pruriens, Pseudoperonospora cubensis on Sechium edule, Oidium neolycopersici on Solanum betaceum (Tree tomato), Cladosporium oxysporum on Prunus nepalensis and Podosphaera xanthii on Momordicha cochinchinensis. Rhizoctonia solani AG 1 IA has been detected on rice and maize.
- Candidatus Phytoplasma asteris has been reported from northeast India on Crotalaria tetragona
- Two rice varieties i.e. Mendri and DSN 60 were found to be moderately resistant against sheath blight based on relative lesion height among 52 varieties/lines screened.
- Virulence monitoring was done for Pyricularia oryzae using eight international differentials and the results indicated that racial pattern was different during different seasons.
- Eight germplasm of Mucuna pruriens were found resistant to rust disease (Uromyces mucunae).
- Commercial formulationNisarga (Trichoderma viride) @ 5 g/l was found effective followed by Carbendazim @ 1g a.i/ l against citrus scab when applied at 15 days interval starting from new flush and sorghum grain based formulation of T.harzianum was found effective against citrus root rot (Phytophthora spp.).
- Agaricus bisporus strains viz: U3 and Ag were found best and their Biological efficiency recorded 27% and 23.5% respectively on long method of composting.
- Blue oyster mushroom (Hypsizygus ulmarius) recorded yields of 66.9 kg fresh mushroom/100kg paddy straw during a period of 60 days.
- Pleurotus sajor-caju strains (PSC 01,02,03,04 and 05) recorded fresh mushroom yield of 60-91 kg/100kg paddy straw in rainy season. P. florida strains PF 01 planted in winter season recorded the highest yield (77kg/100kg straw) followed by PF 04 (71.8kg/100Kg paddy straw) and PF 02 (66.7kg/100Kg paddy straw).

NATURAL RESOURCE MANAGEMENT

- Technology for double cropping of rice in mid altitude under rainfed condition involving pre-kharif rice and its ratoon has been standardized. IR 64 and Shahsarang were found suitable for pre-kharif (March – July) season (4.5 – 5t/ha) that also gives acceptable ratoon yield (2.5 – 3 t/ha). From same piece of land 7.5 to 8.0 tonnes rice could be produced in one year.
- The productivity of low land rice under zero and minimum tillage was at par with conventional tillage from 1st year onward. But, the productivity of succeeding *toria*, pea and lentil were always higher under zero tillage compared to conventional tillage. The same is true in the states like Manipur and Tripura.

- Package of practices for organic production of groundnut, French bean, rice, carrot, ginger, turmeric and maize had been developed.
- In the silvi-horti-pastoral systems, pineapple (var. Kew) under the canopy of silver oak (Grevillea robusta) across the steep slope (25-30%) with 50 x 80 cm spacing with congo signal revealed highest system productivity. The average yield of pineapple in the understorey of G. robusta was16.5 q/ha and congo signal was 28.18 t/ha.
- Collection and evaluation of Mucuna pruriens: Mucuna pruriens is an important medicinal plant of the NEH region which is used for treatment of Parkinson disease. About 150 collections from the states of Meghalaya, Sikkim, Tripura, Assam, Nagaland, Manipur, Uttaranchal, Rajasthan, Uttar Pradesh, West Bengal and Odisha were collected, screened and evaluated in replicated trial. Highest seed yield was obtained from UPMP-06 (1.634 t/ha). L-DOPA content in the 49 genotypes screened was found to be in the range of 4-6%.
- A total of 500 jalkunds have been constructed for rainwater harvesting in different northeastern states.
- A total of 3850 farmers through 77 farmers training and 350 trainer's through 14 trainers from different NEH region have been trained under in various aspects of water management during 2007-12.

- Dairy based farming system was evaluated on a micro watershed of 1.39 ha area including 0.45 ha forest land. The area under planned land use was 0.94 ha, of which 0.22 ha terrace area was under annual fodder crops and remaining under broom and guinea grass. The average slope of the watershed was 32 %. The bottom 1 to10 terraces were utilized for production of annual fodder, maize + cowpea – cowpea and maize – cowpea cropping sequence. The terrace riser was utilized for the production of guinea grass. Four milch cows along with their calves were maintained in the system. Fodder crops/ grasses grown in the micro-watershed, produced sufficient green fodder for the whole year for dairy animals. A total of 37.50 tonnes green fodder was produced from the watershed of which 15.06 tonnes was from broom and 13.58 tonnes from mixed grass. The milk yield obtained from the system was 8,462 litre. In addition 35 tonnes of FYM was produced from cow dung, urine, crop residues, and weed biomass in the system.

- Silvi-pastoral system was established on 2.94 ha area in forest land of which 2.05 ha was under forest and 0.90 ha under planned land use of silvipastoral system. The average slope of the area was 32.18 %. The top portion of the micro-watershed was utilized for broom grass to fulfill the requirement of fodder for the animals during lean period and to get broom sticks as well as fuel woods in the form of stick. An area of 0.74 ha was planted with broom which recorded green fodder of 35.50 t out of which 4.625 t green biomass was used for cow and goat from November to February. Eleven goats (4 adult males, 3 adult females, 3 male kids and 1 female kid) were maintained in the system. The goats were allowed to graze for 3 hours per day and green fodder @ 3 kg per adult along with 250 g of concentrates per adult were provided. Poultry (300 broilers) chicks were also reared in two cycles as subsidiary source of income. The lower half portion of the watershed had been planted with fodder tree species of Symingtonia populnea, Bauhinia purpurea and Ficus spp, Schima wallichii, Indigoferaindica and wild cherry to provide green leaf fodder to the goats during lean period. About 2.68 tonnes tree leaf fodder was obtained from the system.

- **Agro-pastoral system** was developed in 0.64 ha area having an average slope of 32 % with forest land of 0.06 ha and planned land use area of 0.58 ha. Terracing enhanced land surface

area of watershed by 28.2 %, resulting in 0.49 ha area of terraced land and 0.33 ha terrace risers. The terrace area was utilized for growing cereals, oilseeds, spices and vegetables. About 75 % of the area was brought under 200 % cropping intensity which resulted rice equivalent production of 2.0 tonnes excluding guinea grass from the system. Considering the watershed as a whole maximum income was realized from cow milk which was 65.8 % of the total income of the system. The crop component contributed only 34% income from the system.

Facilitation centre on medicinal plants

- A facilitation centre on medicinal plants was established with the objectives to generate awareness and facilitate cultivation and marketing of medicinal plants. Altogether 834 medicinal plants were reported from Meghalaya out which 56 species are used as traditional medicine in Meghalaya. Around 11 species are now categorized as threatened. A total of seventeen (17) farmers' trainings have been conducted and a total of 1049 farmers including nursery growers from different regions of Meghalaya were imparted training. Two (2) buyer-seller meets were organized between growers, traders and industry for establishing linkages between cultivation and marketing and encourage market driven cultivation by the facilitation centre on medicinal plants. One hundred sixty (160) farmers and 7 traders from different states of North East participated during the meets. More than 80 medicinal and aromatic plant species were maintained at the medicinal garden of the facilitation centre and exhibited to farmers, students, traders, scientists, state officials visiting the medicinal garden. Planting materials like seeds, slips and cutting of species such as *Tinispora, Withania, Occimum, Alpinia, Lemon grass, Brahmi* etc available for distribution.

HORTICULTURE

Fruits

- Four guava varieties developed by the Institute viz., RCG-11, RCGH-1, RCGH-4 and RCGH-7 were found promising with regard to yield and quality traits. They have been included under AICRP on Sub-Tropical fruits. The ascorbic acid content varied from 180 -240 mg/100. RCG 11 had very less seed (47 per 100 g fruit). Pink fleshed cultivar RCGH 4 was suitable for processing purpose.
- October (last week) pruning resulted in earlier fruit maturity by 12-15 days in cv. Partap.
- Senile peach plant could be rejuvenated by heading back in November-December followed by 50 % pruning of newly emerged shoots which resulted in quality fruit production (10-110 Brix) with average yield of 9-13 kg per tree.
- Arrangement to procure 25 grape varieties for evaluation in Mizoram has been arranged.
- Around 12500 budded/grafted plants of peaches have been produced and disseminated for multiplication under farmers' field under National Horticulture Mission
- Spray of GA3 @ 40ppm in the last week of May resulted in maximum runner production.
- Off season production technology under low tunnels (50% shade net) during July- August produced fruits 30-35 days earlier. Planting in November under polythene tunnels extended fruit availability by 47 days.
- Underutilized fruitSohiong (Prunus nepalensis) fruit was found to be a fairly good source of anthocyanin (193.38 to 407.73 mg/100g), 'β' carotene (8.97 to 33.18 mg/100 g), total antioxidants (equivalent to 7.88 to 12.25 μ mol trolox/g) and minerals. Tongue and

wedge grafting on one year old rootstock of pencil thickness during second week of Oct. was found suitable. (> 80% success rate)

- S*ohshang* (*Elaeagnus latifolia*) fruit was observed to be rich in fibre (5.48%), phosphorus (95 mg/100 g), total potassium (487 mg/100 g) and iron (16.82 mg/100 g) content.

Vegetables

- Megha Tomato-3 variety developed through hybridization (Pusa Sheetal x Lima) followed by pedigree selection was released by Meghalaya state during 2010. It is tolerant to bacterial wilt and low temperature with yield potential of 500-550 q/ha. Proposal for its notification had been submitted.
- Out of six tomato genotypes, hybrid Rocky produced highest yield (1.8 kg/plant) under low-cost polyhouse planted during November. However, TSS and ascorbic acid were highest in Megha Tomato –2 (6.5.0ºB and 25.2 mg/100g respectively) and lycopene in Selection –2 (37.76 mg/100g).
- Advanced tomato lines viz., RCMBL-1 (included AICVIP trial), RCMBL-2 and RCMBL-3 having high yield potential (400-550q/ha) were found tolerant to bacterial wilt.
- Two advanced ash Gourd lines lines RCAG-15 (oblong shaped) and RCAG-28 (cylindrical) have been identified (AVT –II stage) with yield potential of 41t/ha and 37 t/ha, respectively by AICRP on vegetable improvement.
- Broccoli varieties Fiesta, Aishwarya, Lucky, Pushpa hybrids and variety Palam Vichitra grown during last week of September to mid October at the spacing of 45 x 30cm with application of FYM @ 20 t/ha and N:P:K @ 150:60:60 kg/ha were found suitable under mid hills of Meghalaya.
- About 82 variable germplasm of *Sechium edulae* (chow-chow) has been collected for evaluation and further research.
- Different chilligenotypes were evaluated for yield and quality characters. The highest yield of green chilli was recorded from RCC-04-12-1(339 q/ha) followed by RCC-24 (280q/ha) and RCC-04-10-1 (270 q/ha). Colour value estimates ranged from 28.86 ASTA unit (RCC-04-24-1) to 135.75 (RCC-04-7) ASTA unit.
- Thirty two germplasm of 'birds eye chilli' collection has been evaluated in Mizoram centre.
- Six advanced lines of French bean have been selected. The genotype RCMFB-1 (yield potential 224 q/ha) has been included in AICRP. It is proposed for initiating multiplication trials in different locations of the region.
- RCDL-10 (bush type), a photo-insensitive Dolichos bean line suitable for growing from April to November, was identified. First harvesting can be done after 75 days. The average yield potential was 140-150 q /ha green pod. It is found to be tolerant against aphids, leaf spot and powdery mildew.
- Two high yielding colocasia genotypes, *viz.*, ML-1 (227 q/ha) and ML-2 (220 q/ha) have been identified for higher yield. Among these two ML-1 showed tolerance against Phytophthora leaf blight.

Floriculture

- Gerbera cultivars *viz.*, Piton, Monarch, Pink Elegance, Sazou, Rosalin and Salvador were identified for commercial cultivation under low/medium cost polyhouse.
- Alesmera, Black Heart, Divas Memory, RCGH-117, RCGH-113, RCGH-114 and RCGH-76 were suitable for open conditions.

- Vase solution containing sucrose (2%) + Aluminum Sulphate (300ppm) was found best for enhancing vase life (16 days) of gerbera cv.'Black Heart'.
- Gladiolus cultivars viz., Jester Gold, American Beauty, Candyman, White Prosperity, Pusa Jyotsena, Pusa Gunjan and Priscilla were found to be suitable for cut flower, corm and cormel production. Corms soaked with BAP (25 and 50 ppm) for 24 hours before planting increased number of corms and cormels.

Post Harvest Technology

- Protocols for preparation of tuity fruity from chow-chow (*Sechium edule*) and instant ginger candy have been developed.
- Standardized the corrugated fiber board packaging design for long distance transportation of ginger (>500 Km).
- Optimized ready-to-cook (RTC) green Jackfruit slices in brine solution with treatment: 8% NaCl + 0.2% potassium meta bi-sulphite. This treatment extended storage life by >12 months.
- Standardizedtheprotocols for King chilli sauce by using jack fruit seed as thickener.
- Standardized the protocol of guava RTS, guava squash and leather preparation from ripen guava.

ANIMAL PRODUCTION

- Three breed cross pig was developed including 25% genetic inheritance of Hampshire, 25% genetic inheritance of Khasi local indigenous pig and 50% genetic inheritance of Duroc and the performance was evaluated. The growth performance and average daily weight gain (405 g/day) were equal to upgraded pig (75 % Hampshire inheritance with local), while carcass study revealed lower back fat thickness as compared to the upgraded pig. The three breed cross pig was recommended for lean meat production in the region.
- Efficiency of different short term and long term extenders on preservation and fertility of boar semen at liquid state with different temperatures was evaluated. Beltsville Thawing Solution (BTS) extender was recommended for preservation of boar semen at liquid state. Semen preserved in BTS at 17^{o}C could be used up to three days for artificial insemination without compromising fertility and litter size. The preservation of boar semen at 17^{o}C induces capacitation like changes, reduction in mitochondrial membrane potential (MMP) and DNA integrity.
- Liquid semen volumes (60ml, 80ml and 100ml) and dose (2-3 billion) per intra-cervical insemination for non-descriptive pigs, cross bred and exotic pigs were optimized.
- Different semen transport methods in hilly region and insemination techniques were evaluated. The transport of semen in thermo cool boxes was found to be the most efficacious and economically viable method.
- A total of 250 inseminations were carried out with liquid semen in the institute pig breeding farm and farrowing rates of 80.23% and litter sizes of 8.9 was obtained.
- For technology demonstration and impact analysis, total of 300 artificial inseminations were carried out in 26 selected villages in Ri-Bhoi district and 79.40% pregnancy rate with average litter size of 8.2 was obtained. The upgraded pigs obtained through AI weigh double the weight than the local non-descriptive pigs and yield higher number of piglet per delivery, this resulted in improved productivity and provided higher economic return/pig/year, besides the farmers' saved on incurring mating cost (INR1000-1500).
- A total of 416 blood samples, 450 fodder samples and 387 soil samples were collected from seven districts of Meghalaya. Mineral estimation of serum samples revealed that both macro nutrient (Ca: 5.90mg/dl P: 3.87 mg/dl, Mg: 1.07mg/dl) and micro nutrients (Zn: 15.32mg/dl, Cu: 65.74mg/dl, Mn: 1.17mg/dl) were below the normal range. Out of 416 blood samples, 40, 57 and

32 % of samples showed the deficiency of Ca, P and Mg, respectively. While Cu, Zn, Fe and Mn were deficient in 36, 77, 21 and 12 % of samples, respectively. Maximum deficiency was observed in Zn.

- Calcium content of composite fodder samples was found below the critical level in all the districts of Meghalaya (0.23 ± 0.01 vs. 0.30 %). About 65 % of fodder samples showed Ca deficiency. Similarly Zn was also found to be highly deficient in all the districts of Meghalaya (5.01 ±0.21 vs. 30 %). 85 % of composite fodder sample showed Zn deficiency. However, the values of Mg, K, Cu, Fe, Mn was found within the normal range.
- Soils of Ri-bhoi (pH 4.52) and East Khasi Hills (4.68) were most acidic while Garo Hills' soils were relatively higher in pH (5.37). Available N content averaged across the state was 239 kg/ha, with the East Khasi hills soils showing a mean availability of 275 kg/ha and Ribhoi 212 kg/ha. N Availability in West Khasi, Jaintia Hills and Garo Hills were 222, 237 and 250 kg/ha. P availability in East Khasi, West Khasi, Ribhoi, Jaintia Hills and Garo Hills were 21.1, 8.8, 17.8, 19.2 and 12.3 kg/ha, respectively. Available K in these soils were 165, 98, 126, 172 and 283 kg/ha, respectively. Available S was found more or less similar in all the districts with a mean availability of 10.1 kg/ha.
- Significant positive correlation was found between soil and fodder (r=0.91), fodder-blood (r=0.82) and soil-blood (r=0.71) in case of Ca. Similarly highly significant correlation was found between soil-fodder (r=0.87), fodder-blood (r=0.78) and soil-blood(r=0.76) in case of potassium. Cu was found significantly correlated between soil-fodder (r=0.71), fodder-blood (r=0.65) and soil-blood (r=0.83). Zn was also found to be positively correlated with fodder-blood (r=0.89) and soil-blood (r=0.56). Fe was also found to be positively correlated with soil-fodder (r=0.83) and fodder-blood(r=0.76). On the basis of above findings, the area specific mineral mixture can be formulated in order to improve the productive and reproductive performance of animals in Meghalaya.

ANIMAL NUTRITION

- The performances of different fodders were investigated under agro-climatic condition of Meghalaya, during the *kharif season* in upland terraced area. Bajra and jowar yielded 385.2 and 291.5 q/ha fresh fodder at 60 days of harvesting with DM contents of 30.27 and 27.05% respectively. During the *winter season*, Berseem and Lucerne yielded (62, 113) (87, 50) and, (94, 131) quintal/ha green fodder (fresh basis) in three cuts respectively at Animal Nutrition Farm.
- Mixed/inter cropping of mustard, oats and berseem has been attempted. Mustard fodder was harvested (single cut) and the oats and berseem were harvested subsequently after every 30 days period. The fodder (fresh basis) yields were 270 q/ha for mustard, 140 and 225 q/ha for oats and 89 and 113 q/ha for berseem in second and third cut respectively.
- Silage with different local grasses was developed for lean season and evaluated the nutrient value. Maize fodder (29.75% DM) with common salt (0.5%, fresh basis) had produced good quality silage for feeding of ruminants during the lean period. Local grasses (~25% DM) can be ensiled with use of common salt (1.5%), maize flour (2%) and lactobacillus culture under the conditions of Meghalaya.
- Complete feed block with locally available grass/roughage for cattle was developed. Feeding complete feed blocks (CFB) having 1:1 roughage to concentrate ratio, with chopped and ground paddy straw to crossbred HF lactating dairy cattle resulted in an increase in the daily average milk production and intake of DM, with a smaller reduction in the digestibility of nutrients.
- Feeding maize stover in the form of complete feed block (CFB) increased the palatability and growth in crossbred calves. In lactating cattle, feeding complete feed blocks (CFB) having

chopped maize stover was better than CFB having chopped paddy straw, but grinding of maize stover was not beneficial for feeding in form of CFB.

- Supplementation of legume fodder to the level of 15% in green grasses increased the nutritive value and subsequently increased the milk yield of 5-10% without affecting the fat content.
- Male and female Assam local goats attained an ADG of 61.67g and 48.61g respectively under stall-feeding on seasonally available green grasses and tree laves along with supplementation of 125-175g concentrate (16% CP and 65% TDN) per animal per day.
- Locally available herbs like banana pseudo-stem, alocacia, squash etc. were evaluated for feeding ruminant as well as in swine. Isonitrogenous (14% CP) diets containing with or without chopped and cooked (3:1 w/v, with water for almost 1.5 to 2.0 hr) squash fruit, banana pseudo stem, alocacia stem with leave and sweet potato vine at 17, 25,33 and 25%, respectively replacing 20% of rice polish in concentrate feed resulted ADG (g/d) of 336 and 452.
- Broken rice could be incorporated up to 25% level in the ration of grower-crossbred pigs without any adverse effect on growth rate and nutrient utilization.
- Boiled sweet potato tuber (SPT) can be fed to crossbred piglet to the level of 60% of total dry matter intake for better growth rate and nutrient utilization. Feeding different cultivars of SPT (*Pusa safed*, *Kokrajhar red* and *Sankar*) in piglets revealed that the growth performance of piglets was similar for all the cultivars and hence it was concluded that types of sweet potato or its flesh color did not have any significant effect on growth performance in pigs. *Sankar* cultivar was better in terms of dry matter, digestible energy (DE) and protein yields and it can be used as good energy resource for animal feed in this region. SPT based feeding in pigs, increased the fat thickness. The pork was softer and better in quality on account of acceptability due to improved flavor and taste. In finisher pig ration the SPT as local feed resource may be used at a level of 70% of total DM intake with ADG-612 g/d and FCR-4.08 without affecting the thickness of back fat.
- Incorporation of poor quality rice bran available in the local markets in swine rations decreased the growth performance of piglets. With good quality of rice polish at 50% level (CP 16% and DE 3000 Kcal/kg) in the diet, CB pig gained 72.16 and 136.50 kg body weight in 160 and 300 days respectively.
- Supplementation of phytase enzyme @ 1 lakh unit/100kg feed based on 50% good quality rice polish was sufficient for proper utilization of phosphorus. Supplementation of Phytase enzyme @ 2.0 lakh unit/ 100kg feed in the pig diets containing 70% good quality rice polish provided better growth performance (ADG 423g/d with FCR of 3.11) as compared to supplementation @ 1.0 lakh unit/100kg feed containing 50% good quality rice polish (ADG 452g/d with FCR of 2.97). Field data from the farmers of Ri-Bhoi district also revealed that 12.81% more ADG was observed in CB pigs fed with phytase @ 20g/100kg feed.
- Legume fodders like soybean up to 50% DM requirement in ration of rabbits can provide ADG of 17g and can reduce cost of production substantially.
- Productive and reproductive traits on three types of indigenous fowls *viz*. Miri Bird, Naked Neck and Frizzle Feathered of Northeastern region of India were evaluated under intensive, semi-intensive and extensive rearing systems. The overall production performance of Naked Neck fowls was better than the other two types of fowls and only the extensive system of rearing was found to be economical.

FISHERIES

- Successful spawning of pond reared *Labeocalbasu* was observed at different temperatures (21-26°C) and high altitude (900m) by using both Carp pituitary extract, Ovatide and Ovaprim as stimulating agents.

- Carp Pituitary Extract was also found suitable for breeding with a dose ranging from 4 to 5 mg/kg in male. In female, a first dose of 3 – 4 mg/kg and a second dose of 8 to 10 mg/kg were found effective.
- Ovaprim was found suitable with a dose ranging from 0.3 to 0.5 ml/kg in male, while females required 0.6 to 0.8 ml/kg. Ovatide was found effective for breeding with a dose ranging from 0.3 to 0.4 ml/kg in male and 0.5 – 0.7 ml/kg in case of female.
- Captive breeding of chocolate mahseer was successfully tried in a preliminary experiment at ICAR Complex fish farm at Barapani. The source of broodstock was Umiamriver. The female brood fish weighed 200-300g, while the males were of 50-100g in weight. Incubation of eggs was carried out in enamel trays with mild aeration and the incubation period ranged from 80 to 84 hours. Hatching percent was observed to be 85 and the yolk-sac absorption in larvae was completed 6 days after hatching. The larvae were subsequently maintained on planktonic diet for a period of one month.The fry were subsequently reared in cement cisterns up to fingerling size. Later, the fingerlings were raised in ponds, where they attained about 150 grams in 1 year and matured in 1+ year of age under pond environment.
- The indigenous magur, *Clariasbatrachus*was bred successfully in ICAR Complex fish farm at Barapani in a preliminary experiment. The brood fishes were induced using ovaprim @ 0.75ml/kg for males and 2.0ml/kg for females.
- A genetically improved variety of Common carp –Amur (Hungarian strain) has been introduced for the first time in the ICAR NEH Region fish farm, Barapani, Meghalaya in early 2010.

ANIMAL HEALTH

- For the first time in the NEH, **Porcine reproductive and respiratory syndrome (PRRS)** virus was detected by ICAR Research Complex for NEH Region. This economically important disease causes reproductive failure in breeding stock and respiratory tract illness in young pigs.
- **Brucellosis in livestock:** Seroscreening of 130 serum samples collected from cows in different parts of Meghalaya revealed 3 (2.3%) samples to be positive for *Brucella* antibodies. The *Brucella* isolates were confirmed by PCR based on the gene for 31kDa OMP and the repetitive genetic element *IS711*. Spontaneous cases of swine abortion in an organized farm in Meghalaya were investigated. Out of 68 swine serum samples screened for brucellosis, 5 (7.4%) samples were seropositive for brucellosis. Out of 36 goat serum samples, 2 (5.6%) showed positive reaction for antibodies against brucellosis. Out of 5 suspected tissue samples, the isolates from 2 samples were confirmed as *Brucella suis* by PCR method targeting species specific IS*711* gene sequence. Brucellosis appears to be an emerging problem in the NE.
- **Salmonellosis in poultry:** Out of 53 poultry intestinal samples collected during the postmortem of poultry from various poultry farms in Meghalaya and screened for the presence of *Salmonella* species, 13 (24.53%) were found positive. All the 13 isolates showed the presence of *stn* and*inv*A genes. Water samples from these four farms detected presence of *Salmonella* in 3 out of 8 samples, indicating higher prevalence of Salmonellosis in poultry farms and warranted the immediate attention of the professionals. Water quality monitoring has to be regularly done. *S.Enteritidis* with 9,12:g,m:- antigenic structure was the widely encountered serotype that was followed by *S.*Kentucky serotype with 8,20:i:z_6 antigenic structure. One isolate was serotyped as *S. Typhimurium* with 4,12:i:1,2 antigenic structure. A total of 21 *Salmonella* isolates recovered from chicken intestinal samples were subjected to PCR based detection of *stn* (*Salmonella* enterotoxin), *inv* (invasive), *fim*A (fimbrial), *pef*A (plasmid encoded fimbriae), *sef*C (*Salmonella* Enteritidis fimbriae), *sop*E and *sop*B (*Salmonella* outer membrane protein). The *stn*, *inv* and *fim*A were detected in all the 21 isolates, whereas only 1 (4.76%) isolates showed the presence of *pef*A gene, 3 (14.28 %) for *sef*C gene, 12 (57.14 %) for *sop*E and 1 for *sop*B (4.76%).

Serotyping of the isolates revealed the predominance of *S. Enteritidis* (11, 52.38%) followed by *S. Agona* (4, 19.05%), *S. Kentucky* (3, 14.28 %), *S. Fayed* (2, 9.52%) and *S. Typhimurium* (1, 4.76%). Toxicogenic isolates of S*almonella* are frequently being encountered.

- ***Clostridium perfringens* infection in poultry:** *Clostridium perfringens* was isolated from 14 out of 16 samples collected during the postmortem of the poultry birds and subjected for bacteriological examination. The birds died after showing the symptoms of enteritis. The isolates were confirmed by PCR on the basis of detection of *cpa* gene. The isolates were found to be comparatively resistant to wide number of antibiotics. Only 8 (57.1%) isolates were sensitive to Metronidazole and 7 (50%) to Sparfloxacin.
- **Collibacilosis in poultry and goat:** Out of 57 samples of intestinal contents from the dead birds, 21 were found positive for *Escherichia coli* with varying degree of sensitivity for antimicrobials like Ofloxacin, Ciprofloxacin, Ampicillin, Cephalothin and Sulphfurazole. The *E. coli* was also isolatedfrom a goat that died after severe gastrointestinal disturbances and showed excessive haemorrhages in the intestinal mucosa during postmortem. The serotypes commonly encountered were O5, O63, O9, O20, O128, O33, O154, O15, O146, O12 and O160. A variety of *E. coli* serotypes are prevailing in the NE region thus creating a potential ground for multi drug resistant emergence.
- **Pasteurellosis in Pigs:** Mortality of pigs with severe respiratory problem was reported from two organized farms. Post mortem findings revealed the presence of enlarged, hard and consolidated lungs, adhesion of lobes suggesting death due to pneumonia. The clinical samples were subjected for bacteriological examination in the laboratory. The laboratory findings showed the presence of *Pasteurella multocida* in lung and bronchial lymph node. The isolates were confirmed based on cultural, morphological, biochemical tests and PCR based detection of *P. multocida* specific KMT1 gene. The isolates were found to be pathogenic to mice. The organisms were identified as *P. multocida* type D based on the PCR capsular typing. The isolates were highly sensitive to Ceftriaxone Ci (30 mcg) followed by Cefazolin Cz (30 mcg), Cephalexin Cp (30 mcg), Norfloxacin Nx (10 mcg), Chloramphenicol C (30 mcg), Enrofloxacin Ex (10 mcg) and Ofloxacin Of (5 mcg) and resistant to Sulphadiazine Sz (100 mcg), Co-trimoxazole Co (25 mcg) and Nalidixic acid Na (30 mcg). The disease outbreak could be controlled by using the antibiotics with highest sensitivity.
- **Detection of Streptococcus agalactiae by PCR:** *S. agalactiae,* gram positive cocci which inhibits ducts and cisterns of the mammary gland leading the inflammation and decreased milk production. There is an increased somatic cell count and eventually the involution of cistern. The PCR method was employed for the detection of 16S rRNA gene (220 bp) and *cfb* gene (153 bp) of Group B Streptococci (GBS). A total of 72 milk samples (20 clinical mastitis case and 52 from apparently healthy). Out of 52 apparently healthy 24 were CMT (California Mastitis test) positive, in which 15 isolates were *S. agalactiae,* 4 *Staphylococcu*s and 7 *E coli.* From 20 clinical samples 7 were *Staphylococcus*, 5 E. coli and 2 *S. agalactiae*. Molecular characterization of *S. agalactiae* was carried out against specific gene of 16S rRNA gene (220 bp) and *cfb* gene (153 bp) of Group B Streptococci (GBS).
- **Occurrence of zoonotic organisms in products from livestock and poultry:** The analysis of 436 meat samples (88 beef, 142 pork, 170 chicken meat and 36 goat meat) revealed that 14 (3.2%) samples were positive for *L. monocytogenes*, 38 (8.7%) for mesophilic *Aeromonas* spp., 24 (5.5%) for *Salmonella* spp., 72 (16.5%) for *E. coli* and 14 (3.21%) for thermophilic *Campylobacter* spp. The bacteriological analysis of 99 samples of milk and milk products revealed that 4 (4.04%) samples were contaminated with *Salmonella* spp., 38 (38.38%) with *Staphylococcus aureus*, 18 (18.18%) with *Streptococcus* and 14 (14.14%) with *E. coli*. The isolates showed a varying degree of sensitivity for various antibiotics with highest sensitivity to

enrofloxacin followed by chloramphenicol and tetracycline. The isolates were examined for the presence of various virulence genes to know their pathogenic potential. The PCR based detection methods were used for screening the virulence associated genes viz: *hly*A, *iap*,*plc*A and *plc*B genes in *L. monocytogenes*; *stn*, *invA*, *fim*A, *sef*C, *pef*A, *sop*E and *sop*B in *Salmonella*; *stx*1, *stx*2, *hly*A, *est* and *elt* genes in *E. coli*; *ahh1*, *AH-aerA* and *asa1* in *mesophilic Aeromonas* and *flaA*, *iam*, *cad*F, *rac*R, *pld*A, *cdt*A, *cdt*B, *cdt*C genes in *Campylobacter*. Detection of virulence associated genes were seen in less than 5 % of the samples. Hence as of now there is no need for immediate concern for any major food borne hazard of microbial origin in Meghalaya.

- **Epidemiological study on GIP infections in pig, cattle & goats of the area done :** Studies on overall incidence of gastrointestinal parasitic (GI) infections in goats revealed that the percent of positive animals against GI parasitic infections was 42.34%. Strongyle sp. (69.10%), *Eimeria* sp. (35.47%), *Strongyloides* sp. (28.30%), *Trichuris* sp. (10.07%), *Moniezia* sp. (5.99%) and *Nematodirus* sp. (0.083%) were detected in faecal samples of infected goats. In case of pig, the overall incidence of GI parasitic infection was 33.24% during the period under report. The predominat GI parasites present in the faecal samples of pigs were Ascaris (49.78%) followed by Strongyle sp (43.37%), *Eimeria* sp. (36.52%), *Trichuris* sp (11.89%) and *Strongyloides* sp. (7.69%) and *Stephanurus* sp. (0.08%). In case of cattle the overall prevalence of GI parasitic infection was 29.43%. Among the GI parasites, Strongyle sp. were predominant (68.73%) followed by Strongyloides sp.(27.63%), *Eimeria* sp. (26.42%),*Moniezia* sp. (17.09%), *Trichuris* sp. (6.90%) *Toxocara vitulorum* (4.14%) and *Nematodirrus helvetianus* (3.97%) in infected cattle.

AGRICULTURAL ENGINEERING

- Developed and modified farm tools and implements for hill agriculture including 4-row pre-germinated paddy seeder, cono-weeder, light weight power tiller with attachments, arecanut sheller, grass cutter attachments, seed drill for high slope conditions, pneumatic seed metering device and hand operated winnower and tested their adaptability.
- Complete methodology for agrifilm lining of water harvesting structure standardized and successfully replicated in three water harvesting structures at different locations.
- Studies on improving productivity of farming systems through rainwater harvesting in lined pond was completed. Based on the estimated annual costs and returns, internal rate of return (IRR) and benefit cost ratio (BCR) were computed as 67% and 1.53 respectively, which were found favorable for investment on plastic lined water harvesting tank integrated mixed farming systems.
- Hydrological studies of untreated agricultural hilly watershed and traditional bun system of cultivation was done. The sediment yield of 46 to 87 t/ha in traditional bun cultivation practices, 21 – 23 t/ha in agricultural hilly watershed with nutrients losses: N: 30 kg/ha, P: 0.28 kg/ha, K: 25 kg/ha, OC: 700 kg/ha was observed. Graded bunding at 1 m vertical interval along with water harvesting tank reduced sediment yield by 75% from watershed.
- Biodegradable plastic mulch took 40 weeks for full degradation in mid hill conditions of the region with 6-11% increase in yield of broccoli and tomato.
- Standardized the composition of beehive charcoal briquettes produced from the charcoal of locally available biomass viz, forest and agricultural wastes. Briquettes were characterized for heating value, burning rate, drying rate and emissions. The beehive briquetting mold was modified ergonomically to increase the production efficiency.

SOCIAL SCIENCES

- The economic assessment of different cropping systems revealed that ginger based cropping system gave the highest returns per rupee investment, followed by soybean based cropping system. However, there is a scope to enhance the income by identifying and adopting improved and suitable varieties for different cropping system.
- The impact study on improved technology of horticultural crops demonstrated under technology mission, KVKs, Extension departments revealed that among all horticulture crops Megha Turmeric 1 was widely accepted and found to be more economical. The SHGs also emerged and started business on turmeric and ginger.
- Study on marketing of horticultural commodities under different supply chain revealed that marketing efficiency of passion fruit and anthurium flower could be increased to 125 % if routed through Public-Private Partnership mode. Establishment of processing unit near the producing area, formation of more Grower's Association/ Societies or Organization for specific crops to explore backward and forward linkages.
- Participatory Technology Development (PTD) programme on seed village concept was introduced in the study area with the distribution of upland rice varieties like Bhalum 1 and 2, and lowland variety, Shahsarang to the farmers. Under this project a large quantity of seeds were produced and arrangement was made for buyback system.

SIGNIFICANT ACHIEVEMENTS OF REGIONAL CENTERS:

ARUNACHAL PRADESH

- Out of 180 rice germplasm collected, 18 accessions were identified as best performer for yield and other yield contributing traits for the *jhum* land. The highest grain yield was recorded in SARS-1 (4400 kg/ha) followed by Jarli, Kimin (4000 kg/ha) and Bamtare (3750 kg/ha). All the identified rice germplasm accessions were also characterized according to DUS Testing guideline of PPV&FR Authority (Govt. of India) for further germplasm registration purpose
- Out of eight varieties of Tapioca (H-97, H-165, H-1687, H-226, Sree Jaya, Sree Vijaya, Sree Rekha and Sree Prakesh) grown, the yield was recorded higher on Sree rekha (35.5 q/ha) followed by H-1687 (32.30 q/ha) and H-226 (32.0 q/ha). The lowest yield was recorded on var. Sree jaya
- Out of forteen varieties of colocasia evaluated, the highest yield was recorded in APTC5 (16.17 t/ha) followed by muktakeshi (15.17 t/ha) and APTC1(15.03)
- The plant growth and yield parameters like fruits per plant (604.4), fruit wt (102.9 g/plant) was recorded higher with 50% recommended dose of fertilizer (RDF) + Pig manure (15kg) + Sunhemp (12.5%) + *Azotobactor* (20g) + PSB (20g). Highest fruit yield (63.8 kg/tree) was also recorded with the same treatment. Peel weight (31.09 g) and thickness (4.2 mm) were more with full dose application of NPK while segment weight (88.08 g) and fruit weight (114.4 g) were highest with Pig manure along with other nutrient sources.
- Among different combinations of rootstocks (six species of *Tanyum, C. volckamariana, C. latipes*, Trifoliate Orange, Rough lemon and Karna Khatta) and scions (four types of mandarin i.e. Khasi Mandarin, Nagpur Santra, Hill Mandarin and Sikkim Orange), *Citrus latipes* + Hill Mandarin attained the maximum plant height (2.75 m), root stock diameter (6.9cm) and no. of branches (16). Out of different rootstock - scion combinations, *Tanyum* + khasi mandarin produced highest number of fruits (232) after 9^{th} year of planting followed by *Tanyum* + Hill mandarin. Fruit drop (13.6%) was more in Sikkim Mandarin irrespective of rootstock however, highest fruit drop recorded in rootstock Volkamariana (15.8%).

- High density planting in Khasi Mandarin with a spacing of 3 m x 3 m, sprayed with 2,4 D 25 ppm recorded the highest fruit weight (113.06 g), size (5.1 x 5.9cm^2), segment weight (74.07 g) and also juice content (61.2 ml). On the other hand, highest acidity (0.83 %) was recorded in 2m x 2m spacing.
- To standardize maturity indices Taktir fruits (indigenous fruit) were harvested weekly interval starting from the second week of March to last week of April. It was found that tree comes to flowering in Oct-Dec. Fruit mature during April-May with tomato red colour when fully ripen and green at immature stage. Fruits harvested in the second week - third week of April were rich in quality with high TSS (11.5^0Bx), Juice content (19.4 ml) and more fruit weight (43.7 g).
- Five cane species were grown as intercrop along with 27 species of MPTs in 49 combinations showed *Anthocephalus cadamba + Ada* was observed as best in terms of basal girth (31.0 cm) followed by *Alnus nepalensis + Takek* (29.33 cm) and *Pinus khasiana+Takek* (26.33cm).
- Thirteen bamboo species were grown in 3 different spacings of 5m X 5 m, 6m X 6m and 7m X 7m, and found that clump circumference (m) is more in species of *B. cacharensis* irrespective of spacing. However, number of culms/clump is highest in *B. pallida* (52.0) in 7m X 7m spacing and *D. sahnii* (46.0) in 6m X 6m spacing and *D. hamiltonii* recorded 43.0 in 5 m X 5m spacing.

MANIPUR

- Four promising high yielding genotypes of rice viz., RC maniphou-6, RC Maniphou-7, RC Maniphou-10 and RC Maniphou-11 were identified for Manipur region. Two germplasm viz., RCM-23 and Phougak as a source of neck blast resistance and multi-spikelet's in single cluster, respectively were registered in NBPGR, New Delhi in 2011.
- Two hundred forty germplasm of rice collected from Manipur, Nagaland and Arunachal Pradesh are maintained in the centre.
- About 100 indigenous rice germplasm collected from different parts of Manipur and Nagaland are being maintained in the centre.
- Insect resistant pigeon pea line has been developed by wide and interspecific hybridization.
- Two tomato varieties viz., Selection 9A [RC Manikhamenashinba- 1] have been developed. RC Manikhamenashinba- 1 has been released by the state variety release committee, Govt. of Manipur in October 2012 andSelection 11 is in pipeline for release.The variety, RC Manikhamenashinba- 1 is tolerant to leaf curl, bacterial wilt, fruit borer and cracking.
- One advance breeding line of brinjal, RCMB-10 has been developed. RCMB-10 is moderately resistant to bacterial wilt with a potential yield of 32.40 t/ha. The line has been proposed for inclusion in the AICRP (V).
- Three high yielding clones of colocasia have been developed from a large population of local germplasm of which RCMC-3 was found to be the best in terms of yield (32.66 t/ha).
- One high yielding clone of turmeric (RCMT-7) has been developed, having yield potential of 30 t/ha and 8.5% curcumin content.
- Low cost drip irrigation technique has been standardized for cauliflower.
- The protocol for spray drying of passion fruit (*Passiflora edulis*) and Sohiong, *Prunus nepalensis* has been standardized to ensure maximum powder yield including storability.
- Low cost storage unit, RC Storage Bin (a prototype of bamboo iceless refrigerator) has been developed for storage of fruits.
- A total of 23 diarrheic faecal/ rectal swabs were collected from Aizawl and Kolasib district. Out of 23 numbers of faecal samples 22 strains of *E.coli* and 1 Salmonella is isolated.

MIZORAM

- Integrated nutrient management practice in groundnut (FYM 10t/ha + BF + NPK 40:30:20 kg/ha) was found to improve the soil fertility with a pH of 5.9; organic carbon content of 1.5%; available N, P & K content of 216.0, 16.0 and 240.0 kg/ha, respectively
- Maintenance of 2 suckers/plant of cv. Giant Cavendish at 3×3 m spacing and application of NPK @ 300:100:300 g/ plant are the best to realize the yield potential.
- Double row planting system (0.4×0.6×0.9 m) of pineapple cv. Kew gave early flowering and 10-20 % more yield than other planting system.
- The cabbage variety KGMR-1 has highest the productivity. The best time for transplanting cabbage was found to be 1st December followed 13th November and 18th December. The application of vermicompost @ 7.5-10 t/ ha along with fertilizer NPK @ 25-50:15-30:15-30 kg/ ha gave highest yield in cabbage.
- The yield of green chilli was recorded highest for BSS-782 followed by Tejasiwini, Mahima and Pusa Sadabahar. The cultivation of Naga chilli in net-house under 50 % shade increased green fruit weight and fruit yield as compare to open conditions.
- Megha Turmeric-1 containing higher curcumin content (6-7 %) showed better yield potential.
- The incidence of clinical and sub-clinical mastitis in cows was studied in 14 different farms in Mizoram. A total number of 69 animals were examined using modified California mastitis test (MCMT) and 12 animals (17.39%) were found positive for sub-clinical mastitis. Out of 69 numbers of animals examined using modified California mastitis test (MCMT) 7 animals (10.14%) were found positive for clinical mastitis. Out of 19 positive samples staphylococcus (16), *E.coli* (6) and streptococcus (4) organism were isolated.
- Twenty two (22) numbers of *E. coli* strains were subjected to antibiotic sensitivity and the isolates were sensitive to gentamicin, norfloxacin (76.92%) followed by enrofloxacin, cephotaxime and all the isolates were resistant to - cloxacillin, nitrofurantoin, ampicillin, amoxycillin and sulphomethaxazole.
- Results of soil analysis revealed variations in mineral content among different districts. The calcium content of the soil ranged from 17.73 to 41.58 ppm, while phosphorus content ranged from 4.30 to 9.38 ppm. based on the critical levels reported for soils, it was observed that the soils of the study area were classified as below critical level for Ca, P and Mg.

NAGALAND

- Package of practices for organic production of wonder rice along with its breeding programme was developed
- Method and time of propagation of Assam lemon was standardized.
- Organic farming practices were developed for tomato, cabbage and sweet potato
- Package of practices for banana were developed for Nagaland conditions.
- Superior quality of pig germplasm was produced and distributed to the farmers. Comparative study on productive and reproductive traits were done and Large Black cross pig was found the most suitable for backyard farm.
- Superior quality poultry bird of Vanaraja and Gramapriya varieties were produced and distributed to the beneficiaries in Nagaland, Arunachal Pradesh, Assam and Meghalaya.
- *Axone* was found to have prophylactic effect against piglet diarrhea, but had no significant effect on humoral immune response against *Salmonella choleraesuis.*
- Mrs. Alemla Theriah (An adapted farmer), received Jagjivan Ram Abhinav Kisan Puruskar 2010 (Zonal). She was trained by KVK, Dimapur, ICAR Nagaland centre.

- Mrs. Veikhochong Misao (An adapted farmer) received the Best Farmer Award during the North-East Zone Regional Agri Fair 2010-11.

TRIPURA

- High yielding (5.9 ton/ha) rice variety, TRC-2005-1 (Pyzum x BPT 5204) and direct seeded variety, TRC-87 -251 (Ngoba x Garomality) have been developed.
- About694 Front Line Demonstrations were conducted on Mungbean, Urdbean, Fieldpea, Lentil and Rajmash. Varieties used for Demonstrations are:Mungbean: Samrat & Meha, Pusa Vishal, Hum –12, HUM –16, TMB –37, Pant M – 4,Urdbean: Uttara, Pant U 31,Lentil: DPL 62, DPL 15.Fieldpea: HUDP-15, TRCP-8(Released from Tripura by CVRC), Rajmash: PDR -14
- Introduced high yielding groundnut variety like ICGV-86590, ICGS76, GG-20 and GG-7 (18 to 20 q pod/ha), Toria (TRC-T-1-1-5-1) having an average yield of 893 kg / ha in 73 days and sesamum (TRC-til-1-8-1-1) having an average yield of 1340 kg/ha) in 85 -90 days.
- Developed papaya variety (Ambasa local x Honey Dew) tolerant to ring spot virus producing 55 kg fruit /plant and this variety of papaya is introduced in large numbers.
- Introduced Soil Health card to evaluate the soil fertility status and its use for fertilizer recommendation in production of various crops.
- Introduced agroforestry based farming systems through NABARD and NAIP interventions.
- Introduced SMS service for dissemination of agro-met advisory services among the farming community.
- Introduced cross bred pig (Hampshire x Khasi local) having a capability to produce a body weight of 100-110 kg in a period of 1 year.
- Introduced backyard poultry through imparting training and supply of DOC and 6 week old poultry birds of Gramapriya and bird having a cross between Delham red with Tripura local.
- Introduced composite fish culture with self recruiting fishes and Pig cum fish culture mainly through KVK in South Tripura.

SIKKIM

- Two high yielding green seeded black gram (urd) selection named as PD-3 (selection from local cultivar, *Pahenlo dal* and PD-1 (cross derivatives of *Pahenlo dal* x B local) were evolved.
- Developed 2 high yielding strains in yellow sarson, provisionally named as SSY-1 and SSY-2 (SSY=Sikkim Sarson Yellow). Two strains in brown sarson, designed as SSB-1 and SSB-2 (SSB=Sikkim Sarson Brown), 2 strains in toria coded as SKMT-1 and SKMT-2 (SKMT=Sikkim Toria) and 2 strains of Rai sag
- Developed trunk borer management practices in citrus viz., cleaning of infested plants and insertion of iron wire to kill the larvae followed by Bordeaux paste and insertion of cotton soaked in petrol or kerosene to the holes and plastered with mixture of soil and cow dung are highly effective
- Mass multiplication of planting materials (20000 no's) by means of cutting in Patchouli and separation of rooted slips in *Citronella* and Lemon grass was performed at ICAR farm. Base line survey completed covering 156 farm households of 25 villages.
- Fifteen units of vermicompost have been constructed at Passingdang, HE-Gyathang, Gor, Tingvong and Sudur Bringbong and demonstration of production technology of vermicompost had been done to the SHG. Ten vermibeds were also distributed to ten farmers of Lingdong and Passingdang for production of vermicompost.
- *Escherichia coli*, *Staphylococcus aureus*, coagulase negative staphylococci, *Micrococcus* spp., *Streptococcus* spp.and *Bacillus* spp were isolated from clinical and subclinical cases of mastitis.

E. Coli were serotyped as O13, O132, O88, O26, O162, O86 and O157. Serotype O157 was first time isolated from samples of animal origin in Sikkim.

- *Salmonella* spp, resulting in an overall incidence of 12.5% were isolated from foods of Animal origin. Antibiotic sensitivity testing of isolates showed significant resistance among the isolates. Most effective antibiotics were Colistin, Gentamicin and Ciprofloxacin
- A total of 32,128 animals were examined under All India Network Programme on Gastrointestinal Parasitism and overall prevalence of helminthic infestation was found to be 39.94%. Preparation of Bioclimatographs of *Haemonchus contortus* and *Trichostrongylus* spp. in Subtropical and highly humid zone of Sikkim was done. Correlation of mean epg and prevalence of GI-Helminthic infection with meteorological data was done. *Nematodirus* spp. of goats reported for the first time from Sikkim in India.
- *Under the project -Sustainable Utilization of Mountain Fisheries Resources – A Partnership Mode* the fish germplasm availability was studied and the dominant fish species in Teesta and Rangit tributaries came out to be S*chizothorax spp* (Asala), *Neolissocheilus spp* (Katley), *Garra spp* (Buduna), *Pseudecheneis spp* (Kabrey), *Barilius spp* (Chirkay), *Semiplotus spp* (Chepti). Ornamental species available are Barilius *bendelisis bendelisis*, *Barilius vagra*, *Danioaequipinnatus*, *Danio naganensis*, *Garra lamta*, *Noemacheilus scaturigina* and *Noemacheilus sikkimensis*. However a declining trend has been noted in fish gemplasm.
- *Under* Poultry Seed Project -Establishment, Production and dissemination of day old chicks from ICAR-NEH- Sikkim centres was established and at present the poultry unit is maintaining parent stock for continuous supply of hatch able eggs and supplying day old chicks. The unit has established itself strongly among local poultry farmers.
- The reproductive and breeding behavior was studied in Sikkim local Yaks under Conservation and Multiplication of Yak(*Poephagus grunniens*) using Assisted Reproductive Technologies .

TECHNOLOGIES EMERGED AND DISSEMINATED IN FARMERS FIELD

- A total of 50,000 farmers have been covered annually during last five years under technology transfer including demonstrations, distribution of inputs of high yielding crop varieties, livestock breeds with health care, training to trainers and farmers in the entire NEH region under various programme such as NAIP, TSP, NHM, NICRA, FPARP, Institute programme etc.
- SRI and ICM method of rice cultivation have been introduced in Dhalai (Tripura) and South Garo Hills (Meghalaya). Cost of Cultivation was on an average Rs. 21,500.00/ ha with gross income of Rs. 35,500.00/ha and net Income 14,000.00/ ha. A total of 1200 farmers were benefited.
- About 500 hectares of lowland rice fallow areas have been brought under zero tillage *toria* (Var. M 27) in Tamenglong (Manipur).The practice conserved soil moisture and required less irrigation water, saves tillage cost and the soil is protected from erosion due to the retention of surface residues
- About 75 demonstrations were conducted on zero tillage pea, lentil and *toria* in low land rice fallow in different villages of Ri-Bhoi District and Garo Hills of Meghalaya. The average productivity of green pea and lentil under demonstrations were 5 t/ha and 1 t/ha, respectively. Farmers shown keen interest in adopting the technology.
- A total of 165 demonstrations on various aspects of rainwater harvesting and efficient recycling such as *jalkund*, roof water harvesting, raised and sunken bed technologies, multiple use of water, system of rice intensification, in-situ soil moisture conservation were conducted in

farmers field during 2007-11. The water productivity under raised and sunken bed enhanced by 5 times (0.69 kg/ha/mm) compared to farmers practice of rice monocropping (0.19 kg/ha/mm).

- Introduction of *Jalkund* leads an integration of different component in IFS in which water productivity has increased by three times. Around 200 number of *Jalkund* have been constructed in different parts of NEH region. The cost of harvested water worked out at Rs 0.07 per litre considering 3 years life span.
- Improved varieties of rice (RCPL 1-87-8) yielded 2.5 to 3.0 t/ha as compared to the yield of local variety of rice, which was 1.0 to 1.5 t/ha. Introduction of improved varieties of rice and maize along with new crops such as French bean, Groundnut, cabbage, cauliflower and broccoli led to increase in cropping intensity from 100 to 165 % in two years in the watershed.
- 11 rice varieties has been released (10 by SVRC and 1 by CVRC) during 2007-12 for lowland (pre-*kharif, Kharif* and boro), upland and high altitude areas in addition to 10 varieties released by the Institute earlier. About 40% rice area in Tripura, 35% in Meghalaya and 50 % area of Manipur are under different rice varieties released by ICAR.
- Turmeric variety developed by the institute had a positive impact on increasing the production and productivity across the region particularly in Meghalaya and Nagaland states. During 2010-11, about 1500 q of Megha Turmeric-1 seeds were produced through different SHGs of Ri-Bhoi district of Meghalaya and all the seeds were further distributed in 14 districts of NE India for cultivation.
- A total 1894 ha area was treated with soil conservation measures (contour bunding, bench terracing, contour hedgerow, silt retention tank/ water harvesting pond and drainage line treatments etc.) and improved hill farming technologies.
- Training on mechanization and manufacturing of agricultural implements for local village artisans were conducted to increase farm mechanization level and implement manufacturing in the region.
- The impact of the AI technology was analyzed in term of production, productivity, profitability and sustainability. The upgraded pigs obtained through AI weigh double the weight than the local non-descriptive pigs and yield higher number of piglet per delivery, resulted in improved productivity and provided higher economic return/pig/year, besides the farmers saved mating cost (Rs1000-1500). Therefore, 80% of tribal farmers adopted the artificial insemination technology in pigs in the selected villages and the farmers were highly satisfied with this technology. Skilled AI personnel (inseminators) produced through training of unemployed youth ensured continuity of the programme with less dependency on the government machinery for timely insemination at farm-gate level with affordable cost, thereby generated self-employment opportunities besides enhanced pig production and productivity.- Impacts Section
- To assess the incidence of reproductive disorders in dairy cattle, survey has been conducted in RiBhoi, East Khasi Hill, East Garo Hill, West Garo Hill and South Garo Hill District of Meghalaya. Based on gynaecological examination of cows and reproductive history, animals were classified into normal cyclic/ pregnant, repeat breeder, anoestrous and infertile. Out of 492 animals screened, 136 (27.64%) showed reproductive disorders. These cases were further divided into different categories (table 6). Maximum incidence was found to be of repeat breeding, which comprised of 43.28% of the total reproductive disorders. Incidence of anestous was next to the repeat breeding i.e. 33.90 %. Other reproductive disorders recorded were retention of fetal membrane (15.44%), abortion (2.20 %), pyomettra (2.94 %), vaginal prolapse (1.47 %), dystocia (2.20 %) and mummified fetus (0.07 %) respectively.

Supply of breeder/certified seeds

The institute produced breeder seeds/certified seeds of rice on an average of 20 tonnes/year. There was sharp increase in breeder seed production of rice and maize during 2010-11 & 2011-12 (38 tonnes).

Seeds and planting materials distributed

Production	2010-11	2011-12	Total
Rice (t)	45.7	52.5	98.2
Maize (t)	15.62	48.0	63.62
Groundnut (kg)	1150	2100	3250
Soybean (kg)	100	350	450
Redgram (kg)	2400	50	2450
Rapeseed (kg)	1800	1850	3650
Ginger (t)	51.38	65.90	117.28
Turmeric (t)	14.11	29.0	43.11
Potato (t)	15.0	26.0	41
Goat kid (no)	390	400	790
Piglets (no)	1767	1672	3439
Rabbit Kid (No)	480	450	930
Poultry birds (no)	119077	137233	256310
Fingerlings (no) 23950	224250	252000	476250
Mushroom spawn pkts (200 g/pkt)	31600	34900	66500

Note : Quality Protein Maize such as Vivek QPM 9, HQPM 1 cultivation was introduced for the first time in 2009 in hill region. With the seed distributed by the complex (Hq & Centres) about 15 % area under maize was brought under QPM and productivity enhancement of about 7 to 12 % was recorded in farmers field (as all the varieties were single cross hybrids).

National Initiative on Climate Resilient Agriculture (NICRA)

Brief achievements of research and extension activities under different themes have been summarized as follows:

Theme I: Identification of temperature tolerant Rice and Maize varieties for NEH ecosystem

- Six hundred rice genotypes were screened for high temperature tolerance at early vegetative stage, out of which genotypes showed tolerance to high temperature (45ºC).
- One hundred thirty four (134) Maize genotypes were screened for high temperature tolerance during germination stage; 5 genotypes exhibited tolerance to high temperature (50ºC).
- Drought screening of the maize genotypes tolerant to high temperature was also undertaken. RCPL 1-132 showed highest relative water content (60.01) after 27 days of withdrawal of watering. Other two drought tolerant genotypes were RCPL 1-136 (RWC 48.58) and Deku (RWC 45.11).
- Screening for submergence tolerance of rice genotypes revealed that among the hill rice genotypes, RCM -9 possess medium degree of tolerance (up to 13 days of full submergence).

Theme II: Assessment of mitigation potential through SWM practices for enhancing climatic resilience

- The results of the long term trial (2006-2011) on tillage and residue management in rice-pulse system showed higher build up of SOC under zero tillage. Application of crop/weed biomass with 50% NPK resulted in substantial improvement in SOC.
- SOC build up under tillage residue management studies (2006-2011) in Maize-toria system showed increased crop productivity and higher SOC under zero tillage along with moisture conservation practices (Maize stack cover + Poultry manure 5t/ha + Ambrossia (5 t/ha) in 0-15 and 15-30 cm soil depth.
- Development of techno-socio-economic evaluation of environmentally compatible rainwater harvesting mechanism with focus on water quality and multiple uses has been initiated.
- The collection and validation of ITKs on SWC measures has also been undertaken in Arunachal Pradesh
- Study on production and characterization of boichar and its effect on soil properties has also been undertaken.

Theme III: Understanding the unique traits of indigenous Pig and Poultry which make them resilient to climate change and development of database

- Unique traits of disease resistance and adaptation to adverse climatic condition were identified in local pig and poultry germplasms and the detailed investigation on these traits are under progress.
- An epidemiology of bacterial and viral disease of pig and poultry was investigated by passive surveillance and correlation of meteorological data and disease incidence reveals high disease occurrence in pig and poultry during summer and rainy season.
- Similarly, positive correlation between parasitic disease incidence and high rainfall was found, while the incidence of Ranikhet disease was found higher during post-rainy season.
- In fisheries, the acceptance of the feed and growth enhancement of common carp was significantly higher at elevated water temperature (30ºC) as compared to low temperature ((20ºC). The Critical Temperature max (CTmax), Lethal Temperature max (LTmax), oxygen consumption rate and glucose level was significantly increased with increasing acclimation temperatures in Chocolate Mahseer. However, fish undergoes severe stress at temperature ranges of 27 ºC- 30 ºC in the region.
- A total of 15 ITKs are documented for treatment of various livestock and poultry disease in the tribal region of the North Eastern India.
- Investigation on development of different housing model for physiological adaption and mitigating climatic effect, effect of elevated temperature on embryo quality, conception rate and thermo-stabilization of gametes, vaccine and cell culture are under progress.

Theme IV: Technology demonstration

The following technologies were demonstrated in farmers' field:

- Introduction of upgraded pig variety with scientific method of rearing,

- Introduction of Improved breeds of goat with scientific methods of rearing
- Backyard poultry production with improved Kuroiler chicken germplasm,
- Crop intensification in rice fallow through zero tillage of lentil, pea and rapeseed,
- Scientific cultivation of potato, tomato, cucumber and capsicum with emphasis on offseason production
- Low-cost vermi-composting for organic manure supplementation.
- Demonstration of rain water harvesting structure such as farm pond, *jalkund* etc. have been under taken benefiting 510 farmers. Inputs such as Silpouline, pipes, water pumps have been distributed.
- About 200 fish farmers were given demonstration on scientific fish farming practices.
- Demonstration and distribution of farm implements and tools for hill agriculture benefited about 421 farmers.
- About 13600 farmers across the region have been covered under various activities of NICRA.

To popularize climate resilient production technologies, 'Rice Day" was organized on 17th October, 2011 at Umiam; a seven days farmers' training programme on 'Climate Resilient Agriculture' was organized at Nongthymmai Village during 16-22 January, 2012; a two days farmers' training cum field day on zero tillage pea, lentil and toria in rice fallow was also organized at, Umiam, during 20-21st March 2012;an eight days training programme on 'Carbon management in Agriculture for mitigating greenhouse were organized during 1-8 February, 2012. In Tripura, rural poultry production-training and distribution programme was organized for training and distribution of pig and poultry among some members of Self Help Group and Farmer's Club. On March 26, an awareness programme for the tribal farmers on "Climate Resilient Agriculture" was organized at Nongpoh in Ri-bhoi district of Meghalaya in collaboration with the Farmers Economic Development Agency (FEDA). The programme was attended by more than 2000 farmers from across the region. They actively interacted with the scientific personnel and acquired information on different aspects of climate change and possible methods of its mitigation and adaptation in the region.

KIRAN
(Knowledge Innovation Repository of Agriculture in North-East)

KIRAN has been established as a single window agri-information delivery system for the stakeholders in the north-east.

The work is contemplated in three phases; each phase would be of two years duration. The work aspects to be accomplished in each phase are mentioned below:
Phase I- Development and building up of web portal at the central access terminal, ICAR RC for NEH Region, Umiam. Retrospective data mining and upload after digitization.
Phase-II- Development of the network dynamics and establishment of peripheral access terminals with data integration capabilities.
Phase III- Interactive enabling of created database to respond to need based queries of the farming community through latest IT techniques.

Tasks Completed and work accomplished during 2012-2013

1. Designed and hosted the website under the assistance and technical support of NIC Shillong. The server facility has been housed at the State Information facility, NIC and has a 24x7 hour security and service back up with cloud computing facilities.
2. Web access was enabled after design of the web page and preliminary content uploading completed. The site was available online at www. kiran.nic.in from June 16th, 2012
3. Data collation and collection of publications relevant to agricultural issues of the north east are being complied and uploaded periodically.
4. Lists of financial institutions along with links to the nodal agencies have been uploaded.
5. Health calendars, vaccination schedules and crop calendars have been uploaded.
6. An inventory of SMS advices month wise has been compiled and a farmer tracking system of agricultural advisory for specific commodities has been finalized. Modalities for launching the SMS service, "Kiranews" is now complete and is at the final stages of encryption security clearance at the NIC, New Delhi. The service is likely to be launched by the end of April 2013.
7. The SMS service includes farmer registrations, locator specific services, agromet advisory upload and broadcasts, tracking services and a helpline facility with possible VOIP applications.

Tasks to be completed

- Design a portal that would incorporate information under multiple heads and would be updated regularly.
- Identification and orientation of the linkage partners regarding concept, methodology and functions of KIRAN.
- Data mining for uploading all available agricultural information in the designed format.
- Creating links for gathering data and updating region specific information.
- Setting up a stable portal with functional linkages and maintaining the same in terms of updating information and enabling linkage functionality.
- Deploying the portal created to address farmer specific queries and utilizing the portal for addressing or facilitating farmer level queries. The portal would be interactive and dynamic at this stage.

B-4. NRC ON YAK, DIRANG

Yak, the hairy bovine of snow covered high altitude had long linkage with the mankind inhabiting in the remote mountainous regions of India, Bhutan, China, Mongolia and other parts of central Asia. It is a multipurpose animal, and provides milk, meat, fibre, hide and dung. The yak is also used as pack animal for the transportation of household goods and also for riding. Although yaks are being used for long by the people living in very remote areas of the high altitudes of Himalaya, the information on various aspects of yak husbandry is very meager. Realizing the importance of this animal, Indian Council of Agricultural Research had established National Research Centre on Yak in 1989 at Dirang, West Kameng District of Arunachal Pradesh for improvement of this species through scientific breeding, feeding and management. Yak husbandry facing newer challenges because of impending climatic changes which influence on the performance of animals, and the National Research Centre on Yak (NRCY) had attempted to deal with researchable issues with due care and attention since its inception with well planned systematic study. NRCY could mark the beginning in devising different technologies pertaining to *in-situ* and *ex-situ* conservation through application of reproductive biotechnologies, like Artificial Insemination (A.I), Embryo Transfer Technology (ETT), and taking appropriate scientific measures like nutritional intervention, management practices, establishment of high land pastures etc. Due attempt has also been made to commercialize the yak products technology, like designer paneer etc.

During the last one year under DBT sponsored project significant achievements were made in respect of in vitro production of pure yak embryos up to blastocyst stage and yak hybrid embryos up to morula stage, and few blastocysts and morula were transferred to recipient yaks. Another achievement of the Institute is management of growing yaks at *Mandala* village (10,000 ft above msl) belonging to 'Brokpas' by nutritional intervention in winter months. Many 'Brokpas' were convinced that in winter months also optimum production can be maintained by low cost technology developed by the Institute. Hence, all the research and extension programmes pertaining to yak husbandry conducted by this centre have been aimed for nutritional security and economic upliftment of farmers, and to make the yak husbandry sustainable for the highlanders.

SALIENT ACHIEVEMENTS OF THE INSTITUE:

Livestock Improvement:

- Genetic characterization of yaks for morphological and productive traits indicated high genetic variability in production and reproductive traits. Five types of yaks have been identified based on phenotypic characteristics. Selective breeding is being carried out to improve the performance of yaks.
- Study was conducted on growing yak calves for 112 days revealed that, feeding of paddy straw based complete feed block (CFB) (40% paddy straw, 21% maize grain, 5%, wheat bran, 16% mustard cake, 12% groundnut cake, 3% molasses, 2% mineral mixture and 1% common salt) was found to improve in economic traits compared to yaks allowed for free grazing during winter season. To study the effect of plane of nutrition, four types of ration and average daily gain and feed conversion efficiency was the highest in yaks fed on high protein-high energy ration.
- Ante-partum administration of vitamin E and selenium in yaks was found to reduce the time of placental expulsion, calving abnormalities, increased neonatal birth weight and reduced calf mortality compared to untreated yaks. Area specific mineral mixture formulation for yak feeding is prepared with zinc (Zn), copper (Cu), cobalt (Co) and manganese (Mn) in the ratio of 40:20:2:1. Optimum performance with economic advantage was achieved in growing yaks on feeding Complete Feed Block supplemented with limiting micro-nutrients.

Reproductive Management:

- Cryopreservation of yak semen has been sedenterized and AI is successfully practiced. ETT in yaks has been standardized, and a calf by ETT was born at the Centre for the first time in the World. Yak and yak hybrid embryos could be produced in vitro up to blastocyst and compact morula stage, respectively, and cryopreserved by vitrification.
- A study was conducted to find out relationship between postpartum metabolism and resumption of ovarian activity in female yaks. Postpartum yaks were examined twice weekly by ultrasonography, starting from 4 weeks post calving until the onset of cyclicity. It was observed that, follicular development and growth started in early postpartum and incidence of ovulation of first dominant follicle was low. However, follicular cyst was observed in 15% animals on day 28, 49 and 112 post calving, respectively.
- Ultrasound guided ovum pick up (OPU) has been standardized in yaks and percentage recovery of A and B category oocytes was 59.09 and 22.73, respectively, with an average oocytes recovery of 1.47 per animal. Maturation of oocytes was found to be 71.43% with subsequent in vitro fertilization rate of 42%, using *in vitro* capacitated yak frozen sperm, which gave cleavage up to the stage of morula and blastocysts. Embryos were further cryopreserved and subsequently two of them were transferred to suitable recipients.

Molecular Dissection:

- Two different single stranded conformation polymorphism (SSCP) phenotypes of toll like receptor 2 (TLR2) were identified on the basis of band sharing index. Presence of polymorphism in these relatively conserved domains of genome seems to be significant because earlier studies revealed that, Indian yaks showed considerable monomorphism in other candidate gene loci.

Animal Health:

- First global report of cutaneous papillomatosis in yak has been confirmed through sequence information of proviral partial gene for capsid protein. *Mammomonogamous laryngeus* affects ruminants and human being as well. An egg of this parasite has been identified for the first time in Indian yak during coproscopy. Average arsenic (As) concentration in water in various spots of West Kameng district of Arunachal Pradesh were below permissible limit as per national standard (50 ppb) but higher than that of World Health Organization (WHO) standard (10 ppb).

Extension Activity:

- An awareness camp on "Benefit of Synchronization of Ovulation and Fixed Time Al" organized at *Lubrang - Brokserthung* village, West Kameng district, Arunachal Pradesh. A total of 15 yak rearers participated in the training programme on 8th May, 2011. An extension-cum-animal health camp was organized at *Lubrang-Brokserthung* village, West Kameng district, Arunachal Pradesh. More than 250 yaks, yak-cattle hybrids and hill cattle were treated during the camp on 13'" May, 2011.
- A three days campaign entitled "NRC on Yak at Brokpas Door Step" was organized at *Sela, Bangajung, Mirba, Mukto, RA-3* and *Jawantgarh* area of Tawang district. During this campaign more than 300 yaks and yak-cattle hybrids were treated and yak rearers were made aware about the "Scientific Yak Rearing" and Innovations of scientists of NRCY from 4th to 6'" July, 2011.
- One day Farmers Training-cum-Field Demonstration Programme on "High Altitude Pasture Development and Fodder Conservation" was organized. A total of 21 yak rearers took part in this training programme on 14th July, 2011.

- An animal health camp was organized at *Mouteng* grazing ground, Tawang. More than 300 yaks and yak-cattle hybrids were treated during this camp. This camp was organized with the help of Nguiphoo Charitable Society on 14`h July, 2011.
- An extension-cum-animal health camp was organized at Misopsa, Mandala. More than 300 yaks and yak-cattle hybrids were treated for various ailments on 11"' November, 2011. "Stakeholders meeting" was held on 10th January, 2012. A total of 18 farmers from Arunachal Pradesh and 3 farmers from Sikkim participated in the meeting. An extension-cum-yak health camp was organized at Nyanphoo, Mandala on 1st February, 2012. Around 100 pure yaks were treated for various diseases. Besides these, yak rearers were made aware of various scientific methods of yak rearing.
- NRCY participated in the North Eastern-Agri Fair at Assam Agricultural University, Khanapara, Guwahati from 10th to 13`h February, 2012. NRCY participated in the "Know your Army Mela" at Jung, Tawang district of Arunachal Pradesh on 26"' February, 2012. Farm innovators day was organized. A total of 69 farmers from different places of West Kameng and Tawang districts of Arunachal Pradesh participated in this auspicious occasion from 3rd to 4th March, 2012. NRCY participated in" Know your Army Mela" at St. Lopon Stadium, Dirang from 10 to 11th March, 2012. Training on "Scientific Husbandry Practices for High Altitude Animals" was organized. A total of 65 yak rearers participated in this training programme from 16-18th March, 2012.
- Training-cum-demonstration conducted for first aid approach for yak and yak herders. A total of 44 yak rearers participated in this programme on 19th and 25th March, 2012. A farmers training on "Scientific Dairy Farming" was conducted at Mahadevpur, Lohit district, Arunachal Pradesh in collaboration with KVK, Lohit district and Animal Husbandry and Veterinary Department, Government of Arunachal Pradesh. A total of 41 farmers participated in this programme from 21- 23rd March, 2012. Training programme on "Scientific Feeding and Managemental Practices for High Altitude Animals" was conducted at NRC-Yak, Dirang from 23rd to 25th March, 2012. A total of 32 yak rearers participated in this training programme.
- Two days training programme on "Awareness about Zoonotic Diseases" was conducted at NRCY, Dirang from 24th to 25th March, 2012. Three days training programme on "Disease Management of High Altitude Animals" was conducted in the Tawang district of Arunachal Pradesh in collaboration with Nguiphoo Charitable Society. A total of 42 yak farmers participated in this training programme from 27th to 29th March, 2012.
- A "Capsule training on Yak Milk and Hair Product for Tribal Women" was conducted on 28th March, 2012 at NRCY. A total of 51 tribal women participated in this programme. Field demonstration on urea ammoniation of paddy straw and high land pasture development was conducted at Lubrang village on 31st March, 2012. A total of 23 participants attended in this programme.
- KVK, Lohit under NRC-Yak has made front line demonstration (FLD) on Duck-cum-Fish Culture, Soil nutrient management, High Yielding Varieties on Broccoli (HYV Broccoli), and Oyster Mushroom. Duck-cum-Fish Culture has been popular and twenty five farmers self help groups from thirteen villages have been selected. Presently the package has become very popular and fish farmers are this integrated farming system. Soil nutrient management has been popularized among the farmers by the use of "Vermicompost". Farm school on integrated fish-cum-pig farming has been initiated and incontrovertible response is expected soon.

Publications and Presentations:

- A total of 44 research papers were published in Indian and foreign journals. Other major publications of the institute are: Book Chapters (10), Research Abstracts (19), EMBL-bank submissions (4), Popular/ Technical article (6), Leaflet/Folder (2), Training Manual (3), Newsletter (4) and Annual Report (2).

B-5. NRC ON MITHUN, JHARNAPANI, NAGALAND

Mithun (*Bos frontalis*) is considered to be an animal of special significance by the people of North Eastern Hill Region, which is the home tract of this magnificent animal. Found at an altitude between 300-3000 m (above msl), this animal is distributed in 4 North Eastern states of Arunachal Pradesh, Nagaland, Manipur and Mizoram. Beside India, this animal is also found in adoining countries like Bhutan, Bangladesh, Myanmar, China and Malaysia. The animal has a great potentiality for meat and milk under special climatic and topographic conditions and is integrally associated with the socio-economic, religious and cultural life of the tribal people of these states. It is also known to be a symbol of status prosperity and peace among the locals. This animal is largely dependent on the thick vegetation of the hilly terrains of north eastern states and its rearing by farmers is on the lines of loose housing system. Due to various biotic and abiotic factors viz. deforestation, disease outbreak, inbreeding and shifting cultivation, the population of this animal is dwindling, thereby causing serious concern for protection of this beautiful species by the ICAR and related state Govt. Departments.

According to Livestock Census 2007, the mithun population in our country is 2.64 lakhs out of which 2.19 lakh in Arunachal Pradesh, 0.33 lakh in Nagaland, 0.10 lakh in Manipur and only 1938 in Mizoram. This situation is very alarming and intensive efforts should be made for their conservation, preservation, propagation and genetic improvement of this unique livestock species of North Eastern Hill Region, where tribal population give great value for this animal.

The National Research Centre on Mithun (ICAR) has been in the service of this region for conservation, preservation and propagation along with genetic improvement of this animal and already started two conservation units in Nagaland in participatory mode apart from two existing mithun farms of the Institute. This Institute has also generated many technologies for their betterment of mithun husbandry practices and demonstrated value added products from mithun meat, milk and hide. Some of the important achievements of the Institute are highlighted in the following section -

Scientific/Technical Research Achievements of the Institute in XI Plan

- Superovulation protocol has been standardized in order to do embryo transfer in Mithun.
- First ever birth of Embryo Transfer Mithun calf in the world – "Bharat" on 27 March 2012 and "Mohan" born of 100-day cryo-preserved embryo on 12 May, 2012.
- Preservation of liquid semen of Mithun at refrigeration temperature has been standardized.
- First AI calves of mithun was born in 2006 using liquid mithun semen.
- Standardized the protocol for mithun semen cryo-preservation in liquid nitrogen and also standardized the AI protocol using frozen semen.
- Estrus synchronization protocols in Mithun standardized for fixed time insemination and implemented successfully at field level.

- Two AI calves of Mithun by using this protocol born in 2010 in village (field) conditions.
- The PCR based technique to detect Fertility Associated Antigen (HBP and Osteopontin) transcript in Mithun seminal plasma has been standardized
- Dentition patterns of Mithuns for determination of age under field conditions have been established.
- Cytogenetic screening and analysis of all the Mithuns in the Institute farm were completed.
- First ever R- and C-banded karyotypes of Mithun were prepared in this Institute.
- Characterization of kappa casein (milk protein gene) and leptin gene (gene controlling meat traits) has been progressed and a number of sequences being parts of these genes were sequenced and submitted to GenBank.
- Genetic polymorphisms were identified in Mithun kappa casein and Leptin genes and animals were genotyped based on these polymorphims.
- Morphometric (phenotypic) characterization of all four strains of Mithuns has been completed.
- Established the physiological growth pattern of Mithun of either sex. Myostatin gene found to inhibit body growth of Mithun.
- Study on physiological, hematological and biochemical parameters of Mithun under stress due to load carrying capacity has been assessed.
- More than 260 tree leaves/ shrubs available in NEH region of India for feeding of Mithun has been identified, chemically analyzed and nutritionally evaluated.
- Macro and micro minerals analysis were done in tree leaves / shrubs, soil samples and blood of animals.
- Area specific mineral mixture suitable for Mithus was developed based on the information generated by various studies in the Institute.
- The protein requirement of growing Mithun has been determined and was found to be lesser than cattle as per NRC requirement.
- Different types of feed blocks based on total mixed rations for Mithun were developed.
- Feeding of breweries waste (spent grains) in Mithun was found to improve growth rates and economized feeding cost.
- Important bacterial, viral and protozoan diseases identified in Mithun and control measures were evolved for some of the diseases.
- The hide of Mithun was compared with that of cattle and it was found that Mithun hides and its products were better as compared to that of cattle.
- Different leather products of mithun like jacket, shoe, portfolio bag, *etc* were prepared successfully as demonstration purpose and found to be of superior quaility.
- Isolation of alpha lactabumin and beta lactoglobulin fractions of whey protein and alpha, beta and kappa casein fractions of Mithun milk has been accomplished so far towards identifying bioactive properties of Mithun milk.
- Two locations were selected in Nagaland for establishing ONBS herd of the Mithun under participatory mode with the local tribal community in the native tract of Mithun and population survey has been completed.
- Technology developed in the Institute in feeding, breeding and health care has been implemented in the Mithun rearing areas for better Mithun husbandry practices.
- Technology Injection programme (Transfer of technology) like dissemination of scientific Mithun husbandry practices, conducting health camps for vaccination of important disease of Mithun helped to transmit the information to the farming community.

B-6. NRC, ORCHIDS, PAKYONG, SIKKIM

Crop Improvement

- All total 3860 accessions of orchids species, varieties and hybrids collected and conserved
- Molecular analysis of 10 *Vanda* species and 59 *Dendrobium* species completed using STM markers.
- DUS Test Guidelines of five orchid genera viz. *Cymbidium, Dendrobium, Vanda, Phalaenopsis and Cattleya* prepared using UPOV guidelines under PPV & FRA and out of these *Cymbidium, Dendrobium* and *Vanda* notified for registration .
- The hybrids NRCO-42 , H x B (*Cymbidium lowianum* x *Cymbidium* 'Show Girl') and *Epidendrum* characterized
- *In-vitro* clones of *Paph. venustum* and 1 *ex-vitro* clone of *Cattleya maxima*, 3 variants of *Coel. nitida*, 1 variant each of *Calanthe puberula, Eria spicata* and *Liparis bootanensis* identified
- NRCO –Coll-77 of Red Vanda and NRCO-42 registered through PGRC
- New hybrid lines identified from *Cym. lowianum* x *Cymb. tigrinum*

Crop Production

- Suitable standard, intermediate and miniature hybrids of *Cymbidium, Dendrobium, Vanda, Cattleya, Phalaenopsis, Oncidium, Mokara,* and *Aranda* identified for high and mid hills.
- Innovative method for propagation of *Cymbidium* through backbulbs
- Potting mixtures *of Cymbidium, Dendrobium, Vanda* and *Cattleya* standardized.
- Pre-harvest management practices of *Cymbidium, Dendrobium* and *Phalaenopsis* orchids optimized
- Under post-harvest management of *Cymbidium* orchids, two buds opened stage as best harvest maturity , 5% sucrose for 2 hours as best pulsing solution; 4% sucrose + 200 ppm salicylic acid for opening of tight bud, 1000 ppm CoCl2 for 15 min. for impregnation and 2% sucrose + 200 ppm 8-HQS recorded as holding solution for maximum vase life .

Crop protection

- Viral indexing of 30 Cym. Hyb. and 3 Den. hybrids done by ELISA technique
- RT-PCR of ORSV standardized and used for detection of ORSV from planting material
- Common weeds of orchids like *Drymaria cordata, Crassocephalum crepidiodes, Oxalis corniculata, Oxalis stricta* identified as hosts of CymMV and ORSV
- Ciprofloxacin hydrochloride (400 ppm) and tetracycline hydrochloride (1000 ppm) found sensitive against soft rot bacterium of Cymbidium orchids
- *Trichoderma viridae* showed antagonistic in vitro against orchid anthracnose
- Molecular characterization of orchid anthracnose done by PCR assay
- Neem oil 0.03 EC found effective against red spider mite and aphid on Cymbidium
- IPM module M-5 (tobacco extract 5%, neem oil 0.03% EC 5ml/l and bifenthrin 10EC 0.25%) showed effective against mite on Cymbidium
- IPM module M-3 (tobacco extract 5%, econeem 3000 ppm 2ml/l and imidacloprid 17.8 SL (0.003%) found rffective against aphids

RECOMMENDED VARIETIES AS PER ICAR INSTITUTES

Crop	Varieties
Cymbidium	San Francisco Stephenson, Stanley Fouraker White Magic, Soul Hunt, Yankilla, Show Girl, Red Star, Amesbury, Red Imperial Red Tower,. Tracey Reddaway, Angelia December Gold, Cannon Colour, Norella Jennifer Gail, Velvet Green, Hawtescens, Jungfrau Snow Queen, Volya Craig Sutherland, Miss Sanders, San Francisco Monalisa, Penneshaw Winter Flush, Jungfrau Dos Pueblos, Takarajoke, Concerto, H.C. Aurora, Red Beauty, 'Luna Pink Champion', 'Nonina Paleface','Winter Beach Sea Green', W.W. Wondrous, 'Bob Marlin Lucky', 'Madrid Forest King', Lucky Rainbow, 'Fire Storm', 'Lucky Rainbow Sainte Lapine', 'PCMV', 'Baltic Glaciers', 'Ensikhan', 'Arabian Nights', 'Margaret Thatcher', 'Sungold', 'Levis Duke Bella Vista', 'Sparkle Late Green'
Dendrobium	A. Abraham, Emma White, Pompadour, Burana Stripe, Bangkok Blue, Erika, Big White 4N, Thonchai Gold, Juie, Big White Jumbo, Lervia, Earsakul, Dang Saard, Kating Dang, Madam Pompadour
Vanda	Roberts Delight Blue, Pakchong Blue, KS.SD, Prao Sky Blue, Pures Wax, RBSD Black, Pat D, Sansai Blue, Dr. Anek
Cattleya	B/c Guanmiau City, B/c Chinese Beauty Orchid Queen, L/c Purple Cascade Fragrant Beauty, B/c Pamela x L/c Raiwan, C. Queen Sirikhit, L/c Ahmad Sheikhi, B/c Hsinging Catherine, Blc 'Mem Ann Balmores Convess
Phalaenopsis	Dtps. Ox Plum Rose x Ox Black Jack, P. Taida Salu Red, P. Kaleidoscope, P. Miki Wata Nabe, Dtps. Ox Prince Thunder, P. Strawberry, P. Memoria Francis Hunter, Dtps. Chian Xen Magpie, Dtps. Hsin Yang Fortune, Dtps.Shih Hua Long First Love, Brother and White
Aranda	Christine, Christine coerulea, Prapin Spot, Anne Khoo x V.Kasems Delight, Sayan x Ascda Bangkhuntian Gold, Majula, Ren. Storier, Anne Khoo x V. Fuchs Delight, Kalsum Storier, Propine White, Noorah Alsagoff Red, Noorah Alsagoff Blue, Fatimah Alsakoff Blue, Thailand Sun Spot
Mokara	Happy Beauty, Khan Piak Suan x Kultana Gold, Walter Oumae White, Khan Piak Suan x V. Rasri Gold, Chark Kuan Orange, Chark Kuan Pink,Madame Pani, Jitti Orange
Oncidium	Wild Cat Bobcat, Wild Cat Carmera, Pixie Ruth, Sweet Sugar, Gower Ramsay, Sharry Baby Sweet Fragrance, Taka Yellow, Popki Red, Jairak Rainbow Pink Spot, J.R. Orange Red, J.R. Yellow Brown, J.R. Orange Spot

DISEASES, INSECT PESTS AND THEIR CONTROL

DISEASES & THEIR CONTROL

- Fungal diseases of orchids like orchid wilt, white rot, Black rot and rust reported.
- Metalaxyl (0.1%) found effective to control black tot disease of Cymbidium
- Application of Mancozeb (200-500 ppm) + Carbendazim (200-500 ppm) found effective against anthracnose of Cattleya and Phalaenopsis orchids
- Ciprofloxacin hydrochloride (400 ppm) and tetracycline hydrochloride (1000 ppm) found sensitive against soft rot bacterium of Cymbidium orchids
- *Trichoderma viridae* showed antagonistic in vitro against orchid anthracnose

- Cym. Mosaic Virus (CyMV) and Odontoglossum Ringspot Virus (ORSV) were reported in most of orchid species

INSECT PESTS AND THEIR CONTROL

- Based on survey, mites, thrips, scales, shoot borers, slugs and mealy bugs reported to infest orchids
- Among different insect pests of 175 orchid species, mite was reported highest in May and mealy bugs from May to September
- A new species of thrips Dichromothrips nakahari reported on Cymbidium
- Among pesticides, Imidacloprid 17.8 SL (2ml/l) found effective against mites in Cymbidium
- Dipel @0.012% found effective against shoot borer of Cymbidium orchids
- Neem oil 0.03 EC found effective against red spider mite and aphid on Cymbidium
- IPM module M-5 (tobacco extract 5%, neem oil 0.03% EC 5ml/l and bifenthrin 10EC 0.25%) showed effective against mite on Cymbidium
- M-3 (tobacco extract 5%, econeem 3000 ppm 2ml/l and imidacloprid 17.8 SL (0.003%) found effective against aphids

MULTIPLICATION OF PLANTING MATERIALS

- In-vitro protocol of Cymbidium 'Golden Girl' and Cymbidium 'Lunavian Atlas', Cymbidium 'Soul Hunt-I', Cymbidium 'Sleeping Nymph' and Cymbidium 'Pine Clash Moon Venus' developed
- In-vitro protocol of Zygopetalum intermedium developed
- Altotal 20,000 tissue culture plants of Cymbidium orchids produced

TECHNOLOGY READY FOR TRANSFER

- Protocols for meristem culture of Cymbidium orchid hybrids 'Golden Girl', 'Lunavian Atlas', 'Baltic Glaciers Mint Ice', 'Soul Hunt', 'Sleeping Nymph', 'PCMV', 'Star Guard Mc Angel', 'Show Girl Cooks Bridge'
- Protocols for seed culture in Zygopetalum intermedium, Colelogyne cristata, Phaius tankervilleae, Vanda coerulea, Cymbydium dayanum, Cattleya maxima
- DUS Test guidelines in Cymbidium, Dendrobium and Vanda orchids
- Low cost production technology of Cymbidium orchids
- Propagation of Cymbidium orchids through backbulbs
- Improved propagation techniques in lilium
- Package of preparation of slow release organic fertilizers
- Package of practices for production post-harvest management of Cymbidium and Dendrobium orchids for cut flowers
- Genetical analysis of rare, endangered and threatened orchid species.
- Botanical extracts for control of shoot borer, thrips and mite in orchids
- Availability of dipsticks for virus detection

Constraints

- Non availability of skilled technical staff, at present 3 skilled technical staff are in position against 10 scientists working in both the campus i.e., Pakyong and Darjeeling.
- Supply of electricity in Pakyong is very pitiable condition and heavy fluctuation of electric current during day and night.
- Dust pollution due to construction of airport at Pakyong.

B-7. NRC ON PIG, ASSAM

National Research Centre on Pig is committed to undertake Research and Training in the areas of pig production, health and product processing through innovative research in order to provide technology backstopping for enhanced pork production, employment generation and poverty reduction among socially and economically weaker sections through the medium of pig husbandry.

Salient achievements

1. Conservation of indigenous pig germplasm and their Genetic characterization: Genetic characterization of two phenotypically different strains of indigenous pigs viz. Ghungroo and Niang Megha was done. The productive and reproductive traits of these breeds were evaluated whereby facilitated to register them as first Indigenous pig breeds of India. **The Institute was successful in the process whereby the two breeds were recognized and registered by NBAGR in May, 2012**. Institute has identified a suitable strain of indigenous pig namely 'Ghungroo' from Tarai Region of North Bengal. The breed has been evaluated for productive and reproductive traits under farm conditions for several years, and found to have good productive and reproductive performance. Accordingly, the breed has been distributed to the farmers for its popularization at field conditions.

2. **Development of improved strain of crossbred pig for superior performance:** Considering the importance of upgraded variety of pigs for the farmers, the institute has developed an improved variety of crossbred pig by crossing Ghungroo (indigenous) with Hampshire (exotic) breeds. The crossbred pig is found to have superior growth rate, litter size at birth and weaning and feed conversion efficiency. This technology has been validated at farmers' field through IVLP programme of the institute.

3. Molecular screening of PSE condition of pigs: Genetic screening of Pale-soft-executive (PSE) and condition in pigs has been completed and results revealed the absence of deleterious mutation associated with PSE in pigs.

4. **Standardization of boar semen collection and processing technique & popularization of Artificial Insemination technology in pig:** Standardized the technology for extended preservation of liquid boar semen at 15^{o}C in GEPS extender up to 7 days. The institute has also standardized methods for AI in pig under farm and field conditions and the technology has been found to be readily acceptable by the client group. So far, both in field and farm level, a total of 9,500 piglets were born (through AI) and the Institute could spread the technology to more than 170 villages till date with some of them is even more than 250 kilometres away from the Institute.

5. **Standardization of Good Management Practices of scientific pig production**: Package of Good Management Practices (GMP) for improved pig production has been developed and standardized.

6. **Formulation of feed for different stages of pigs by using conventional and unconventional feed resources & Ration for modification of body fat composition in pigs:** Nutritional requirement for starter pigs has been developed and formulation of economic rations for application in farmers' field has been standardized

7. **Standardization of package of practices for swine health care & Development of health calendar for pig:** Developed and standardized various PCR protocols for rapid detection of bacterial diseases caused by different pathogens**.** In addition, epidemiological studies have been carried out to identify bacterial agents associated with respiratory diseases of pigs.

8.Standardization of technologies for value addition of pork: The Institute pork processing unit has refined and standardized the technologies for processing an array of emulsion based value added pork products viz. frankfurter, salami, cocktails, ham slices, patties, nuggets, kebab, momos etc.Designing of model retail pork shop and portable insulated container for packaged meat are some of other achievements in meat processing technology.

PPP initiative: The Institute has established close linkage with small-scale entrepreneurs who are willing to take up the improvised technologies/products from the Institute and willing to market the fresh pork and processed pork products. Institute has already signed a Memorandum of Understanding (MoU) with M/s Arohan Foods, Guwahati to establish a Public-Private-Partnership (PPP). The pork processing unit has processed and marketed more than 900 kg of value added pork products under Public Private Partnership mode for popularizing the pork products in the region.

IVLP: Institute is also undertaking the prestigious **Institute Village Linking Programme** to popularize the scientific pig rearing practices in the region. During the year 2012-13, Institute has produced and distributed about 2100 numbers of improved varieties of crossbred piglets. Institute has also provided training in scientific pig production practices to many numbers of progressive farmers from KVK, ATMA and other line departments of several districts of Assam

Quality Management System and ISO certification: The Institute has adopted **ISO 9001:2008** standard to continually improve its Quality Management System and to accomplish its programmes to meet the stakeholders' requirements. The Institute has established Quality Management System procedure for controlling documents required for the operation of the Quality Management System and quality policy and quality objectives are documented.

In order to meet the quality requirements and to undertake the brand building activity of the final marketable products, the Institute has obtained license from **Food Safety and Standards Authority of India (FSSAI)**, Ministry of Health and Family Welfare. Additionally, the unit has also adopted **Hazard Analysis Critical Control Points** (HACCP) procedures for processing of fresh meat as well as value added pork products.

Various **Entrepreneurship Development Programmes**, **Kisan melas, Farmers interaction meetings and Exhibitions** were also organized by the Institute during past years with the objectives to provide a platform for, technology support, prospective funding for initiation and development of Agriculture based enterprises by new and existing entrepreneurs and other target groups.

B-8. REGIONAL CENTRE, NBSS & LUP, JORHAT

1. Study of crop moisture availability of soils during post- *kharif* period in Sibsagar district of Assam

Soil profiles samples at an incremental depth of 0-20, 20-40, 40-60, 60-80 and 80- 100 cm have been collected from fifteen different locations of Sibsagar distrct, Assam under paddy-fallow system only. Quantification of moisture content by gravimetric method (oven dry and weigh) as well as by volumetric basis has been carried out. The relationship between soil properties and FC shows that the water content at FC increases probably due to increasing clay, silt and organic matter content and PWP shows an increasing water content may be due to increase in clay and organic matter content. Correlation study shows that bulk density holds a negative correlation with O.C (0.-277*). Soil moisture tension both at 0.3 and 15 bar are negatively correlated with all the sand fractions and positively correlated with clay and O.C while silt failed to show any significant relationship. Regression shows variation of 75.62% of moisture content in 1/3 bar and 70.95 % in 15 bar with independent soil variables (B.D., O.C., Sand, Silt , Clay and vfs) is explained by the regression model.It can be said that the light soils will suffer from severe water stress at early stages of the growing period. Therefore, it is inferred that *rabi* cropping based only on AWC in these types of soils may not be feasible during post – *kharif* period in the district unless there is some life saving irrigation facility / advancement of sowing time.

2. Assessment of heavy metal pollution and its mapping in soils of contaminated areas of Morigoan, Dibrugarh and Tinsukia districts of Assam

Four contaminated areas *viz.,* Ledo, Digboi, Jagiroad and Namrup of the Assam state have been identified. The mean concentration of heavy metals is more in Ledo coal mining area than the other sites.In all the studied sites the heavy metals viz. Pb, Cd, Cr and Fe are significantly negatively correlated with pH and significantly positively correlated with organic carbon. The present scheme of soil sampling is sufficient for mapping and assessment of investigated heavy metals as their ranges are more than 500 m and their G values are positive except for Pb of Digboi oil refinery area.Among the three studied sites Ledo coal mining site having more risk of hazard for all studied heavy metals.

3. Land Resource Inventory of East Lahing Gaon Panchayat of East Jorhat Development Block, Jorhat District, Assam (Part of Land Resource Inventory for Farm Level Planning in Different Agro-ecological Regions of India)

A detailed survey was carried out at 1: 12,500 scale using IRS P6 LISS-IV imageries along with cadastral maps (1: 4000 scale) as base maps coveringa total area of 760 ha. In the study area, it has been observed that strong soil acidity coupled with low CEC and low base saturation affected the crop production. Soils were classified into five classes of surface texture, viz., loam (11.6% of TGA), sandy loam (40.8%), silt-loam (23.3%), sandy clay loam (11.7%) and silty clay loam (3.6%). Three pH classes were observed viz., 40% of the area is under strongly acidic (5.1-5.5) soils followed by very strongly acidic (4.5-5.0) (33.2%) and 17.8% of the area was under moderately acidic (5.6-6.0) soils. Soils were categorized into three base saturation classes, viz., low (<35%) covering 33.2% of TGA, medium (35-50%) covering 16.2% of TGA and high (>50%) covering 41.6% of TGA. Short term bund fishery may be practiced in flood plains during *Khraif* period along with paddy in Churamoni Series. Installation of Shallow Tube Wells (STW) is suggested for

minor irrigation for *Rabi* vegetables like cabbage, potato, *etc.* in raised bed furrows in Janzi, and Panitola Series. Suitable water harvesting structures may be constructed in lands occupied under Panitola and Churamoni Series for life saving irrigation.

4. Land Resource Inventory of Katonigaon Panchayat of Titabar Block, Jorhat District (Part of Land Resource Inventory for Farm Planning in different Agro-ecological Regions of India)

In the study area, a detailed survey was carried out at 1: 12,500 scale using IRS P6 LISS-IV imageries along with cadastral maps (1: 4000 scale) as base maps coveringa total area of 475 ha.The dominant texture is sandy loam (40.2%), followed by loam (29.4%) and silt loam (14.8%). The results revealed that extremely acidic, very strongly acidic and strongly acidic soils were predominant covering 25.4%, 17.3% and 40.0% area, respectively. The suitability assessment study showed that 45.6% area is moderately suitable and 40.1% area is marginally suitable for rice. Further, the study showed that 36.3% area is highly suitable and remaining 40.9% area is marginally suitable for tea.Water harvesting technologies may be adopted with initiatives from State line departments.Renovation of drainage streams is required.After paddy, vegetables cultivation with irrigation facilities in Bachabihari soil series.

5. Correlation of Soil Series of North-Eastern States (Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland and Tripura)

A total of 30 soil series from North Eastern States of the country have been entered in to the National Register including 8 soil series from Assam, 3 soil series from Arunachal Pradesh, 2 soil series from Meghalaya and 2 series from Mizoram and 15 soil series from Tripura.

6. Development of District Level Land Use Planning of Jorhat District, Assam under Rain-fed Ecosystem

In the district, Land Management Unit (LMU) map has been prepared by overlaying generalized soil map on land use land cover map followed by incorporation of production system. Eight Land Management Units (LMU) were obtained which were assessed for suitability for various crops and as well as interpretation of socio-economic status of the farmers. A Decision Support System (DSS) of the district has been prepared based on biophysical evaluations of Land Management Units and subsequent socio-economic interpretation using MGLP operations.For each Land Management Unit, strategic planning for crops were suggested based on district contingent plans. For LMU-1, application of flood resistance paddy varieties viz., *Plaban, Jalashri* & *Jal Kuwari* in flood prone zones, use of HYV of Paddy *viz., Ranjit, Swarnamasuri, Bahadur, etc.* with recommended dosages of fertilizers, construction of suitable rain water harvesting structures for irrigation of early *Ahu*, *Boro* paddy and *Rabi* crops, cultivation of Potato and other *Rabi* vegetables in broad bedded furrows, cultivation of Rape & Mustard (M-27, TS-36, TM-4) and Black gram (T-9, PU-31) after rice with recommended fertilizer dosages are suggested.

7. Land Use Planning of Diring-Thanglong Micro-watershed of Karbi-anglong and Golaghat districts of Assam under Hills & Mountain Ecosystem for Integrated Development

The watershed has been identified under the Watershed Atlas of India specification as 3B2E3, where, 3-Brahmaputra and N.E. states rivers (Region), B-Left bank of Brahmaputra (Basin), 2-Kalong to Dhansiri confluence (Catchment), E-Along the left bank of Brahmaputra (Sub catchment) and 3-Diphlu (Watershed)**.** Detailed soil survey was carried out in the watershed using

IRS P6 LISS-IV imageries as base maps. In the watershed, 10 soil series with 15 mapping units (phases) were identified.7 priority classes were developed based on integration of slope, soil depth and productivity index for crop planning.Integrated action plans were suggested for each priority class based on assessment of land suitability and socio-economic interpretations. In Priority zone 1, construction of suitable water surplussing structures to provide a stable outlet for safe runoff disposal by creating temporary hold up of high velocity flow of water at the up-streams and integrated Paddy--Fishery-Livestock (Pig + Duck/ Poultry + Goat/ Cow) were suggested, whereas, in priority zone 7, use of STW with pump set as micro-irrigation for cultivating cabbage, mustard and black gram after rice has been suggested.

8. Assessment and mapping of some important soil parameters including macro and micro nutrients for 13 priority districts of Assam state towards optimum land use planning

This is a consultancy project with the objectives to prepare district-wise maps of pH, organic carbon, available N, P, K and micro-nutrients (Cu, Zn, Mn and Fe) on 1:50,000 scale for agricultural development towards land use planning for 13 priority NFSM districts. Soil nutrient maps for all the districts were prepared and reports have been published. It was observed that extremely, very strongly and strongly acidic soils together covered 72.9 % area of Tinsukia district, whereas, 61.3% area of Goalpara district contained high organic carbon. Low (<34 kg P_2O_5 ha^{-1}) was observed in 38.5% area of Tinsukia district, whereas, 22.2% area was deficient (<0.6 mg kg^{-1}) in available zinc status in Karbi-Anglong district. From the study it becomes evident that soil acidity together with the low range P, low to medium N & K status as well as deficient zones of zinc certainly indicates in general the low fertility status of the district and therefore requires attention regarding soil management practices for optimum agricultural production.

9. Soil microbial biomass carbon and Nitrogen in selected soil series of Northeastern Region as affected by different land uses and varied agro- ecological conditions

From the study it was found that the microbial biomass content was highest at the surface (0-20 cm) and decreased with soil depth in all the three land use systems viz. tea garden, cultivated area and forest. It was found that in Assam, MBC content ranged from 120.21 µg g^{-1} to 12.35 µg g^{-1} soils in the profiles in cultivated land followed by 184.26 µg g^{-1} to 15.10 µg g^{-1} soils in tea garden and 248.16 to 17.10 µg g^{-1} soils in forest eco-systems. Soil microbial biomass nitrogen content in the profiles of cultivated land ranged from 41.45 to 0.81 µg g^{-1} soils and from 51.10 to 1.15 µg g^{-1}, soils in tea garden and 68.12 µg g^{-1} to 1.01 µg g^{-1} soils in forest eco-system.

10. Soil and land capability map for land use planning, Dzongu Farm, North Sikkim

ICAR Research Complex for NEH, Tadong, Sikkim farm namely Dzongu of North Sikkim lies between 27° 30′ 08" to 27° 30′ 24" N and 88° 31′ 12" to 88° 31′ 20" E covering an area of 1.1 ha**.** Three soil series namely Dzongu-1, Dzongu-2 and Dzongu-3 with seven phases were identified.Dominant soil reaction classes in the farm is very strongly acidic (pH 4.5 to 5.0) covering 44.5 per cent area of the farm.The entire area of the farm are high organic carbon content (> 0.75%).About 40% of the farm are low in available N and 37.3 per cent area of the farm are low in phosphorous.Only about 12.7 per cent of the farm area are deficient in Zn. 54.4 per cent area of the farm is moderately suitable whereas 27.2 per cent area is marginally suitable for tomato, whereas, 54.4 per cent area of the farm is moderately suitable whereas 27.2 per cent area is marginally suitable for cabbage.

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11. Land resource management for integrated farm planning in Bhomoraguri Missing Goan, Pub-Teok Circle, Jorhat district, Assam under TSP

Bhomoraguri Missing gaon belongs to Pub Teok Circle of Jorhat and has been identified as a typical tribal populated village (Missing tribe). Differrent components such as, crop planning, livestock rearing, apiculture, vermicompost, fishery etc. under the TSP programme have been provided to the farmers. Two 5 HP STW diesel pump sets, packages of practices for mustard (Toria T-36), cabbage, brinjal and ahu rice, with seed and fertilizer inputs, 24 nos. of piglets for piggery, 3 concrete tanks with earthworm for production of vermicompost were provided.

B-9. REGIONAL RAINFED LOWLAND RICE RESEARCH STATION GERUA, HAJO, ASSAM

GENESIS

Flood is a recurrent problem in Assam and annually more than 5 lakh ha of rice lands plunge under varying depths of flood water causing drastic reduction in production and productivity of rice in the state. Rice productivity under rainfed lowlands to deepwater conditions is only around 1 t ha^{-1} in spite of excellent soil and water resources available. In order to strengthen the state's efforts for increasing rice productivity by developing production technologies specially suited for flood-prone rainfed lowlands of Assam, the Ministry of Agriculture, Government of Assam requested Indian Council of Agricultural Research, New Delhi to consider establishing a research station of Central Rice Research Institute in Assam. As a result, on Monday, the September 15th, 1997, Regional Rainfed Lowland Rice Research Station (RRLRRS) was established as a research station under Central Rice Research Institute (CRRI), Cuttack at the site of the erstwhile Field Trial Station under the Department of Agriculture, Government of Assam, at the village Gerua in Hajo circle of Kamrup district of Assam.

LOCATION

RRLRRS, Gerua is situated on the northern bank of river Brahmaputra in Kamrup district in the Lower Brahmaputra Valley Agro-Climatic Zone of Assam at about 32 km away from Guwahati railway station on Guwahati-Hajo road. It is located between 91^{o}47" East longitude and 26^{o}11" North latitude and at 49 m above the mean sea level. The climate is humid, sub-tropical. The annual average rainfall is 2200 mm. The minimum and maximum air temperature varies between 8^{o}C to 37^{o}C. The relative humidity ranges between 76% and 88%.

GOAL

To improve the income and quality of life of rice farmers of rainfed lowland ecosystem

MANDATE

1. To conduct basic, strategic, applied and adaptive research on crop improvement, production and protection for increasing and stabilizing rice productivity in rainfed lowland ecosystem
2. To cater to the research needs and requirements of rice farmers of flood-prone lowlands affected by flash floods
3. To explore, evaluate, conserve and exchange rice germplasm
4. To develop high yielding and input responsive rice varieties resistant/tolerant to different biotic and abiotic stresses under rainfed lowland ecosystem
5. To generate appropriate agronomic and protection technologies for increasing and sustaining the productivity of rice-based production systems under rainfed lowland ecosystem
6. To impart training to the rice farmers, field functionaries, extension specialists and research workers on improved rice production & rice-based cropping and farming systems

ORGANIZATIONAL SET-UP

RRLRRS, Gerua is under administrative control of the Director, CRRI, Cuttack. However, an Officer In-Charge of Principal Scientist rank heads the station to plan, organize, guide and coordinate research at the station. The Officer In-Charge performs day to day administration of the station and participates in inter-institutional activities. He executes the mandate of the station with

the help of the scientists belonging to disciplines of Crop Improvement, Crop Production, Crop Protection, Fisheries Science & Social Science supported by administrative, technical and skilled support staff. The Officer In-Charge also serves as the key person in collection, maintenance and dissemination of information on rice research and technology in the mandated area.

Staff Position

Category	Sanctioned	In-Position	Vacant
Scientific Staff	10	5	5
Administrative Staff	5	3	2
Technical Staff	10	2	8
Supporting Staff	6	2	4
Total	**31**	**12**	**19**

FACILITIES

The total area under the station, at present, is 12.5 ha of which 10 ha are under cultivation and the remaining 2.5 ha are under buildings, ponds, children's park, roads, pavements etc. The station possesses the Office-cum-Laboratory building, a training hall, one unit each of rice-fish-horti farming system and horti-fish farming system, submergence tanks, a meteorological observatory, an open threshing floor, two covered threshing floors, seed storage module, godowns, guest house, residential quarters (for scientists and other staff members) and a few other farm infrastructure.

ONGOING RESEARCH PROGRAMMES

The multi-disciplinary research programmes of the Institute to develop production and protection technologies for increasing productivity of rainfed, lowland rice constitute the core programme of RRLRRS. It addresses specific researchable issues by conducting basic and strategic research. Major thrust area of crop improvement programme is on development of rice varieties for early *ahu* (pre-flood) &*boro* seasons. The on-going research programmes are as follows:

Programme: Genetic improvement of rice

Project: Development of rice genotypes for rainfed, flood-prone lowlands

Objectives:

1. To develop high yielding genotypes with cold tolerance at early vegetative stage for *boro* and pre-flood *ahu* rice
2. To maintain and evaluate rice germplasm of flood-prone ecosystem
3. To identify genes responsible for low temperature stress during early vegetative stage in rice

Programme: Enhancing the productivity, sustainability and resilience of rice based production system

Project: Soil and crop management for productivity enhancement in rainfed flood-prone lowland ecosystem

Objectives:

1. Development and evaluation of integrated rice-fish-horticulture-duckery farming system under flood-prone lowland rice
2. Development and evaluation of rice-based cropping system under post-flood situation in rainfed lowland ecosystem

3. To develop integrated crop management practices under flood-prone, rainfed lowland ecosystem
4. To study the effect of weather parameters on productivity and stability of the cropping system

Programme: Rice pests and diseases: Emerging problems and their management

Project: Management of major rice diseases in rainfed, flood-prone lowlands
Objectives:
1. To evaluate relative efficacy of bio-control agents and fungicidal chemicals in managing sheath blight disease of rice
2. To survey rainfed, flood-prone lowlands for the incidence of major rice diseases
3. To evaluate diverse rice genotypes for resistance/tolerance against major rice diseases

SIGNIFICANT RESEARCH ACHIEVMENTS

Crop Improvement:
1. Altogether 1450 germplasm accessions, collected from the Eastern and North-Eastern India, are being maintained and evaluated.
2. Variety 'Chandrama' was released by SVRC, Assam in 2007 for cultivation in shallow lowland areas in *sali* and *boro* seasons.
3. Variety 'CR Dhan 601' was released by CVRC in 2010 for cultivation as *boro* rice in Odisha, West Bengal and Assam.
4. Rice varieties 'Anjali', 'Kalyani-II', and 'Nilagiri' have been identified suitable for growing as pre-flood *ahu* crop in Assam.
5. Rice variety 'Tapaswini' has been identified suitable for *sali* season.

Crop Production:
1. The Rice-Rice-Rice cropping sequence has been standardized for irrigated condition.
2. Scheduling of Nitrogen application for *boro* rice has been done.
3. For *ahu* + *bao* mixed cropping, suitable varietal combination has been identified.
4. Integrated Rice-Fish-Horti Farming System model developed by CRRI has been validated and improvised for flood-prone lowland situation.

Crop Protection:
1. Important fungal diseases affecting rice in Assam and parts of Meghalaya were identified.
2. Effective non-chemical methods for managing blast and sheath blight diseases were identified.

EXTERNALLY FUNDED PROJECTS

RRLRRS, Gerua was a consortium partner in the NAIP Component III Sub-Project: Livelihood Promotion through Integrated Farming System in Assam. Under the sub-project, certified seed production of rice variety Ranjit was undertaken during *kharif* 2009 & 2010 by select group of farmers in Kokrajhar, Bongaigaon, Diphu and Lakhimpur districts of Assam. RRLRRS, Gerua, is also playing a major role in supplying requisite rice seeds for NFSM activity in Assam.

COLLABORATIVE EFFORTS

1. Local Institutions: The research station has close collaboration with the Department of Agriculture, Government of Assam and Krishi Vigyan Kendras under ICAR & Assam Agricultural University for development and evaluation of varieties and farming system research.

2. National Institutes and Agricultural Universities: Besides CRRI, Cuttack and the Directorate of Rice Research, Hyderabad, the station collaborates with Assam Agricultural University, Jorhat (Assam), and ICAR Research Complex for NEH Region, Barapani (Meghalaya) for network research.

3. International Institutes: The station is associated with the International Rice Research Institute, Manila, Philippines for evaluation and utilization of germplasm of INGER nurseries.

4. Extension & Developmental Agencies: The station maintains close cooperation with field functionaries of the Department of Agriculture, Government of Assam, NGOs, *viz*., North East Centre for All Round Development, Mangaldoi, Lotus Progressive Centre, Nalbari and farmers of the region for transfer of technology.

FUTURE THRUST AREAS OF RESEARCH

1. Development of short duration, high yielding, medium slender-grained rice varieties for late *sali* (post-flood) season
2. Development of submergence tolerant varieties for rainfed shallow lowlands
3. Agronomic management of *boro* rice and post-flood *sali* rice
4. Improvisation of integrated rice-fish farming system model for flood-prone lowlands
5. Development of integrated pest and disease management module for rice

B-10. CPCRI, REGIONAL CENTRE, KAHIKUCHI

Status of research:

- Recommended varieties for North East:
- Arecanut-Kahikuchi, Nalbari, Mohtinagar
- Significant research achievements:
- Variety released for NE India-Arecanut- "Nalbari".

Production of planting materials:

Items	2011-12	2012-13	Total
Arecanut	14500	15000	29500
Cinnamon layers	1200	1200	2400
Black pepper seedlings	10000	10000	20000
Citrus (Assam lemon)	1500	1500	3000
Coconut seednuts	2500	2500	5000

- Okra during summer and French bean during winter found to be more suitable intercrops in arecanut under NE condition.
- Evaluation of local accessions of black pepper, coconut, arecanut are in progress.
- Evaluation of released varieties/hybrids of coconut, arecanut and black pepper are in progress.
- An experiment on MLT on cocoa varieties/hybrids under arecanut in initiated.
- Drip irrigation at 100% pan evaporation at 2/3rd dose of recommended dose of fertilizer found effective in growth, yield (3.6 kg challi/palm/year) of arecanut and moisture distribution/ utilization.
- *In-situ* conservation methods with catch pit filled with coconut husks showed maximum yield in arecanut under sloppy hills of NE India
- Development of arecanut based high density multispecies cropping system models for NE region. The model comprising arecanut, black pepper, banana and assam lemon under 2/3rd dose of fertilizer resulted highest B:C ratio (3.56)
- Arecanut palms fertilized with 1/3rd chemical fertilizer + 2/3rd vermicompost resulted in maximum yield of arecanut palm.
- Surveillance for diseases and pests of major spices and plantation crops are carried out.
- For the first time survey and assessment for eriophyid mite in coconut has been carried out in Assam
- Development of management practices against ganoderma wilt of arecanut in NE India
- Field evaluation for management of eriophyid mite of coconut is in progress both in research field and farmer's field
- Field evaluation on management of rhinoceros beetle of coconut is in progress.
- *In vitro* study on efficiency of botanicals, bioagents, chemicals are carried out for major diseases/ pests of coconut and arecanut
- Supply and production of bioagents mainly, *Trichoderma viride*
- Conducting 15 numbers of demonstration gardens on arecanut/coconut based High Density Multispecies Cropping System and 3 on-farm trials in farmers' fields.
- Training programmes conducted and farmers benefitted

B-11. RAMIE RESEARCH STATION, BARPETA

1. Area, production and productivity trends- for the last five years

Source: Directorate of Economics and Statistics, DAC, MOA, Govt. of India

Year	Jute			Mesta		
	Area (x 000 ha)	Production (x000 bales)	Yield (kg/ha)	Area (x 000 ha)	Production (x000 bales)	Yield (kg/ha)
Assam						
2007-08	60.0	656.8	1970	5.0	26.9	968
2008-09	60.1	647.5	1939	5.3	26.8	910
2009-10	65.3	715.3	1972	5.0	20.2	727
2010-11	62.3	625.4	1807	5.0	25.3	911
2011-12	65.6	607.9	1669	6.1	30.9	917
Meghalaya						
2007-08	4.0	34.9	1571	4.4	20.0	818
2008-09	4.0	34.6	1557	4.4	20.0	818
2009-10	3.9	34.7	1590	4.2	18.4	797
2010-11	3.9	34.4	1586	4.1	18.2	799
2011-12	3.9	34.4	1600	3.7	16.0	777
Nagaland						
2007-08	3.0	6.4	384	-	-	-
2008-09	2.5	1.3	84	-	-	-
2009-10	1.3	2.0	277	-	-	-
2010-11	3.0	5.4	324	1.6	3.0	338
2011-12	3.0	5.5	324	1.6	3.0	345
Tripura						
2007-08	0.5	3.7	1332	1.0	6.8	1224
2008-09	0.5	3.7	1332	0.6	5.0	1500
2009-10	0.5	3.8	1453	0.8	5.6	1302
2010-11	0.5	4.2	1527	0.8	6.5	1463
2011-12	0.6	5.5	1541	0.6	5.2	1489

2. Research Support in the region

- Regional Agricultural Research Station Shillongini at Nagaon under AssamAgriculturalUniversity, Jorhat is engaged in research and development and conducting the various AINP trials on jute and allied fibre crops since early seventies.
- Ramie Research Station, Sorbhog (Assam) under CRIJAF, Barrackpore is operational since 1959 and engaged in research and development of various aspect of ramie cultivation in the region. Production of ramie planting materials and its area expansion is one of the primary mandate of this station besides varietal improvement and development of cost effective production and protection technologies of ramie cultivation.

3. Major achievements

a) Recommended variety

White jute – JRC 80, JRC 7447, JRC 698, AAU CJ 1 and Bidhan Pat 1, 2 and 3

Tossa jute - AAU OJ 1, JRO 204, JRO 524, JRO 8432, JRO-128, JRO-66, JRO-7835 and JRO 2407

Mesta *(H. cannabinus)*-AMC 108, HC 583, MT 150, JRM 3, JRM 5 and JBM 2004D and JMB 81

Mesta *(H. sabdariffa)*-AMV 1, 2, 3, 4 and 5, AMV 7 and HS 4288

Ramie – R-67-34 (Kanai) and R 1411 (Hazarika)

b) New varieties released/identified

One variety each in of *Tossa* jute (*C. olitorius*) & white jute (*C. capsularis*) viz., AAUOJ 1 (Tarun) and AAUCJ 1 (Apeswaree) developed by the AINP (Jute & Allied Fibres) centre in Assam Agricultural University at Nagaon have been released by CVRC & SVRC, respectively. Despite, one variety of ramie namely, R-1411 (Hazarika) developed at Ramie Research Station, Sorbhog has been identified during last AINP Workshop held at CRIJAF, Barrackpore.

c) Disease/ pest problem

Jute: Semilooper, Bihar hairy caterpillar, yellow mite and stem weevil indigo caterpillar and grey weevil are the important insect pests of jute. Recently mealy bug has been recorded to infest jute. Stem rot, root rot, anthracnose and seedling blight are the common diseases on jute.

Ramie: *Cercospora* leaf spot disease, leaf roller (*Sylepta derogata*), Indian red admiral caterpillar (*Vanessa indica* Hurbst.) and leaf eating caterpillar (*Spodoptera exigua*) are the important insect pests and diseases affecting ramie crop at different stages of crop growth.

d) Important package of practices

Jute

Variety/Cultural practices	Recommendations	
	C. capsularis	*C olitorius*
Variety	AAUCJ 1, JRC 80, JRC 7447 and JRC 698,	AAUOJ 1, JRO 204, JRO 2407, JRO 8432 and JRO 7835
Time of sowing	3rd week of March	2nd week of April.
Method of sowing and spacing	Line sowing: 30cm x 5-7cm or Broadcasting	Line sowing: 25cm x 5-7cm. or Broadcasting
Seed rate	Broadcasting :6-8 kg/ha Line sowing with seed drill: @ 2.5 kg/ha	Broadcasting :4-6 kg/ha Line sowing with seed drill: @ 2.5 kg/ha
Seed treatment	Carbendazim @ 3g/kg seed.	Carbendazim @3g/kg seed.
Nutrient management	Under low fertility condition – 80:40:40 (N: P_2O_5 : K_2O, kg/ha) Under medium to high fertility condition – 60:30:30 (N: P_2O_5 : K_2O) Organic matter – 5-8 t/ha	Under low fertility condition – 80:40:40 (N: P_2O_5 : K_2O) Under medium fertility condition – 60:30:30 (N: P_2O_5 : K_2O) Under high fertility condition 40:20:20 (N: P_2O_5 : K_2O) Organic matter – 5-8 t/ha
Weed	Application of post-emergence	Application of post-emergence

management	herbicide quizalofop ethyl 5% EC (40-50 g a.i. /ha + adjuvent @ 1 ml/li) at 15-20 DAE followed by 1 hand weeding on 35 DAE is recommended Mulching with organic waste (10 t/ha) or intercropping with red amaranth.	herbicide quizalofop ethyl 5% EC (40-50 g a.i. /ha + adjuvent @ 1 ml/li) at 15-20 DAE followed by 1 hand weeding on 35 DAE is recommended Mulching with organic waste (10 t/ha) or intercropping with red amaranth.
Crop protection	Fenazaquin 10 EC or fenpyrozimnate 5EC @ 2 ml/lit may be sprayed at 30 and 60 DAS for effective management of yellow mite. In the later stage of crop the lepidopteran pests can be controlled by foliar spray of profenophos (0.1%) at 10 days interval. For managing stem rot and anthracnose of jute and foot and stem rot of mesta, seed treatment with carbendazim @ 3g/kg seed and 2-3 spraying of carbendazim (0.2%) or Copper oxychloride (0.3%) can be applied.	
Stage of harvesting	120 days after harvesting	
Retting	Proper retting and extraction of fibre (after 12-15 days of jaking) should be done in clear and slowly flowing water for quality fibre. CRIJAF microbial consortium mediated retting improves the quality and reduces the retting time by 7 days.	

Ramie

Variety /Cultural practices	Details
Land preparation	2-3 deep ploughing followed by laddering
Variety	R-67-34 (Kanai) and R 1411 (Hazarika)
Time of planting	For North-Eastern states – Rainfed condition : February – March / April & end September – October Irrigated condition : Throughout the year except winter; during peak rainfall planting can be done only if adequate drainage is provided
Method of planting & spacing	With newly developed planting technique using furrow opener; 60 cm (row-row) x 30 cm (plant-plant) at 5 cms depth
Seed rate	Rhizome planting : 8-10 quintal / ha) Plantlets/stem cutting : 55000 – 60000/ha (including 10% mortality)
Nutrient management	$N:P_2O_5:K_2O$ – 30:15:15 kg/ha/cutting ; 10-15 t/ha of organic matter to be added at beginning of every year
Weed management	Quizalofop ethyl 5% E.C. @ 60-90 g a.i./ha 15 days after emergence effectively control grassy weeds
Crop Protection	Disease control : spraying of propiconazole or difenconazole @ 0.1% or mancozeb @ 0.25% 15 days after previous harvest for management of foliar diseases insect pests and termite control: spraying of chlorpyriphos @ 0.05% at 15 days intervals
Harvesting	Under rainfed condition, usually 4 cuts may be taken in a year at 50, 45, 45 and 50 days interval respectively. Under irrigated condition 5 cuts can be

	taken. Harvesting is done manually by cutting the stalks manually near ground level.
Decortication	Fibre is extracted from harvested defoliated canes by a decorticator machine. It is a 5 HP machine run by diesel or electricity. Around 800 – 1000 kg cane can be decorticated everyday by this machine which produces approximately 35 to 45 kg fibre. The raw fibre is then washed thoroughly in clean water to remove some of its gum and then sun dried for 2 to 3 days.
Degumming	The decorticated ramie fibre contains a large amount (19–30%) of gummy matter. According to the chemical degumming method developed at NIRJAFT, decorticated fiber is boiled in 1% caustic alkali solution with liquor ratio 1:6 or 1:7 containing some wetting agent at 96-98^{o}C for two hours in a digester under pressure. Treatment of fibre with of 0.5% sodium sulphite treatment improves tenacity of the fibre. The excess alkalinity is neutralized by treating with 6% acetic acid. The resultant fibre is creamy yellow in colour and is bleached with 6% H_2O_2 or sodium hypochlorite solution, to make the colour milky white with gum content.

e) Seed production report

Seeds of the newly released and notified *olitorius* jute var. 'Tarun' developed by the centre are produced at various research stations and KVKs of AAU. The Govt. of Assam has been procuring Breeder and Foundation seeds of 'Tarun' from AAU for their seed production programme. The Government of Assam has taken a massive seed production programme of this variety, 'Tarun' in different districts. Likewise a seed production programme is taken by AAU for the newly recommended high yielding *capsularis* jute variety, 'Apeswaree' (AAUCJ 1) developed by the centre, recommended by Assam State Seed Subcommittee.

Seed production of *olitorius* jute var. 'Tarun' in Assam

Type of seeds	Amount of seed produced (in q)	
	AAU, Assam	**Assam Govt.**
Breeder seed	3.00	-
Foundation seed	9.00	500.00
Certified seed	-	84.00

4. Major constraints

- Lack of mechanization for different intercultural operations.
- Incidence of diseases like foot and stem rot of jute and emergence of new pests in ramie e.g., Indian red admiral caterpillar.
- Non adoption of improved retting techniques for quality fibre production.
- Non-availability of quality seed of improved varieties.

5. Suggestion for Improvement

- Development and popularization of machines for sowing, weeding and harvesting
- Improved package of practices for the management of stem rot disease of jute
- Development of varieties for biotic and abiotic stress
- Popularisation of consortium mediated retting technique

- Steps to improve seed replacement rate by active involvement of public sector in certified seed production.
- Production of quality planting materials of ramie for area expansion
- Improved decorticator with higher fibre recovery of >10%

B-12. CIFRI, BARRACKPORE IN NE REGION

A. Research

1. Standardizing fish stock enhancement protocols in floodplain wetlands

The Institute has been carrying out studies on various aspects of stock enhancement in Assam for many years with a view to standardizing their stock enhancement protocols. These have more than 25% of water-spread area covered by floodplain wetlands in the country. As part of the study, field data were collected from 8 beels of Lower Brahmaputra Valley (LBV) Sub-zone of Assam (Barundanga, Rowa, Dahor-Jogra, Harinchora, Tariachora, Motirkuti, Bhoispuri, Paborchara), ten beels of Central Brahmaputra Valley Sub-zone (Jaluguti, Dandua, Kachadhara, Charan, 47 Morakolong, Deorah, Damal, 46 Morakolong, Lakhanabandha, Borghuli) and six beels of Barak Valley Sub-zone (Korkoria, Fulbari anoa, No. 26 Sibnarayan anoa, Baraknadi anoa, Chri anoa, Baskandi anoa) during 2011-13. Stock enhancement was practiced in all the beels except in 47 Morakolong beel (because of fear of possible floods) to increase their fish yield. Among the selected beels, Damal beel, Paborchaora beel and Siri anoa were very small in size (<20 ha), Fulbari anoa and Singra beel were medium-sized (114-146 ha) whereas the remaining beels were small in size (20-99 ha). Seven of the selected beels were closed and the remaining were seasonally open ones. Supplementary stocking has been practiced in the selected beels since the past 10 years or more except in Chiri anoa, Baskandi anoa (since the past 3-4 years), and in Rowa beel (from last year). All beels were under the administrative control of the Assam Fisheries Development Corporation.

Fish production: Fish production from both stocked and natural fish stocks in the selected closed beels ranged from 149.3 (Puthimari beel) to 1387.8 $kgha^{-1}yr^{-1}$ (Damal beel). Contribution of stocked fishes to fish production in varied from 134.3 to 832.7 $kgha^{-1}yr^{-1}$. In seasonally open beels, total fish production varied from 41 (Kapla beel) to 528.8 $kgha^{-1}yr^{-1}$ (46 Morakolong beel). The contribution of stocked fishes to fish production varied from 24.6 (Kapla beel) to 416 $kgha^{-1}yr^{-1}$ (Bhoispuri beel). Both total fish production and contribution of stocked fishes to fish production was higher in closed beels than that in seasonally open ones.

Contribution of stocked and natural fish stocks:The contribution of stocked fishes to total fish production was 60% or more in all the closed beels indicating that culture-based fisheries was practiced in these beels. In seasonally open beels, the contribution of stocked fishes to total fish production was as low as 25% (Baraknadi anoa) to 30% (Singra and Charan beel), which were regularly flooded from the adjoining rivers. In the remaining seasonally open beels, it ranged from 40% (Akra beel) to 80% (Dandua, Jaluguti, Bhoispuri, Chiri anoa). The contribution of stocked fishes to total fish production was 50% or more in 11 out of 17 seasonally open beels indicating that culture-based fisheries was practiced in these beels.

Determination of optimal stocking density: Data on fish production and related aspects was collected from seven beels of LBV sub-zone of Assam and also from six more beels of Central Brahmaputra valley zone of Assam were analyzed for standardizing fish stocking density during the report period. Fish production from both stocked and natural fish stocks in the selected closed beels

ranged from 149.3 to 1387.8 $kgha^{-1}yr^{-1}$. Based on the field data, optimal stocking density was estimated at 3000 and 3600 fingerlings/ha for closed and seasonally open beels, respectively.

Impact of stocking on fish yield: A case study was conducted in Charan beel, Morigaon district, Assam for assessing the impact of stocking on fish yield. Yield rates in this seasonally open wetland having 60 ha water spread area was estimated at 228 kg/ ha/ yr during 2000-01, which was exclusively from natural fishes with major and minor carps contributing 31.32%, large carnivores contributing 15.78% and small economic fishes contributing the major share of 52.9%. Fish stock enhancement was practiced in this beel during 2010-11 as a result of which fish yield rates increased by 324% (740 kg/ ha/ yr). The share of major carps increased to 62.8% during this year. While the share of large carnivores remained relatively unchanged (11.4%), the share of small economic fishes drastically reduced to 25.8%.

Assessment of habitat variables, aquatic communities and fisheriesin selected wetlands of Manipur

Four wetlands (Takmu pat, Ungamlen pat, Utrapat and Sanapat) form Bishnupur district and one wetland (Waithou pat) from Thoubal district of Manipur was assessed for their habitat variables, aquatic communities and fisheries during the period. Except in Takmu pat which was under the administrative control of the Department of Fisheries, Govt. of Manipur, all the other wetlands faced the problem of encroachment for agriculture or Pisciculture in the peripheral areas of the lakes. Takmu pat and Ungamlen pats are moderately (15-35%) infested with macrophytes, while the other three pats were heavily (>80%) infested with macrophytes. Some of the edible aquatic plants of the wetlands having economic importance to the people living around are *Zizania latifolia, Carex* sp., *Saccharum* spp., *Setaria pumila, Alpinia nigra, Hedychium spicatum, Narenga, Trapa natans,Euryale ferox,Nelumbo nucifera, Nymphoides indicum,Nymphea pubescence, etc*. The water quality parameters assessed in the pats were pH (6.6-8.4), DO (2.1-7.4 mg/l), CO_2 (3.8-11 mg/l) and alkalinity (25-30 mg/l). Soil texture in all the pats were predominantly sandy (88-93%) in nature. Soil was acidic, organic C (%) ranged between 1.43- 1.58, PO_4 between 1.3- 1.61 mg/kg and pH ranged from 6.5- 7.3. In these wetlands, the fisheries comprised of common carp, grass carp, tilapia, IMCs and other small indigenous fishes. Some of the endangered indigenous fishes in the pats were *Anabas testudinus, Anguilla bengalensis, Acanthophthalamus punctatus, Channa orientalis, Botia bagarius, Barilius dogarsinghi, Garra graveli, Ompok bimaculatus,* etc.

Utrapat in Bishnupur district, Manipur

Encroachment for Pisciculture on the periphery of Ungamlen pat in Bishnupur district, Manipur.

2. Demonstration of enclosure culture technology

A pen culture demonstration was carried out in Takmu pat of Bishnupur district for assessing the technological feasibility in Manipur valley conditions. The pen measuring approximately 0.1 ha was constructed using nylon net (25 mm mesh size) with bamboo supports in collaboration with the Directorate of Fisheries, Govt. of Manipur during March, 2012. The pen was stocked with yearlings of Indian major carp, minor carp and exotic carps @ 5 fingerlings/ m^2. The number of fish stocked, average length and weight were as follows: *Labeo rohita* (1000, 14.8 cm, 38.6 g), *Catla catla* (750, 16.1 cm, 39.0 g), *Cirrhinus mrigala* (1000, 16.2 cm, 41.9 g), *Hypophthalmichthys molitrix* (1250, 14.2 cm, 30.3 g), *Ctenopharyngodon idella* (100, 22.4 cm, 115.2 g), *Cyprinus carpio* (500, 14.8 cm, 55.1 g) and *Osteobrama belangeri* (500, 9.4 cm, 10.6 g). The stocked fishes were fed with commercially available pelleted feed (23.4% crude protein) at the rate of 5% of body weight twice a day. Water in the pen was characterized by favorable temperatures (23.8-28^{o}C), clear water (Secchi disc visibility 85-95 cm), pH (6.6-6.8), optimal dissolved oxygen (6.5-7.0 mg/l), low free carbon dioxide (undetectable) concentrations and moderate total alkalinity (25-30 mg $CaCO_3$/l). The seed were reared in the pen for 180 days. The highest average weight gain percent (±SD) was recorded for pengba (1107.55±2.92), followed by grass carp (785.42±53.21), catla (738.82±16.78) mrigal (323.39±7.6), rohu (251.19±6.97), common carp (191.08±4.88) and lowest weight gain was recorded for silver carp (123.01±4.6). Similarly, the highest specific growth rate (SGR) was recorded for pengba (1.38) and lowest for silver carp (0.45) indicating suitability of culturing *O. belangeri*, a high-demand indigenous minor carp in pen enclosure in Takmu pat, Manipur. Grass carp and catla were also found to be suitable for culturing in pen enclosures. In conclusion, net pen enclosures can be used for culturing different fish species having local demand either for rearing them up to advanced fingerling size for their subsequent release into wetland-proper or table fish for consumption in large water bodies such as Takmu pat.

Adoption of pen culture technology developed by CIFRI in Sonitpur district of Assam

A field survey was conducted in four sites in Sonitpur district of Assam where pen culture is being practiced to assess the adoption of pen culture technology developed by CIFRI. Nayanjyoti Self help group (SHG) of Parmaighuli, Balipara Block, Sonitpur Dist., Assam took up pen culture practice in Rangapani Jan beel in April 2010 with the partial financial assistance of District Fishery Development Office (DFDO), Sonitpur Dist., Tezpur, Assam. The area covered under pen culture was 1 ha with an average water depth of 5.5 ft. The pen area was encircled with split-bamboo screen (height 8 ft) lined with polyethylene netting from inside. Stocking was done with *Labeo rohita, Catla catla, Cirrhinus mrigala, Cyprinus carpio* and *Labeo gonius* following species ratio of 30 Catla: 30 *Labeo* spp.: 30 C. *mrigala*&*10 C. carpio* at stocking density of 5000 fingerlings/ ha. The total cost including construction, seed and feed was ₹ 1.06 Lakhs of which 85% was borne by the DFDO. Another pen culture activity was undertaken by a Non-governmental Organization (NGO) known as Maandal in Kachu beel, Morabhalari, Chiloni, Sonitpur Dist. covering an area of 1.35 ha during 2009-2010. The total cost involved in this case was ₹ 3,73,950.

Refinement of cage culture

The Institute carried out cage culture experiments at Charan beel, Morigaon district, Assam with a view to refine the technology during 2011-12.

Optimization of stocking density in cage culture: The Centre conducted one cage culture experiment at Charan beel, Morigaon, Assam with a view to standardizing stocking density of *Cirrhinus mrigala* fry. A battery of twelve cages (individual cage dimensions 2 x 2 x 2 m) were stocked with *C. mrigala* fry (av. length 4.18 ± 0.07 cm, av. weight 0.71 ± 0.03 g) at six different

stocking densities, viz. 50 (SD1), 100 (SD2), 150 (SD3), 200 (SD4), 250 (SD5) and 300 (SD6) fry/ m^3 with two replicates each. Fishes were fed twice daily with a formulated mashed feed (34.61% CP) for three months. The stocking density of 100 and 150 fry per m^3 showed better growth performance compared to other groups in terms of final weight, weight gain percent (WG) and specific growth rate (SGR). Since the survival percentage in SD6 was statistically insignificant with the groups having higher growth rates (SD2 and SD3), a stocking density of 300 fry/ m^3 may be considered optimal for raising *C. mrigala* seeds in Charan beel. In view of the present findings, stocking densities higher than 300 fry/ m^3 may also be tried for raising *C. mrigala* fry.

3. Fish assemblage, habitat preference and assessment of exotic fishes in inland open waters.

Data were collected from Takmu lake, Bishnupur district, Manipur; Umiam lake, Meghalaya; Dumbur reservoir, Dhalai district, Tripura and six beels of Dhubri district, Assam on the occurrence of exotic fishes in the lakes/ reservoir. The catch from both the lakes (Takmu and Umiam) suggest dominance of exotic fishes especially *Cyprinus carpio*. The local people also have preference for the exotic fishes. The catch from Dumbur reservoir suggested that *Cyprinus carpio* (common carp) is the only exotic fish caught from the reservoir and its contribution to the total catch is negligible (0.5%). The major contributors were indigenous fish *Chanda* spp. (70%) followed by *Amblypharyngodon mola* (10%), which also had higher demand due to its low price (₹ 30-60/kg). Indian major carps were reported to contribute only 4% of the total catch. From Dhubri district, Assam, data were collected from Harinchora, Barundanga, Paborchora, Kalidanga, Matirkuti and Tariachora beels. In all beels, seeds of Indian major carps (IMCs) and exotic carps were stocked annually and in one beel (Tariachora) *Chitala chitala* seeds were stocked. But the percentage catch of exotic carps were higher than the IMCs indicating that the exotic carps have established in the beels better than IMCs. The local people in the district have high preference for small indigenous fish species, followed by exotic carp and IMC.

4. ICAR Outreach Activity on Fish Genetic Stocks

As part of the activity led by the National Bureau of Fish Genetic Resources (ICAR), Lucknow, the Institute was entrusted the task of assessing genetic stocks of catla, rohu and mrigal occurring in R. Brahmaputra. As part of the activity CIFRI Regional Centre, Guwahati collected data on length and weight and reproductive parameters for the targeted species. A total of 95 fish samples (15 *Catla catla*, 24 *Labeo rohita*, 11 *Cirrhinus mrigala* and 45 *Clarias batrachus*) were collected during the period 2011-12 from different landing centres of R. Brahmaputra (Uzanbazar, Dhubri, Tezpur and Kolongpar).

5. ICAR Outreach Activity on Nutrient Profiling of Fish

As part of the activity led by CIFRI, Barrackpore, CIFRI Regional Centre, Guwahati collected samples of selected fish species (*Tenualosa ilisha*, *Amblypharyngodon mola* and *Puntius sophore*) from Uzanbazar, Amingaon, Panikhaiti and Tezpur landing centres of R. Brahmaputra during three different seasons (pre monsoon, monsoon and post monsoon). These were analyzed for their moisture, protein, lipid and ash contents for determining their nutritional values. Seasonal variation in proximate composition of the fishes was observed. During the monsoon season, all fishes recorded lower lipid content. There may be possibilities of the fish storing more fat prior to breeding for development of gonads. It is also possible that the fishes build up body fats during active feeding seasons and the stored energy is used up during low feeding season. Except for *A. mola*, the protein content also decreased during the monsoon season, whereas it was similar during the other two seasons in all the fishes. Slight variation was seen in the moisture content of the fishes

both seasonally and among the fishes. From the above findings, it can be concluded that these fishes have high nutritional values in terms of lipids and proteins contents during the pre- and post-monsoon seasons, whereas, the nutritional values were reduced during the monsoon season.

6. Central Sector Scheme on 'Development of Inland Fisheries Statistics'.

Field surveys were conducted for collecting data on inland fisheries resources in nine blocks of Nagaon district, Assam. The data collected were collated with existing information available with the District Fisheries Office, Nagaon district, Assam as part of standardization of protocol for collection of inland fisheries statistics. A total of 40, 066 ponds have been recorded and reported from the district in the range of 0.01 to 3 ha. The density was worked out at 29.14 ponds per village. Analysis of data collected/ validated showed that majority of the ponds (94.85% of total 40,066 ponds) currently available in the district were in the range of 0.02 to 0.26 ha.

7. NICRA project on 'Assessment of spawning behaviour of major fish species in inland environment with a view to harness the beneficial effects of the temperature'.

A total of 438 IMC brooders (67 male & 89 female rohu, 39 male & 58 female catla and 90 male & 95 female mrigal) were collected from selected carp seed farms of Assam and Tripura during 2011-12 and their reproductive biology was studied. The studies showed that maturity of the IMCs advanced by nearly one month (from April to March) and the spawning season also extended for nearly one month (from July to August). A total of 150 hatcheries of Assam and 7 hatcheries of Tripura state were surveyed. Analysis of the data showed that a number of minor carps (*L. calbasu, L. bata, L. gonius*), new exotic fishes (*Barbonymus gonionotus* and *Hypophthalmichthys nobilis*)and indigenous catfishes (*Pangasius pangasius* and *Ompok pabda*) were used in addition to IMCs and exotic carps. Drastic reduction in the fecundity (up to 50%) was reported by some hatchery owners in the last few decades.

During 2012-13, a total of 432 fishes (75 male & 69 female rohu, 90 male & 54 female catla and 65 male & 79 female mrigal) were collected till March 2013 from Assam and Tripura. Majority of mrigal collected (85% of males & 87.54% of females) were found to be in matured stage followed by rohu (46.85% of males & 68.23% of females) and catla (34.54% of males & 29.57% of females). Length and weight of male rohu, catla and mrigal brooders ranged from 33.2-48.6 cm & 210-1120 g; 34.3-50.5 cm & 250-2050 g and 29.1- 41.3 cm & 180-540 g, respectively. The length, weight and absolute fecundity of female rohu, catla and mrigal brooders ranged from 31.4-50.5; 340-1500 and 51634-269328 ova; 33.3-49.5, 450-1820 and 75216-191280 ova and 31.8-42.7, 170-640 & 34585-124621 ova, respectively. The GSI values of the collected specimens were found to be in the range of 0.514-3.912, 0.113-3.284 and 0.179-3.602 for male rohu, catla and mrigal, respectively. Similarly for the female specimens of rohu, catla and mrigal the range was between 0.612-16.942, 0.578-13.5, 0.911-22.812, respectively.

Similar to the observations made in 2011-12, the maturity of IMCs in the study areas advanced by one month i.e. from April to March and the period extended upto one month i.e. from July to August during 2012-13. Incidences of abnormal gonadal development in case of *C. mrigala* such as presence of single-lobed ovary and retarded growth of one lobe of the ovary were observed in the present year.

8. **Contract research work initiated in the region**

i) 'Investigation of minimum environmental flow required for the sustenance of ecology and biodiversity in Nyamjang Chhu river in Arunachal Pradesh' as part of a consultancy project sponsored by Bhilwara Energy Ltd.

ii) 'Investigation and suggestive measures in fish migration in river Kameng' in Arunachal Pradesh as part of a CP sponsored by GMR Londa Hydropower Private Ltd.

iii) 'Study of minimum environmental flow requirement for aquatic life in river Dri and Tangon' in Arunachal Pradesh for Etalin hydroelectric power project and 'Study of minimum environmental flow requirement for aquatic life in river Tangon' in Arunachal Pradesh for Attunli hydroelectric power project.

B. Training and extension activities

1. Training programmes conducted

i) The Centre conducted a training programme on "Recent Advances in Management of Fisheries and Aquaculture in Northeast Region" for 19 number of Programme coordinator (PC), Subject matter specialist (SMS) and Programme assistant (PA) working under Krishi Vigyan Kendra (KVK) in Northeast India sponsored by ZPD, Zone III, ICAR Complex, Barapani during July 05-07, 2011 at CIFRI, Regional Centre, Guwahati.

ii) The Centre conducted training programme on 'Sustainable fishery management of freshwater wetlands' for 20 fishery officials from the states of Uttar Pradesh, Bihar, West Bengal, Assam, Arunachal Pradesh and Meghalaya sponsored by NFDB during November 15-21, 2011 at CIFRI Regional Centre, Guwahati

iii) The Centre conducted training programme on 'Fishery management of floodplain wetlands' for students of industrial fish and fisheries, Cachar College, Silchar, Assam during January 17-23, 2012 at CIFRI Regional Centre, Guwahati

iv) The Centre conducted a training programme on "Sustainable utilization of floodplain wetland resources for fisheries development" for 17 officials (Beel Managers and Junior Engineers) of AFDC Ltd., Guwahati, Assam during October 15-19, 2012.

v) The Centre conducted a model training course on "Fisheries enhancement/ culture-based fisheries in floodplain wetlands for increasing fish yield on sustainable basis" sponsored by Directorate of Extension, New Delhi during January 29 to February 5, 2013. Twelve State fisheries officials (from the states of Punjab, West Bengal, Bihar and Assam), Fisheries officers (from Bodoland Territorial Council and Dima Hasao Autonomous Council) and KVK personnel of AAU, Assam and Arunachal Pradesh were trained in the programme.

vi) The Centre conducted a training programme on "Wetland fishery management techniques" sponsored by NFDB, Hyderabad during February 19-23, 2013. Twelve State fisheries officials from the states of Assam, West Bengal, Bihar, Arunachal Pradesh and fisheries officials from AFDC Ltd., Assam were trained in the programme.

3. Participation in exhibitions

i) The Institute participated in an exhibition organized by the Directorate of Fisheries, Govt. of Assam on December 29, 2011 at Meen Bhawan, Guwahati on the occasion of inauguration of new Kamrup District Fishery office building by the Hon'ble Chief Minister of Assam.

ii) The Institute participated in the exhibition 'North East Agri Fair' at College of Veterinary Science, Assam Agricultural University, Khanapara during February 10-12, 2012.

iii) The Institute participated in an exhibition on the occasion of "ICAR-CII Industry Regional Meet 2012" at the College of Fisheries, Agartala on 03.07.12 and displayed CIFRI's activities/ technologies.

iv) The Centre participated in an Agri-business camp organized by Zonal technology management and business planning & development unit, NIRJAFT, Kolkata in collaboration with NRC on Pig, Rani, Guwahati at Rani on February 13, 2013.

4. Other extension activities

i) The Centre conducted an Inception workshop on "Scientific fisheries management of wetlands and reservoirs of NE Region" under ICAR NEH Component of the Institute on June 20, 2012, wherein fisheries officials from fisheries departments of Assam, Meghalaya, Arunachal Pradesh, Manipur and Tripura, Assam Fisheries Development Corporation as well as scientists/ teachers from NRC on Pigs (ICAR), Rani and College of Fisheries, CAU, Lembucherra participated.

ii) Pronob Das, Scientist, CIFRI Regional Centre, Guwahati participated in a live phone-in TV programme telecast by DDK, Guwahati under Krishi Darshan programme on 12.09.12.

B-13. NBPGR REGIONAL STATION, UMIAM, MEGHALAYA

The North-eastern region of India, due to its native variety of ecological habitats, supports great diversity of vegetation ranging from the cultivated plains to alpine vegetation. This region holds about 43% of total flora in India and is recognized as biodiversity hotspot and centre of origin of many cultivated plants. The National Bureau of Plant Genetic Resources is involved in PGR management in this region since 1978 through germplasm collection, characterization, evaluation and conservation. It also supplies germplasm accessions to the researchers for utilization of the collected germplasm in crop improvements programmes.

Major activities of the station

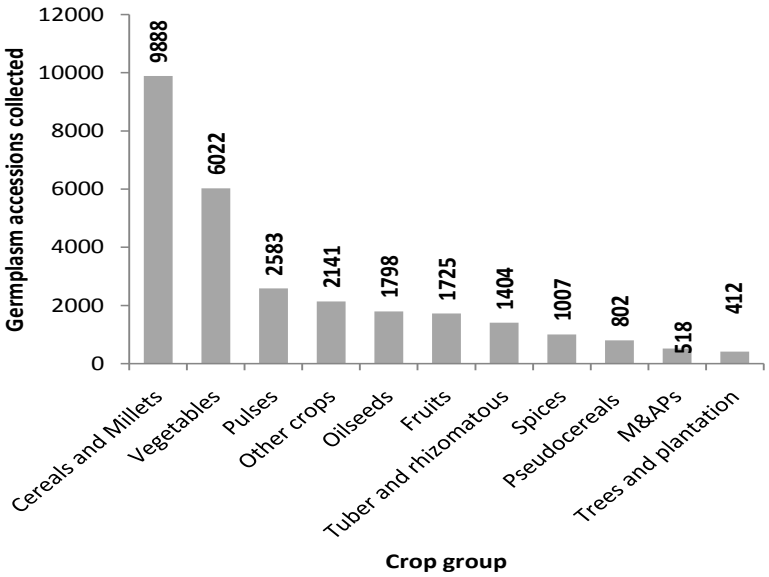
- Collection of local crop diversity, including crop wild relatives from North-eastern states through explorations.
- Characterization, evaluation and maintenance of germplasm of mandate crops such as field crops: paddy and maize; horticultural crops: chilli, ginger, turmeric, *Citrus*, banana, yam, taro and passion fruit; under-utilized crops: *Perilla*, Job's tear, buckwheat and rice bean.
- Documenting information in the form of inventories and catalogues on PGR.
- Conservation of germplasm both at National Genebank and at regional level in seed Genebank (under MTS) and in Field Genebank.
- Introduction and utilization of exotic crop germplasm.
- Need based supply of crop germplasm and information for research purpose.
- Imparting training on PGR management and building linkages with regional crop-based institutes.

Research programmes: Augmentation, characterization, evaluation, maintenance, regeneration, conservation, documentation and distribution of plant genetic resources in north-eastern India

Project 1: Augmentation, characterization, evaluation, maintenance, regeneration, conservation and documentation of genetic resources of agricultural crops (paddy-low land/upland, maize, and mustard) and their wild relatives.
Project 2: Augmentation, characterization, evaluation, maintenance, regeneration, conservation and documentation of genetic resources of horticultural crops (chilli, ginger, turmeric, yams, taros, *Citrus*, banana and passion fruit) and their wild relatives.
Project 3: Augmentation, characterization, evaluation, maintenance, regeneration, conservation and documentation of genetic resources of underutilized (UU) crops (rice bean, *Coix* , perilla and buck wheat) and their wild relatives.

Salient achievements

Exploration and Germplasm Collection:
Intensive efforts were made to collect diversity of NEH region in collaboration with various national organizations, which led to the collection of 28,300 accessions of crop germplasm in about 260 explorations. Crop group-wise classification of collected germplasm is given below:



Details of germplasm collection by NBPGR

Germplasm Characterization and Evaluation:

This Station has been performing characterization and evaluation of the germplasm accessions of mandate crops. Based on characterization results, accessions with superior trait value have been identified. The evaluation data are documented in form of catalogues/research papers for sharing information among the potential users of the germplasm and encouraging germplasm exchange.

Table: Characterization of Crop Germplasm during 1986-2012

Crop group	Major crops	Till 1990	1991-95	1996-00	2001-05	2006-10	2011	2012
Cereals	Paddy, maize	17,209	16,823	12,344	12,780	12,962	653	482
Legumes	Rice bean	2,015	1,719	853	3,643	903	155	106
Oilseeds	*Perilla*	75	257	143	229	196	40	51
Tuber & rhizomatous	Taro, *Dioscorea*, turmeric, ginger	1,000	2,653	2,081	3,005	2,249	-	335
Spices	Chilli	195	198	197	514	343	-	105
UU&UEP	Buckwheat, Job's tear	36	54	177	514	710	139	55

Several germplasm were identified for agronomic/unique traits. A maize line (MCM-11/01) with multiple cobs (3-5 cobs/plant) was selected from trial plot of an indigenous collection (IC524594). Evaluation of the selected line showed that it had a higher (3.4) number of cobs/plant comparison to the checks with single cob/ plant. Though the selection had higher number of cobs/plant, but the grain yield/plant was not significantly higher than the checks, mainly due to its

smaller grain size. Besides higher number of cobs, MCM-11/01 had dark brown coloured husk and cream coloured kernel (see below). This trait can be exploited to enhance maize yield.

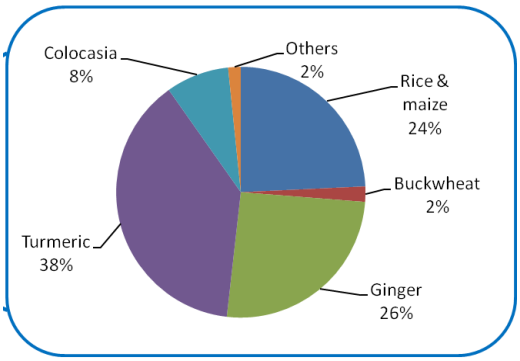
A multi-cob maize line (MCM-11/01) selected from indigenous germplasm

Germplasm conservation and maintenance:

A total of 7,570 germplasm accessions were sent to National Genebank, New Delhi for long-term conservation. As many as 1070 germplasm have been maintained under medium term storage (MTS) at the StationAll together 610 germplasm accessions comprising of ginger (152), turmeric (186), yam (46), taro (20), *Musa* spp. (60), *Citrus* spp. (29), guava (8), passion fruit (5), minor fruits (4) and M&APs (100) have been maintained in the field genebank.

Exchange of germplasm:

Supply of PGR to the researchers is one of the important activities of this station. A total of 6,449 accessions of various crops have been supplied and about 4,800 accessions have been received from different research organizations for maintenance and conservation at Genebank.



Crop-wise distribution of supplied materials

B-14. CPRS, REGIONAL STATION, SHILLONG

History of the Station

Central Potato Research Station, Shillong (Meghalaya) was established in 1959 under the Central Potato Research Institute, Shimla as a potato experimental trial center. The center was strengthened and upgraded to the status of a "Research Station" during the 5th Five-year plan to conduct research on the regional problems in potato cultivation. The station is also an important centre of the All India Coordinated Potato Improvement Programme (AICPIP).

Central Potato Research Station is located in Upper Shillong at an elevation of 1860 m above MSL and is spread over an area of 12.6 hectares. The station is about 8 km from Shillong on the road to Shillong Peak. It is strategically located in East Khasi Hills, which is highest potato growing district of Meghalaya. The average temperature varies from a minimum of 1.3^0 C in January to a maximum of 25.4^0 C in July. The relative humidity ranges from 38% in February to 96% in November. The rainfall averages 2850 mm.

Potato Status in Meghalaya

Potato was introduced into India in the beginning of the 17th Century and was reported to have been cultivated in several parts of the country including probably the North Eastern parts. However, records show that potato cultivation probably came into existence with the introduction of popular variety 'Khasi' in Meghalaya (then Assam hills) around 1830. Nearly 10% of the total geographical area of Meghalaya is under cultivation. Agriculture in the state is characterized by limited use of modern techniques and low productivity. Potato is an important crop of the NE region contributing nearly 10% of the country's total potato area. The total area under potato in Meghalaya is about 18,000 ha and largest area under the crop is in the East Khasi Hills District. . The area under potato as a percentage of the net cropped area is about four times the national level. The per capita availability of potato in Meghalaya (96.5 Kg annually) is much higher than the national level (16.5 Kg annually). The productivity of all North Eastern states except Tripura (17.5t/ha) is low (4-10 t/ha) as compared to the national average of 18.2 t/ha. The productivity in the state varies from 9-10 t/ha.

There are many inherent problems in the region which makes agriculture difficult to practice. A substantial portion of the cultivated area is under the traditional shifting agriculture known locally as "Jhum" cultivation which led to degradation of land causing soil erosion and loss of nutrients. The fixation of applied phosphorous due to high aluminum content in the acidic soils of the region, results in poor yields. High rainfall in the main season (March- July) causes heavy infestation of weeds and attack of many diseases like late blight, brown rot and pests. The non-availability of good quality potato seed at the right time leads to use of degenerated planting material while non- availability and/ or imbalanced use of fertilizers and inappropriate plant protection measures further reduces the yield levels.

Mandate of the Station

- Breeding for resistance to late blight of potato
- Seed production
- Standardizing agronomic and manurial practices
- Integrated Diseases and Pest Management
- Evaluating the impact of potato production technologies

Major Research Area

- Integrated approach for maximization of quality seed potato production.
- Breeding cultivars for multiple disease resistance for Indian hills and plateau region.
- Development of true potato seed (TPS) population.
- Resource management strategies and information technology tools for potato based cropping systems.
- Nutrient and weed management in potato.
- Analysis of adoption pattern and technology gap in important potato growing areas.
- Management and enhancement of potato germplasm.
- Characterization, detection and management of major soil and tuber borne pathogens of potato.

Brief achievement of research

Crop Improvement

Evaluation for growth potential of top, middle and lower portion of nodal cuttings of micro-plants of four potato varieties namely Kufri Giriraj, Kufri Girdhari, Kufri Himalini and Kufri Himsona were done under laboratory condition. There was no clear cut distinction between top, middle and lower stem segment of microplants for subsequent sub-culturing. The top segment showed vigorous rooting and better leaf size while the lower segment produced maximum number of nodes. The middle segment exhibited highest growth rate. Thus, all the stem segments can be used for micro propagation through sub-culturing of nodal segments in potato microplants.

Effects of different spacing and grading on potato minitubers multiplication was studied under net-house conditions using the cultivar Kufri Himalini. At reduced spacing, the same sized tubers gave more number of tubers per plant but the total yield is reduced due to reduction in tuber size. Since more number of tubers/plant are needed for fast multiplication of the seed material hence, the spacing can be reduced to 30 x 15 cm for relatively large sized mini-tubers (>6 g).

Development of Varieties/ Hybrids

High yielding varieties like Kufri Jyoti, Kufri Megha, Kufri Giriraj, Kufri Kanchan, Kufri Girdhari, Kufri Himalini and Kufri Himsona have been developed for the NE states. The varieties like Kufri Jyoti and Kufri Giriraj are predominant in the region. Besides, Kufri Megha (late blight resistant) is popular in Meghalaya and Assam and Kufri Kanchan (red skinned variety) is preferred in Sikkim and Arunachal Pradesh and parts of Nagaland. The newly released varieties Kufri Girdhari, Kufri Himalini and Kufri Himsona have been demonstrated in the farmers filed and they are also being adopted gradually by the farmers in the region.

Seed Production

Disease free quality planting material of Kufri Jyoti, Kufri Giriraj, Kufri Himalini, Kufri Himsona, Kufri Girdhari and Kufri Megha are being produced through micro-plants and micro tubers/mini under controlled condition and are being supplied to various states in NEH region. The station has produced 450 quintals of disease free quality seed, out of which about 348 quintals of seed was supplied to different government, research and private department during 2011-12. However 200 quintal of disease free quality seed was produced during 2012-13 and 110 quintals of seed was supplied to different states of NEH region.

Production Technologies

Based on the field experiment on 2011-12 and 2012-13 to evaluate potato based cropping system in Meghalaya hills, the Potato-Cabbage cropping system has been found better for

maximum profitability under rainfed condition of Meghalaya hills. Further, it is concluded that planting of radish as an intercrop with potato in the ratio of 1:1 was more remunerative for intercropping system for the hilly region of Meghalaya. Among the cropping system Potato-Cabbage gave the highest potato equivalent yield while application of 50% Recommended dose of fertilizer (RDF) to potato and 50% N through FYM and 100% RDF to subsequent crop brought about significant improvement in potato equivalent yield over rest of the treatments. Weed management study in potato in NEH region indicated that application of Metribuzin @ 1kg/ ha as pre emergence application was found more effective from economics point of view in controlling the weeds in potato crop. Soil of this region is rich in potassium but deficient in phosphorus and hence emphasis has been given on identification of phosphate efficient potato varieties for this region. Based on last two years experiment, Kufri Girdhari has recorded highest potato tuber yield with application of 50kg P_2O_5/ha as compare to other treatment. Evaluation of organic farming practices in potato has also been conducted**.** The highest tuber yield was found in inorganic treatment (RDF) followed by second highest under organic treatment (application 30 ton FYM + Azotobacter and PSB).

Protection Technologies

Screening of potato germplsam against late blight of potato was done regularly in the natural epiphytotic condition. Among 77 germplasm lines of potatoes tested, CP-3841, CP-3605 were found resistant late bight as compared to K. Girdhari. CP lines viz. 1750, 2298, 2379, 2380, 2423, 3841, 3277, 3768, 2279, 2132, 3766, 3374, 3776 were found moderately resistant to late blight of potato. Combinations of systemic and contact fungicides were found most effective and economic in management of late blightof potato. Three sprays *viz*. prophylactic spray with mancozeb (0.2%) + (dimethomorph (0.2%) + mancozeb (0.3%)) +mancozeb followed by Curzate M 0.3% (Cymoxanil+Mancozeb) provided maximum protection from late blight in Kufri Jyoti. Efficacy of bio control agents against late blight of potato was tested in field in natural epiphytotic condition. Three sprays application of bio-agent *Trichoderma harzianum* WP was found best effective in controlling late blight followed by *Chaetomium globosum* WP II.

Molecular characterization of *Ralstonia solanacearum* strains of potato in Meghalaya was done using bio-chemical method of testing. Based on the ability to utilize disaccharides and oxidise hexose alcohols, forty three isolates were categorized as biovar 2T, twenty one isolates as biovar 2 and three isolates as biovar 3. Based on multiplex PCR analysis, forty three *R. solanacearum* isolates were assigned to phylotype IV, twenty one isolates to phylotype II and three isolates to phylotype I revealing the prevalence of three out of four phylotypes in Meghalaya.

Soil application of Phorate 10 G @ 15 kg/ha at planting and drenching of ridges with Chlorpyriphos 20 EC @ 2.5 ml/litre of water on the appearance of the pest was found effective and gave highest yield.

Storage technology

Farmers of NE states are unaware of scientific storage methods for both table and seed potatoes and the scarcity of cold storages prompts them to use various indigenous methods for *in situ* and *ex situ* storage. Community level storage structure has been designed and implemented with the financial assistance of NABARD in Mylliem village with a capacity of 50 quintals of seeds. The community level storage structure was intended for storing seed potatoes for 6 to 8 months under diffused light with proper ventilation. In the mid hills of Meghalaya, temperature remains low during the storage period (August to January) which delays dormancy release and sprouting and reduces the losses. It also maintains the right physiological age of seed potatoes for the next planting. Before storing, the well cured seed after sorting should be treated with 3% boric acid solution for control of diseases. The potatoes are well spread on the racks and the layer should

not be very thick (only 3-4 potato layer). Covering the seeds with sun dried foliage of Lantana helps in lowering the incidence of PTM on these potatoes. The diffused light helps in slower development of sprouts and they do not become very long by the end of storage duration. On an average each farmers kept 1.4 quintals of potato seed in the seed storage structure and could save Rs. 2100 on seed expenditure in the next sowing season.

By adopting the practice of storing seed potatoes in community level storage structure and also delaying selling of potatoes at harvest, the farmers from Mylliem, Mawnanglah, Nongpyiur, Myrkhan, Lmsohriew and Mawklot villages of East khasi hills district not only ensured availability of healthy seeds for planting but also increased their profit through potato cultivation. The storage technology did not require any sophisticated implement and was constructed solely of locally available structure. Moreover, the structure can be modified to increase or decrease its capacity to suit individual's requirement. The farmers have shown their keenness to adopt such storage practice. It is expected that the success story of *on farm* storage structure in these villages will spread to other places through the farmers and others will also be motivated to follow the same.

On-farm demonstration

On-farm demonstrations have been conducted in the farmers' fields to demonstrate production and protection technologies. More than 1200 farmer beneficiaries received quality planting material and cultivation technology and this enabled them realise 36-180% yield increase over their own seed and technology. Farmers favourably perceived the newly introduced variety Kufri Giriraj on the attributes of plant growth, resistance to late blight, yield and better marketability of the produce. Front line demonstrations on TPS hybrids were conducted and TPS 92-PT-27 was found suitable due to its tuber uniformity, high yield and late blight resistance. During 2011-12, field demonstration with High yielding potato variety: Kufri Giriraj, Kufri Giridhari and TPS population 92-PT-27 was done in 40, 4 and 10 farmers fields respectively in of East Khasi Hills district of Meghalaya. Whereas in 2012-13 field demonstration with High yielding potato variety: Kufri Himalini, Kufri Giridhari and TPS population 92-PT-27 was done in 20, 20 and 11 farmers fields respectively in East Khasi Hills district of Meghalaya.

Training

Training is an integral part of the station and our station is continuously organising both *on farm* and *off farm* farmers' trainings. Training for knowledge and skill up-gradation in potato production technologies of the farmers as well as extension officers in this region is an ongoing activity of the station. More than 1,600 farmers and 80 extension officers have been trained in the last few years and improved potato production, protection, post harvest and storage technologies imparted to them from which they have greatly benefited. During 2011-12 our station organised 5 farmers training benefitting 270 farmers whereas 10 trainings were conducted during 2012-13 which benefitted 540 farmers.

Impact of Improved Technology

- Kufri Giriraj used for the demonstration recorded an average yield of 17.4 t/ha. While the local variety used by the farmers recorded only 6.9t/ha. An average 152.1 % increase in yield was observed in Kufri Giriraj over local variety. The farmers expressed their desire to adopt the improved variety.
- Stable bleaching powder reduced incidence of bacterial wilt in low land/lower slope conditions - from 10 – 20% to 1 – 2% with up to 15% yield advantage.
- Farmers' meeting/Field days helped to create awareness among the farmers about improved technologies of potato production, protection, storage *etc.*, their knowledge and skill increased considerably.

Chapter-5

RESPONSE AND STATUS OF DIFFERENT DIVISIONS

B-21. CROP SCIENCE DIVISION

FOOD & FODDER CROPS

Important crops of the region

The states under Regional Committee III are Assam, Sikkim, Mizoram, Arunachal Pradesh, Nagaland, Tripura, Meghalaya and Manipur. Rice is the main crop of this region. Other food crops grown are maize and wheat. Rice is grown as rain-fed upland, lowland and irrigated crop. The main seasons for growing rice in Assam are *Ahu* (March-June); *Sali* (June-October); and *Boro* (Nov-May)

Area, production and productivity of rice and wheat in Assam

Crop	2010-11			2011-12		
	Area (m ha)	Production (m t)	Yield (kg/ha)	Area (m ha)	Production (m t)	Yield (kg/ha)
Rice	2.57	4.74	1844	2.17	4.01	1849
Wheat	0.04	0.05	1250	0.05	0.06	1135

Research support in the region

1. **ICAR/Institutes/ Directorates/ Regional Stations/ Centres:** CRRI Rainfed Lowland Research Station, Gerua, Kamrup, Assam
2. **All India Coordinated Research Centres:** The list of research centres under All India Coordinated Research Projects of important food and fodder crops are given below:

Crop	AICRP Centres
Rice	(i) CAU, Imphal, Manipur (ii) Kohima, Nagaland, (iii) Agartala, Tripura, (iv) Upper Shillong, Meghalaya, (v) AAU Jorhat & Karimganj, Assam
Wheat	(i) CAU, Imphal, Manipur (ii)Shillongani, AAU Jorhat
Maize	) CAU, Imphal, Manipur (ii) AAU Jorhat
Forages	(i) CAU, Imphal, Manipur (ii) AAU Jorhat

Major recommendations

Rice

- To ensure optimum plant population, transplant 25-30 days old seedlings at a spacing of 20 x 10 cm (for early and medium duration varieties) with 2-3 seedling per hill.
- Apply lime and / or potash in acid soils to alleviate iron toxicity.
- For effective spilt application of nitrogen, drain out water prior to top dressing and irrigate after 24 hours.
- Apply coated fertilizers such as neem-coated urea or adopt 3 or more splits of nitrogen in soils with excessive percolation.
- Apply zinc sulphate @ 30-50 kg/ha to ameliorate zinc deficiency.
- Ensure adequate irrigation at critical crop growth stages- panicle initiation and flowering.

- Under late conditions, planting at 10-15 cm apart using 5-7 seedlings per hill.
- Timely use of recommended doses of chemicals to control weeds and pests

Wheat

For Assam and plain areas of other NE states

- The area is prone to brown rust and leaf blight diseases. Therefore, varieties recommended for the region should be encouraged.
- For irrigated timely sown (mid November), seed rate of 100 kg/ha and fertilizer doze of 150:60:40 kg NPK /ha (1/3 N at sowing and 2/3 at first node stage) is recommended
- For irrigated late sown (first fortnight of December),seed rate of 125 kg/ha and fertilizer doze of 120:60:40 kg NPK / ha (1/3 N at sowing and 2/3 at first node stage i.e. 35-40 DAS) is recommended.
- For rainfed (second fortnight of October) a seed rate of 125 kg/ha and fertilizer doze of
- 60:30:20 kg NPK / ha to be applied at the time of sowing is recommended.
- For control of weeds, proper doze & time of applying of the recommended weedicides should be followed or hand weeding should be done to have good yields.

Forages

- Apart from the other recommended forage crops' varieties, use of other released variety CVS 21 F and two forage hybrids CSH 20 MF and CSH 24 MF is also recommended.
- One rice bean variety 'Shyamalee' has been recommended for Assam.
- In Setaria, a new variety PSS-1 has been recommended.

Maize

Area, production and productivity of maize in North Eastern states (2009-10 to 2011-12)

State/ UT	Area ('000 ha)			Production ('000 tonnes)			Yield (kg/ha)		
	2009-10	**2010-11**	**2011-12**	**2009-10**	**2010-11**	**2011-12**	**2009-10**	**2010-11**	**2011-12**
Arunachal Pradesh	44	45	46.5	60	65	69	1380	1435	1473
Assam	19	20	21.3	14	14	15	726	722	718
Manipur	5	22	24.9	12	42	45	2436	1856	1823
Meghalaya	17	17	17.4	26	26	27	1529	1499	1523
Mizoram	9	9	6.9	12	14	8	1347	1508	1217
Nagaland	68	68	68.5	73	134	134	1075	1958	1961
Sikkim	40	40	40	66	66	66	1671	1648	1655
Tripura	2	3	3.7	2	4	5	1006	1322	1378
A & N Islands	0	0	0.2	0	0	3	2000	2476	15000
Total/average	**203**	**225**	**229**	**266**	**365**	**373**	**1305**	**1618**	**1625**
All India	**8262**	**8553**	**8782**	**16719**	**21726**	**21723**	**2024**	**2540**	**2474**

Maize varieties suitable for various North eastern states and seasons

List of hybrids and composite varieties of different maturity groups for different states for *kharif* season

States	Extra early maturity	Early maturity	Medium maturity	Late maturity
NEH Region	Vivek 21& 25, PEMH 5	Parkash , JKMH 1701, X 3342	Pratap Makka 4, HQPM 1	Pro 311, Bio 9681, Seed Tech 2324, NLD white
Assam	-	Parkash, X 3342	DK 701, Pratap Makka 4, HQPM 1	Vijay, NLD white,

List of hybrids and composites varieties of late maturity groups for different states for *rabi* season

States	Late maturity
NEH Region	Pro 311, Bio 9681, Seed Tech 2324, NLD white
Assam	NLD white

List of hybrids and composites varieties of different maturity groups for different states for *spring* season

States	Extra early maturity	Early maturity
NEH Region	Vivek 21& 25, PEMH 5	Parkash , JKMH 1701, X 3342
Assam	-	H:Parkash, X 3342

Diseases and pest, and their management

Diseases	Management
Turcicum leaf blight	1. Use resistant moderately resistant varieties/hybrids (PEMH-5, Vivek 21, Vivek 25. 2. Practice rotation of maize with non-host crops to reduce disease incidence. 3. Sanitation, clean plough down of infected crop debris. 4. Spraying with mancozeb (Dithane M-45/ Indofil M-45) or zineb (Dithane Z-78) @ 2-4g/litre at 8-10 days interval.
Banded leaf and sheath blight	1. Stripping of lower 2-3 leaves along with their sheath considerably lowers the incidence and also does not affect grain yield. 2. Seed treatment with peat based formulation @16 g/kg of Pseudomonas fluorescence or as soil application @ 7g/litre of water, carbendazim, thiophanate-methyl and captan. 3. Foliar spray (30-40 days old crop) of tolcofos-methyl (Rhizolex 50 WP) @ 10g/10 litre or validamycin @ 2.7 ml/litre of water.
Common rust	1. Cultivate early maturing varieties. 2. Spray of mancozeb (Dithane M-45/ Indofil M-45) @2-4g/litre of water at first appearance of pustule. 3. Three sprays of fungicide at 15 days interval are recommended if needed.

Management practices for insect pests

A. Cultural

- Deep summer ploughing followed by fallowing helps in exposing resting stage of pests

- Inter-cropping with legume reduces borer incidence. Maize-Soybean/Maize-Cowpea/ Maize-Green gram are some of the good examples
- Use of well decomposed farm yard manure (FYM) reduces termite attack
- Plant spacing 75 cm x 18 cm in Kharif and 60 cm x 18 cm in Rabi is recommended
- Balanced use of fertilizers (NPK 120:60:40) kg/ha and supplement of micronutrient
- Proper water management practices to avoid foot rot

B. Genetic

- Use certified seeds of recommended verities having built-in mechanisms for resistance of local pest problems

C. Mechanical

- Removal of dead hearts will help to reduce second generation infestation
- Use of bird scarer prevents seed damage
- Manual collection and destruction of white grub and chaffer beetle during adult emergence period reduces the pest population

D. Bio-pesticides

- Soil application of neem cake for control of nematode and chaffer beetle

E. Biological control

- Conservation of naturally occurring biocontrol agents such as *Trichogramma chilonis* Ishii., *Cotesia flavipes* Cameron, Carabids, Coccinellids, Chrysoperla, spiders and wasps, etc. and by reducing chemical pesticides.
- Release of *Trichogramma chilonis* @ 1,60,000 /ha. on 7 and 15-day old crop

F. Chemical control

- Need based and judicious application of pesticides is an important components of IPM.
- Granular application of Carbofuran 3% CG in whorls of infested plants to control stem borer, shoot fly and thrips
- Spray of Carbaryl 85% WP @ 2.35 g/L against borer at 15-18 days after germination.
- Spray Monocrotophos 36% SL @ 625 mL/ha or Dimethoate 30% EC @ 1155 mL/ha or Oxydemeton – methyl 25% EC @ 1000 mL/ha or Phorate 10% CG @ 30 Kg/ha for the management of shoot fly

Varieties/hybrids released by NARS during last two years for the region

Crop	Variety/Hybrid	State
Paddy	RC Maniphou 11	Meghalaya and Manipur
Wheat	DBW 39	Assam
	HD 2985	Plains of Assam
	VL Gehun 907	Sikkim
	HS 507	North Eastern states (low and mid hills)
	CBW 38	Assam and Manipur
Maize	HM 11	Assam
	HM 10	Assam
	Pusa Sankul Makka 3	Assam
	Vivek Maize Hybrid 33	North Eastern states
	Vivek QPM 9	North Eastern states
Forage crops		
Cowpea	UPC 625	Assam
Guinea grass	Bundel Guinea Grass 2	Entire country including NEH States
Job's tear	BidhanCoix 1	Assam

OILSEEDS & PULSES

Overall, oilseeds cover 6-8% of gross cropped area in North Eastern States including Sikkim except Manipur (2.4%), Meghalaya (3.8%) and Tripura (3.3%). Over 2007-08, total oilseed acreage has increased by 0.37 lakh ha in 2009-10 mostly in Nagaland (0.24 lakh ha) but also in Assam (0.9 lakh ha) and Arunachal Pradesh (0.4 lakh ha). At the same time, rapeseed-mustard area in this region increased by (0.45 lakh ha) that too mostly in Nagaland (0.31 lakh ha) and also in Assam (0.10 lakh ha) and Arunachal Pradesh (0.4 lakh). There has been 110% increase in the area of rapeseed-mustard in Nagaland but area under soybean, sesame and groundnut has reduced in the state. The area under linseed has also increased in Nagaland by 25% during this period. Nevertheless, Assam still contributed 63% to the total oilseeds acreage and over 78% to the total acreage under rapeseed-mustard in the North Eastern States including Sikkim. Soybean, Sesame, Groundnut, Castor, Sunflower and Niger are the other oilseeds being cultivated in the region on a small scale and in isolated pockets.

There has been a marginal increase (0.5%) in the area of total pulses in the North Eastern States including Sikkim in 2009-10 over 2007-08, which is hovering around 2.0 lakh ha. This increase mainly came from the states like Assam, Arunachal Pradesh and Sikkim. A little decline in the pulses' acreage has been observed in Nagaland, Mizoram and Tripura while the area in Manipur and Sikkim remained stagnant over this period. Contribution of Assam to total pulses acreage has been substantial, i.e. about 57% mostly occupied by *rabi* pulses especially, urdbean, lentil, field pea, rajmash and mungbean. Similar situation prevails with regard to the choice of pulses crops in other important pulses growing states of North Eastern India like Nagaland, Manipur, Sikkim and Arunachal Pradesh.

Research support in the region

The following All India Coordinated Research Projects (AICRP) of ICAR operate in the region for providing necessary support to research needs of the region in specific reference to the crop.

Crop	**AICRP Centres**
Soybean	CAU, Imphal, Manipur; COA, Medzipharma, Nagaland; AAU, Bishwanath Chariali, Assam
Rapeseed-Mustard	CAU, Imphal, Manipur; AAU, Shillongani, Assam
Linseed	AAU, Shillongani, Assam
Groundnut	CAU, Imphal, Manipur
Mungbean, Urdbean, Lentil, Lathyrus, Rajmash, Field Pea	AAU, Shillongani, Assam; CAU, Imphal, Manipur,; ICAR Research Complex, Agartala, Tripura
Pigeon pea	COA, Medzipharma, Nagaland, CAU, Agartala, Tripura
Chickpea	AAU, Shillongani, Assam, CAU, Imphal,

Major achievements and recommendations

Varieties of oilseeds and pulses recommended for the region:

Crop	Improved varieties
Rapeseed-Mustard	Indian mustard Sej-2, JD 6, Kranti, NDRE 4, NPJ-112; Toria: PT-507; Yellow sarson: Ragini, Subinoy, NRCYS 05-02, YSH - 401
Groundnut	**Rabi**: TG-38 B, Vasundhara, TG-51, Vijetha, Girnar-3, GPBD-5; **Kharif:** Mallika, Girnar 3, Vijetha
Soybean	NRC 2, JS 80-21, PK 472, MAUS 71, Pratap Soya , Indira Soya 9, Pusa 16, JS 335, RKS 18, JS 97-52
Sunflower	**Hybrid**: KBSH44, DRSH1 **Variety:** DRSF 108, DRSF 113
Castor	GCH-7, DCH 519
Linseed	Shekhar, Sweta, Shubhra, T- 397, **Double purpose** : Rashmi, Meera, Shikha, Gaurav, Parvati
Sesame	Uma, Rama, Krishna, JTS-8, TKG-21, TKG-22, TKG-55, Nirmala-22,
Niger	JNS-9 , Biras Niger-2, BNS-10, NRS 96-1
Lentil	KLS 218, HUL 57, WBL 77, VL 507, VL 126
Urdbean	Azad Urd 1, Utara, WBU 109, NDU 99—2, Pant U 31
Rajmash	Amber, utkarsh, PDR 14, Hur 15
Mungbean	Pant M-4, HUM 12, Meha, TMB 37, HUM 16, AAU 34, Pusa 0672, KM 2241, Pant M-6
Pigeon pea	Bahar, Pusa 9 and UPAS 20
Chickpea	JG 74, KWR 108, Radhey, KPG 59, Pusa 372
Field pea	Gomti, HUDP15, VL Matar 47

Major package of practices for oilseeds and pulses

Rapeseed-Mustard

- The recommended spacing is 30 cm row- to- row and 10 cm plant- to- plant for irrigated and 45 cm row to row and 15 cm for plant to plant for rainfed situation.
- Half of the fertilizer dose of nitrogen of 80: 40:40 Kg/ha. N, P, K. is to be given at the time of sowing and remaining half of the nitrogen is to be applied after first irrigation.
- Two irrigations, first at 35 DAS and other at 65 DAS are recommended.

Weed Management: Pre-sowing application of fluchloralin @ 1kg a.i./ha followed by one hand weeding at 30 DAS significantly reduces weeds population and its dry matter. Pre emergence application of Pendimethalin supplemented with one hand weeding at 30 DAS was also found very effective against most of the common weeds.

Control of mustard aphid: Balanced fertilization (NPK @80:40:40 kg/ha) is suggested as overdose of nitrogenous fertilizers attract aphid attack in mustard; Plucking and destruction of infested twigs is essential and should be done 2-3 times at ten days interval in the crop season; Use dimethoate 30 EC @ 0.1% for three sprays at fifteen days interval

Control of Alternaria blight: Spray the crop with mancozeb @ 0.2% at 50-60 days after sowing followed by two more sprays at 30 days interval depending upon severity of the disease; Collect and burn the diseased plants debris to minimize the primary source of inoculum.

- For control of white rust, use the seeds from disease free plants to avoid carryover of spores through seeds and treat the seeds with Apron 35 SD @ 6 g/kg seeds and destroy the diseased plant debris.

Groundnut

- Row to row spacing for Spanish bunch type should be kept 30x10 cm and for Virginia types 15x15 cm
- For effective weed management, pre-emergence application of Pendimethalin @ 1.0 kg a.i./ha plus one hand weeding at 40 days after sowing is recommended. Sesame + Spring groundnut (4:2) inter cropping is suggested.
- Nutrient: N: P2O5: K2O: Gypsum:: 40: 80: 60: 250 kg/ha recommended for Kharif with only reduction of 20 kg K2O and doubling the amount of Gypsum for rabi crops. Nitrogen is applied in split dose i.e 50% at the time of sowing and 50% at the time of inter culture. Gypsum is applied during the peak flowering stages.
- Seed treatment with biofertilzers (bradyrhizobium, rhizobium, phosphorus solubilising microbes and PGPR): This enhances nitrogen fixation in the root nodules and also enhances the availability of phosphorus. Application of Rhizobium is a must in the soils where groundnut is cultivated for the first time.
- Control of major insect-pests
- Major sucking pests like aphids, jassids and thrips can effectively be controlled by spraying 0.05% Monocrotophos or 0.05% Dimethoate.
- Setting up light traps for destroying the moths can control leaf miner. Chemical control should be adopted at the economic threshold level (larval population 61-70 per 100 leaflets). Carbaryl 50 WP 0.2% spray is most economical.
- Red-hairy caterpillars can be controlled effectively by spraying Monocrotophos 40 EC @ 1000 ml/ha before the caterpillars develop hair. Egg masses and larvae, which can easily be detected, may be collected and destroyed.
- Spodoptera and Helicoverpa, are nocturnal in habit and hence control measures have to be taken up either in the early morning hours or in the late evening hours. To control these pests spray of Quinalphos @ 0.05% @ 400 ml/ha may be undertaken. Other insecticides like Carbaryl 0.2%, Endosulfan 0.04%, Parathion 0.05% are also effective. Planting of castor, pearl millet and pigeon pea as trap crops in groundnut has also been found effective.
- Control of major diseases
- Early and late Leaf spots and Rust: Bavistin 0.05% along with Dithane M 45 0.2% should be sprayed two or three times at 15-20 day intervals starting from 4-5 weeks after planting. Two or three sprays of Chlorothalonil 0.3% at 45, 55 and 75 DAS control these diseases effectively. Two to five percent crude neem leaf extract at two-week intervals can also control the foliar diseases. This practice, besides being eco-friendly, is cheaper and could be adopted by the small and marginal farmers.
- Collar rot, stem rot and dry root rot: Each kg of seed should be treated with 3 g. Dithane M-45 or 2 g Bavistin. Soil amendments with castor cake @0.5 t/ha and bio pesticide formulation of Trichoderma viride @ 25kg/ha effectively controls stem/root rots.
- Peanut bud necrosis disease (PSND): This disease is caused by peanut bud necrosis virus (PSNV) and cannot be controlled through chemicals. Thrips which transmit the disease should be controlled by using Dimethoate @ 400 ml/ha. The cultural methods like early planting, closer spacing and intercropping with millets are also advised.

Soybean

- Optimum sowing times for north eastern states lies during 15th to 30th June.
- The row spacing of 45 cm and seed rate of 75 kg/ha.
- Seed treatment with Thiram 75 WP + Cabendazim 50 WP (2:1) @ 3 g/kg seed or Trichoderma viride @ 4-5 gm/kg seed.
- For weed management, two hand weedings at 20 and 40 DAS or application of Fluchloralin or Trifluralin @ 1 kg a.i./ha as pre-plant incorporation or Alachlor @ 2 kg a.i./ha or Pendimethalin @ 1 kg a.i./ha or Metolachlor @ 1 kg a.i./ha or Clomazone @ 1 kg a.i./ha as pre-emergence or Imazethapyr @ 75 to 100 g a.i./ha or quizalofop ethyl @ 50 g a.i./ha as post-emergence (15 –20 DAS) dissolved in 750 to 800 litres water/ha.
- Insect management, furrow application of Phorate 10G @ 10 kg/ha, followed by 1 or 2 sprays of Quinalphos 25 EC (1.5 lit/ha) or Endosulfan 35 EC @ (1.5 lit./ha) or Monocrotophos 36 SC (0.8 lit./ha) or Triazophos 40 EC (0.8 lit./ha) or Methomil 40 SP (1 kg/ha) or Chlorpyriphos 20 EC (1.5 lit./ha) or Ethofenprox 10 EC (1 lit./ha), depending on the pest damage. For one ha, the spray volume has to be 750 to 800 lit.
- Foliar diseases like Myrothecium, Cercospora leaf spot and Rhizoctonia aeria blight: Two spray of carbendazim 50 WP or thiophanatemethyl 70 WP @ 0.5 kg in 1000 l water/ha at 35 and 50 DAS.
- Bacterial pustule: Spray of Copper oxychloride 2 Kg + Streptocycline 200 g /1000 l water at the appearance of the disease.
- Yellow Mosaic: Spray of thiomethoxam 25 WG @ 100 g/ha or methyl deinaton @ 0.8 l/ha.
- Rust: Two to three sprays of hexaconazole or propiconazole or triadimefon or ocycarboxin @ 0.1%. First spray at the time of appearance of rust followed by subsequent sprays at 15 days control. For hot spot areas one prophylactic spray of any of above fungicide at 35 to 40 days after sowing.

Linseed

- Seed rate: 25-30 kg seed for seed purpose and 45 kg for double purpose and optimum spacing is 25 cm whereas for double purpose varieties 20 cm is recommended.
- Half dose of Nitrogen (NPK::60:80:20 kg/ha) at the time of sowing and rest after the first irrigation.
- Post emergence application of weedicide i.e., isoproturon @1kg/ha + 2, 4 D @0.5kg/ha at 35 DAS controlled weeds effectively.
- Developed IPM Module (Sowing of treated seed with Topsin M @2g/kg during end of October to early November with recommended agronomic inputs and need based application of imidacloprid 200 SL (100 ml/ha) for bud fly and seed treatment with Trichoderma viride (4g/kg seed) followed by two spray of mancozeb (0.25%) for Alternaria blight for the management of insect pest and diseases.

Pulses

- Integrated nutrient management strategy with 18-20 Kg N, 40-60 kg P_2O_5 , 20 kg K_2O and 20 Kg S per ha along with inoculation using rhizobium culture.
- Application of lime @ 200 kg/ha in acidic soil.
- Basal application of 25 kg $ZnSO_4$ is suggested for zinc deficient soils.
- For effective weed control, two hand weeding at 30 and 60 days after sowing with pre-emergence application of Pendimathalin @1 kg a.i./ha is recommended.

Urdbean & Mungbean

- Planting time: Kharif: 25 July – 15 Aug, Spring: 2nd fortnight of Feb to 1st fortnight of March
- Seed rate: 15Kg for kharif and 20-25 kg for spring season
- Irrigation: 1st irrigation at 30 DAS and 2nd and 3rd after 10 days' intervals in spring crop
- Insect pest: Spray of Imidachloprid at the time of flowering to control thrips.
- Use of short duration MYMV resistant varieties and control of thrips at podding 36-45 DAS is very important to avoid flower drop in spring / summer Mungbean.

Lentil

- Rainfed : 40-45 kg/ha, 25x5 cm spacing
- Utera : 50-55 Kg/ha in standing crop of rice
- Late sown lentil crop in rice fallow can be taken successfully with 20 % enhanced seed rate. Spray 2% urea solution at the time of flowering

Pigeonpea

- Soil application of lime at 200 kg/ha and seed inoculation with molybdenum @ 4 g/kg of seed was found to enhance the yield of pigeonpea in acid soil.
- Cropping system: Intercropping Pigeonpea with millets/ Mungbean/Urdbean / Sesame by pairing Pigeonpea row at 40/60 cm and planting one row of intercrop.

Major constraints

Oilseeds

- Crop is cultivated in marginally poor soil.
- Lack of awareness among farmers about the latest technologies.
- Problem of diseases (Alternaria blight and white rust) and insect pest (aphid)
- Delayed sowing of crops in the rice based cropping system.
- Rapid loss of viability in the produce of rabi-summer groundnut which renders kernels unfit to be used as seed for sowing in next rabi summer season in Groundnut.

Pulses

- Non –availability of certified seed of high yielding varieties
- Pulses are mainly grown in acidic soils
- Non-availability of improved technology of zero tillage in rice fallow.
- Long spell of foggy weather resulting in flower and pod drop in pigeonpea.
- Most genotypes of pigeonpea are photo thermo sensitive also having low harvest index
- Flower drop due to high infestation of thrips at flowering resulting in excessive vegetative growth of mungbean and urdbean.

Suggestions for improvement

- Land and water management technique specifically for acid soils
- Surveillance of major pests and diseases and adoption of timely control measures
- Creating storage facilities Improved crop cultivation practices for jhumming in hill areas
- Programmes to take care of cropping pattern in pre and post flood situations in the flood affected areas.

COMMERCIAL CROPS

Important commercial crops of the region are Jute, Mesta, Ramie and Sugarcane.

Jute and Allied Fibres

Area, production and productivity trends of Jute and Mesta

Year	Jute			Mesta		
	Area (000 ha)	Production (000 bales)	Yield (kg/ha)	Area (000 ha)	Production (000 bales)	Yield (kg/ha)
Assam						
2007-08	60.0	656.8	1970	5.0	26.9	968
2008-09	60.1	647.5	1939	5.3	26.8	910
2009-10	65.3	715.3	1972	5.0	20.2	727
2010-11	62.3	625.4	1807	5.0	25.3	911
2011-12	65.6	607.9	1669	6.1	30.9	917
Meghalaya						
2007-08	4.0	34.9	1571	4.4	20.0	818
2008-09	4.0	34.6	1557	4.4	20.0	818
2009-10	3.9	34.7	1590	4.2	18.4	797
2010-11	3.9	34.4	1586	4.1	18.2	799
2011-12	3.9	34.4	1600	3.7	16.0	777
Nagaland						
2007-08	3.0	6.4	384	-	-	-
2008-09	2.5	1.3	84	-	-	-
2009-10	1.3	2.0	277	-	-	-
2010-11	3.0	5.4	324	1.6	3.0	338
2011-12	3.0	5.5	324	1.6	3.0	345
Tripura						
2007-08	0.5	3.7	1332	1.0	6.8	1224
2008-09	0.5	3.7	1332	0.6	5.0	1500
2009-10	0.5	3.8	1453	0.8	5.6	1302
2010-11	0.5	4.2	1527	0.8	6.5	1463
2011-12	0.6	5.5	1541	0.6	5.2	1489

Source: Directorate of Economics and Statistics, DAC, MOA, Govt. of India

Research support in the region

- Regional Agricultural Research Station, Shillongini at Nagaon under Assam Agricultural University, Jorhat is engaged in research and development and conducting the various AINP trials on jute and allied fibre crops since early seventies.
- Ramie Research Station, Sorbhog (Assam) under CRIJAF, Barrackpore is operational since 1959 and engaged in research and development of various aspect of ramie cultivation in the region. Production of ramie planting materials and its area expansion is one of the primary mandate of this station besides varietal improvement and development of cost effective production and protection technologies of ramie cultivation.

Major achievements

Recommended varieties

White jute – JRC 80, JRC7447, JRC 698, AAU CJ 1 and Bidhan Pat 1, 2 and 3
Tossa jute - AAU OJ 1, JRO 204, JRO524, JRO 8432, JRO-128, JRO-66, JRO-7835 and JRO2407
Mesta *(H. cannabinus)*-AMC108, HC583, MT150, JRM3, JRM5 and JBM2004D and JMB 81
Mesta *(H. sabdariffa)*-AMV 1, 2, 3, 4 and 5, AMV 7 and HS4288
Ramie – R-67-34 (Kanai)

New varieties released/identified

One variety each in of *Tossa*jute (*C. olitorius*) &white jute (*C. capsularis*) viz., AAUOJ 1 (Tarun) and AAUCJ 1 (Apeswaree) developed by the AINP (Jute & Allied Fibres) centre in Assam Agricultural University at Nagaon have been released by CVRC & SVRC, respectively. Despite, one variety of ramie namely, R-1411 (Brahmaputra) developed at Ramie Research Station, Sorbhog has been identified during last AINP Workshop held at CRIJAF, Barrackpore.

Disease/ pest problem

Jute: Semi-looper, Bihar hairy caterpillar, yellow mite and stem weevil, indigo caterpillar and grey weevil are the important insect pests of jute. Recently mealy bug has been recorded to infest jute. Stem rot, root rot, anthracnose and seedling blight are the common diseases on jute.
Ramie:*Cercospora* leaf spot disease, leaf roller (*Sylepta derogata*), Indian red admiral caterpillar (*Vanessa indica* Hurbst.) and leaf eating caterpillar (*Spodoptera exigua*) are the important insect pests and diseases affecting ramie crop at different stages of crop growth.

Important package of practices

Jute

Variety/cultural practices	Recommendations	
	C. capsularis	***C olitorius***
Variety	AAUCJ1, JRC 80, JRC 7447, JRC 698,	AAUOJ 1, JRO 204, JRO 2407, JRO 8432, JRO7835
Time of sowing	3rd week of March	2nd week of April.
Method of sowing and spacing	Line sowing: 30cm x 5-7cm or Broadcasting	Line sowing: 25cm x 5-7cm. or Broadcasting
Seed rate	Broadcasting@ 6-8 kg/ha Line sowing by seed drill @ 2.5 kg/ha	Broadcasting :4-6 kg/ha Line sowing with seed drill: @ 2.5 kg/ha
Seed treatment	Carbendazim @ 3g/kg seed.	Carbendazim @3g/kg seed.
Nutrient management	Under low fertility: (NPK: 80:40:40 kg/ha); Under medium to high fertility (NPK:60:30:30 kg/ha) Organic matter – 5-8 t/ha	Under low fertility: (NPK: 80:40:40 kg/ha) Under medium fertility (NPK:60:30:30 kg/ha); Under high fertility (NPK:40:20:20 kg/ha); Organic matter – 5-8 t/ha
Weed management	Application of post-emergence herbicide quizalofop ethyl 5% EC (40-50 g a.i./ha + adjuvent @ 1 ml/l)	Application of post-emergence herbicide quizalofop ethyl 5% EC (40-50 g a.i./ha + adjuvent @ 1 ml/l)

	at 15-20 DAE followed by 1 hand weeding on 35 DAE recommended Mulching with organic waste (10 t/ha) or intercropping with red amaranth.	at 15-20 DAE followed by 1 hand weeding on 35 DAE recommended Mulching with organic waste (10 t/ha) or intercropping with red amaranth.
Crop protection	Fenazaquin 10 EC or fenpyrozimnate 5EC @ 2 ml/lit may be sprayed at 30 and 60 DAS for effective management of yellow mite. In the later stage of crop the lepidopteran pests can be controlled by foliar spray of profenophos (0.1%) at 10 days interval. **For managing stem rot and anthracnose of jute and foot and stem rot of mesta**, seed treatment with carbendazim @ 3g/kg seed and 2-3 spraying of carbendazim (0.2%) or Copper oxychloride (0.3%) can be applied.	
Retting	Proper retting and extraction of fibre (after 12-15 days of jaking) should be done in clear and slowly flowing water for quality fibre. CRIJAF microbial consortium mediated retting improves the quality and reduces the retting time by 7 days.	

Ramie

Variety	R-67-34 (Kanai)
Cultural practices	2-3 deep ploughing followed by laddering
Time of planting	For North-Eastern states – **Rainfed condition** : February – March / April & end September – October **Irrigated condition** : Throughout the year except winter; during peak rainfall planting can be done only if adequate drainage is provided
Method of planting/ spacing	Ridge & furrow planting; 60 cm (row-row) x 30 cm (plant-plant)
Seed rate	**Rhizome planting** : 8-10 quintal / ha **Stem cutting / plantlets** : 55000 – 60000/ha (including 10% mortality)
Nutrient management	$N:P_2O_5:K_2O$ – 30:15:15 kg/ha/cutting ; 10-15 t/ha of organic matter to be added at beginning of every year
Weed management	Quizalofop ethyl 5% E.C. @ 60-90 g a.i./ha 15 days after emergence effectively control grassy weeds
Crop Protection	**Disease control**: spraying of propiconazole or difenconazole @ 0.1% or mancozeb @ 0.25% 15 days after harvest for management of foliar diseases **insect pests and termite control:** spraying of chlorpyriphos @ 0.05% at 15 days intervals
Harvesting	Under rainfed condition, usually 4 cuts may be taken in a year at 50, 45, 45 and 50 days interval respectively. Under irrigated condition 5 cuts can be taken. Harvesting is done manually by cutting the stalks near ground level.
Decortication	Fibre is extracted from harvested defoliated canes by a decorticator machine. It is a 5 HP machine run by diesel or electricity. Around 800 – 1000 kg cane can be decorticated everyday by this machine which produces approximately 35 to 45 kg fibre. The raw fibre is then washed thoroughly in clean water to remove some of its gum and then sun dried for 2 to 3 days.
Degumming	The decorticated ramie fibre contains a large amount (19–30%) of gummy matter. According to the chemical degumming method developed at NIRJAFT, decorticated fiber is boiled in 1% caustic alkali solution with liquor ratio 1:6 or 1:7

	containing some wetting agent at 96-98^{o}C for two hours in a digester under pressure. Treatment of fibre with of 0.5% sodium sulphite treatment improves tenacity of the fibre. The excess alkalinity is neutralized by treating with 6% acetic acid. The resultant fibre is creamy yellow in colour and is bleached with 6% H_2O_2 or sodium hypochlorite solution, to make the colour milky white with gum content.

Seed production report

Seeds of the newly released and notified *olitorius* jute var. 'Tarun' developed by the centre are produced at various research stations and KVKs of AAU. The Govt. of Assam has been procuring Breeder and Foundation seeds of 'Tarun' from AAU for their seed production programme. The Government of Assam has taken a massive seed production programme of this variety, 'Tarun' in different districts. Likewise a seed production programme is taken by AAU for the newly recommended high yielding *capsularis* jute variety, 'Apeswaree' (AAUCJ1) developed by the centre, recommended by Assam State Seed Subcommittee.

Seed production of *olitorius* jute var. 'Tarun' in Assam

Type of seeds	Amount of seed produced (in q)	
	AAU, Assam	Assam Govt.
Breeder seed	3.00	-
Foundation seed	9.00	500.00
Certified seed	-	84.00

Major constraints

- Lack of mechanization for different intercultural operations.
- Incidence of diseases like foot and stem rot of jute and emergence of new pests in ramie e.g., Indian red admiral caterpillar.
- Non adoption of improved retting techniques for quality fibre production.
- Non-availability of quality seed of improved varieties.

Suggestions for improvement

- Development and popularization of machines for sowing, weeding and harvesting
- Improved package of practices for the management of stem rot disease of jute
- Development of varieties for biotic and abiotic stress
- Popularisation of consortium mediated retting technique
- Steps to improve seed replacement rate by active involvement of public sector in certified seed production.
- Production of quality planting materials of ramie for area expansion
- Improved decorticator with higher fibre recovery of >10%

Sugarcane

Area, production and productivity trends of sugarcane in Assam

Year	Area ('000 hectare)	Production ('000 tonnes)	Productivity (t/ha)
2008-09	28	1100	38.4
2009-10	27	1059	39.1
2010-11	30	1075	36.2
2011-12	26	994	38.6
2012-13*	28	1065	38.0

Research support in the region

The Assam region comes under North East Zone of the country. Sugarcane is not commercially cultivated in other states viz., Sikkim, Mizoram, Arunachal Pradesh, Nagaland, Tripura, Meghalaya& Manipur. In Assam region, research network on sugarcane is organized with the involvement of Buralikson centre of Assam Agricultural University, Jorhat. The centre is conducting location specific experiments for increasing productivity of sugarcane and sugar. Indian Council of Agricultural Research provides financial and technical support to Assam through the All India Coordinated Research Project on Sugarcane. A special attention has been paid during XI Plan for allocating the budget separately for the Assam region. During 2011-12 & 2012-13, funds have also been provided under Tribal Sub-Plan for the welfare of farmers in tribal region.

Major achievements

a. Recommended varieties for Assam

Early maturing varieties	Mid-late maturing varieties
CoBln 9101, CoBln 9102 and CoBln 9103	CoBln 9104 and CoBln 9605

b. New varieties (identified/released)

Early maturing varieties	Mid-late maturing varieties
Co 0232	Co 0233, CoBln 04174

Disease/pest problem

In Assam region, top borer, shoot borer and plassey borer are the major insect pests. Stray incidence of sugarcane woolly aphid has also been reported in Assam. Among diseases, wilt and leaf spots (ring spot) are the major ones, whereas grassy shoot disease is minor.

c. Important package of practices

i) Sustaining sugarcane production & soil health through integration of nutrient sources
For sustaining higher sugarcane yield and better soil health, sugarcane plant and ratoon crops be fertilized with 75% of recommended NPK through inorganics + 25% of recommended N through organics (FYM/PSM) along with furrow application of Azotobacter + PSB @ 2.5 kg/ha each and biopesticide (Trichoderma) inoculated @1kg/ha mixed with one quintal FYM; apart from trash mulching and green manure of legumes (*Sesbania*) in alternate rows in ratoon crop.

ii) Ratoon management

For multiple ratooning integrated use of agro-technologies viz., stubble shaving, gap filling, trash mulching and cultivation in alternate rows with use of phorate (15 kg/ha) has been found effective to sustain higher ratoon yields. Keeping ratoon beyond third does not appear to be economical. As component technology, trash mulching and gap filling have been identified as critical technologies to sustain multiple ratoon productivity.

iii) Weed management

Metribuzin 1.0 kg a.i./ha or ametryn 2.0 kg a.i./ha or atrazine 2.0 kg a.i./ha as pre-emergence application followed by 2,4-D @1.0 kg a.i./ha at 60 days after planting and one hoeing at 90 days after planting has been found effective and recommended for effective economic weed control in sugarcane.

iv) Drought management in sugarcane

Under drought conditions, additional application of 60 Kg K2O/ha at 150-180 DAP over and above soaking setts in saturated lime water + foliar spray of urea and KCl @ 2.5% at 90, 105 & 120 DAP + trash mulching after 60 DAP + application of FYM @ 10t/ha in furrows before planting be adopted to improve cane yield. Under drought conditions in light and medium textured soils, sugarcane planting following pit method may be adopted in combating drought situation.

v) Sub-soiling on soil physico-chemical characteristics and sugarcane productivity

Sub-soiling especially cross sub-soiling at 1.0 m is recommended for enhancing cane yield and sustaining soil health.

(v) Integrated Pest Management

Soil application of chlorpyriphos 20 EC or endosulfan @ 1.0 kg a.i./ha at planting, removal of shoot borer infested dead-hearts, removal of egg masses of top borer in I and II brood and release of parasites emerging from egg masses in the field, application of carbofuran 3 G @ 1.0 kg a.i./ha against III brood of top borer, removal of lower dry leaves in November and late/water shoots at 30 days interval from November onwards in stalk borer prone areas were found effective in reducing the insect-pest infestation in sugarcane crop and sustained cane yield.

d. Seed production report

In 2012-13, 1500 quintal Breeder Seed of improved varieties of sugarcane was produced by the Centre.

Major constraints

In the region, wilt disease is a major one. Insect pests *viz.*, plassey borer, top borer as well as water logging and drought are of importance and adversely affect the production of the crop in different areas. Inadequate availability of good quality seed of improved varieties and lesser awareness among farmers for adoption of latest technologies are the major constraints in sugarcane cultivation. In Assam, acidic soils are the major constraint in increasing sugarcane productivity.

Suggestions for improvement

- Varieties with high sugar and high cane yield together with tolerance to red rot and acidic soils need to be developed.
- Production of quality seed of recommended varieties should be taken up on large scale.
- Mechanization in sugarcane production as per location specific need should be adopted.
- Training should be imparted to farmers and development workers on improved technologies.
- Strengthening of development work by State Govt. Departments should be taken up.

PLANT PROTECTION

The research programmes on plant protection in the region (Assam, Sikkim, Mizoram, Arunachal Pradesh, Nagaland, Tripura, Meghalaya & Manipur) are carried out through centres of All India Coordinated/Network Research Projects of ICAR.

Assam

Plant Parasitic Nematodes with integrated approach for their control; Biological Control of Crop Pests and weeds; Honey bee & Pollinators; White grubs and Other Soil Arthropods; Rodent Control; Agricultural Ornithology and Agricultural Acarology are in operation at AAU, Jorhat

Major Achievements

- Dagaon locality of Sonitput district was the hot spot area for *M. incognita* infecting jute and rice root nematode *Hirschmunniella oryzae* led to 11.4% yield loss infecting rice.
- Seed treatment with neem seed kernel powder + *Trichoderma viride*, each @ 5g/kg seed recommended in the package of practices of the University for the management of root knot nematode infecting urdbean and mungbean.
- Inoculative release of *Xylocoris flavipes* @ 30 nymphs/kg of stored rice could reduce the infestation of *Corcyra* by 18.0% in homestead stores of Assam.
- Five *Apis cerana* colonies per hectare have recommended for getting maximum yield of guava (75.22g/ha) with a benefit cost ratio 3.87. Stingless bee species have been indentified from all India collection as *Trigoma iridipemmis* Smith *and T. ruficermi* Smith, pollinating cucurbits and fruit crops such as guava. Five *Apis cerana* colonies have been found effective for the pollination of pigeon peas, *Cajanus cajan* per ha. Bamboo top (var.*jati*) with 2.5 cm width has been found suitable for rearing Carpenter bee, *Xyocopa fenestruata.*
- The technology on "Soil application of imdiacloprid 200 SL@ 48g a.i./ha at the time of sowing + one spray of NSKE 5ml/l 15 DAS + gram bait 1st at 25 DAS and 2nd at 55 DAS to reduce the infestation of cutworm (*Agrotis ipsilon)* in potato crop has been recommended for On-Farm Trial. The technology on "Soil drenching of furrows with chlorpyriphos 20EC @ 0.06 per cent before sowing of potato tubers' to reduce the infestation of red ant, *Dorylus orientalis* has been recommended for On farm trial.
- *Sali* rice suffered higher rodent infestation and damage than the *boro* rice in Assam. Hoarding of rice grains in the rodent burrows ranged between 170-191 g / burrow. Ratio of burrow density of *B. bengalensis* and *Mus booduga* was 3:2 during both the seasons. Hollow bamboo piece and banana sheath proved effective bait stations under homestead as well as field conditions. Interventions on rodent management under farmers' participatory activities, social engineering campaigns were done. This (training, demonstrations and input supply) registered higher rice yields in adopted villages (4.17 t/ha) as compared to control village (3.65t/ha). Study on the comparative nutritional value of rodents revealed that protein content of rodent (23.6g/100g) is higher than mutton (18.5g/100g) but lower than fowl (25.9g/100g). Fat content is higher (1g/100g) than fowl (0.6 g/100g) and lower than mutton (13.3g/100g) rodent meat is affordable to common people.
- Food habits of spotted Owlet were studied and recorded high occurrence of insects (76.8%) followed by small mammals (2.2%) and unidentified vertebrates (21%).
- Early maturing rice variety Luit Kapili during grain filling stage 10to 30% damaged was caused by Baya weaver and Scaly breasted Munia. The ribbon and old CD's were effective to the extent of 90% in scaring the birds in early maturing *Sali* rice. Use of T shaped- Perches and Tree branches in Tomato experimental field recorded less fruit borer infestation (8.04%) caused by *Heliothis* than the control plot with netting (17.90%). Large scale demonstration of T-Perch @ 50/ha was conducted in 100 ha paddy field each ten locations under ten districts of Assam in winter paddy during the *Kharif* season 2012 in association with KVKs under Assam Agricultural University. Total of 37 species of bird species were recorded in Homestead garden 24 spp recorded during season with relative abundance 44.4% 29.6%and 25.9% respectively. Identified nine techniques/traditional knowledge generally adopted by the farmers of Assam for bird

scaring in paddy and vegetable crops. Cob wrapping method in maturing maize was employed both in RARS field and farmer's field. 3.4% bird damage to cobs in treatment plot was observed against 14.4% in unprotected control plots. It was observed that the Eurasian Tree Sparrow (*Passer montanus*) preferred wooden nest box and shoe box for breeding than earthen pots.

- Of 40 chilli germplasm were screened for resistance against yellow mite (*P. Iatus*). 7 of them were resistant, 20 were moderately resistant, 9 were moderately susceptible and 4 were susceptible. Three sprays of propargite 57Ec @ 2ml/l at 10 days interval reduced the infestation of Iitch mite (*Aceria Iitchi*) by 87%. Two spider mite *(Oligonychus caffeeae)* reduced mite population by 97%. 21 species of plant feeding as well as predatory mites were recorded from various ecosystems of Assam.

Tripura

Network Project on Biosystematics, Tripura University, Agartala

Major achievements

- Field surveys covered 34 locations in 5 districts of Tripura state for 96 man days. Collected 1675 specimens from 81 plants under 46 families. Collected specimens were identified into 85 families under 13 orders. Of these, 571 specimens were identified under 157 genera and 132 species including 21 species of Aphididae and 24 species of Coccinellidae.
- A new species of aphid, Cerataphis sp. nov (Hormaphidinae) from Calamus erectus (Arecaceae), and an unknown alate morph of Ceratovacuna indica from Bambusa balcoa were described. A species of longhorn beetle, Imantocera penicillata (Lamiinae: Gnomini) redescribed.
- Inventories of 38 species of Odonata, pests of citrus, bamboo, and potato made. Diversity of 26 species of aquatic insects compiled. Field diagnostic keys for 11 families of Hemiptera from Tripura prepared. Pictorial checklists of 38 species of dragonflies and damselflies, and 9 species of mantids from northeast India prepared.
- 3 project staff and 10 PG students trained in taxonomy, microscopy and microphotography.

Meghalaya

Network Project on Biosystematics, NEH Region Barapani

Major achievements

- Surveys covered 350 ha in 3 states Collected 1533 specimens of 11 orders, specimens identified up to the order. 25 lepidopteran (moths) and 30 coleopteran species identified. Biology of Leucopholis coneophora, and Liriomyza trifolii studied. Rearing of butterflies, moths and other insects done. All the identified species of the region were documented.
- DNA barcodes based on mtCOI developed for 10 species. DNA sequence identity of these confirmed by BLAST. Contractual staff specialized in Coleoptera (Chrysomelidae, Cerambycidae), Lepidoptera and in insect collection and curation.

Nagaland

AICRP on Honey bee & Pollinators, Nagaland University, Medziphema

Major achievements

- Three species of stingless bees were identified as pollinators from different districts.
- Seven true major pollinators in sweat orange and 10 major pollinators in pigeon pea were observed having key role to enhance the quality and productivity of fruits.

- Deep freezer at -8 to -10 C treatment is superior rest of the treatment against wax moth to store the empty comb.
- An indigenous technology for transfer the underground stingless bee colony was developed.

Mizoram

AINP on Pesticide Residues is in operation at CAU, Aizawl.

Major achievements

- Pesticide usage data have been collected on various crops in collaboration with the state agriculture department and sent to BCKV, Kalyani for the analysis of pesticide residues.

Arunachal Pradesh

Biological Control of Crop Pests and weeds (AICRP), Rodent Control (AINP) and Agricultural Ornithology (AINP) are in operation at CAU, Pasighat.

Major achievements

- Bio-control based IPM of rice pests was refined and the module could increase the grain yield to 5.43, 4.68 and 5.53q/ ha in three locations of Arunachal Pradesh, viz., Sille, Pasighat and Mebo, respectively. The grain yield of the IPM fields was even comparable with the chemical control fields.
- Pineapple crop suffered maximum rodent damage (10.66 to 12.65%) in sub tropical plain zone of Arunachal Pradesh.
- Bamboo flowering occurred in Geku circle of Upper Siang district, but concomitant rodent population did not increase to outbreak level.
- Estimation of nutritional value of bamboo seeds and other staple food revealed no significance difference in nutritional value between bamboo seeds and other cereal grains like rice, maize.
- At Arunachal Pradesh, among different treatments, no parakeet infestations were recorded in the ribbon +wrapping of cobs (100% reduction in parakeet infestation) and it was on par with installation of ribbon alone with 0.50% infestation (99.10% reduction control). Wrapping of cob with leaves in the four boundary line showed 23.50% infestation and 57.47 reductions over control.

B-22: HORTICULTURE DIVISION

Recommended varieties:

Fruits:

Citrus - Khasi mandarin, Khasi mandarin CRS-4 selection, Khasi mandarin
Banana - Jahaji and Borjahaji
Coconut - Kamrupa (Assam Green Tall),Kalpa Samrudhi (MYD x WCT)
Arecanut - Kahikuchi, Nalbari, Mohtinagar

Vegetables:

Chilli - VR-338
Brinjal - VNR-218
Potato: Kufri Jyoti, Kufri Megha, Kufri Giriraj, Kufri Kanchan, Kufri Girdhari, Kufri Himalini, Kufri Himsona, Kufri Jyoti, Kufri Giriraj, Kufri Megha (late blight resistant) Kufri Kanchan (red skinned variety) Kufri Girdhari, Kufri Himalini and Kufri Himsona.

Mushroom:
Oyster mushroom - *P. sajor caju* strains (codes P6 to P10), *P. florida* strains (codes P1 to P5), *Pleurotus* strains codes PL-11-01 to 06,
Floriculture
Gladiolus- IIHR G-12 , American Beauty, Jacksonville Gold, Priscilla,White Prosperity, Pusa Kiran, Pusa Shubham
Tuberose- Hybrid -1 and GK-T-4, Prajwal, Phule Rajani, Shringar
Gerbera - Dubai, Ice Queen P. Intezz, Rising Sun, Torbin, Cantida, Lieke, Lion, C.F. Gold, Jaffana

Orchids
Cymbidium - San Francisco Stephenson, Stanley Fouraker White Magic, Soul Hunt, Yankilla, Show Girl, Red Star, Amesbury, Red Imperial Red Tower,. Tracey Reddaway, Angelia December Gold, Cannon Colour, Norella Jennifer Gail, Velvet Green, Hawtescens, Jungfrau Snow Queen, Volya Craig Sutherland, Miss Sanders, San Francisco Monalisa, Penneshaw Winter Flush, Jungfrau Dos Pueblos, Takarajoke, Concerto, H.C. Aurora, Red Beauty, 'Luna Pink Champion', 'Nonina Paleface','Winter Beach Sea Green',W.W. Wondrous, 'Bob Marlin Lucky', 'Madrid Forest King', Lucky Rainbow, 'Fire Storm','Lucky Rainbow Sainte Lapine', 'PCMV', 'Baltic Glaciers', 'Ensikhan', 'Arabian Nights', 'Margaret Thatcher', 'Sungold', 'Levis Duke Bella Vista', 'Sparkle Late Green'

Dendrobium - A. Abraham, Emma White, Pompadour, Burana Stripe, Bangkok Blue, Erika, Big White 4N, Thonchai Gold, Juie, Big White Jumbo, Lervia, Earsakul, Dang Saard, Kating Dang, Madam Pompadour Vanda - Roberts Delight Blue, Pakchong Blue, KS.SD, Prao Sky Blue, Pures Wax, RBSD Black, Pat D, Sansai Blue, Dr. Anek Cattleya- B/c Guanmiau City, B/c Chinese Beauty Orchid Queen, L/c Purple Cascade Fragrant Beauty, B/c Pamela x L/c Raiwan, C. Queen Sirikhit, L/c Ahmad Sheikhi, B/c Hsinging Catherine, Blc 'Mem Ann Balmores Convess Phalaenopsis - Dtps. Ox Plum Rose x Ox Black Jack, P. Taida Salu Red, P. Kaleidoscope, P. Miki Wata Nabe, Dtps. Ox Prince Thunder, P. Strawberry, P. Memoria Francis Hunter, Dtps. Chian Xen Magpie, Dtps. Hsin Yang Fortune, Dtps.Shih Hua Long First Love, Brother and White

Aranda - Christine, Christine coerulea, Prapin Spot, Anne Khoo x V.Kasems Delight, Sayan x Ascda Bangkhuntian Gold, Majula, Ren. Storier, Anne Khoo x V. Fuchs Delight, Kalsum Storier, Propine White, Noorah Alsagoff Red, Noorah Alsagoff Blue, Fatimah Alsakoff Blue, Thailand Sun Spot Mokara - Happy Beauty, Khan Piak Suan x Kultana Gold, Walter Oumae White, Khan Piak Suan x V. Rasri Gold, Chark Kuan Orange, Chark Kuan Pink,Madame Pani, Jitti Orange

Oncidium - Wild Cat Bobcat, Wild Cat Carmera, Pixie Ruth, Sweet Sugar, Gower Ramsay, Sharry, Baby Sweet Fragrance, Taka Yellow, Popki Red, Jairak Rainbow Pink Spot, J.R.Orange Red, J.R. Yellow Brown, J.R. Orange Spot

Significant achievements and important package of practices

Citrus

- At Tinsukia, 35 pummelo (*Citrus maxima)* types with white/pink flesh with bitter/sweet/sour tastes and 3 types of Jeneru Tenga (*Citrus nobilis*) have been collected. Of the 52 accessions maintained, 40 have been evaluated and the results revealed that maximum number of fruits and yield was reported in Assam lemon (327 fruits/ tree with 49.05kg/tree).
- Among the 12 Khasi mandarin clones, CRS- 4 consistently produced the highest fruit yield (401.52 Kg/ plant having 3019 fruits), juice content (48.22%), ascorbic acid content (51.92 mg/100 ml), TSS/Acid ratio (18.33) and total sugar (6.70%) with favourable growth characters.
- Integrated nutrient management in Khasi mandarin indicated thatapplication of 75% recommended dose of fertilisers (600g N, 300g P_2O_5 ,600g K_2O and 5.63 kg Neem Oil Cake) + along with AM (500 g/plant) + PSB (100 g/plant) + *Azospirillum* (100 g/plant) + *T. harzianum* (100 g/plant) has recorded an yield of 97.97kg/tree with average fruit weight of 117.9g having 831 fruits.
- Orchard efficiency analysis results revealed that, in mandarin, all the orchards were deficient in organic carbon while, low yielding orchards were deficient in soil phosphorus content. However, high status of organic carbon (0.6-0.75%) and nutrients (20-48 kg/ha of P2O5 and 253-538 kg/ha K2O) were observed in high yielding orchards.
- In standardisation of stage wise requirement of nutrients in Khasi mandarin revealed that, the treatment involving nutrient application at 0:0:0, 30:40:10, 30:35:10, 20:25:30, 10:0:25 and 10:0:25% N:P_2O_5:K_2O during stage I to VI, respectively was found to be effective in improving the yield (20.07 t/ha) and quality (highest juice content, of 48.55%; TSS of 11.57^oB; ascorbic acid of 44.69% and lowest acidity, 0.39%).

Pasighat (CAU, Imphal)

- Seventeen citrus species/varieties - *Citrus medica* L., *C.volkameriana* Ten. & Pasq., *C. latipes*(Swingle) Tan., three strains of *C. jambhiri* Lush., *C. aurantifolia*(Christm.) Swingle, *C. aurantium* L., *C. limon* Burm., *C. maxima* Merr., *C. sinensis* var. Valencia, *C. sinensis* var. Mosambi, *C. reticulata* var. Khasi mandarin, *C. reticulata* var. Nagpur mandarin, *C. reticulata* var. Hill Mandarin, *C. reshni* var. Cleopatra Mandarin and *Poncirus trifoliata* [L] Raf.) were collected from East Siang District, Arunachal Pradesh and maintained in the field gene bank for evaluation.

Banana

- Evaluation of twenty local banana germplasm revealed that highest TSS (22.49^oB) and total sugars (21.59%) were recorded in Bhutmanohar. The cv. Garomaina showed

highest acidity (0.90%) and ascorbic acid content (9.85 mg). Organoleptic test showed highest scores of 8.62 for pulp colour, 8.97 for taste, 8.97 for firmness, 8.93 for meatiness and 9.00 for appearance with skin in the cultivar Kanaibari.

- Among the nine varieties evaluated, the maximum bunch weight (19.11kg), number of hands per bunch (7.55) and yield (58.97 t/ha) were recorded in the cultivar Jahaji.
- Application of 100% RDF along with AM fungi (250g/plant) + Phosphate solubilising bacteria (50g/plant) + Azospirillum (50g/plant) + Trichoderma harziamum (50g/plant) recorded the highest bunch weight (17.13kg) in BarJahaji.

Jackfruit

- Five genotypes of jack have been collected from Upper Assam.
- In Varietal trial in jackfruit,Observation on growth characters revealed that Muttan Varrika recorded the highest plant height and girth in Valipala. However, the spread was more in Gumless jack followed by Valipala.
- Epicotyl grafting during second week of July in 25 days old seedling has recorded maximum success (20%).

Coconut

- Application of fertilizer through micro-irrigation technique in coconut has been standardized for the state. It is concluded that application of 75% NPK through drip recorded the best results with respect to nut yield (80.3 nuts/palm/year) and other growth parameters i.e., no. of leaves on the crown, number of spadices, female flowers/palm etc.
- Coconut based integrated cropping system model has been developed at the centre with the following crop combinations viz., Coconut + Black pepper + Pineapple + Assam lemon + Banana + Turmeric or rotation of rabi and kharif vegetables. In the partially concluded trial comprised of a compact block of 0.4 ha, a gross return of Rs. 97,777.00 was achieved.
- The above two technologies will be placed in the Annual Technical Committee Meeting of the University for recommendation in the package of practices of the state and are also ready for transfer in the farmers' field.

Vegetable

- Cowpea: Application of vermicompost @ 2.5 t/ha +1/2 NPK (20:45:10 kg/ha) gave the maximum yield (146.3 q/ha) along with highest C:B ratio (1:1.56) in cowpea.Hence, it is recommended for Jorhat conditions of Assam. (2011)
- Potato: Kufri Megha (late blight resistant) is popular in Meghalaya and Assam and Kufri Kanchan (red skinned variety) is preferred in Sikkim and Arunachal Pradesh and parts of Nagaland. The newly released varieties Kufri Girdhari, Kufri Himalini and Kufri Himsona have been demonstrated in the farmers filed and they are also being adopted gradually by the farmers in the region.

a) Assam

- At Jorhat in Assam, Kufri Megha & Kufri Pukhraj varieties are recommended for early as well as late planting up to 20 days whereas Kufri Ashoka variety is recommended for late planting only up to 10 days as compared to planting date of 15th November.

b) Arunachal Pradesh

- At Pasighat in Arunachal Pradesh, Kufri Chandramukhi, Kufri Ashoka, Kufri Pukhraj & Kufri Pushkar varieties are recommended for early planting up to 20 days while; Kufri Chandramukhi & Kufri Ashoka varieties are recommended for late planting up to 10 days and Kufri Pukhraj & Kufri Pushkar are recommended for late planting up to 20 days than the planting date of 15th November.

Arecanut

- Okra during summer and French bean during winter found to be more suitable intercrops in arecanut under NE condition.
- Drip irrigation at 100% pan evaporation at 2/3rd dose of recommended dose of fertilizer found effective in growth, yield (3.6 kg challi/palm/year) of arecanut and moisture distribution/ utilization.
- In-situ conservation methods with catch pit filled with coconut husks showed maximum yield in arecanut under sloppy hills of NE India
- Development of arecanut based high density multispecies cropping system models for NE region. The model comprising arecanut, black pepper, banana and assam lemon under 2/3rd dose of fertilizer resulted highest B:C ratio (3.56)
- Arecanut palms fertilized with 1/3rd chemical fertilizer + 2/3rd vermicompost resulted in maximum yield of arecanut palm.
- In vitro study on efficiency of botanicals, bioagents, chemicals are carried out for major diseases/ pests of coconut and arecanut

Pasighat

Turmeric

- Thirty eight (35 old + 3 new) diverse genotypes of turmeric were collected from entire NE region and evaluated with local variety Megha Turmeric-1. The genotypes CHFT-8 (30.41 t/ha), CHFT-32 (29.42 t/ha), CHFT-12 (29.60 t/ha) recorded significantly higher fresh rhizome yield as compared to check variety Megha Turmeric-1 (25.80 t/ha). However, check variety Megha Turmeric-1 had highest curcumin content (7.40%) followed by CHFT-17 (6.87%) and CHFT-24(6.41%).
- In a coordinated varietal trial of turmeric, among the six turmeric genotypes evaluated only RH-9/90 (32.41 t/ha) recorded maximum fresh rhizome yield as compared with local check variety Megha Turmeric-1(25.75 t/ha). Highest curcumin content observed in Megha Turmeric-1 (7.40%) followed by RH-9/90 (6.00%) and RH-50 (5.83).

Ginger

- In an experiment to study the performance of ginger varieties in various agroclimatic conditions Variety Surabhi recorded maximum yield (24.17 t/ha) at Pasighat followed by Nadia (23.25 t/ha) and Varada (21.64 t/ha).

Barapani

Turmeric

- Under the study Genotype and environment (GXE) on growth and quality characters of turmeric , Roma recorded maximum yield 10.67 t/ha followed by Megha Turmeric-1 (10.00 t/ha) whereas lowest yield was registered by Kedaram (8.50 t/ha). Maximum curcumin content was recorded by Allepey Supreme (8.46 %) with a dry recovery of 22.81 % followed by Kedaram(7.3).

Ginger

- In the case of ginger, Variety Mahima recorded maximum yield (5.22 t/h) followed by Nadia (4.44 t/ha). Highest oleoresin (10.51) and Crude fibre content was found in Khasi Local (7.80 %) followed by Mahima.

Mizoram

Turmeric

- In Genotype × environment interaction on quality of turmeric , maximum yield was recorded by RCT-1 (4.17t/ha), followed by Duggirala (4.00 t/ha), IISR Pratibha (4.00 t/ha), Rajendra Sonia (3.80 t/ha) and Roma (3.71t/ha). Dry matter content was found to be highest in Rashmi (22.86%) followed by Roma (21.76 %), and IISR Allepy Supreme (21.56).

Ginger

- In the case of ginger (GXE) maximum yield was recorded by Himgiri (1.81t/ha) followed by Nadia (1.55t/ha), Varda(1.41t/ha) and Mahima (1.30 q/ ha).

Large Cardamom

ICAR Research Complex (Gangtok)

- Cultivation of Varlangey variety in 75% shade resulted in maximum growth and yield (253kg/ha)
- Minimum blight disease was noticed in Varlengey and Seremna cultivars whereas maximum in the selection ICRISKM-1.
- Among several insect pollinators, Bumble bee , Bombus harmorrhoidalis was identified as main pollinator of Large cardamom.

ICRI Regional Station (Gangtok)

- Nineteen accessions of Large cardamom were collected and conserved at germplasam conservatory of Kabi (N. Sikkim), of this 9 accessions were selected based on high yield and other specific desiarable characters and 10 accessions were based on diseases escape. Recived IC number for 13 collections during 2009-11 from germplasm division, NBPGR, New Delhi.
- Fourteen disease (blight caused by Colletotrichum gleoosporioides) escapes were collected from Sikkim and Darjeeling hills of West Bengal.Six units of each accession were planted in ICRI research farm at Kabi for further multiplication and evaluation.

Floriculture

Crop Management

- In the chemical weed control experiment on gladiolus, the application of Pendimethalin (1.0 kg a.i / Ha) was found best compared to other treatments at Kahikuchi (Asom) condition.

Crop Protection

- Sclerotial wilt (Sclerotium rolfsii) in the range of 10-23% have been recorded. In tuberose, leaf blight caused by Alternaria polyanthis in var. Prajwal and Phoma polyanthis in local single have been recorded (10-35%) at Kahikuchi.
- Pre-storage and pre-planting treatment of gladiolus corms in hot water at 50 0C for 30 min followed by dipping of corms in the fungicidal solution of captan (0.2%) + carbendazim (0.2%) recorded the less disease incidence at Kahikuchi.
- Application of Difenconazole (0.1%) or Iprodione + carbendazim (Quintal) (0.1%) were found effective in managing the leaf spot disease of tuberose and the same at the concentration of 0.1% and 0.2% respectively for marigold leaf blight.
- Neem cake colonized by T. harzianum @ 500 g m2 followed by drenchingandfoliar spray either with captan (0.3%) (9.33 PDI) or Metalaxyl MZ 72 WP (0.3%) (9.67 PDI) or Copper oxychloride (0.3 %) (10.00 PDI) showed significantly least foot rot/root rot in gerbera at Kahikuchi.
- Application of Difenconazole + carbendazim @ 0.1%+0.1% and 0.1%+0.2% were found effective in managing the leaf spot disease in tuberose and leaf blight in marigold respectively. Similarly, spraying of iprodine + carbendazim (0.2%) and difenconazole (0.05%) were effective for controlling leaf spot / blight of gerbera at Kahikuchi.

Post harvest technology

- In orchid, DendrobiumVar. Sonia, pulsing with 1000ppm Al2(SO4)3for one minute followed by keeping in holding solution containing sucrose (5%) along with BAP (25 ppm) and Al2 (S04)3 (300 ppm) exhibited maximum vase life at Kahikuchi.
- The gladiolus flowers (cv White Prosperity) harvested at tight bud stage and packing in LDPE (100 gauge) resulted in better vase life and other floral parameters and is recommended for distant marketing.
- Pre-transit pulsing solution comprising of 1000 ppm NaOCl is best for anthurium. The maximum vase life (37.62 days) was observed when their stalks were harvested at fully open stage held in 5% sucrose+ 50 ppm NaOCl. (Kahikuchi)
- In gerbera, the cv Rich exhibited maximum vase life (9.5 days) when kept at NaOCl (50 ppm) (Barapani). However at Kahikuchi, pulsing of gerbera cv Optima for 1 min at 1000ppm Al2(SO4)3 resulted in longer vase life.

Medicinal & Aromatic Plants and Betelvine

- During 2011-12 and 2012-13, twenty seven germplasms of *Piper longum* have been collected from different parts of North East India some of which has shown very promising results.

Mushroom

Oyster mushroom

- Five P. sajor caju strains (codes P6 to P10) were grown on paddy straw substrate. Strain P-6 (PL-1150) and P-9 (PL-1150) (H-34) recorded highest yields viz. 91.4 and 87.2 kg / 100 kg of dry paddy straw, respectively.
- Among P. florida strains (codes P1 to P5), strain P1 gave the highest yield i.e. 80.6 kg/ 100 kg of dry paddy straw.
- Six high yielding Pleurotus strains codes PL-11-01 to 06 were tested. The highest fresh mushroom yield per 100 kg dry paddy straw was recorded in PL-11-03 (P-1 x P-50) (H-3) (74 kg) closely followed by PL-11-02 (PL-50) (73 kg). Fruit body weight did not vary significantly.
- Two wild mushrooms from Umiam, Meghalaya were collected, photographed and preserved. Market survey was done and Cantharellus cibarius was collected, photographed and preserved.
- Seven specimens belonging to Ramaria, Lactarius, Scleroderma, Boletus genera and three unidentified mushrooms from forest were collected. Market survey was done and Ramaria spp, Gomphus sp and Clavaridelphus were purchased and dried. Assorted Ramaria sp locally called 'Tit syier' i.e. chicken mushroom and mixed wild mushrooms were found to be sold at Barabazar, Shillong Meghalaya.
- Practical demonstration of mushroom cultivation on 14 Feb, 2011 in a training course on 'Technology interventions for resource conservation and mechanization in hill agriculture' at ICAR RC, Umiam, Meghalaya
- Mushroom Production-A boon for land less farmers on 17 Feb, 2011 in training programme entitled 'Improvement of land and water productivity through farming system approach' for AGRI/Hort/Fishery officers under SWPAL project at ICAR RC, Umiam, Meghalaya.

CAU, Pasighat

Oyster Mushroom

- Out of 10 strains of Oyster mushroom (P. florida and P. sajor-caju), P6 (PL-6) performed well over others in respect of yield (82.0 kg per 100 kg dry substrate) followed by P10 (PL-10) (76.6 kg per 100 kg dry substrate)
- Six high yielding Pleurotus strains were tested. The average yield was very high in strain PL-11-02 (PL-50) (55 kg per 100 kg dry substrate) followed by PL-11-03 (P-1 x PL-50) (H-3) (42.7 kg). Strain PL11-05 (DMRP-219) and PL11-06 (DMRP-231) has taken fewer days compare to other strains.
- Wild oyster mushrooms were surveyed and collected during rainy season in jungle, deep forest and decayed wooden trees of east siang district. 11 edible mushrooms were collected. Wild edible mushroom of Oyster (Pleurotus sp), Wood oyster (Shizophyllum communae), Tuber (Tuber sp), Shiitake mushroom (Lentinus edodes) and Jews ear (Auricularia sp) were collected and cultured in the laboratory.
- The oyster mushroom cultivation technology was standardized for Pasighat region.
- Maize grain identified as one of the best suitable substrate for multiplication of spawn.
- Low cost model mushroom house was constructed for training and demonstration.
- Paddy straw was the best substrate for mushroom bed preparation oyster.

Tuber Crops

- At AAU, Jorhat a total of 197 germplasms of different tuber crops are being maintained, 35 in cassava, 15 in sweet potato, 75 in taro and 27 in Dioscorea alata.
- At CAU, Imphal 138 numbers of germplasms are conserved with maximum in cassava (41) and sweet potato (39).
- 65 numbers of different collections of tuber crops are being maintained at ICAR NEH, Barapani with maximum in taro (35).
- At Imphal maximum Sweet Potato tuber yield was recorded from CiPSWA-2 followed by IGSP-15 under URT.
- The results of URT showed that, Da-25 recorded highest yield at Jorhat followed by TRC Da.
- Single Pruning in cassava at 3MAP increased cassava yield by 17%(29.48 t/ha) at Jorhat
- 4 Hand weedings and black polythene mulching was found effective in weed management of cassava which led to higher tuber yield at Jorhat.
- Highest sweet potato yield of 28.12 t/ha was recorded with the organic sources FYM 10 t/ha, Vermi Compost/poultry manure 2.5 t/ha + Azospirillum and Phosphobacterium 5 kg/ha at Imphal
- FYM (10 t/ ha) + Mustard cake (1 t ha-1) exhibited maximum number of cormels and highest cormel yield in taro at Barapani.
- Maximum shelf life of taro cormels was observed when treated with carbendazim and stored ion pits or in pacca floor at Barapani.
- In Jorhat and Imphal, the experiment on biofertilizers in sweet potato revealed that application of 1/3rd or 2/3rd recommended N (60 kg N ha-1) + 2 kgAzospirillum ha-1 as vine dipping + 10 kgAzospirillum ha-1 as soil application increased the marketable tuber yield as well as dry matter of tuber.
- Taro+ Ginger (1:2) performed better with taro yield of 17.64 t/ha and ginger yield of 35.67 t/ha at Imphal.

Orchids

Crop Improvement

- All total 3860 accessions of orchids species, varieties and hybrids collected and conserved
- Molecular analysis of 10 Vanda species and 59 Dendrobium species completed using STM markers.
- DUS Test Guidelines of five orchid genera viz. Cymbidium, Dendrobium, Vanda, Phalaenopsis and Cattleya prepared using UPOV guidelines under PPV & FRA and out of these Cymbidium, Dendrobium and Vanda notified for registration .
- The hybrids NRCO-42 , H x B (Cymbidium lowianum x Cymbidium 'Show Girl') and Epidendrum characterized
- In-vitro clones of Paph. venustum and 1 ex-vitro clone of Cattleya maxima, 3 variants of Coel. nitida, 1 variant each of Calanthe puberula, Eria spicata and Liparis bootanensis identified
- NRCO –Coll-77 of Red Vanda and NRCO-42 registered through PGRC
- New hybrid lines identified from *Cym. lowianum* x *Cymb. tigrinum*

Crop Production

- Suitable standard, intermediate and miniature hybrids of Cymbidium, Dendrobium, Vanda, Cattleya, Phalaenopsis, Oncidium, Mokara, and Aranda identified for high and mid hills.
- Innovative method for propagation of Cymbidium through backbulbs

- Potting mixtures of Cymbidium, Dendrobium, Vanda and Cattleya standardized.
- Pre-harvest management practices of Cymbidium, Dendrobium and Phalaenopsis orchids optimized
- Under post-harvest management of Cymbidium orchids, two buds opened stage as best harvest maturity , 5% sucrose for 2 hours as best pulsing solution; 4% sucrose + 200 ppm salicylic acid for opening of tight bud, 1000 ppm CoCl2 for 15 min. for impregnation and 2% sucrose + 200 ppm 8-HQS recorded as holding solution for maximum vase life .

Crop protection

- Viral indexing of 30 Cym. Hyb. and 3 Den. hybrids done by ELISA technique
- RT-PCR of ORSV standardized and used for detection of ORSV from planting material
- Common weeds of orchids like Drymaria cordata, Crassocephalum crepidiodes, Oxalis corniculata, Oxalis stricta identified as hosts of CymMV and ORSV
- Ciprofloxacin hydrochloride (400 ppm) and tetracycline hydrochloride (1000 ppm) found sensitive against soft rot bacterium of Cymbidium orchids
- Trichoderma viridae showed antagonistic in vitro against orchid anthracnose
- Molecular characterization of orchid anthracnose done by PCR assay
- Neem oil 0.03 EC found effective against red spider mite and aphid on Cymbidium
- IPM module M-5 (tobacco extract 5%, neem oil 0.03% EC 5ml/l and bifenthrin 10EC 0.25%) showed effective against mite on Cymbidium
- IPM module M-3 (tobacco extract 5%, econeem 3000 ppm 2ml/l and imidacloprid 17.8 SL (0.003%) found rffective against aphids

Disease Pests and their control

Banana

- Roving survey was conducted in three districts of Assam viz. Nagaon, Jorhat and Sibsagar revealed four major insect-pests viz. Odoiporus longicollis, Nodostoma viridipinne, Parasa lepida and Pentalonia nigronervosa associated with banana plantations. Highest infestation of Odoiporus longicollis, Nodostoma viridipinne and Pentalonia nigronervosa was recorded in cv. 'Jahaji' followed by cv.'Borjahaji' and cv.'Chenichampa' or Chenikol'. Infestation of Nodostoma viridipinne was lower in the cvs 'Bhimkol' and 'Kachkol'. Amongst other insect-pests, Stinging caterpillar Fruit fly, Stephanitis bug and Gandhi bug were recorded in banana plantation during the survey. Incidence of leaf and fruit scarring beetle (Nodostoma viridipinne) was recorded from March, 2011 to February, 2012 on cv. 'Jahaji'. Population of N. viridipinne increases with the raise in atmospheric temperature to reach its peak during August and decrease during winter. Population of leaf and fruit scarring beetle shows positive correlation with the rainfall and maximum and minimum temperature.
- Among the treatments, tilling and clean cultivation, together with application of carbaryl @ 0.3% exhibited the best result in reducing the scarring beetle population, number of leaf scars/leaf and increasing the yield of the crop.
- Survey indicated different genera viz. Helicotylenchus, Pratylenchus, Meloidogyne, Hoplolaimus, Macroposthonia, nematodes of Tylenchid group had been recorded from the rhizosphere of banana plantation. Two nematode genera viz., Ogma and Psilenchus has been recorded for the first time from banana rhizosphere in Assam. Amongst the nematode genera, Helicotylenchus dihystera was the dominant nematode species, followed by Meloidogyne incognita.

- Swabbing Beauveria bassiana in a suitable carrier on the pseudostem at 5, 6 and 7 month after planting was the best treatment in reducing the pseudostem borer infestation (33.33 % as against 59.26 % under control) with higher yield of banana followed by spraying of Beuveria bassiana @ 107 spore/ml at 5, 6 and 7 month after planting.
- Survey was conducted in five districts viz. Darrang and Kamrup Metro (under Lower Brahmaputra Valley Zone), Sonitpur (Under North Bank Plain Zone) and Dibrugarh and Golaghat (under Upper Brahmaputra Valley Zone) during Apr., 2011-Mar., 2012. Bunchy top, Panama wilt and yellow Sigatoka diseases were found to be the major diseases of banana of Assam. The highest incidence of yellow Sigatoka disease (PDI = 22) was recorded in Golaghat district (UBVZ) on cv. Jahaji (dwarf Cavendish, AAA).The highest incidences of Panama wilt (25%) and banana bunchy top virus (6%) were recorded in Darrang district (LBPZ) on cv. 'Malbhog' and 'Jahaji' respectively and that of anthracnose disease (8%) was recorded on cv. 'Chenichampa' in Kamrup Metro district (LBVZ). The causal organism(s) were isolated and identified as Pseudocercospora musae for Sigatoka leaf spot and Fusariuim oxysporum f. sp. cubense for Panama wilt. The main causal organism associated with crown rot has been recorded as Colletotrichum musae.
- The treatment viz., disease free suckers from disease free field + dipping in carbendazim (0.2%) for 30 min. followed by carbendazim drenching 0.2% solution and carbendazim injection @ 3 ml of 2% solution at 2nd, 4th and 6th month after planting was found most effective in managing the Panama wilt disease with the least plant mortality of 11.11% against 66.66 % in the control. The average bunch weight was also found the highest (5.8 kg against 2.13 kg in control) in the treatment.
- The treatment with propiconazole 0.5 ml/l (0.05%) + petroleum based mineral oil (1%) was found to be the most effective treatments in managing the Sigatokaleaf spot diseasedisease with 8.33 PDI against 36.35 in control. The average bunch weight (11.06 kg) in the treatment was significantly higher than all other treatments.
- The reaction of 25 germplasm collections against Sigatoka leaf spot was studied and Desikachkal and Aathiya kal were resistant against the disease.
- Application ofTBZ (0.1%) was found most effective followed by *Solanum torvum* (50%) and *Ocimum sanctum* (50%) to manage crown rot of banana.

Citrus

- Surveys showed that citrus leaf miner, lemon butterfly and citrus psylla, bark eating caterpillar, trunk borer were present in all the areas throughout the year. Their infestations were recorded from end of February and reached its peak during hotter months of the year. Correlation studies showed that maximum temperature, minimum temperature and RH (%) had positive effect on leaf miner, lemon butterfly and psylla infestation while rainfall showed negative effect.
- Studies showed that both leaf miner and psylla were highly attracted to the yellow sticky traps indicating that YST can be used as a monitoring tool for these insects.
- Application of imidacloprid 200 SL (0.005%) showed significantly better performance up to 14 days after treatment closely followed by thiodicarb 75 WP (75%) in reducing leaf miner infestation. Among the natural products, Neem seed bitter (1%) and NSKE (5%) were effective at the initial stage of infestation.
- Seasonal incidence of Citrus butterfly was observed in Khasi mandarin nursery. Population tends to increase from end of May and reached peak during August (32 larvae per 10 twigs). Population starts declining from second fortnight of October and become almost rare during December.

- Survey of plant parasitic nematodes including citrus nematode, Tylenchulus emipenetrans indicated that seven species of plant parasitic nematodes was associated with Khasi mandarin plants. The citrus nematode, T. semipenetrans was present in most of the samples. The highest frequency of occurrence (100%) in soil and root was reported from Nakathalguri area of Tinsukia district.
- The roving survey was carried out at 9 locations of Tinsukia districts and 18 orchards were surveyed. Studies revealed that 3 major fungal diseases viz., Phytophthora root rot (Phytophthora sp.), Twig blight (Colletotrichum gloeosporioides) and Scab (E. fawcetti) were present in the entire Khasi mandarin orchard surveyed. However, CTV were detected in some orchards.
- Fixed plot survey on an old Khasi mandarin orchard revealed the presence of twig blight throughout the year. The maximum incidence (46.66%) was observed during February and while minimum incidence (13.33%) was recorded during July to September. Gummosis and foot rot incidence was recorded maximum (23.33%) in August. The incidence of scab and sooty mould diseases were recorded up to a maximum of 13.33 and 16.66% respectively. Fruit drop due to stem end rot was observed during July to November up to 16.66%.
- For integrated management of Phytophthora root rot in mandarin, maximum reduction in disease severity (59.27%) and fruit yield (891.5) was observed by application of all three bioagents viz.,Trichoderma viride, Trichoderma harzanium and Pseudomonas fluorescens followed by foliar spraying of Al-phosetyl. The reduction in disease severity of 46.14% was achieved with the spraying of Al-phosetyl alone, while, 48.32% reduction in disease severity was recorded when all three bioagents were added to the soil.
- For management of Citrus canker bacteria, alternate application of COC (0.3%) + streptomycin sulphate and NSKE5% found effective (72.64%) when compared to NSKE 5% (55.38%) and COC (0.3%) + streptomycin sulphate (1g/10lit) (51.76%) separately. Although the alternate application of chemical treatment and NSKE 5% resulted in higher yield per tree (337 fruits) than chemical (272 fruits) and NSKE treatment (284 fruits), the benefit cost ratio per tree is high in NSKE (3.93:1) when compared to alternate application of COC and streptomycin sulphate and NSKE (2.53:1) and COC and streptomycin sulphate alone (2.28:1).

Jackfruit

- New insect-pests like Jelly worm, Cispia sp. has also been recorded at Jorhat.
- Roving surveys conducted at Jorhat and Sibsagar district of Assam revealed that fruit and shoot borer was the major pests of jackfruit. Aphids and a leaf eating caterpillar were also recorded on jackfruit seedlings.
- The fruit rot was the only major disease of jackfruit and the highest incidence of the disease (21%) was recorded in Darrang district under Lower Brahmaputra Valley Zone.

Coconut

- The control the major diseases i.e., bud-rot, stem bleeding and crown chocking and pests like rhinoceros beetle the recommendations made by CPCRI, Kasaragod and AAU, Jorhat are followed.

Potato

- First prophylactic spray with Mancozeb @ 0.2% (just at the time of canopy closure).
- Second spray with mixed formulation of (Dimethomorph 0.2% + Mancozeb @ 0.3%) after one week of first spray.
- Third spray with Mancozeb @ 0.2% after one week of second spray.

- Stable bleaching powder reduced incidence of bacterial wilt in low land/lower slope conditions - from 10 – 20% to 1 – 2% with up to 15% yield advantage.

Spices

- Bavistin+ Mancozeb@3g/lit was found to be effective for management of leaf blight of Large Cardamom at Gangtok.
- Neem formulations like Nimbicidine@3ml/l and Bacillus thuringencis @ 2g/l are found to be effective against leaf eating caterpillar, shootfly and stem borer of Large Cardamom at Gangtok.

Mushroom

- During monthly visit to the progressive grower Mr. Taimur Jamoh production unit, some pests and diseases were noticed and incidence was calculated. The incidence of *Trichoderma* (10%), *Coprinus* (30%), and Beetle (25%) infestation was observed.

Tuber Crops

- IPM package against weevil revealed superiority over control and chemical treatments in Jorhat,
- Lowest rotting index in taro seed tubers was found when stored in moist sand pix, and recorded highest sprouting index at Jorhat.
- Maximum shelf life of taro cormels was observed when treated with carbendazim and stored ion pits or in pacca floor at Barapani.

Orchids

- Fungal diseases of orchids like orchid wilt, white rot, Black rot and rust reported.
- Metalaxyl (0.1%) found effective to control black tot disease of Cymbidium
- Application of Mancozeb (200-500 ppm) + Carbendazim (200-500 ppm) found effective against anthracnose of Cattleya and Phalaenopsis orchids
- Ciprofloxacin hydrochloride (400 ppm) and tetracycline hydrochloride (1000 ppm) found sensitive against soft rot bacterium of Cymbidium orchids
- Trichoderma viridae showed antagonistic in vitro against orchid anthracnose
- Cym. Mosaic Virus (CyMV) and Odontoglossum Ringspot Virus (ORSV) were reported in most of orchid species
- Based on survey, mites, thrips, scales, shoot borers, slugs and mealy bugs reported to infest orchids
- Among different insect pests of 175 orchid species, mite was reported highest in May and mealy bugs from May to September
- A new species of thrips Dichromothrips nakahari reported on Cymbidium
- Among pesticides, Imidacloprid 17.8 SL (2ml/l) found effective against mites in Cymbidium
- Dipel @0.012% found effective against shoot borer of Cymbidium orchids
- Neem oil 0.03 EC found effective against red spider mite and aphid on Cymbidium
- IPM module M-5 (tobacco extract 5%, neem oil 0.03% EC 5ml/l and bifenthrin 10EC 0.25%) showed effective against mite on Cymbidium
- M-3 (tobacco extract 5%, econeem 3000 ppm 2ml/l and imidacloprid 17.8 SL (0.003%) found effective against aphids

Multiplication of planting material
Citrus

Planting material	2011-12	2012-13
Khasi mandarin seedlings	18,060	1680 nos
Assam lemon rooted cuttings	150	100 nos
Rough lemon seedlings	306	
Seeds of Rangpur lime	750g	500g
Seeds of Rough lemon	400g	
Seeds of Volkamarina	100g	
Seeds of Citrange	1150g	
Seeds of Cleopatra mandarin	550g	

Coconut

- Every year nearly about 2000 coconut seedlings are being produced by the centre which are sold and distributed to the farmers.

Arecanut

Items	2011-12	2012-13	Total
Arecanut	14500	15000	29500
Cinnamon layers	1200	1200	2400
Black pepper seedlings	10000	10000	20000
Citrus (Assam lemon)	1500	1500	3000
Coconut seednuts	2500	2500	5000

Medicinal & Aromatic Plants and Betelvine

- Multiplication of planting materials for the promising germplasms are going on. So far more than one thousand cuttings have been generated for various trials.

Mushroom

ICAR Complex, Barapani:

Spawn sale

- Oyster mushroom spawn 235.2 kg
- Culture tubes 6 nos
- Fresh mushroom 9.4kg

Revenue (`)

- Spawn @ Rs. 50/- per kg 11,760
- Culture tubes@ Rs. 50/tube 300
- Mushroom @ Rs. 50/- per kg 4670
- Training fee 1000

Total Rs.17, 730

CAU, Pasighat:

- 146 kg commercial spawn and eight mother spawn bags were sold to the growers during 2012 to Mr. Gekong Pertin.

Potato

- The station has produced 450 quintals of disease free quality seed, out of which about 348 quintals of seed was supplied to different government, research and private department during 2011-12. However 200 quintal of disease free quality seed was produced during 2012-13 and 110 quintals of seed was supplied to different states of NEH region.

Tuber Crops

- Thrust has been given to production of disease free healthy planting materials of EFY, Taro, Sweet Potato and Cassava.
- 45 Kg of Colocasia, 3600 Sweet potato wine cuttings were distributed to farmers from CAU, Imhpal.

Orchids

- *In*-vitro protocol of Cymbidium 'Golden Girl' and Cymbidium 'Lunavian Atlas', Cymbidium 'Soul Hunt-I', Cymbidium 'Sleeping Nymph' and Cymbidium 'Pine Clash Moon Venus' developed
- In-vitro protocol of Zygopetalum intermedium developed
- Altotal 20,000 tissue culture plants of Cymbidium orchids produced

Technology ready for transfer

Banana

- Application of 100% RDF along with *AM fungi* (250g/plant) + *Phosphate solubilising bacteria* (50g/plant) + *Azospirillum* (50g/plant)+ *Trichoderma harziamum* (50g/plant) has been recommended for Bar-jahaji banana.

Citrus

- For the management of Phytophthora root rot of Khasi mandarin, Bordeaux paste on trunk with soil application of Trihoderma harzanium (100g/plant)(10-7) + Pseudomonas fluorescens (100g/plant) (10-8) with carrier material of neem cake (1 kg) and or FYM (1 kg) with spray of Fosetyl Al (Aliette at 0.2 %) has been recommended.
- The treatment package involves soil application of 25 kg FYM + 5 kg neem cake + multiple microbial culture T. harzanium, P. flouroscens and Azotobacter/ Azospirillum) +1kg Dolomite / plant/year + 50% RDF (comprising 100g ZnSO4 50g borax / plant) soil application. + 50% RDF (comprising 100g ZnSO4 + 50g borax/plant) as foliar application (applied in two equal splits as pre and post monsoon application) along with pruning and pest and disease management measures has been recommended for the rejuvenation of old and senile orchards of Khasi mandarin.

Vegetable

- Cowpea**: One** variety of chilli and one resistant variety of brinjal were identified and one production technology have been developed for the region and may be transferred to the farmers.

Coconut

Drip fertigation for coconut: Application of fertilizer through micro-irrigation technique in coconut has been standardized for the state. It is concluded that application of 75% NPK through drip recorded the best results with respect to nut yield (80.3 nuts/palm/year) and other growth parameters i.e., no. of leaves on the crown, number of spadices, female flowers/palm etc.

Coconut based cropping system: Coconut based integrated cropping system model has been developed at the centre with the following crop combinations *viz*., Coconut + Black pepper + Pineapple + Assam lemon + Banana + Turmeric or rotation of rabi and kharif vegetables. In the partially concluded trial comprised of a compact block of 0.4 ha, a gross return of Rs. 97,777.00 was achieved.

Potato

- The new varieties, agro-techniques and control measures for diseases and pests stated above are ready for transfer in the respective states.

Spices

Ginger

- Based on GXE interaction study the ginger varieties Surabhi, Nadia and Varada are suited to Pasighat conditions.
- Based on GXE interaction study, Variety Mahima and Nadia are the most suited ginger varieties to Barapani . Highest oleoresin (10.51) and Crude fibre content was found in Khasi Local (7.80 %) followed by Mahima (7.28 %)
- Based on GXE interaction study the ginger varieties Himgiri, Nadia and Varada are suited to Mizoram conditions.

Turmeric

- Based on GXE interaction study Roma and Megha turmeric are the most suited varieties to Barapani conditions and Alleppey Supreme recorded maximum curcumin content (8.46%)
- Based on GXE interaction study RCT-1 , Duggirala , IISR Pratibha, Rajendra Sonia and Roma are the varieties suitable to **Mizoram** conditions.

Medicinal & Aromatic Plants and Betelvine

- Technology for the cultivation of *Centella asiatica* with proper spacing will ready for transfer this year.

Mushroom

- Standardized cultivation technology for **Oyster**, ***Volvariella, Hypsizygus ulmarius,, Lentinus edodes, Macrocybe giganteum.***

Tuber Crops

- **Integrated Nutrient Management in Sweet Potato:** Application of 1/3rd or 2/3rd recommended N (60 kg N ha^{-1}) + 2 kg*Azospirillum* ha^{-1} as vine dipping + 10 kg*Azospirillum* ha^{-1} as soil application at Jorhat and Imphal.
- **Pruning in Cassava:** Single Pruning in cassava at 3months after planting increased cassava yield by 17% (29.48 t/ha) at Jorhat

- **Integrated weed management in cassava:** 4 Hand weedings and black polythene mulching was found effective in weed management of cassava which led to higher tuber yield at Jorhat.
- **Storage Techniques in Taro:** Maximum shelf life of taro cormels was observed when treated with carbendazim and stored ion pits or in pacca floor at Barapani.

Orchids

- Protocols for meristem culture of Cymbidium orchid hybrids 'Golden Girl', 'Lunavian Atlas', 'Baltic Glaciers Mint Ice', 'Soul Hunt', 'Sleeping Nymph', 'PCMV', 'Star Guard Mc Angel', 'Show Girl Cooks Bridge'
- Protocols for seed culture in Zygopetalum intermedium, Colelogyne cristata, Phaius tankervilleae, Vanda coerulea, Cymbydium dayanum, Cattleya maxima
- DUS Test guidelines in Cymbidium, Dendrobium and Vanda orchids
- Low cost production technology of Cymbidium orchids
- Propagation of Cymbidium orchids through backbulbs
- Improved propagation techniques in lilium
- Package of preparation of slow release organic fertilizers
- Package of practices for production post-harvest management of Cymbidium and Dendrobium orchids for cut flowers
- Genetical analysis of rare, endangered and threatened orchid species.
- Botanical extracts for control of shoot borer, thrips and mite in orchids
- Availability of dipsticks for virus detection

Constraints, if any

Potato

- Bye and large, peculiar biotic and abiotic conditions inherent to the region can be made responsible for the dismal performance of this most potential sector. The main problem areas in the way of development of potato in this region and some of the burning issues, which need to be addressed immediately, are discussed below:

Non availability of quality seeds

- Availability of quality potato seed of improved varieties is the major bottleneck for potato production in the NEH region. There is very limited supply of quality seed from the State Departments of Agriculture and other associated agencies in respective states. Hence, most of the farmers have to depend on home-grown seeds or buy it from the open-local markets. It has been estimated that for an area of nearly 0.124 million hectares in NEH region, the total requirement of healthy seed comes to around 0.308 million tonnes. If the seed is replaced every third year, the requirement of healthy seed in the region comes to around 0.103 million tonnes every year.

Lack of improved/high yielding varieties

- It is factually true that the farmers of the entire region mostly use their own seed of traditional varieties. The practice of growing potato from the same seed lot year after year has resulted into degeneration of seeds. Although these varieties are low yielder, their very good keeping qualities attract the farmers to use them and majority of the farmers do not like to replace their own seed stocks with new ones. In addition to the own seed, farmers procure the seeds from local traders. Among

the improved varieties, Kufri Jyoti is the most popular variety of the region. Next to this, Kufri Pukhraj and Kufri Bahar find place in many potato growing areas of the region.

Rainfed crop with poor irrigation facilities

- Majority of potato growing areas of the NEH region are rainfed and occurrence of moisture stress is a regular feature especially during rabi season. Being situated in the high rainfall region of the country, the rich residual moisture, of course, plays an important role in few potato growing areas of the region. Typical upland situation is more prone to moisture deficit during the growing period.

Inadequate infra-structure facilities

- Being semi-perishable in nature, potato needs much care in post-harvest handling and marketing. In Assam, infrastructure facilities *viz.*, cold storage, proper transport, communication and other post harvest management are not adequately developed. In recent years, although several cold storages (both in public and private sector) have been built up, in the entire state and various agricultural commodities have been housed in such cold storages, the storage space for potato seed tubers is still inadequate. Poor input-supply and support services and unorganized marketing system have direct impact on the farmers. Such lack of infrastructure facilities lead to market glut immediately after harvest that ultimately results in drastic fall in potato prices in the market. Further, there are only limited numbers of potato processing units grown up in a commercial way. In such situation local markets are the primary outlets for the producer.

Spices

- In order to provide adequate technical support to the spices farmers in region III, establishment of one center of AICRPS in this region where the spices cultivation is concentrated is to be looked into. It is essential to upgrade the coopting center Gangtok for Large Cardamom to a regular center under AICRPS during the next plan period with full financial support. Sikkim being an organis state plant protection by chemicals is not encouraged. No resistant source of viral and fungal diseases are available in Large Cardamom. Survey to identify resistant source is in progress.

Floriculture

- The center have requested for additional manpower , Recurring contingency and TA for research activities, as the present amount is not sufficient to meet out the expenditure.

Medicinal & Aromatic Plants and Betelvine

- Service of a Research Associate is required.

Orchids

- Non availability of skilled technical staff, at present 3 skilled technical staff are in position against 10 scientists working in both the campus i.e., Pakyong and Darjeeling.
- Supply of electricity in Pakyong is very pitiable condition and heavy fluctuation of electric current during day and night.
- Dust pollution due to construction of airport at Pakyong.

a) **Network Projects**

(i) AINP on Onion & Garlic

DIRECTORATE OF ONION AND GARLIC RESEARCH RAJGURUNAGAR, PUNE – 410 505

Progress of research made with special reference of technologies developed for the farmers of the Zone-III under All India Network Research Project on Onion and Garlic at Central Agricultural University, Imphal (Manipur) centre during last two years (2011-12 & 2012-13)

DOGR is working in Zone-III only through All India Network Research Project on Onion & Garlic at CAU, Imphal which was started during February 2009 Work on collection, evaluation of germplasm, varietal evaluation trials, trials on production, plant protection are in progress. The status of research is as below:

2011-12 & 2012-13

Crop Improvement

- Onion and garlic wild species including germplasm (15) were collected, being evaluated and maintained at CAU, Imphal (Manipur). In IET kharif, 6 lines and 22 lines in AVT-I were evaluated. RO-316 (156.52 q/ha) in IET and VG-19 (160.52 q/ha) and Bhima Super (162.34 q/ha) are performing better. In IET during rabi out of 33 lines SEL-397 (234.4 q/ha), Bhima Kiran (235 q/ha) and NOL-115 (218.4 q/ha) are performing better than the check. Whereas in AVT-I during rabi out of 30 lines NOL-103 (242 q/ha) followed by NRCRO-2 (235.8 q/ha) are performing better than the check. In AVT-II, out of 9 varieties SEL-126 (yield 321.6 q/ha) performed better than the check, which was followed by white onion NRCWO-1 (302.6 q/ha).

- In case of garlic out of 7 lines in IET, CITH-1 (15.3 q/ha), in AVT-I out of 7 lines NRCWG-5 (18.5 q/ha) and in AVT-II out of 9 lines Mukteshwar Garlic Selection-2 (16.4 q/ha) is performing better than the check.

Production

- In case of production trials higher yield of 391.15 q/ha and 374.87 q/ha, respectively in 2011-12 & 2012-13 was recorded in treatment of NPKS (110:40:60:40 kgs) + 7.5 t/ha poultry manure.

Protection

- In plant protection – management of foliar diseases of onion, marketable yield (239.30 q/ha) was highest with spray of Mancozeb (0.25%) of 15 days interval.

b) **National Horticulture Mission**

(i) Technology Mission (MM-I)

Horticulture Mission for North East and Himalayan States (HMNEH)Nodal Office: National Research Centre for Orchids, Pakyong, SikkimComponent wise Physical Progress Report for the period 2011-12

Programme I: Production of nucleus/basic seeds and planting material of horticultural crops.

SN	Category	Type of planting materials	Target	Achievement	% of Achievement
1.	**Fruit Crops (**Banana, Khasi Mandarin, Assam lemon, Peach, Pineapple, Passion fruit, etc.**)**	Plantlets/Suckers/Grafts/Cuttings/Seedlings/Layers (Nos.)	830100	751652	90.00
2.	**Vegetable Crops (**Okra, Potato, Tomato, Brinjal, Cucumber, French bean, etc**.)**	Seed/Minituber (Kg)	1125.5	2680.45	238.00
		Cuttings/Microplants (Nos.)	25000	64398	258.00
		Spawn (Pkts)	7500	6800	91.00
3.	**Flower Crops (**Marigold, gerbera, chrysanthemum, gladiolus, orchids, tuberose, Anthurium**)**	Cuttings/Suckers/Pseudobulbs/Bulbs/Corms (Nos.)	414350	456246	110.00
		Seeds (Kg)	3	2.6	87.00
4.	**Plantation and Spices crops (**Arecanut, black pepper, coconut, ginger, turmeric, cinnamon, etc.**)**	Rooted Cuttings/Seedlings/ Seednuts/Slips/Air layers (Nos.)	142200	125600	88.00
		Rhizome (Q)	135	115	85.00
5.	**Medicinal and Aromatic crops (**Lemon grass, vetivar, citronella, patchouli, etc.**)**	Cuttings/Slips (Nos.)	231000	195000	84.00

Establishment of Rootstocks, Bud wood & Mother blocks for the year 2011-12

Centre		Crop	Targets	Achievement
AAU, Jorhat	Rootstock Bank	Assam lemon, Rough lemon, Khasi mandarin (Cuttings, Seedlings)	01	One block of citrus is developed at AAU, Jorhat for establishment of rootstock bank. Plants are at vegetative growth stage.
	Mother block	Arecanut (Mohitnagar, Mangala, Sumangala, Srimangala, Kahikuchi)	02	One at AAU, Jorhat and one at RARS, Buralikson respectively.
		Banana (Tall Cavendish)	02	One block at AAU, Jorhat and one block at RARS, Buralikson respectively.
	Bud wood production	Citrus (Rough lemon, Rangpur lime, Cleopatra mandarin)	03	Plants are in vegetative stage (Apart from local selection 4 Nos of NRCC, Nagpur rootstocks are maintained). Plants are in vegetative stage.
CAU, Imphal	Rootstock Bank	Citrus	02	2 rootstock banks established at Horticultural Research Farm (HRF) Andro, CAU- Imphal, Manipur) with 6 rootstock vars. – 'Rich 16-6, X-636, Karnakhatta, Pumello, Champra Heithum, Trifoliate are being maintained at present.
	Mother block	Pineapple (Kew and	01	Establishment of Queen, Mauritius and

		Mauritius)		Kew at HRF, Andro.
		Banana (Meitei Hei, Maring Hei, Grand Naine, Dwarf Cavendish)	01	Establishment of 4 (Meitei Hei, Dwarf Cavendish, Maring Hei and G-Naine) varieties of banana and are at fruiting stage at present.
	Budwood production	Citrus (Khasi Mandarin & Tamenglong mandarin)	02	Khasi mandarin in Arunachal and Tamenglong mandarin in Manipur established at HRF, Andro.
	Orchid Sanctorium	Orchids	01	Establishment of Orchid sanctorium established with 63 epiphytes, 8 terrestrial, 10 species cultured *in vitro.*

Programme II: Standardization of improved production and protection technologies for horticultural crops.

- In high density planting of peach, three low chilling varieties of peach viz. Partap, Shan-e-Punjab and Floradasun were planted at a spacing of 2 x 2m. The yield was recorded highest in Pratap (6.31 kg/tree) followed by Shan-e-Punjab (4.96kg/tree) and lowest in Floradasun (2.65 kg/tree). (Barapani centre)
- Fruit based farming system (Sweet orange cv. Valencia): The highest number of fruits per plant and fruit weight was recorded under 3x3 m (91.94 and 180.56g) followed by 4x4m (85.10 and 173g) and minimum in 2 x 2 m (60.09 and 165.43g) along with gerbera (16.11 flower/m2), marigold (29.5 flower/m2), cucumber (8.51 t/ha), capsicum (3.6 t/ha), french bean (2.2 t/ha) cow pea (3.96 t/ha), pea (5.31 t/ha) colocasia (5t/ha) and chow-chow (11.30 t/ha) and 324 kg of vermin-compost. (Barapani *centre)*
- Rejuvenation techniques of Khasi mandarin: Treatments likePruning and training, correction of soil pH, integrated nutrient management, integrated management of trunk borer and bark eating caterpillar, integrated management of diseases & integrated weed management increased the Soil pH, organic carbon and reduced the weed population, incidence of insect pest and diseases after treatment of the plants in all the treated plots (CRS, Tinsukia)
- MS medium containing NAA (0.1mgl-1) and BAP (0.5mgl-1) gives the best response (100%) for in-vitro protocol of Banana cv. Meitei Hei.(CAU, Manipur centre)
- Squash and nectar making from passion fruit: Combination of 1 litre of juice, 2 kg of sugar, 1 litre of water, 2 g KMS and 1 g citric acid was found to be the better in terms of TSS, acidity, pH and sensory attributes. (A.P. centre)
- Fertigation with 100% recommended dose of N, P & K and drip irrigation with 0.75 evaporative replenishment increases the yield (72.90 t/ha) of banana under Assam condition. Fertigation with 100% recommended dose of fertilizers (N, P & K) along with black plastic mulch could be the most effective combination for Assam lemon under Assam condition to increase the yield (32.16 t/ha) and subsequent higher income. (AAU, Jorhat)
- Organic cultivation of watermelon variety Sugar baby: AZB+ PSB+ RP +Vermicompost @ 5t/ha gives the maximum yield of 30.34 t/ha. (AAU, Jorhat)
- Mulching of tuberose cv. Calcutta Double with black polythene mulch during the lean period (round the year) resulted in much higher production of quality spikes (86.25%) in comparison to the spikes production (48.75%) without mulch. (AAU, Jorhat)
- Bone meal treatment in Cymbidium resulted maximum no. of new shoot (2.78) and no. of back bulb. Similarly more no. of leaves (62.78), no. of pseudobulb (6.33), plant height

(69.78cm) and leaf length (67.55 cm) were found with Pushkal (20N) + Biophos + Biopotash + Megacal. (NRCO, Pakyong)

- Thirteen locally collected pepper accessions for growth and yield was evaluated. It was observed that maximum fresh berry weight (5.93kg) was recorded in KKHP-13 followed by KKHP-3 (5.6kg). (CPCRI, Kahikuchi)
- Turmeric cv. Megha Turmeric: Vermicompost (5 t/ha) + Azospirillum (10 kg/ha) + Bacillus (20 kg/ha) + AM (Glomus fasciculatum) (65 kg/ha) was found to be the most effective in terms of yield (25.33 t/ha) and curcumin content (6.8%). (Manipur centre)
- Catch pit filled with coconut husk is found to be best in situ measure in terms of growth and production producing 2.91 kg challi of arecanut per palm per year. (CPCRI, Kahikuchi)
- Evaluation of local germplasms of coconut revealed that KKHC-8 recorded maximum leaf production (12) and highest no. of nuts (33 nuts/palm) was recorded in KKHC-8 on 7th year of planting. (CPCRI, Kahikuchi)
- Evaluation of coconut varieties/hybrids under Assam Condition WCT x GB and LO x GB recorded the maximum spadices (6.33) and WCT x GB produced highest no. of nuts (32 nuts/palm/year). (CPCRI, Kahikuchi)

Programme III: Technology refinement and imparting training to extension functionaries.

SN	Type of Training	Target	Achievement	No. of beneficiaries	% of Achievement
1.	On campus & Off campus training	254	195	5655	76.77
2.	Demonstrations	232	221	3315	95.26

Besides, field visits, exposure visits, television programme, farmer's field day, workshops, horticulture show and other extension visits are running alongside of the training and demonstration activities.

2012-13

Programme I: Production of nucleus/basic seeds and planting material of horticultural crops.

Sl.No.	Category	Type of planting materials	Target	Achievement	% of Achievement
1.	**Fruit Crops (**Banana, Khasi Mandarin, Assam lemon, Peach, Pineapple, Passion fruit, etc.**)**	Plantlets/Suckers/Grafts/Cuttings/Seedlings/Layers (Nos.)	1089000	863983	79.30
2.	**Vegetable Crops (**Okra, Potato, Tomato, Brinjal, Cucumber, French bean, etc.**)**	Seed/Minituber (Kg)	847.5	7724.27	911.40
		Cuttings/Microplants (Nos.)	153200	78447	51.20
		Spawn (Pkts)	3000	3250	108.30
3.	**Flower Crops (**Marigold, gerbera, chrysanthemum, gladiolus, orchids, tuberose,	Cuttings/Suckers/Pseudobulbs/Bulbs/Corms (Nos.)	439300	328857	74.90
		Seeds (Kg)	3.5	2.5	83.30

	Anthurium**)**				
4.	**Plantation and Spices crops (**Arecanut, black pepper, coconut, ginger, turmeric, cinnamon, etc.**)**	Rooted Cuttings/Seedlings/ Seednuts/Slips/Air layers (Nos.)	102200	81000	79.30
		Rhizome (Q)	131	95	72.50
5.	**Medicinal and Aromatic crops (**Lemon grass, vetivar, citronella, patchouli, etc.**)**	Cuttings/Slips (Nos.)	220000	190900	86.80

Establishment of Rootstocks, Bud wood & Mother blocks for the year 2012-2013

Centre		Crop	Targets	Achievement
AAU, Jorhat	Rootstock Bank	Assam lemon, Khasi mandarin (Cuttings, Seedlings)	01	One block of citrus (Assam lemon) is developed at AAU, Jorhat for establishment of rootstock bank. Plants are at vegetative growth stage.
		Khasi mandarin	01	One block of Khasi mandarin is developed at AAU, Jorhat. The plants are in vegetative stage.
	Mother block	Arecanut (Mohitnagar, Mangala, Sumangala, Srimangala, Kahikuchi)	02	One at AAU, Jorhat and one at RARS, Buralikson respectively.
		Banana (Tall Cavendish)	02	One block at AAU, Jorhat and one block at RARS, Buralikson respectively.
	Bud wood production	Citrus (Rough lemon, Rangpur lime, Cleopatra mandarin)	03	Plants are in vegetative stage (Apart from local selection 4 Nos of NRCC, Nagpur rootstocks are maintained). Plants are in vegetative stage.
CAU, Imphal	Rootstock Bank	Citrus	01	Establishing of Rootstock banks consisting of five citrus rootstock species viz. Karnakhatta, *Citrus aurantium*, Rich 16-6, X-639,Trifoliate, Pumello at Horticultural Research Farm, CAU, Andro,Imphal East to be continued.
	Mother block	Pineapple (Kew and Mauritius)	01	Establishment of Kew and Mauritius at Horticultural Research Farm, CAU, Andro to be continued.
		Banana (Meitei Hei, Maring Hei, Grand Naine, Dwarf Cavendish)	01	Establishment of Four (4) varieties – Meitei Hei, Maring Hei, Grandnaine, dwarf Cavendish Horticultural Research Farm, CAU, Andro, Imphal East to be continued
	Budwood production	Citrus (Tamenglong mandarin)	01	Establishment of Tamenglong mandarin at Horticultural Research Farm, CAU, Andro, Imphal East to be continued.
	Orchid Sanctorium	Orchids	01	Establishment of Orchid sanctorium with 63 epiphytes, 8 terrestrial, 10 species cultured *in vitro* to be continued.

Programme II: Standardization of improved production and protection technologies for horticultural crops.

- Seed treatment with copper oxychloride @ 3g/litre dip the seed for 45 min + Steptromycin (200 ppm) air dry and sow followed by two soil drenching with copper oxychloride @ 2 g/l, 250 ml/clump at 2 months and 3 months after planting is the best treatment for management of rhizome rot of ginger. (AAU, Jorhat)
- Tomato packed in a CFB box with separator lined by foam and ethylene absorber is found to be the best treatment for long distance transportation of tomato (1000km).The treatment showed the lowest physiological loss in weight (9.53%) and highest cost benefit ratio of 1:1.23. (AAU, Jorhat)
- Development of Vegetable based farming system model: the highest yield per unit area were recorded from Brinjal cultivar Megha Brinjal-2 (39.18t/ha) followed by tomato variety Megha tomato-3 (31.25t/ha) and other crops. From economic point of view the highest income was recorded from brinjal Rs 3,91,800.00. (Barapani centre)
- During summer, amaranthus found to be more suitable as intercrop in arecanut garden with the highest B:C ratio of 2.91 and in winter, spinach was found to be more suitable in arecanut garden with a benefit : cost ratio of 2.52. (CPCRI, Kahikuchi)
- Fertigation in Banana & Assam Lemon standardized- Water saving up to 30 %, Fertilizer saving up to 25 % and Increase in yield up to 3 times compared to rainfed. (CRS, Tinsukia)
- Fruit based farming system (Sweet orange cv. Valencia): The highest number of fruits per plant and fruit weight was recorded under 3x3 m (91.94 and 180.56g) followed by 4x4m (85.10 and 173g) and minimum in 2 x 2 m (60.09 and 165.43g) along with gerbera (16.11 flower/m2), marigold (29.5 flower/m2), cucumber (8.51 t/ha), capsicum (3.6 t/ha), french bean (2.2 t/ha) cow pea (3.96 t/ha), pea (5.31 t/ha) colocasia (5t/ha) and chow-chow (11.30 t/ha) and 324 kg of vermin-compost. (Barapani centre)
- Water use efficiency in Khasi mandarin was recorded higher when the water was applied through drip irrigation at 0.6 Epan with black polythene mulch. (A.P. Centre)
- In Khasi Mandarin, plant spacing of 3 x 3 m with 25 ppm of 24D spray recorded the highest fruit weight (113 g), size (5.1 x 5.9 cm2), segment weight (74 g) and also juice content (61 ml). However, highest acidity (0.83%) was recorded in 2 x 2 m spacing. (A.P. Centre)
- MS medium containing NAA (0.1mgl-1) and BAP (0.5mgl-1) gives the best response (100%); this treatment induces callus development at the bases of leaf sheath as well as microshoot (0.5-0.6 cm) development from the shoot tips of Meitei Hei. (CAU, Manipur centre)
- Drip irrigation at 66%Eo with 2/3rd dose of recommended fertilizer resulted in maximum production of arecanut under North East condition.(CPCRI, Kahikuchi)
- Highest tuber yield (11.79 tonnes/ha) was recorded by application of 75% Recommended Dose of Fertilizers and 25% N through FYM. (CPRS, Shillong)
- Catch pit filled with coconut husk is found to be best in situ measure in terms of growth and production with an annual arecanut production of 3.22 kg challi per palm. (CPCRI, Kahikuchi)
- Arecanut based high density multispecies cropping system with black pepper, banana and lemon is found to be the best model for North East region of India. Application of 2/3rd level of fertilizer instead of full recommended dose of fertilizer found to achieve maximum yield and benefit : cost ratio from different cropping system models. (CPCRI, Kahikuchi)

- Use of black polythene mulch of 50 micron increased flower quality, higher production of spike and bulb. It also produced flowers during lean period (Dec – Feb) and lead to year round production of tube rose flower spikes. (AAU, Jorhat)
- Protocol for Cymbidium giganteum: In vitro seed germination, multiple protocorm like body formation using pseudo stem segments and plantlet regeneration of Cymbidium giganteum has been standardized. Dual phase culture medium supplemented with 0.2 mg/L TDZ was found to be the effective condition on the induction of multiple shoot buds/plbs in the pseudo-stem segments and suitable for development for multiple plantlets of this rare orchid species. (Barapani centre)
- Vermicompost @ 100 g/pot of Cymbidium plant resulted in maximum no. of new shoot (2.78), more no. of leaves (55.78), no. of pseudobulb (5.34), no. of back bulb (6.67) and plant height (69.67cm). (NRCO, Pakyong)
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Programme III: Technology refinement and imparting training to extension functionaries.

SN	Type of Training	Target	Achievement	No. of beneficiaries	% of Achievement
1.	On campus & Off campus training	195	93	2883	47.70
2.	Demonstrations	244	192	3072	78.69

Besides, field visits, exposure visits, television programme, farmer's field day, workshops, horticulture show and other extension visits are running alongside of the training and demonstration activities.

Appendices:

I) List of ICAR Institutes/NRC's/Regional Station in the region:

Assam- Central Plantation Crops Research Institute Research Centre, Guwahati, Assam.

Meghalaya- Central Potato Research Station, Research Station, Shillong Meghalaya.

Sikkim- National Research Centre for Orchids, Pakyang, Sikkim.

II) AICRP Centres in the region:

Assam

1. All India Coordinated Research Project on Tropical Fruits, Tinsukia & Jorhat, (AAU)
2. All India Coordinated Research Project on Betelvine, Jorhat
3. All India Coordinated Research Project on Potato, Jorhat
4. All India Coordinated Research Project on Tuber Crop, Jorhat
5. All India Coordinated Research Project on Palms, Guwahati
6. All India Coordinated Research Project on Vegetable Improvement Project, Jorhat
7. All India Coordinated Research Project on Floriculture, AAU, Guwahati

a) Network Projects- AINP on Onion & Garlic

b)National Horticulture Mission- Technology Mission (MM-I)

B-23. NATURAL RESOURCE MANAGEMENT DIVISION

The NRM division of ICAR has been looking after researchable issues of agriculture in the North Eastern Hill region through its constituent institute ICAR RC NEH region Barapani and its regional centres and 14 Krishi Vigyan Kendras under this institute. In addition the Assam Agricultural University, Jorhat, and CAU, Imphal, gathers the need of agricultural research and education in the region. The ICAR Research Complex at Barapani and its regional centres at different locations and variable ecologies has eight divisions with sixteen disciplines to carry out agricultural research with the mandate of holistic and integrated research agenda to improve production, productivity and sustainability through ecologically suitable technologies.

Challenges in NEH Region:

1. Making the region self sufficient in food and nutritional security
2. Stable agricultural productivity in skewed climatic and apparent weather conditions
3. CDR (Complex, Diverse and Risk) prone agriculture
4. Excessive soil erosion, and degradation
5. Soil acidity, water scarcity in lean season
6. Farm mechanization (hilly and farm modulating topography)
7. Socio-economic, including complex land tenure systems
8. Secondary agriculture and marketing
9. Adapt biological diversity
10. Productivity enhancement of acid soil and water resources
11. Humidity, pests and diseases
12. Detection and Surveillance of trans boundary diseases
13. Livelihood improvement and nutritional security of jhumias
14. Capacity building of farmers in remote areas and Human resources development

Outcome of NRM Research in Region III:

A. Agri-biodiversity and variety development and release

- A total of 2441 germplasm lines of different crops have been collected after 2009 out of which 145 accession numbers from NBPGR has been obtained.
- Eleven rice varieties (one high altitude, eight low to mid altitude wet land, two upland varieties) have been released/notified by the state/central varietal release committee.
- Two tomato and two brinjal varieties have been released by the state varietal release committee.
- Developed two composite maize varieties namely RCM-75, RCM-76 (100-110 days) for the NE hills having potential yield of 5-5.5 t per ha.
- Identified one open pollinated genotype of maize showing quality protein characteristics (tryptophan 0.86, lysine 3.87g/16g N in the grains).
- Seven photo insensitive lines (1.5 – 1.7 t/ha) of rice-bean identified and two genotypes suitable for spring season developed.
- Eight urd-bean genotypes suitable for upland condition had been identified. Superior genotypes were KU 527 (9.9 q/ha) and Pahelo Dal 4 (7.5 q/ha).
- Seven promising lentil genotypes (L4147, PL639, PL4, VL 1, VL 126, Pant L 406, LH84-8) were identified as suitable for Meghalaya (Table). Seeds of the genotypes are being supplied to KVKs and DAOs for popularizing in lowland rice fallows.

- Two Soybean lines – RCS 1-9 and Cross – 2 – 2 (3.16 – 3.21 t/ha) had shown promise. Both were significantly superior to JS-335 and JS 80-21(1.8-2.1 t/ha), the recommended varieties for the region.
- A composite variety of toria developed from local germplasm that has yield potential better than M-27.
- Some of the rice germplam from the north east such as Taothabi, Moringphou, Chahou amoba, Moringphou were rich in Lysine, Methionine, Iron, Calcium, respectively.
- Screened about 600 rice germplasm for aluminum toxicity, heat and cold tolerance, and identified core genotypes for each stress.
- Developed 28 hyper variable SSRs for rice-bean.
- Diversity analysis of chilli using 32 SSR markers led to identification of unique genotype from Mizoram with morphological similarity to king chilli, but genetically different.
- Surveyed 67 districts in eight states of NE India from which 42,000 insect specimens belonging to twelve taxonomic orders were collected and 1140 insect species identified and catalogued.

B. Agronomic Practices

- Package of practices for newly released crop varieties are developed.
- Conservation agriculture based technologies in rice and maze based cropping systems has been developed and popularised in farmers field. The pea (Prakash, Vikash, Arkel etc), Lentil (DPL 15, DPL 62 etc), toria (M27, TS 36, TS 48 etc) and frenchbean (Naga local, Arka Kamal) varieties suitable for zero tillage cultivation after kharif rice and maize has been identified.
- Short duration rice variety Vivek Dhan 82 has been identified for late planting conditions as Mid altitude condition. Upland rice line IURON 514 has been identified for upland and jhum land condition with yield potential of 3 to 3.5 t/ha.
- Efficient rice cultivation practices such as System of rice intensification and integrated crop management practices suitable for the region is developed that resulted 15-20% yield enhancement in Institute and upto 50% yield enhancement in farmers field of Ribhoi, Garo Hills and Dhalai.
- Technology development for organic agriculture has been addressed through network project on organic farming. Package of practices for organic production of frenchbean, carrot, groundnut, rice, maize, lentil, turmeric, ginger has been developed.
- Application of biorganics has been popularised for control of diseases such as soft rot in ginger and productivity enhancement in various crops.
- Raised and sunken bed technology for efficient land utilization and cropping intensity enhancement has bee popularised under various programme.
- About 103 tonnes of rice varieties Ranjit, Naveen, Gomati has been given under TSP to the tribal farmers in the NEH under boro rice.
- Seventy tonnes of QPM (Quality Protein Maize) has been demonstrated under TSP to tribal farmers.
- Eleven Integrated farming systems/models has been demonstrated under TSP covering 532 farmers in the different districts of North East.

C. Soil Management

- GIS based Soil Organic Carbon map of the north eastern states including Assam has been prepared.

- Acid soil management using lime sludge application, furrow liming and/or application of organic residue/manures has been standardized and popularized under various programmes such as NAIP, TSP, NICRA etc.
- New approach of ameliorating acid soils through lime peleting, core shell hydrogel (in collaboration with IARI) are under trial.
- Acidity induced aluminium and iron toxicity tolerant varieties in rice, pulses, oilseeds and spices like ginger and turmeric has been identified.

D. Water Management

- Zero tillage coupled with in-situ residue management has been identified as efficient and low cost technology for crop and water productivity enhancement of rabi crops such as lentil, pea, toria, frenchbean etc under AICRP on water management.
- Buckwheat is found suitable under drought and can also be used in the contingency plan during post flood conditions.
- Jalkund - a micro rain water harvesting structure and roof water harvesting models has been standardized and popularised among the farming community specially residing in hills.
- Roof water harvesting along with deep litter piggery, poultry enhanced water productivity by manifolds.
- Water efficient cropping systems has been identified for upland farming to increase cropping intensity and enhancing crop-water productivity.
- Soil treatments such as bench terracing, contour bunding, fodder grasses on terrace risers, cover cropping/mulching etc. under different farming systems reduces water runoff by about 90%.
- A total of 3850 farmers through 77 farmers training and 350 trainer's through 14 trainers from different NEH region have been trained under in various aspects of water management during 2007-12 under Scaling up of Water Productivity in Agriculture for livelihood (SWPAL) programme.

E. Agroforestry and Integrated Farming

- Fourteen agroforestry/farming system models have been developed to suit the needs, preferences and resource base of different farmers of the NEH region and optimized for improving system productivity.
- Dairy based land use system with crop-fish integration and Agro-pastoral systems have been found most profitable and ecologically sustainable.
- Farming system models could reduce annual soil loss from 46 t/ha to 8 to 10 t/ha and reduced runoff by about 90%.

F. Horticulture

- Tuber crops such as colocasia, tapioca, elephant foot yam, dioscorea etc. has been found potential as food-feed crop in hill farming system integrating pigs and poultry. It is also found suitable for vertical farming especially dioscorea and sweet potato in combination with tree based land use system.
- Thirty two germplasm of 'birds eye chilli' collection has been evaluated in Mizoram centre.
- Twenty three grape varieties will be evaluated in Mizoram in collaboration with NRC on Grapes.
- Early maturing mangoes are being evaluated in Tripura Centre.

- Underutilized/less commercial horticultural crops such as chow-chow (Sechium edulae), bitter brinjal (Solanumgilo), Mimordica spp., Allium spp. etc as vegetables and condiments are under evaluation.
- AICRP on tuber crops, spices, vegetables:

G. Animal Sciences and Fisheries

- Artificial Insemination (liquid and frozen semen) technology in pig has been standardized for pig with about 70-80% success rates. Breed improvement, nutritional and health management in pigs has increased quality pork production.
- Livestock based integrated farming module (eg. pig, cattle, murrah buffaloes, emu, backyard and rural poultry) has increased system productivity and employment attracting youth farmers.
- Introduction of new fish species (Golden mahseer, Oseobrama belangeri, Amur carp, Labeo bata, Gonius) and portable hatcheries in north-eastern hills have increased fish production.
- Thermal tolerance of two indigenous fish species of Danio group has been evaluated.
- Integrated fish based farming system (rice + fish, fish- poultry-horticulture, fish –dairy, fish-piggery, fish-duckery, fish-goatery etc) has been standardized and quantified economy has attracted rural youths as entrepreneurs.

H. Farm Mechanization and agricultural Implements

- Two prototype implements & tools (cono-weeder & adjustable row marker) licensed to one fabricating agent in Arunachal Pradesh
- Standardized the composition of bee-hive charcoal/biomass briquettes from locally available agriculture wastes and forest litters.
- Small implements and farm tools suitable for the hill farming are improvised, evaluated and popularized under AICRP on farm implements and machineries.
- Use of plastics in various farm activities and practices is being tried under AICRP on Use of Plastics in Agriculture.

E. Agrometeorological Services:

- Long term data of important weather stations have been collected and analyzed for climate projections.
- Integrated Agro-advisory services are being provided to the farmers by ICAR Research Complex for NEH Region, CAU, AAU, other institutes.

All India Coordinated Research Projects for Region - III

AICRP on Farming System Research

ICAR Research Complex for NEH Region, Barapani

Research on IFS in farmer's field has been initiated in 2012-13 on animal based, horticulture based, fish based, and agroforestry based systems in all the seven states. Poultry and Piggery integrated with tomato, cabbage, bottle gourds, sweet potato have been demonstrated in about 50 ha covering 450 farm families. Action research on QPM + Pig, Fish + Poultry, Paddy cum fish culture, Chow-chow + Piggery, poultry + cabbage/other vegetables, floriculture + pig/poultry, Tuber crops (Tapioca, Colocassia, Dioscorea, Elephant foot yam) + pig etc has been initiated.

AAU, Jorhat

AAU joraht is actively involved in identifying efficient cropping systems and developing farming system modules involving complementarities of crop-fish-livestock interactions for diversifying farming activies, enhancing cropping intensities and improving food and nutritional security of farmers.

Network project on Organic Farming

ICAR Research Complex for NEH Region, Barapani

- Supply of nutrients on the basis of N equivalent through integrated sources i.e., 50 % recommended doses of N through FYM + 50 % recommended doses of N through VC was found best for improving productivity and soil health in vegetable(frenchbean, potato & tomato) based cropping systems. System productivity in terms of maize equivalent yield (MEY) was found maximum in maize + soybean –frenchbean (35.75 t/ha) cropping system. Soil properties such as bulk density (1.09 g/cc), soil organic carbon (2.33%) and soil microbial biomass carbon (222.50 µg/g dry soil) was found maximum under integrated source of nutrient supply after six cropping cycle.
- The results obtained after six cropping cycle (2010-12), revealed that Rice- tomato cropping system was found most profitable followed by rice – carrot compared to all other systems and integrated sources of nutrient supply was found more profitable followed by organic and inorganic sources of nutrients on raised beds.
- Produce quality of tomato such as TSS (4.70 %), ascorbic acid (28.06 mg/100 g), reducing sugar (2.53 %), total sugar (4.81 %) and lycopene (16.49 mg/100 g) was found better under organic management practice followed by integrated sources of nutrient supply. Quality of carrot such as total soluble solids (8.28 %), ascorbic acid (39.94 mg/100 g), acidity (0.21 %), beta-carotene (7.97 mg/100g) and total carotenoides (68.93 mg/100g) were found better under organic management practice followed by integrated sources of nutrient supply.
- After 6 cropping cycle, soil organic carbon increased by 25.54 % and 20.73 % compared to the initial value of 2.46 % in integrated and organic treatment, respectively. The SMBC was found maximum (222.50 µg/g dry soil) in integrated sources of nutrient supply.
- Field experiments on plant protection revealed maximum yield of maize and soybean with the application of derisom (3 ml/lit) alone or in combination with panchagavya (3%) and cow urine (10%) whereas, maximum fruit yield of tomato was recorded with panchagavya (3%) + lantana leaf extract (10%) + vermiwash (10%). Sole application of panchagavya (3%) or in combination with lantana leaf extract (10%) and vermiwash (10%) was found effective in minimizing the percent disease index (PDI) and percent insect damage in maize, soybean and tomato. Application of neem oil (3 ml/lit) and derisom (3 ml/lit) was found effective in controlling stem borer, Monolepta and Epilenchna in maize and leaf folder, flea beetle and mylloceros in soybean.

AICRP on Agroforestry

ICAR Research Complex for NEH Region, Barapani

- Four hedge row species Fleminggia macrophylla, Indigofera tinctoria, Crotolaria tetragona and Tephrosiacandida were evaluated for their productivity of green leaf manure. Highest leaf biomass from 3 cuttings was obtained from Indigofera tinctoriai (7.1 t ha-1). If incorporated to the soil, it can add 60 to 70 kg nitrogen per ha.
- In the long term (20 years) evaluation of MPTs (Alnus nepalensis, Prunus cerasoides, Symingtonia populnea, Parkia roxburghii, Michelia oblonga, Gmelina arborea, Cryptomeria japonica, Cupressus torulosa, Pinus kesiya) maximum volume (278.29 m3/ha) was recorded in Michelia oblonga.
- In the silvi-horti-pastoral systems, pineapple (var. Kew) under the canopy of silver oak (Grevillea robusta) across the steep slope (25-30 %) with 50 x 80 cm spacing with congo signal revealed highest system productivity. The average yield of pineapple in the understorey of G. robusta was 16.5 t/ha and congo-signal was 28.18 t/ha.
- A herbal garden was established consisting of different medicinal and aromatic plants of the region to generate awareness and impart training to the farmers of the state. Eighty four species were maintained and about 600 farmers were given exposure visits and training on cultivation practices of major medicinal and aromatic crops.
- One hundred fifty germplasm lines of *Mucuna pruriens* (a medicinal plant and leguminous cover crop) has been evaluated and highest seed yield of 1.5 to 2 t/ha and L-Dopa content of 4-6 % was observed.

DIRECTORATE OF WATER MANAGEMENT, BHUBANESWAR

Progress of AICRP on Water Management

Assam Agricultural University, Jorhat Centre

- Drip irrigation at 100% EpR along with application of 75% recommended dose of N and K fertilizers through drip (T3) produced significantly higher fruit yield (88.33 q/ha) of capsicum over other treatments and conventional basin irrigation (67.19 q/ha). Water use efficiency (WUE) at 100% EpR was 14.23 cm, while it was 10.67 cm in case of drip irrigation at 75% EpR. Economic analysis showed that drip irrigation at 100% EpR along with application of 75% recommended dose of N and K fertilizers through drip (T3) resulted in the highest gross returns (Rs. 263740.00/ha).
- Increase in levels of fertilizer application from 40-40-40 to 60-60-60 kg N-P2O5-K2O/ha favorably influenced the yield parameters and yield of the coriander crop. As such application of 60-60-60 kg N-P2O5-K2O/ha being at par with 50-50-50 kg N-P2O5-K2O/ha recorded significantly higher seed yield of coriander. It was observed that the amount of irrigation as well as total water used by the crop increased with the increasing levels of irrigation regimes. Thus, the highest amount of irrigation (36.0 cm) and total water use (42.91 cm) were recorded under irrigations at 10 days interval, requiring 9 irrigations of 4 cm depth during the crop growing season. IW: CPE = 1.0 and 1.2 recorded the lowest irrigation water requirement. The total water use was lowest under IW: CPE = 1.2. Thus highest field WUE was observed under IW: CPE = 1.2.

- In Jorhat, provision of surface drains at 6 m spacing greatly helped in increasing the yield of sesamum. The crop with drains produced mean seed yield of 6.95 q/ha against 4.81 under farmers' practice. It is evident that the provision of surface drainage in sesamum was essential for crop establishment and subsequent crop growth which led to increase the yield by 44.5 per cent over the conventional farmers' practice of no drains. This is obvious because of the fact that during the sowing time as well as early crop stage, i.e., in July-August, there are frequent showers in Assam that cause temporary water stagnation leading to poor crop stand and lower yield.

ICAR Research Complex for NEH Region, Shillong Centre

- Residue management and conservation tillage in rice-based system revealed significantly higher grain yield of rice under zero tillage for all crops with residue retention (5800 kg/ha) followed by the treatment where reduced tillage was practice along with residue incorporation(5000 kg/ha).
- Under terrace land situation, zero tillage was equally good with conventional tillage in respect of yield of maize and succeeding toria. Further, maize along with groundnut intercropping system with or without residue incorporation was found suitable with significantly higher Maize equivalent yield.
- In Maize-Mustard cropping system, zero tillage was equally good with conventional tillage. The grain yield of maize and seed yield of mustard was significantly higher under the treatment that received Maize stalk cover + Poultry Manure + Ambrossia @ 5t/ha.
- Maize intercropped with Ash gourd was found as the best system for the terrace condition of mid altitude of Meghalaya in regards to soil moisture conservation and yield of Maize.
- The yield attributes and berry yield of strawberry was highest under black polythene mulch than straw mulch. Among the irrigation levels, irrigation at 1.0 EPan resulted in maximum berry yield.
- Drip irrigation along with rice straw mulching was suitable under terrace land situation in respect of yield of Tomato and soil moisture conservation.
- Micro – Rain water harvesting structure with Silpaulin lining and Jalkund are getting popularity in different hill districts of NEH Region.

B-24. AGRICULTURAL ENGINEERING DIVISION

1. INFRASTRUCTURAL STATUS

The Region III, comprising of the states of Sikkim, Meghalaya, Tripura, Arunachal Pradesh, Nagaland and Manipur, has no Institute under the SMD of Agricultural Engineering. However the following All India Coordinating Research Projects are in operation in different ICAR Institutes/Agricultural Universities.

Sl.	Name of the AICRP	Location of the Centre
1	Farm Implements and Machinery	ICAR Complex for NEH region. Umiam, Barapani
		Assam Agricultural University, Jorhat
		College of Agricultural Engg. & Post Harvest Technology, CAU, Ranipool Gangtok (Sikkim)
2.	Post Harvest Technology	Assam Agricultural University, Jorhat.
		Assam Agricultural University, Khanapara, Guwahati (Assam)
		Sugarcane Research Station, Assam Agricultural University, Buralikson
		College of Agricultural Engineering and Post Harvest Technology, CAU, Ranipool, Gangtok (Sikkim)
3	Renewable Energy Sources	Assam Agricultural University , Jorhat
		College of Agricultural Engineering and Post Harvest Technology, CAU, Ranipool, Gangtok (Sikkim)
4	Ergonomics and Safety in Agriculture	North Eastern Regional Institute of Science and Technology, Nirjuli (Itanagar)
		College of Agricultural Engineering and Post Harvest Technology, CAU, Ranipool, Gangtok (Sikkim)
5	Utilisation of Animal Energy for Enhanced System Efficiency	Assam Agricultural University, Jorhat
		College of Agricultural Engineering and Post Harvest Technology, CAU, Ranipool, Gangtok (Sikkim)
6	Application of Plastics in Agriculture	ICAR Research Complex for NEH Region, Umiam, Barapani
		College of Agricultural Engineering and Post Harvest Technology, CAU, Ranipool, Gangtok (Sikkim)

2. SALIENT ACHIEVEMENTS

2.1 Farm mechanization

The following farm equipment suitable for hilly regions were developed by centres of AICRP on Farm Implements and Machinery.

Development and evaluation of power tiller operated bench terracer-cum-leveller for hilly region: In hilly areas, the farming is practiced in terraces and sloppy land. All the work is done by

manual labour in hilly areas which enhances the cost of operation and drudgery. To mechanize the bench terracing work, a power tiller operated 1.0 m wide terrace-cum-leveller has been developed by CSKHPKV Palampur centre. The capacity of the terracer was 0.12 ha/h for terracing the field.

Development and evaluation of power tiller operated zero-till drill for hilly region : A prototype of power tiller operated zero-till drill was designed and developed by CSKHPKV Palampur centre for sowing wheat crop. The field performance of zero-till drill was carried out farmers' field . The effective field capacity was 0.09-0.10 ha/h at a forward speed of 2.1-2.2 km/h with field efficiency 56-62%. The cost of operation with zero-till drill was 60-63% lower as compared to traditional method.

Power weeder for horticultural crops : The power weeder is suitable for interculture operations in orchard crops. It consists of 4 blades, mounted on an adjustable shaft suitable for weeding in various horticulture crops. The blades are rotated by 1.4 hp petrol engine. The effective width of the weeder is 25 cm. Depending on the requirement; the weeder can be operated on 4, 3 or 2 wheels with 25 cm, 20 cm or 16 cm operating width. The weeder is suitable for weeding in chillies, turmeric, sugarcane, banana, vegetable crops, sweet orange lemon, papaya, medicinal plants and other row crops like jowar, groundnut and mulberry.

Design and development of power tiller operated inclined plate planter : Power tiller operated 3 row inclined plate planter was designed and developed for sowing maize and pea in terraces and valley lands. The incline plate planter was having V-shaped furrow opener of 45 mm width and chain and sprocket type drive mechanism. The planter was tested in the field for sowing of pea at row to row spacing of 300 mm and average plant to plant spacing of 83 mm. The performance of the planter was satisfactory with 8% missing.

Prototype Manufacturing Workshop : The following farm tools and implements were fabricated and supplied to different organizations and individual farmers of the NEH region by Barapani centre during 2012-13

Item	**Quantity**		
Pedal paddy thresher	3	Circular blade weeder	3
Cono weeder	3	U-blade weeder	7
Wheel hoe (single tyne)	2	Hand fork	8
Animal drawn row marker	5	Straight blade weeder	3
Maize sheller	8	Garden Rake	8
Metallic tip dibbler	2	Grass slasher	1
Bordoli seed drill	1	Adjustable row marker	1
Groundnut decorticator	1	Total	56

Front Line demonstration conducted

Name of centre	Name of equipment	Area covered, ha/ hours used
AAU, Jorhat	Rotavator	18 ha
	Rice transplanter	2 ha
	Axial flow paddy thresher	52 h
	Animal drawn helical blade puddler	3 ha
	Zero till seed drill	3 ha
	Inclined plate planter	5 ha

2.2 Utilization of Animal Energy

The following activities suitable for hilly regions were developed by centres of AICRP on Utilization of Animal Energy for Enhanced System Efficiency:

(i) CAE&PHT, Gangtok Centre

A survey of status of draught animal population in Sikkim was carried out and gaps for improvement in cultivation operations were identified. This was carried out in all the 4 districts of Sikkim covering 10 villages. Salient findings were:

- Wooden plough and traditional clod crusher cum puddler were the animal drawn equipment used by farmers.
- Custom hiring of bullocks was prevalent. They were used for 7-30 days in each working season depending on location.
- Thatched and GI roof with kaccha flooring, open on all sides were the main characteristics animal housing used.
- The mechanization gaps were in the area of tillage, puddling and sowing equipment for different crops in narrow terraces of hills.
-
- The following animal drawn implements were developed and tested:
- Wedge plough
- 3 tyne wing plough.
- Clod crusher cum leveler.
- Planter for mustard and maize crop.
- Single row zero till drill.

(ii) AAU, Jorhat Centre

- A four row bullock drawn mustard seed drill was developed.
- The database on draught animal power (DAP) and DAP based technologies of Assam was completed for upper Brahmaputa Valley Zone and Hill Zone.
- The animal operated rotary transmission system for operation of agro-processing machinery was design refined by using old transmission system of a truck. This increased efficiency of system. The size of paddy thresher was increased resulting in increase in

output capacity from 148 to 196 kg/h for paddy thresher and for chaff cutter from 215 kg/h to 287 kg/h. The fatigue score did not cross the limit of 20 even after 3 h operations.

- 10 FLD of improved bullock drawn implements was carried out in villages Katonipar, Pirakota, Solmare and South Duliagaon villages. In addition 10 FLDs were conducted with the help of KVKs. Based on success of demonstrations, State Government has ordered for 500 sets of implements.

2.3 Post Harvest Technologies

Technology of onion storage

IIT Kharagpur centre of AICRP on PHT found that pre-storage treatment of onion treated with ethanol vapour (7.89 $g \bullet kg^{-1}$ of onion) showed best physical and chemical attributes for post harvest storage. Control of post harvest losses in onion needed treating onion with combination of ethanol (75 %) and potassium sorbate (0.7 %) in minimization of physiological loss in weight and rotting percent.

In another study on 'Development of post harvest practices for enhancing the storage life of small onion' conducted by TNAU Coimbatore centre of AICRP on PHT, it has been found that curing of onions could be achieved in 3 days under open field condition followed by shade curing for two days. Lowest physiological loss in weight (1.26 %) and minimum sprouting (0.05 %) were recorded in onion bulbs stored in low cost bottom ventilated storage structure when compared to cold storage at 0, 5, 10°C.

Suitable post harvest technologies ready for commercialization

List of field level successful technologies from AICRP on PHT centres in NEH Region

No.	Centre	Technology
1.	AAU, Jorhat	Cauldron paddy parboiling technique Process for utilization of paddy soaked for days under flood water Value added products from ginger Process for storage of ginger rhizomes in fresh form RCC ring bin for paddy storage Drying racks for efficient sun drying of paddy
2.	AAU, Buralikson	Low cost double pan furnace for jaggery making by small/ marginal farmers Herbal clarificants for sugar-cane juice in jaggery making
3.	AAU, Khanapara	1. Technology for production of (i) Fermented chicken sausage, (ii) Intermediate spent chicken meat, and (iii) Spent chicken meat pickle developed for storage at room temperature. 2. Technology for production of intermediate moisture pork

Entrepreneurship development in post harvest handling, quality parameters and packaging

Jorhat (AAU) centre under AICRP on PHT established 4 Agro-Processing Centres (APC) in four districts of Assam, viz. Jorhat, Sonitpur, Nagaon and Golaghat to carry out primary processing of the surplus agricultural produce in the production catchment by the rural entrepreneurs (individual and SHG). These APCs have been quite effective in post harvest loss reduction, value addition, income and employment generation in rural areas.

2.4 Renewable Energy

(i) CAEPHT, Gangtok centre

The centre evaluated the performance biogas plants of different designs for hilly region of Sikkim. The biogas produced from plants during different months of the year was found as 1.545 m^3 per day in May to 1.055 m^3 per day in December with mean gas production of 1.43 m^3 per day. The average biogas produced with cow dung was 30-33 litres per kg in cold climate of Sikkim. The payback period for gas produced from plant was one and half year with daily preparation of meal for six members family.

The performance of 80 liters capacity solar refrigerator was evaluated by the centre. The working of the refrigerator was found satisfactory without any trouble.

The performance of improved combustor devices for domestic applications in Sikkim was determined by the centre. The improved cook stoves selected for evaluation showed that SPRERI designed inverted down draft gasifier had 28-31% thermal efficiency.

ii) AAU, Jorhat centre

Field evaluation of family size cattle dung based biogas plant was done on poultry litter/poultry dropping as substrate. It was found that cattle dung based feedstock in a biogas plant can be suitably substituted with poultry litter.

The centre conducted ORP of inverted downdraft gasifier (wood stove). The thermal efficiency of the cook stove was found to be 21.5%. The stove was found to be very suitable for Assam region since 100% biomass is utilized as fuel.

B-25: ANIMAL SCIENCE DIVISION

Status of the on-going schemes of Regional Committee No. III for the States of Assam, Arunachal Pradesh, Mizoram, Meghalaya, Manipur, Nagaland, Sikkim, and Tripura, Assam

1. **Project : National Research Centre on Pig**

Location : Rani, Guwahati

Objectives :

- To undertake basic, strategic and applied research in the areas of pig production and health including product/byproduct processing, value addition through quality control measures & transfer of the evolved technologies to the client groups.
- To act as a repository of information houses on pig production & health for regional, national & global policy planning & implementation

Achievements:

- Procured indigenous breeds (Niang-Megha and Ghungroo) and exotic breeds (Hampshire and Duroc)
- AI in pig has been undertaken at the institute Farm and village farms. The total of 1006 AIs were done in 2011-12 and more than 1900 in 2012-13.
- Supply of pig seed to farmers as well as development agencies.
- Production of Quality pig meet products in public private partnership mode the products are being supplied to various states in the North-East Regions.
- A model retail pork shop suitable under rural conditions has been designed (minimum operational costs, off-floor operations, and hygienic display and storage facilities) to facilitate clean pork production.
- The Institute has got ISO 9001:2008 Certification for
- Quality Management System for Research & Training in the field of Pig Prodution.
- R & D Pore Processing Plant for Production of Pork and Pork Products.
- NRC on Pig organized an ICAR-Entrepreneur meeting/Agri Business Camp on 13th February, 2013 to showcase technologies related to agriculture and animal husbandry developed by various institutes of ICAR in North Eastern and Eastern region of India in collaboration with Institute Technology Management cells of various research institutes, Zonal Technology Management Unit, National Agricultural Innovation Project and Agri-business programme of ICRISAT and Federation of Industries and Commerce of NE region (FINER).
- NRC on Pig organized a 'farmers interaction meeting of piggery' on 23rd February, 2013 in conjunction with the 'Livestock and Poultry India' meeting organized by Indian Chamber of Commerce, Guwahati chapter in association with Ministry of Food Processing Industries. More than 100 farmers were participated in the interactive meeting and exchanged their views. Institute has hosted a 'Group discussion on medicinal plants of NE India' on 10th February, 2013.

2.Project **AICRP on Poultry Breeding**

Location AAU, Khanapara

Objective:

- To develop & test germ plasm suitable for rearing under rural/back-yard system in the state of Assam and adjoining regions.

Achievement:

- Local survey about the preference of birds under backyard rearing has been completed and the centre is now involved in multiplying/selecting the rural germplasm for its purity

3. Project AICRP on Improvement of feed resources and nutrient utilization in raising animal production

Location : AAU, Khanapara

Objectives:

- To identify the limiting nutrients at farm gate level
- Strategic supplementation of limiting nutrients (macro & micro) through locally available feed resources.

Achievements:

- Region specific resource based feeding schedules developed.
- Mineral mapping done.
- Area-specific mineral mixture developed.
- Locally available feed resources assessed.
- Validating the optimum zinc in the diet of pig(100-200 ppm in diet).
- Strategic supplementation of limiting nutrient (protein) through 100g de-oiled soyabean meal in addition to the existing feeding practices in rural situation improved the growth rate of weaned piglets with higher economic returns (Net profit of Rs. 475.00 per animal for achieving total body weight gain of 47 kg). The technology has potential for wide scale application.

4. Project AICRP on ADMAS

Location: College of Vety Science, Khanapara, Guwahati

Objective:

- Sero surveillance and monitoring of livestock diseases and investigation of endemic, emerging and re-emerging livestock disease/outbreak in their area.

Achievements:

- Taken part in the DBT-Twining NE programme at College of Veterinary Sciences, AAU, Khanapara, Guwahati, Asom on the research project entitled, "Serosurveillance and association of toll-like receptors, Th1-Th2 status and viral genotypes in susceptibility and severity of Peste des petits ruminants among goats (capra hircus) and sheep (ovis aries) or North East India" with a counterpart in the Department of Microbiology. Through this project, NER Scientists and SRF are to be trained at the collaborating institute appropriately with respect to the project related

research work to empower the Scientist and R & D programmes for promotion of Biotechnology in the North Eastern Region of India.

- Utilizing the database available at PD_ADMAS, Bengaluru monthly forecasting of the following livestock diseases is carried out viz. Swine fever, Anthrax, Bluetongue, Black quarter, CCPP, Enterotoxaemia, Foot and Mouth Disease, Haemorrhagic septicaemia, Sheep and Goat Pox, Theileriosis and the Director of State AH Deparments of NE region were informed two months in advance to take up necessary preventive measures. Necessary infrastuctures in the form of scientific equipments have been provided to these centres to carry out research.

5. Project : Network Project on Buffalo Improvement

Location: (Swamp buffalo) AAU, Khanapara
Objective :

- To establish elite herd of buffaloes for production of genetically superior young bulls, performance recording and improvement of Swamp buffalo

Achievements:

- The centre has established the herd of Swam Buffaloes by purchase from the breeding tract.
- Free treatment and mineral mixture were provided to the farmers buffaloes.

6. Project: AICRP on FMD
Location: AAU, Khanapra, Guwahati.

Objective:

- Sero surveillance, monitoring and control of FMD in livestock

Achievements:

- Total of 45 outbreaks of FMD were recorded in Assam. In Assam highest number (22) outbreaks were recorded in Kamrup district. Cattle were effected in all the outbreaks and in only 2 outbreaks pigs were also effected along with cattle.
- FMDV serotype O was diagnosis as causative agent for 30 outbreaks in Assam.
- Highest no. of outbreaks were recorded in the months of September like the previous year followed by August and February.

7. Project: Network Programme on Haemarrhagic septicaemia
Location: AAU, Khanapara, Guwahati

Objective:

- Identification and typing of field isolates If pharullea Multocida from livestock for epidemiological study and development of vaccine against HS.

Achievements:

- Drug sensibility patterns against Pmultocida were studied which reveal maximum sensitivity against Cefotaxime, Enrofloxacin and Less for gentamicin and Ampicinnin.
- The vaccination trials for pig have been conducted in rabbits with encouraging results.

8. Project **Network on Animal Genetic Resources**
Location Core Laboratory, AAU, Guwahati

Objective:

- Collection of blood samples, characterization studies and data collection from various buffalo herds associated under the Network Project on Buffalo Improvement located at different Institutions/Universities in the country.

Achievement

- The infrastructure and furnishing to purchase of lab equipment has been completed.
- Molecular characterization of 6 different populations of pig viz. Ghungroo(West Bengal), Niang-megha (Meghalaya), Doom and Assam local (Assam), Zovok (Mizoram) and Suwo (Nagaland) of Eastern India was undertaken with 240 samples(40 from each population) and hetrozygosity of more than 0.5 was observed among the pig populations with genetic distance between 0.1 to 0.2 due to high rate of shared alles and genetic similarity between the populations.
- Molecular characterization of 4 different populations of goat from Eastern India was undertaken using a pool of 126 samples (40 Assam Hill goat, 40 Assam Local, 16 Naga Long haired goat, and 30 Bengal Goat), using 25 microsatellite markers. No of alleles ranged from 2 to 9 in different goat populations. Some of the populations showed private alleles also. F1s values were close to zero showing inbreeding. Majority of the populations showed genetic distance between 0.1 to 0.2 showing high rate of shared alleles and genetic similarity between the populations.

9.Project **AICRP on Goat Improvement**
Location Assam Hill goat (Field Unit) AAU, Khanapara

Objectives:

- To assess the production performance of goat breeds in farmers' flock in village management system and improve the germplasm through selection.
- To improve the socio-economic status of goat breeders and the economics of goat production in farmers flock.
- To disseminate the pro-poor goat based technologies under field conditions and assessment of their impact on goat production.

Achievements:

- The Centre has adopted Batabari (Dighirpar) of Darrang Distt. And Khetri of Kamrup Distt. of Assam as two field clusters under the project and is providing improved breeding and health cover facilities to the farmers crops.

10. Project AICRP on Pigs

Location AAU, Khanapara

Objective:

- Production of Hampshire crossbred pigs(50% & 75%), package of practices and their dissemination under field conditions.

Achievement:

- The Centre has evaluated 50% and 75% exotic inheritance pigs and have found 75% better performing. The Centre has also released books/leaflets in local languages for the benefit of the farmers.

12. Project Outreach programme on Monitoring of Drug Residues and environmental pollutants.

Location College of Vety Sciences, Assan.

Objectives:

- Monitoring of drug residues and environmental pollutants and evaluation of their safety.
- Toxico dynamic and depletion kinetic studies of drugs/ pollutants for safety evaluation.
-

Achievements:

- Areas for monitoring of pesticides and heavy metal residues have been selected. Methods for safety evaluation studies scrutinize.
- Standardized methods for analysis of antibiotics and pesticides (chlorphyrifos, endosulphane in blood/tissues)

13. Project Outreach programme on Ethno Veterinary Medicine

Location AAU, Khanapara, Guwahati

Objective:

- Selection and authentification of herbal medicinal plants having antiviral.anti new plastic and nefro protective as well as wound healing and anti diabetic activity.

Achievements:

- Collection and authentification of various herbal plants from various sources.
- Information on 30 medicinal plants of north east region have been documented.
- Plant extracts collected showed significant effect in reduction of Cystic Stones.
-

14. Project Mega Seed Project on Pig

Location AAU, Khanapara.

Objective:

- Large scale production of quality germplasm of crossbred (50%) pigs (Hampshire X Ghunghroo) and (Tamworth X Desi.)

Achievements:

- More than 1000 piglets have been provisioned to farmers and development agencies.
- Technological interventions (Assam)
- Assam has 0.1 million crossbred cattle, 1.4 million non-descript cattle and 0.15 million buffaloes in milk, producing around 0.8 million tonnes of milk, non-descript cows contributing the major share (0.5 million tonnes) besides, 21.7 million poultry contributing 0.5 billion eggs per annum. The state has a sizeable number of goats (3.0 million) and pigs (1.5 million). The state has great potential to enhance productivity of cattle, goat and poultry by adopting following technologies:
- Improved germplasm of Frieswal cattle for 5 % increase in milk production, Black Bengal goat for increased twinning percentage and backyard poultry (Vanaraja, Gramapriya, CARI Priya) for 100 % increase in egg production over indigenous birds
- Field based diagnostic kits (Brucella, TB, Peste des petitis ruminants, IBR) and vaccines (FMD, Goat pox, Raniket) for enhanced production and income
- Complete feed blocks and urea-treatment of paddy straw for 5-8% increase in production
- Value addition of milk (low cholesterl ghee, pizza cheese) and poultry products (nuggets, patties, pickles)

Arunachal Pradesh

1. Project **NRC on Yak,**
Location Dirang, West Kemang Distt, Arunachal Pradesh

Objectives:

- Survey for genetic resources, managemet practices, production level and problems associated with production.
- To establish a herd of pure yaks to carry out observations on performances under range and semi-range systems of management.
- To conduct research on improvement of yak and its products through selection and breeding with exotic frozen semen.
- To conduct research on nutrition, physiology, production and managemental aspects under semi-range and confinement.
- To conduct research on fodder and development of pasture at mid and high altitude for yaks.
- To provide complete health coverage through proper therapeutic and prophylactic measures based on clinical and laboratory findings on the prevalent diseases of yak.
-

Achievements :

- Standardization of protocols for freezing semen and improved post thaw motility in progress
- Complete feed formulations in the form of feed blocks utilizing cost effective locally available feed resources field validated
- Breeding behaviour of adult yaks assessed
- Value added wool & fibre products from sheep and yak developed
- Designer paneer (insulin incorporated low fat paneer) developed from yak milk which can be stored upto 12 days at refrigeration temperature (4 + 10 C)
- Value addition of yak milk for various products carried out

2. Project **AICRP on Improvement of feed resources and nutrient utilization in raising animal production**

Location NRC Yak, Dirang

Objectives:

- To identify the limiting nutrients at farm gate level
- Strategic supplementation of limiting nutrients (macro & micro) through locally available feed resources.

Achievements :

- Region specific resource based feeding schedules developed. Mineral mapping done.
- Area-specific mineral mixture developed.
- Locally available feed resources assessed.
- Complete feed blocks prepared using locally available tree fodders and concentrate feeds supplemented with area specific mineral mixture had positive effect on growth performance of yak calves during winter which otherwise resulted in 15% loss of body weight in the winters.

3. Project **AICRP on FMD**

Location DAH&VS, Itanagar.

Objective:

- Sero surveillance and monitoring of the region

Achievement:

- Three FMD outbreaks in the state of Arunachal Pradesh were investigated and diagnosed for prevention.

4.Project Outreach programme on Monitoring of Drug Residues and environmental pollutants.

Location NRC Yak, Dirang

Objectives:

- Monitoring of drug residues and environmental pollutants and evaluation of their safety.
- Determination of pesticides and heavy meals in soil, feeds , fodder and livestock products in food chain.

Achievements:

- Standardization of assay/procedures for conducting depletion kinetic studies.
- Areas for monitoring of pesticides and heavy metal residues have been selected. Methods for safety evaluation studies scrutinized.

Technological interventions(Arunachal Pradesh)

- The state has only 1,000 crossbred and 10,000 non-descript cows in milk, the average daily yield of which is 6.0 and 1.2 kg respectively. The state has a strength in mithun (0.19 million) and yak (9,000) population besides, 0.33 and 1.7 million pigs and poultry.

There is further scope to enhance productivity of pig, mithun, yak and poultry through the following technologies:

- Improved germplasm of cross bred pig for 125 % increase in litter size and backyard poultry (Vanaraja, Gramapriya, CARI Priya) for 100 % increase in egg production over indigenous birds
- AI technology for mithun and embryo transfer for yak
- Area-specific mineral (Mg, Cu, Mn) supplementation for 10-15% improvement in productivity
- Health (FMD) and management (feeding, shelter) package for yak and mithun

Mizoram

1. Project Mega Seed Project on Pig

Location Selesih Pig Farm, State Vety Deptt, Govt of Mizoram

Objective:

- Large scale production of quality germplasm of Large White Yorkshire.

Achievement:

- More than 1000 piglets have so far been provisioned to farmers and development agencies through the centres.

2. Project AICRP on Pigs

Location Central Agricultural University, Mizoram

Objectives

- Improvement of 50 and 75% crossbred pigs. Market survey of pork production alongwith the use of location specific economic ration and adoption of integrated farming systems.

Achievement

- The centre has established the farm and is maintaining Zovwak (Mizoram local pig) and Large White Yorkshire animals.

3. Project AICRP on FMD

Location Deptt of AHMVS, Aizawl

Objective:

- Sero surveillance, monitoring and control of FMD in livestock.

Achievement:

- FMD outbreaks are being routinely monitored/diagnosed for suitable preventive steps.

Technological interventions (Mizoram)

- In Mizoram, major livestock is pig (0.2 millions) and 1.1 million poultry contributing 32.6 million eggs per annum. The state has the potential to enhance productivity of pig and poultry with the following technologies:
- Improved germplasm of cross bred pig for 125 % increase in litter size and backyard poultry (Vanaraja, Gramapriya) for 100 % increase in egg production over indigenous birds
- Artificial Insemination (AI) technology for pig

- Total mixed rations (TMR) for better feed conversion efficiency in pigs
- Field based diagnostic kits and vaccines (Swine fever, Fowl pox) for enhanced production and income
- Value addition of pork (smoked ham, pickle) and poultry (chicken chunkalona, nuggets)

Manipur

1. Project Poultry Seed Project

Location Cooperating Centre, Regional Centre of ICAR Res Complex for NEH Region, Imphal, Manipur.

Objective:
- Production of quality germplasm of rural poultry, Vanaraja and Gramapriya varieties.

Achievement
- Poultry Seed is being produced and provisioned to the farmers and development agencies approximately around 3000 chicks are being provisioned every month. The centre has given the target of producing around 50000 chicks during the year.

2. Project AICRP on ADMAS

Location Deptt of Vety & AH, Imphal
Objective:
- Epidemiology, surveillance, monitoring, forecasting, forwarding and estimation of economic losses due to various livestock diseases and their impact.

Achievement:
Regular sample collection and testing for sero prevalence of BR in bovines is being done.

3. Project AICRP on FMD
Location Deptt of Vety & AHS, Imphal
Objective:
- Sero surveillance, monitoring and control of FMD in livestock.

Achievement
- FMD outbreaks are being routinely monitored/diagnosed for suitable preventive steps.

Technological interventions(Manipur)
- In Manipur, major livestock is pig (0.42 million) and 2.9 million poultry contributing 83.5 million eggs per annum. The state has the potential to enhance productivity of pig and poultry, with the following interventions:
- Improved germplasm of cross bred pig for 125 % increase in litter size and backyard poultry (Vanaraja, Gramapriya) for 100 % increase in egg production over indigenous birds
- AI technology for pig and mithun

- Complete feed blocks for increasing production efficiency
- Field based diagnostic kits and vaccines for major diseases of livestock and poultry

Meghalaya
Project **AICRP on ADMAS**

Location ICAR Res Complex, Barapani. Shillong

Objective:
- Epidemiology, surveillance, monitoring, forecasting, forwarding and estimation of economic losses due to various livestock diseases and their impact.

Achievement:
- Under tribal sub-plan piglets and poultry were distributed to the tribal people of the adopted villages for their socio-economics upliftment.

Technological interventions (Meghalaya)
- In Meghalaya, the major livestock comprises 0.3 million goats, 0.4 million pigs and 2.8 million poultry contributing 97.3 million eggs per annum. The productivity of pig and poultry could be enhanced with the following technological interventions:
- Improved germplasm of cross bred pig for 125 % increase in litter size and backyard poultry (Vanaraja, Gramapriya) for 100 % increase in egg production over indigenous birds
- Artificial Insemination (AI) technology for pig
- Total mixed rations (TMR) for better feed conversion efficiency in pigs
- Field based diagnostic kits and vaccines (Swine fever, Fowl pox) for enhanced production and income
- Value addition of pork (smoked ham, pickle) and poultry (kabbab, nuggets, pickles)

Nagaland

1. Project **NRC on Mithun**
Location Jharnapani, Nagaland.

Objectives:
- Identifiation, evaluation and characterization of mithun germplasm available in the country.
- Conservation and improvement of mithun for meat and milk.
- To act as a repository of germplasm and information centre on mithun.

Achievements:
- World's first ever mithun calf through embryo transfer technology was born at the National Research Centre on Mithun, Jharnapani, Nagaland on March 27, 2012.
- Under the back drop of Reh festival, an interaction programme was held between the scientists of NRCM, Jharnapani, Medziphema (Nagaland) and Mishmi tribes men who are tradition mithun owners/farmers in Rowing village, Lower Dibang Valley, Arunachal Pradesh during 13-14 February, 2013 to spread the awareness of scientific mithun

husbandry practices among these tribal villages and overall socio-economic development by rearing more number of elite mithun.

- An interaction programme was held between the scientists of NRC-Mithun, Jharnapani, Arunachal Pradesh and few Mishmi Tribes men who are traditional mithun ownders/farmers at Ezengo village, Lower Dibang Valley, Arunachal Pradesh. A socio-economic survey was also conducted and free literature published by this Institute was distributed among the mithun owners/farmers on this occasion.

2. Project **Poultry Seed Project**

Location Cooperating Centre, Regional Centre of ICAR Res Complex for NEH Region, Jharnapani, Nagaland

Objective:

- Production of quality poultry seed of Vanaraja and Gramapriya.
- Achievement: The centre has procured the basic stock and established infrastructure facilities. The centre has been given the target of producing 80000 chicks per annum

3. **Project** **Mega Seed Project on Pig**

Location ICAR Res Complex for NEH Region, Jharnapani, Nagaland

Objective:

- Large scale production of quality germplasm of crossbred (50%) of Hampshire x Ghunghroo.

Achievement :

- New initiative during XI Plan. More than 500 piglets have been produced and sold to farmers and development agencies

4. Project **AICRP on FMD**

Location Deptt of Vety & AH, Kohima.

Objective:

- Sero surveillance and monitoring of the region.

Achievement:

- A total of 582 samples were tested using DIVA ELISA Kit out of which 134 samples were identified as positive indicating 23% FMD effected.

5. Project **AICRP on Pigs**

Location Nagaland University, Medziphema, Nagaland

Objective Improvement of 50 and 75% crossbred pigs. Market survey of pork production alongwith the use of location specific economic ration and adoption of integrated farming systems.

Achievement New initiative during XI Plan. The centre has established the farm by procurement of animals.

Technological interventions (Nagaland)

- In Nagaland, the livestock comprises 0.7 million pigs and 2.8 million poultry, contributing 86.8 million eggs per annum. The state also has 40,000 mithun. The state has the potential to enhance productivity of pig, poultry and mithun by adopting following technologies.
- Improved germplasm of cross bred pig for 125 % increase in litter size and backyard poultry (Vanaraja, Gramapriya) for 100 % increase in egg production over indigenous birds
- AI technology for pig and mithun
- Complete feed blocks for increasing production efficiency
- Field based diagnostic kits and vaccines for major diseases of livestock and poultry
- Value addition of mithun hide, skin and milk (bags, shoes, jacket, rasgolla, cheese)

Sikkim

1. Project **Network Programme on Gastrointestinal Parasitism.**
Location Cooperating Centre, ICAR NEH Region, Gangtok

Objective:

- Epidemiology of GI nematode including Nematodirus infection.

Achievements:

- Epidemiology studies on gastro intestinal helmonthe of goats, cattle and yaks were carried out in four agro climatic zones in all the seasons of Sikkim among animals maintained at organized and unorganized farms.
- Highest prevalence of parasitic infestation was seen in Govt. Goat Farm at Mangalbarey, West Sikkim (78-79%) with EPG ranges from 900-3900.
- The prevalence of G.I Parasites at private yak farm, Gnathang, East Sikkim was 15.77%
- Economic impact of Gastro intestinal Parasitism in cattle was evaluated.

2. Project **Poultry Seed Project**

Location Cooperating Centre, Regional Centre of ICAR Res Complex for NEH Region, Gangtok, Sikkim

Objective:

- Production of quality poultry seed of Vanaraja and Gramapriya.

Achievement:

- The centre has established the necessary infrastructure and has procured the necessary germplasm. The centre has given the target of producing around 50000 chicks during the year.

Technological Interventions (Sikkim)

- The major livestock comprises of 0.13 million goats and 0.32 million poultry contributing 14.6 million eggs per annum. The state also has 7,000 yak populations. The state has the potential to enhance productivity of yak and goat with the following technological interventions:
- Embryo transfer technology for faster multiplication of yak
- Complete feed blocks for sustaining production

- Health and management packages for yak and goat
- Value addition of yak milk and hair (churpi, cheese, carpet, brooming brush)

Tripura

1. Project **AICRP on Poultry Breeding**
Location ICAR Res Complex for NEH, Agartala
Objective:

- To test rural poultry stains developed under the project

Achievements:

- The centre has produced and distributed more than
- 1500 chicks (improved germplasm X local native) to farmers for evaluation for conducting molecular characterization of the local germplasm.
- The centre has evaluated Tripura native germplasm (black) Gramapriya, coloured broiler, sire and dam lines and produced commercial stock for distribution to the farmers.

2. Project **AICRP on FMD**
Location IRDD, DIC, Agartala
Objective:

- Sero surveillance and monitoring of the region against FMD

Achievement:

- A total of 27 outbreaks were recorded in state which involved cattle and pigs.12 outbreaks could be diagnosed using sandwhich ELISA, 3 were diagnosed retrospectively using LPB ELISA. All the 15 outbreaks were caused by FMDV serotype 'O' virus. FMD outbreaks involving type 'O' virus have been recorded constantly in the state.

Technological interventions (Tripura)
The major livestock comprises of 0.5 million goats and 0.2 million pigs and 3.1 million poultry contributing 0.1 billion eggs per annum. The state could enhance productivity of goat and poultry with the following technologies:

- ✓ Improved germplasm of backyard poultry (Vanaraja, Gramapriya) for 100 % increase in egg production over indigenous birds and Black Bengal goat for improved meat production
- ✓ Field based diagnostic kits and vaccines for major diseases for production and income enhancement
- ✓ Goat/poultry based integrated farming system technology

B-26. FISHERIES DIVISION

Review of Progress:
Research and support activities from the Fisheries division in the Region No. III, covering the states of Assam, Sikkim, Arunachal Pradesh, Nagaland, Meghalaya, Tripura, Manipur and Mizoram, have been carried out by four Institutes like the Central Institute of Fisheries Technology (CIFT), Central Institute of Fisheries Education (CIFE), Central Inland Fisheries Research Institute (CIFRI) and Central Freshwater Research Institute (CIFA) through local partners. The support was provided in the areas including fisheries, aquaculture, harvest & post-harvest technology.

Fisheries Institutes are regularly organizing training/ workshops/ exhibition/ demonstrations/extension on **the development of fisheries & aquaculture,** harvest, post harvest, fish handling and preservation technologies and production of value added products in this region during the period under report.

The **Central Inland Fisheries Research Institute (CIFRI**) is represented by its Regional Research Centre at Guwahati in Assam which caters to the research and development needs of open–water fishery resources in this region.

Standardizing fish stock enhancement protocols in floodplain wetlands
The Institute has been carrying out studies on various aspects of stock enhancement in Assam with a view to standardizing their stock enhancement protocols. As part of the study, field data were collected from 8 beels of Lower Brahmaputra Valley (LBV) Sub-zone of Assam (Barundanga, Rowa, Dahor-Jogra, Harinchora, Tariachora, Motirkuti, Bhoispuri, Paborchara), ten beels of Central Brahmaputra Valley Sub-zone (Jaluguti, Dandua, Kachadhara, Charan, 47 Morakolong, Deorah, Damal, 46 Morakolong, Lakhanabandha, Borghuli) and six beels of Barak Valley Sub-zone (Korkoria, Fulbari anoa, No. 26 Sibnarayan anoa, Baraknadi anoa, Chri anoa, Baskandi anoa) during 2011-13. Stock enhancement was practiced in all the beels except in 47 Morakolong beel (because of fear of possible floods) to increase their fish yield. Supplementary stocking has been practiced in the selected beels since the past 10 years or more except in Chiri anoa, Baskandi anoa (since the past 3-4 years), and in Rowa beel (from last year).

Fish production: Fish production from both stocked and natural fish stocks in the selected closed beels ranged from 149.3 (Puthimari beel) to 1387.8 kg ha-1yr-1 (Damal beel). Contribution of stocked fishes to fish production in varied from 134.3 to 832.7 kg ha-1yr-1. In seasonally open beels, total fish production varied from 41 (Kapla beel) to 528.8 kg ha-1yr-1 (46 Morakolong beel). The contribution of stocked fishes to fish production varied from 24.6 (Kapla beel) to 416 kg ha-1yr-1 (Bhoispuri beel). Both total fish production and contribution of stocked fishes to fish production was higher in closed beels than that in seasonally open ones.

Contribution of stocked and natural fish stocks: The contribution of stocked fishes to total fish production was 60% or more in all the closed beels indicating that culture-based fisheries was practiced in these beels.

Determination of optimal stocking density: Fish production from both stocked and natural fish stocks in the selected closed beels ranged from 149.3 to 1387.8 kg ha-1yr-1. Based on the field data, optimal stocking density was estimated at 3000 and 3600 fingerlings/ha for closed and seasonally open beels, respectively.

Impact of stocking on fish yield: A case study was conducted in Charan beel, Morigaon district, Assam for assessing the impact of stocking on fish yield. Yield rates in this seasonally open wetland having 60 ha water spread area was estimated at 228 kg/ ha/ yr during 2000-01, which was exclusively from natural fishes with major and minor carps contributing 31.32%, large carnivores contributing 15.78% and small economic fishes contributing the major share of 52.9%. Fish stock enhancement was practiced in this beel during 2010-11 as a result of which fish yield rates increased by 324% (740 kg/ ha/ yr). The share of major carps increased to 62.8% during this year. While the share of large carnivores remained relatively unchanged (11.4%), the share of small economic fishes drastically reduced to 25.8%.

Assessment of habitat variables, aquatic communities and fisheries in selected wetlands of Manipur

Four wetlands (Takmu pat, Ungamlen pat, Utrapat and Sanapat) form Bishnupur district and one wetland (Waithou pat) from Thoubal district of Manipur was assessed for their habitat variables, aquatic communities and fisheries during the period. Except in Takmu pat which was under the administrative control of the Department of Fisheries, Govt. of Manipur, all the other wetlands faced the problem of encroachment for agriculture or Pisciculture in the peripheral areas of the lakes. In these wetlands, the fisheries comprised of common carp, grass carp, tilapia, IMCs and other small indigenous fishes. Some of the endangered indigenous fishes in the pats were *Anabas testudinus, Anguilla bengalensis, Acanthophthalamus punctatus, Channa orientalis, Botia bagarius, Barilius dogarsinghi, Garra graveli, Ompok bimaculatus*, etc.

Demonstration of enclosure culture technology

A pen culture demonstration was carried out in Takmu pat of Bishnupur district for assessing the technological feasibility in Manipur valley conditions. The pen measuring approximately 0.1 ha was constructed using nylon net (25 mm mesh size) with bamboo supports in collaboration with the Directorate of Fisheries, Govt. of Manipur during March, 2012. The pen was stocked with yearlings of Indian major carp, minor carp and exotic carps @ 5 fingerlings/ m^2. The stocked fishes were fed with commercially available pelleted feed (23.4% crude protein) at the rate of 5% of body weight twice a day. Grass carp and catla were also found to be suitable for culturing in pen enclosures. Net pen enclosures can be used for culturing different fish species having local demand either for rearing them up to advanced fingerling size for their subsequent release into wetland-proper or table fish for consumption in large water bodies such as Takmu pat.

Adoption of pen culture technology developed by CIFRI in Sonitpur district of Assam

A field survey was conducted in four sites in Sonitpur district of Assam where pen culture is being practiced to assess the adoption of pen culture technology developed by CIFRI. Nayanjyoti Self help group (SHG) of Parmaighuli, Balipara Block, Sonitpur Dist., Assam took up pen culture practice in Rangapani Jan beel in April 2010 with the partial financial assistance of District Fishery Development Office (DFDO), Sonitpur Dist., Tezpur, Assam. Stocking was done with *Labeo rohita, Catla catla, Cirrhinus mrigala, Cyprinus carpio and Labeo gonius* following species ratio of 30 Catla: 30 Labeo spp.: 30 C. mrigala & 10 C. carpio at stocking density of 5000 fingerlings/ ha. The total cost including construction, seed and feed was ₹ 1.06 Lakhs of which 85% was borne by the DFDO. Another pen culture activity was undertaken by a Non-governmental Organization (NGO) known as Maandal in Kachu beel, Morabhalari, Chiloni, Sonitpur Dist. covering an area of 1.35 ha during 2009-2010. The total cost involved in this case was ₹ 3,73,950.

Fish assemblage, habitat preference and assessment of exotic fishes in inland open waters.
Data were collected from Takmu lake, Bishnupur district, Manipur; Umiam lake, Meghalaya; Dumbur reservoir, Dhalai district, Tripura and six beels of Dhubri district, Assam on the occurrence of exotic fishes in the lakes/ reservoir. The catch from both the lakes (Takmu and Umiam) suggest dominance of exotic fishes especially *Cyprinus carpio*. The local people also have preference for the exotic fishes. The catch from Dumbur reservoir suggested that *Cyprinus carpio* (common carp) is the only exotic fish caught from the reservoir and its contribution to the total catch is negligible (0.5%). The major contributors were indigenous fish *Chanda spp*. (70%) followed by *Amblypharyngodon mola* (10%), which also had higher demand due to its low price (₹ 30-60/kg). The percentage catch of exotic carps were higher than the IMCs indicating that the exotic carps have established in the beels better than IMCs.

ICAR Outreach Activity on Fish Genetic Stocks
As part of the activity led by the National Bureau of Fish Genetic Resources (ICAR), Lucknow, the Institute was entrusted the task of assessing genetic stocks of catla, rohu and mrigal occurring in R. Brahmaputra. As part of the activity CIFRI Regional Centre, Guwahati collected data on length and weight and reproductive parameters for the targeted species. A total of 95 fish samples were collected during the period 2011-12 from different landing centres of R. Brahmaputra (Uzanbazar, Dhubri, Tezpur and Kolongpar).

ICAR Outreach Activity on Nutrient Profiling of Fish
As part of the activity led by CIFRI, Barrackpore, CIFRI Regional Centre, Guwahati collected samples of selected fish species (*Tenualosa ilisha, Amblypharyngodon mola and Puntius sophore)* from Uzanbazar, Amingaon, Panikhaiti and Tezpur landing centres of R. Brahmaputra during three different seasons (pre monsoon, monsoon and post monsoon) and were analyzed for their moisture, protein, lipid and ash contents for determining their nutritional values. Seasonal variation in proximate composition of the fishes was observed.

Central Sector Scheme on 'Development of Inland Fisheries Statistics'.
Field surveys were conducted for collecting data on inland fisheries resources in nine blocks of Nagaon district, Assam. The data collected were collated with existing information available with the District Fisheries Office, Nagaon district, Assam as part of standardization of protocol for collection of inland fisheries statistics. A total of 40, 066 ponds have been recorded and reported from the district in the range of 0.01 to 3 ha. The density was worked out at 29.14 ponds per village. Analysis of data collected / validated showed that majority of the ponds (94.85% of total 40,066 ponds) currently available in the district were in the range of 0.02 to 0.26 ha.

NICRA project on 'Assessment of spawning behaviour of major fish species in inland environment with a view to harness the beneficial effects of the temperature'.
A total of 438 IMC brooders (67 male & 89 female rohu, 39 male & 58 female catla and 90 male & 95 female mrigal) were collected from selected carp seed farms of Assam and Tripura during 2011-12 and their reproductive biology was studied. The studies showed that maturity of the IMCs advanced by nearly one month (from April to March) and the spawning season also extended for nearly one month (from July to August). A total of 150 hatcheries of Assam and 7 hatcheries of Tripura state were surveyed. Analysis of the data showed that a number of minor carps (*L. calbasu, L. bata, L. gonius*), new exotic fishes (*Barbonymus gonionotus and Hypophthalmichthys nobilis*) and indigenous catfishes (*Pangasius pangasius and Ompok pabda*) were used in addition to IMCs and exotic carps. Drastic reduction in the fecundity (up to 50%) was reported by some hatchery owners in the last few decades.

Similar to the observations made in 2011-12, the maturity of IMCs in the study areas advanced by one month i.e. from April to March and the period extended upto one month i.e. from July to August during 2012-13. Incidences of abnormal gonadal development in case of *C. mrigala* (presence of single-lobed ovary) and retarded growth of one lobe of the ovary were observed.

Transfer of Technologies / Training Programmes / Workshops

The Institutes **Central Institute of Freshwater Aquaculture, Bhubaneswar, Central Institute of Fisheries Education, Mumbai and Central Institute of Fisheries Technology, Cochin** are extending their technologies in the field of fish culture, fish harvest and post harvest technologies and also human resource development in the Region III.

CIFA, Bhubaneswar is directly involved in the aquaculture development in the North-east Region through conducting trainings, demonstrations, establishment of hatcheries, capacity building, and production of extension literature in local languages, consultancy, exposure visits and conducting workshops. The institute has developed a network of scientists working on freshwater aquaculture in the region.

Training programme on Ornamental fish culture and breeding

The Institute organized a training programme on Ornamental fish culture and breeding at Gangtok during 26-28 April, 2011 for 25 entrepreneurs and officials of State Fisheries Department, Sikkim.

Popularization of murrel culture

- Under the project 'AValue Chain on Murrel Seed Production in Tamilnadu and Odisha' funded by NAIP, a workshop-cum-training was jointly organized by CIFA and Dept. of Fisheries of Assam at Bagibari, Sonapur, Kamrup (M) Assam Kaliong Kapili on 'Popularization of murrel culture and other economical species in Assam' on 11 September, 2011.
- A workshop was jointly organised by CIFA and Dept. of Fisheries, Govt. of Assam on 'BMP for murrel and other economical species in Assam' at Nalbari, Assam on 12 September, 2011 which was attended by 56 persons comprising Fisheries Dept. Officials and NGOs.

Entrepreneurship development in aquaculture for livelihood security

A training programme ''Entrepreneurship development in aquaculture for livelihood security in Assam'' was organized for fish farmers of Assam at Guwahati, Assam, during 20-21 December, 2011.

Water and soil analysis

Training programme for the Fishery Extension Officers of Assam entitled "Hands on training on water and soil analysis'' was organized in Guwahati, Assam during 20-23 December, 2011. Total nine fishery extension officers participated in this programme. The trainees were trained to analyze different parameters like pH, EC, dissolve oxygen (DO), free carbon dioxide, alkalinity, water hardness, dissolved phosphorus, soil pH, soil organic carbon, soil phosphorus, etc.

Aquaculture through entrepreneurship development

A training programme on 'Aquaculture for entrepreneurship development was organized in Mizoram State' during 1-3 February, 2012 in which Govt. officials from the Fisheries Dept. of Mizoram and farmers participated. Programme coordinators of all 7 KVKs of the state were present in addition to SMS, and other staff members. Training manual and pamphlets prepared in the local languages were released on the occasion.

Other programmes

Training programme was conducted at the Institute on Breeding and hatchery management of carps for participants from Meghalaya (30.7.2011-8.8.2011) and organized workshop on Jayanti rohu and minor carp: exploring possibilities to increase fish production in North-East India at Guwahati, Assam (18-19 June, 2012). Two training programmes for Bodo Territorial Council (BTC) and Meghalaya farmers were held at the Field Station, Kalyani. Three training programmes have been organized in Assam and Manipur on magur farming. A workshop on Popularization of pabda fish culture in eastern and north-eastern states was organized by the Institute at Agartala on 18 August, 2012. Two bulletins entitled "*Pabda-Seed Production & Culture*" in English and "*Pabda macher projonon o chas poddhoti*" in Bengali were released and Pabda seeds were distributed to the progressive farmers of Tripura. In collaboration with Association of Aquaculturists and NFDB organized a Conclave on Aquaculture development for stakeholders of North-East Region at Shillong on 11 September, 2012. A training programme on "Sensitizing Fish Farmers on Small Scale Aquaculture in Sikkim" was conducted by CIFA during 6-7 December, 2012 at Gangtok. 25 FRP carp hatcheries and 13 FRP magur hatcheries were supplied from CIFA for seed production in the North-East Hill Region of the country. On 5 December, 2012, the installation and operation of FRP carp hatchery was demonstrated at State Dept. Fish Farm, Rengpo, Sikkim.

The Central Institute of Fisheries Technology, Cochin has installed Solar fish drying plant ('CIFT Dryer JSDL-55SM') with LPG backup at ICAR Research Complex, Manipur on 24 October, 2011. Another Solar Fish Dryer with electrical backup was installed and commissioned at Directorate of Fisheries, Manipur on the same day.

Training on 'Production of value added fishery products'

Two training programmes on 'Production of value added fishery products from fresh water fish for employment and income generation' were organized in collaboration with the State Department of Fisheries, Manipur and the National Association of Fishermen, Manipur. The programme was conducted at Uchiwa Kabui Tribal Village, Imphal West during 22-24 March, 2012 and at Sekmaijin tribal village, Thoubal District, Manipur during 26-28 March, 2012. During the training production of value added fishery products viz., fish pickle, fish cutlet, fish wafers, fish balls, fish fingers, dried fish and fish silage were demonstrated.

Training on 'Value added fishery products'

Two batches of training programme on 'Production of value added fishery products from freshwater fish for employment and income generation' were conducted at Dimapur, Nagaland during 26-29 March, 2012. The programme was organized in association with the Directorate of Fisheries, Government of Nagaland. Value added products form freshwater fishes such as rohu and Pangasius were demonstrated. The products prepared included fish balls, fish wafers, fish pickle, fish cutlets, fish fingers, coated fish fillets, fish burgers, fish kebab and silage from fish wastes. The women members actively took part in the hands-on training.

Training on 'Responsible fishing and extension methods'

A training programme on 'Responsible fishing and extension methods - Fabrication of improved gillnets' was conducted at Doyang Reservoir Wokha district in Nagaland during 30-31 March, 2012. During the programme, lectures on general status of the inland fishing craft and gear of Indian, the ill-effects of destructive fishing methods and the basic principles of gillnetting were rendered. Awareness was created among the participants about the responsible fishing methods to be followed.

Training Programme on 'Fabrication of improved gillnets and eco-friendly fishing gear'

A two-days training programme on 'Fabrication of improved gillnets and eco-friendly fishing gears' was organized at Shillongani, Nagoan District, Assam on 24 and 25 September, 2012. The programme was jointly organized by CIFT and Department of Fisheries, Govt. of Assam.

Training programme on 'Hygienic fish handling and processing techniques'

A training programme on 'Hygienic fish handling and processing techniques' was conducted at Howly, Barpeta District, Assam during 27-29 September 2012.

Training Programme on 'Fabrication of improved gillnets and eco-friendly fishing gear'

Training programme on 'Fabrication of improved gillnets and eco-friendly fishing gear' was conducted at Hapoli, Ziro in Lower Subansiri District of Arunachal Pradesh during 3-5 November, 2012. Awareness was created among the participants about the responsible and eco-friendly fishing methods to be followed by lectures on responsible fisheries, inland fishing methods, craft and gear for inland fishing in India, the ill-effects destructive fishing methods and the principles of gillnetting. Hands-on training on fabrication/ mounting of improved gillnets were also conducted. The programme was followed by on-site front line demonstration in the large water bodies/ large scale freshwater aquaculture ponds.

'Skill based training programme on value addition of fish for tribal farm women and fish farmers'

A 'Skill based training programme on value addition of fish for tribal farm women and fish farmers' was conducted at Roing, Lower Dibang Valley District in Arunachal Pradesh during 1-3 November, 2012. The programme was organized in association with Krishi Vigyan Kendra, Lower Dibang Valley. Hands-on training and demonstration was imparted on processing of fishes for value addition through preparation of various products like fish pickle, fish cutlets, fish balls, fish fingers, fish rolls and fish kebabs. The target groups included tribal farm women and fish farmers from SHGs.

Training programme on 'Value added products - Canning of fishery products'

Training programme on 'Value added products' with special emphasis on canning of fishery products was conducted at Yazali in Arunachal Pradesh during 5-7 November, 2012. The target groups included officials from the Dept. of Fisheries, Arunachal Pradesh, fish farmers and entrepreneurs.

Training programme on 'Introduction of eco-friendly fishing gears and harvesting of fish by scientific methods' and 'Hygienic handling of fish and preparation of value added products'

A training programme on 'Introduction of eco-friendly fishing gears and harvesting of fish by scientific methods' was conducted at Doyang Reservoir, Wokha District in Nagaland during 21-22 November 2012 and another training programme on 'Hygienic handling of fish and preparation of value added products' was conducted at the same place during 23-25 November 2012. Two batches of 50 Fishermen and fisherwomen from Doyang Reservoir area and officials from the Dept. of Fisheries, attended the programmes.

Training programme on 'Improved gillnets and eco-friendly fishing gear'

Training programme on 'Improved gillnets and eco-friendly fishing gear' (fabrication of collapsible fish or prawn traps and on the fabrication of improved gillnets) for reservoir fisheries was held at Gandacherra, Tripura (Dumbur Reservoir) during 24-25 November, 2012. Two sessions on the extension methodologies and management issues in the adoption of responsible fishing techniques was also conducted.

Training cum demonstration programme on 'Hygienic handing of fish and preparation of value added products'

Training cum demonstration programme on 'Hygienic handing of fish and preparation of value added products' for the benefit of fisherwomen at Rudrasagar Reservoir area, Melaghar, Tripura was conducted during 26-28 November, 2012. Fifty fisherwomen members of Rudrasagar Fisheries Cooperative Society have got benefit from the programme.

Workshop on"Prioritization of Research & Education for fisheries development in North-East

The Central Institute of Fisheries Education has conducted two days workshop on **"Prioritization of research & education for fisheries development in North-East"** in collaboration with **Assam Agricultural University, Jorhat at AAU Campus** on 26th& 27th November, 2012 for academicians, researchers, government officials and progressive fish farmers of Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim and Tripura.state fisheries department officials, progressive farmers, NGO and financial institutions and experienced fisheries experts.

Workshop on "Feed Based Aquaculture in North East Region: Status, Constraints and Potential"

CIFE in collaboration with College of Fisheries, CAU, Lembucherra, Tripura s conducted two days workshop on "Feed Based Aquaculture in North East Region: Status, Constraints and Potential" during 11-12, January, 2013. The workshop was held at **College of Fisheries, CAU, Lembucherra, Tripura** to address the major constrains towards aquaculture development in North-East (NE) India i.e. the identification and availability of locally produced and locally available cheaper feed ingredients for aqua feed formulation.

Capacity Building

The Central Institute of Fisheries Education, Mumbai has been playing a significant role in developing aquaculture specially the high-value freshwater prawn culture in the North Eastern States of Tripura, Mizoram and Manipur by setting up hatcheries using artificial sea water. The institute has initiated several programs in collaboration with Departments of Fisheries of different states for capacity building of extension personnel and other stakeholders in the areas of participatory and cost-effective extension services and fisheries co-management.

The Institute is conducting Short Term Training Programmes, Customised Sponsored Training programmes,PDP/ EDP Programmes, In Plant Training Programmes and Skill improvement to mid- career professionals. Various developmental problems, gender perspectives, resource use patterns, Indigenous Technical Knowledge in Fisheries and Aquaculture, Market research of value added fish and fish products in North Eastern region of India and Fisheries Extension Strategies of the NEH region is being taken up/studied by CIFE through students research programmes for MFSc and PhD and results brought out through publications.

III Visit Coordination

Visit Coordination, Kolkata Centre

1.	24.06.2011 to 28.06.2011	IFTC, Imphal, Manipur	20
2.	02.01.2012	College of Agricultural & Post harvest technology (Central Agricultural University), Ranipool,	24
3.	27.12.2011to06.01.2012	College of Fisheries, Central Agricultural University, Lembucherra, Tripura	20
4.	07.02.2012	Govt. of Tripura, Agartala	25

Visit Coordination, CIFE Kakinada Centre

27.02.2012 to 03.03.2012	Assam state fish farmers	20

Apart from these programmes CIFE, Kolkata Centre is conducting different modules of PDP programme on Capture & Enhanced fisheries, aquaculture and Development Planning & Management in Fisheries for the State Fisheries officers, Entrepreneurs, Fish Farmers & Students from different NE States. The institute also participated in exhibitions organised by universities/ departments/ institutions, organised Farmers Mela / Farmers Meet and developed policy notes and NE specific posters reflecting current developments in technology.

New technologies Ready for Transfer

- Utilization of saline soils for aquaculture.
- Cage aquaculture for raising fingerlings.
- Ornamental fish culture in cages for livelihood of fisherwomen.

B-27: EXTENSION DIVISION

The Zonal Project Directorate, Zone-III comprises of eight states namely; Assam, Arunachal Pradesh, Manipur, Meghalaya, Nagaland, Mizoram, Sikkim and Tripura. Presently the Zone-II has 74 sanctioned and established KVKs and 11 new KVKs are in the process of their establishment with 4 in Assam, 3 in Arunachal Pradesh, 2 in Nagaland and 2 in Meghalaya. Besides, a total of 9 districts have been newly created with 4 in Meghalaya, 4 in Tripura and I in Arunachal Pradesh which have been proposed for consideration in the XII plan EFC. The list of KVKs located in the region along with their host institutions are given in Table-1.

Table-1: List of KVKs located in the region along with their host institutions

Host Institutions	No. of KVKs	Districts
AAU, Jorhat	20	Barpeta, Cachar, Chirang, Darrang, Dhemaji, Dhubri, Dibrugarh, Golaghat, Jorhat, Karbi Anglong, Karimganj, Kokrajhar, Kamrup, Nagaon, Nalbari, Lakhimpur, Sivasagar, Sonitpur, Tinsukia, Udalguri
ICAR RC for NEH Region, Umiam	14	Ribhoi, West Garo Hills, Imphal West, Chandel, Churachandpur, Tamenglong, Ukhrul, Dimapur, Wokha, Longleng, West Siang, South Tripura, Hailakandi, East Sikkim
State Dept of Agriculture, Govt. of Arunachal Pradesh	9	West Kameng, East Kameng, Tawang, Tirap, Lower Dibang Valley, Upper Subansiri, Lower Subansiri, Upper Siang, Changlang
State Dept of Agriculture, Govt. of Nagaland	4	Kohima, Mokokchung, Mon, Tuensang
State Dept of Agriculture, Govt. of Meghalaya	3	Eash Khasi Hills, West Khasi Hills, Jaintia Hills
State Dept of Agriculture, Govt. of Mizoram	7	Mamit, Serchip, Kolasib, Lawngtlai, Saiha, Lunglei, Champai
State Dept of Agriculture, Govt. of Manipur	1	Thoubal
State Dept of Agriculture, Govt. of Tripura	2	North Tripura, Dhalai
State Dept of Agriculture, Govt. of Sikkim	3	West Sikkim, South Sikkim, North Sikkim
State Dept of Veterinary & A.H., Govt. of Arunachal Pradesh	1	Papumpare
CAU Imphal, Manipur	3	Imphal East, Aizawl, East Siang
Nagaland University	1	Zunheboto
NRC on Yak	1	Lohit
NRC on Pig	1	Goalpara
NRC on Mithun	1	Phek
JCPCS Utlou, Manipur (NGO)	1	Bishnupr
FEEDS, Hengbung (NGO)	1	Senapati
Rama Krishna Seva Kendra (NGO), Kolkata	1	West Tripura
Total	**74**	

1. Technology Assessment & Refinement: The data in Table 2 depicts that during the last two years under observation, a total of 4087 trials were conducted by the KVKs of Zone-III in different locations.

Salient achievements:

- Under rainfed upland cropping system in Golaghat distirct of Assam, rhizome rot causes substantial yield loss in zinger. The KVK of the district assessed the rhizome treatment technology with Biofor-Pf in addition to its soil application. This resulted in effective control of the disease, higher yield (117.45 q/ha) and higher B:C ratio (4.16). The farmers could receive higher net return (Rs. 3,12,325/ha).
- Under rainfed medium land, cereal based cropping system (maize – rice) in Tirap district of Arunachal Pradesh, the yield of maize crop is very low. As identified by the KVK, Tirap inadequate soil nutrient management is the root cause. The technology with application of FYM, chemical fertilizers, seed inoculation with Azotobactor helped in increasing the yield and net return with a considerably high B:C ratio.
- Concerned by the low growth rate and lower production of carps in West Kameng district of Arunachal Pradesh, the KVK of the district initiated high protein supplementary feeding of carp and assessed the impact. The results showed that the carps attained higher growth rate and consequently the yield increased upto 300 Kg./600 m2/6 month. The farmers realized net return of 30,000/600 m2 with 5.0 B:C ratio.
- As a consequence of high disease outbreak in pig in form of swine fever, piglet diarrhoea, worm infestation, skin infection, and swine erysipelas in Kolasib district of Mizoram, the KVK of the district started OFT on integrated disease management by means of regular surveillance, instant medication, iron injection at appropriate time, timely vaccination and regular deworming in pig and studied the impact. The result shows effective control of diseases, enhancement in growth rate, zero mortality and increased production with a benefit-cost ratio of 2.6.
- The KVK, Dibrugarh conducted OFT in order to assess convenience in handling stored grain using improved duli (storage structure) in comparison to the traditional ones. The technology was found to be time and labour saving, hence much more convenient over the traditional ones.

Table-2: Technology Assessment & Refinement by KVKs of Zone-III during 2010-11 and 2011-12

Thematic area	Assessment and refinement	
	No. of Technology	No. of Trials
INM	115	489
Varietal Evaluation	289	1007
IPM	68	345
ICM	85	281
IDM	62	280
Weed Management	13	57
RCT	5	21
Farm Machinery	8	18
Seed Production	40	147
Drudgery Reduction	18	76
Storage Technique	16	48
Value addition/ Enterprises	31	110
Small scale Income generating enterprises	24	126
Water management	22	56

Bio control of Pest & Diseases	4	14
Biofertilizer	1	4
Awareness and Motivation	1	4
IFS	3	7
Community institution (Custom hire services)	1	2
Organic farming	3	6
Disease Management	14	56
Feed & Fodder Management	29	91
Nutrition Management	38	137
Fish Production	8	29
Breed evaluation	75	531
Livestock production and management	35	145
Grand Total	-	**4087**

*Adding the number of technologies under OFT for the two years in order to get the total figure will be misleading as many of the technologies under OFT in 2011-12 were not entirely different and newer ones when compared to those of 2010-11.

2. Front Line Demonstrations:

KVKs under Zone-III during 2010-11 and 2011-12 conducted Oilseeds (**3056**) demonstrations on an areas of **877.08** ha, pulses (**3118**) on an areas of **736.62** ha, cereals (**4328**) on an area of **1083.03** ha, vegetables (**1524)** on an area of **230.07** ha, spices (**425)** on an area of **57.79** ha, fruits (**160**) on an area of **30.23** ha, fodder (**27**) on **4.63** ha. Other demonstrations were conducted on livestock (**1219**), Fisheries (**91**), mushroom (**56**), vermi-compost (**125**) and apiculture (**11**).

Salient findings:

1. Demonstration on a variety of groundnut, namely, ICGS-76 was found highly effective in terms of its yield (23q/ha.) as compared to the local check (16.7q/ha.).
2. TS-36, a variety of rapeseed was found to be yielding 34.78% more than the local check.
3. Bragg and JS-335 were found prominent varieties of soybean which had shown yield level of 21.14 q/ha and 17.3 q/ha respectively compared to 13.5 q/ha and 11.4 q/ha of farmers' local checks.
4. Among the black gram varieties, T-9 gave the highest yield (12q/ha) increase of 50% over the local check (8q/ha)
5. Pratap, a variety of green gram gave 38.4% higher yield than the local check.
6. The maize variety HQPM-1 had shown an yield increase of 43.52% over the local check.
7. RC Maniphou-10 emerged as the most prominent variety of rice in the region with an yield increase of 51.28% over the local check.

The details of crop wise demonstration conducted and area covered under FLD programme during 2010-11 and 2011-12 are given below in Table-3.

Table-3: Front Line Demonstrations conducted by KVKs of Zone-III during 2010-11 and 2011-12

Enterprise	Crops	Demonstration	Area (ha)
Oilseeds	Groundnut	216	32.34
	Sesame	353	125.2
	Rapeseed	802	253.85
	Mustard	217	49.5
	Toria	941	301.03
	Linseed	40	20
	Soybean	487	95.16
	Total	**3056**	**877.08**
Pulses	Lentil	302	118
	Pigeonpea/Arhar	65	17.65
	Blackgram	718	165.46
	Greengram	906	213.35
	Frenchbean	57	12
	Garden Pea	364	82.9
	Fieldpea	452	96.72
	Cowpea	89	6.54
	Rajma	127	17
	Rice bean	38	7
	Total	**3118**	**736.62**
Cereals	Paddy	2156	720.61
	Wheat	7	1.33
	Maize	2165	361.09
	Total	**4328**	**1083.03**
Vegetables	Brinjal	151	11.26
	Bottle Gourd	5	1.5
	Bitter Gourd	3	0.5
	Pointed gourd	10	1
	French Bean	**28**	**6**
	Pumpkin	4	1
	Onion	75	12.35
	Potato	386	40.13
	Cabbage	322	48.33
	Cauliflower	72	9.7
	Carrot	3	0.05
	Coriander	10	0.5
	Tomato	300	67.9
	Chillies	34	4.1
	Broccoli	101	13.75
	Capsicum	16	10.5
	Cucumber	4	1.5
	Total	**1524**	**230.07**
Other crops	Sugarcane	24	1.91
	Jute	30	6.3
	Total	**54**	**8.21**

Spices	Ginger	249	25.27
	Turmeric	130	25.52
	Black pepper	21	2
	Large cardamom	25	5
	Total	**425**	**57.79**
Fruit	Banana	43	5.89
	Water melon	11	1.63
	Khasi Mandarin	40	7.26
	Pineapple	58	14.69
	Papaya	7	0.75
	Strawberry	1	0.01
	Total	**160**	**30.23**
Fodder Crops	**Total**	**27**	**4.63**
Livestock	Goatery	43	350
	Poultry	716	2438
	Piggery	353	653
	Duckery	33	100
	Dairy	74	117
	Total	**1219**	**3658**
	Fisheries	91	-
Others	Mushroom	56	6 Units
	Vermi-compost	125	5 Units
	Apiculture	11	11 Units
	Total	**283**	**-**

3. Training Achievements:

KVKs of Zone-III during 2010-11 and 2011-12 organized a total number of **9352** training programmes for **243874** beneficiaries. The detailed breakup is given in Table-4.

Table-4: Training Programmes conducted by KVKs of Zone-III

Types of Training	**Courses**	**Male**	**Female**	**Total**
Farmers & Farm Women	6314	98657	65836	164493
Rural Youths	1523	21830	16270	38100
Extension Functionaries	588	9170	4721	13891
Sponsored	927	16553	10837	27390
Vocational	150	2035	1507	3542
Total	**9502**	**148245**	**99171**	**247416**

2. Extension Activities:

KVKs organized a total number of **38010** different extension activities, where **307725** participants were benefitted during 2010-11 and 2011-12**.** Besides, **6414** nos. of other extension activities like Extension literature, News paper coverage, Literature delivered, Animal Health Camp, Popular article, radio talk, TV talk etc. were organised for **118356** beneficiaries. The extension activities organised by KVKs during the last two years are given below.

Table-5 Extension Activities conducted by KVKs of Zone-III during 2010-11 and 2011-12

Sl. No.	Activity	Number	Beneficiaries
	A. Extension Activities		
1.	Diagnostic Visit	5230	19450
2.	Advisory Services	6720	23818
3.	Training Manual	138	12892
4.	Calibration of Important days	146	9523
5.	Exhibition	179	42714
6.	Exposure visit	238	5765
7.	Farm Science Clubs' Convenors meet	139	3223
8.	Farmers' Seminar	39	4080
9.	Farmers' visit to KVKs	13212	34069
10.	Field day	319	14964
11.	Film show	540	8010
12.	Kishan Goshthi	110	3962
13.	Group Meeting	507	8010
14.	Kishan Mela	66	49098
15.	Mahila Mandal	37	745
16.	Method demonstration	1148	16073
17.	Scientists' visit to farmers' field	8195	30410
18.	SHG convenors' meeting	227	15448
19.	Soil Health Camp	32	812
20.	Soil Test Campaign	673	1413
21.	Workshop	115	1551
	Total	**38010**	**307725**
	B. Other Extension Activities		
1.	Extension literature	871	27860
2.	News paper coverage	1669	33109
3.	Literature delivered	2208	38966
4.	Animal Health Camp	165	11089
5.	Popular article	704	7332
6.	Radio talk	535	-
7.	TV talk	236	-
8.	Awareness camp	26	1695
	Total	**6414**	**118356**

5. Soil, water & plant analysis:

No. of samples	Number of Farmers	Number of villages	Amount realized (Rs)
7910	**2456**	**731**	-

Table- 6: Important Initiatives and Inter-Institutional Linkages.

Name of programme	Division of ICAR	Institutions involved	Associated KVKs
Maize seed production and promotion programme	Division of Agril Extension, Division of Crop Science	50 KVKs, DMR, ICAR, New Delhi, ZPD- III	50 KVKs
Biotechnology Led Organic farming in North East India	Division of Agril Extension	14 KVKs, DBT, New Delhi, ZPD-III	14 KVKs
National Initiative on Climate Resilient Agriculture (NICRA)	Division of Agril Extension Division of Crop Science	17 KVKs, CRIDA, Hyderabad, ZPD-III	17 KVKs
Mushroom production and promotion programme in North East	-	KVKs, DMR, Solan, ZPD-III	29 KVKs
Entrepreneurship Development Programme for Rural Youth in North East	-	ASSOCHAM, New Delhi. KVKs, ZPD-III	6 KVKs
ATMA	-	KVKs, Dept. of Agri, Govt. of Assam/ Nagaland/ Meghalaya/ Mizoram/ Tripura/ Manipur	51 KVKs
Extension and Research Prioritization in North East	-	AAU, Jorhat, KVKs, ZPD-III, CIFRI, Dept. of Agri, Assam, NGOs	20 KVKs
Kisan Mobile Advisory	-	KVKs, ZPD-III	46 KVKs
Strategy for Harnessing fish production potentialities in flood affected areas of Assam	-	AAU, Jorhat, ZPD-III, KVK	20 KVKs
Fisheries enhancement/ culture based fisheries in floodplain wetlands for increasing fish yield on sustainable basis	-	CIFRI, Guwahati, KVK, ZPD-III	2KVKs
Stakeholders Interface meeting under project-"Biotechnology Led Organic Farming in North East"	-	DBT, New Delhi, ZPD-III, KVK Kamrup, Guwahati	14 KVKs
Workshop on ATMA-KVK Interface	-	ZPD-III, AAU, State Agri Dept. KVKs, NGOs	50 KVKs
Interface meeting of KVKs-NGOs of Assam	-	ZPD-III, NGOs, KVK Kamrup	35 KVKs
Floriculture Entrepreneurs Meet, 2011	-	ZPD-III, KVK Kamrup, NGOs, State Agri Dept.	2 KVKs
Interaction cum Discussion on Goatery production and management in North East for the KVKs of Manipur, Nagaland and Tripura	-	ZPD-III, Goat research Station, AAU, KVKs	22 KVKs
Orientation programme for SMSs (Crop Sciences) of KVKs in North East	-	ZPD-III, AAU, KVKs	72 KVKs
Orientation programme for SMSs	-	ZPD-III, AAU, KVKs	35 KVKs

(Livestock, Fishery and Social Sciences) of KVKs in North East			
Entrepreneurship development in agriculture and allied sectors in NE Region	-	ZPD-III, IIE, Guwahat, KVKs, CAU	46 KVKs

3. New agenda item, if any with a brief note to be included for discussion in the meeting

Following are Agenda items for discussion during the XXI Meeting of ICAR Regional Committee-III to be held at Assam Agricultural University, Jorhat during April 17-18, 2013.

1. Regular technological backstopping on the part of Directorate of Extension Education for all the KVKs falling in the area jurisdiction of the Central Agricultural University and Assam Agricultural University, Director, ICAR research complex for NEH region, Barapani irrespective of host organizations under which KVKs are functional.
2. Regular updating of district specific technological inventory by the Universities and its availability to KVKs.
3. Submission of monthly progress, expenditure statement and timely submission of AUC/UC by the host organizations.
4. Proper review and monitoring of KVK including financial matters and infrastructural development i.e. administrative building, Farmers' hostel, demonstration units etc. on priority.
5. Timely release of funds to the KVKs.
6. Implementation of QRT recommendations as approved by ICAR Governing Body regarding efficient flow of funds from host institutions to KVK account at KVK filling up of the vacant positions and delegation of power (financial and administrative) to the Program Coordinator of KVKs equivalent to Head of the Departments in ICAR Institutes.
7. Filling up of vacant posts in KVKs and ZPD on priority basis: A total of 993 staff are presently in position out of the total strength of 1184 in 74 KVKs in the region as on 1st February, 2013.The vacant post of KVK staff s under Department of Agriculture, Govt. of Tripura and Meghalaya were partly filled up and all the host institutes were requested to fill up the remaining16.13% vacant posts on priority basis as early as possible.
8. Non-receipt of proposals from host institutes for establishment of new KVKs in Assam, Meghalaya and Arunachal Pradesh: This directorate has invited all concerned host institutes for submission of new/ fresh proposal for establishment of KVKs which have been approved during XI plan for the districts of North Cachar (Dima Hasao) and Morigaon in Assam, South Garo Hills in Meghalaya and Dibang Valley and Kurung Kumey districts of Arunachal Pradesh. However, till now this directorate has not received any proposal from any host institute for establishment of KVK in the said districts.
9. Constitution of Special Scientific Advisory Committee for establishing and strengthening the temperate fruit production involving selected KVKs drawing scientists from CITH, Srinagar, Dr. Y.S. Parmar University of Horticulture and Forestry, Solan, CIH, Medziphema, Nagaland and ICAR Complex for NEH Barapani.
10. ICT tools should be effectively used for quicker and low cost Transfer of Technology and Information dissemination as well as for the purpose of Intra & Inter institutional communication, reporting, monitoring and coordinating activities of KVKs.

B-28: NAIP (NATIONAL AGRICULTURAL INNOVATION PROJECTS)

National Agricultural Innovation Project (NAIP) funded with the World Bank, was approved on April 18, 2006 and became effective for implementation on September 18, 2006 with closing date as December 31, 2012 which has been extended up to 30th June, 2014. NAP is a World Bank and Govt. of India funded project being implemented by the ICAR with a budget outlay of US$ 250 million. Besides this, US$ 7.37 million is granted for the Sustainable Land and Ecosystem Management Programme under the Global Environmental Facility.

Two approaches viz, competitive mode and sponsored mode were used in inviting, peer reviewing and approving sub- project proposals. First the concept notes (CNS) were invited and then the full proposals were invited for approved concept notes. The sub- projects under component-1 were processed under sponsored mode.

To address project objective, research agenda is divided into four components in which, 191 consortia leaders and 646 consortia partners are participating, adding up the number of participating institutions to 834. In this Zone, 31 NAIP subprojects costing **Rs. 4930.77025** lakhs are operating at various centres.

Objectives of the NAIP

The overall objective is to contribute to the sustainable transformation of Indian agricultural sector from an orientation of primary food self-sufficiency to one in which a market orientation is equally important for poverty alleviation and income generation. The specific objective is to accelerate the collaborative development and application of agricultural innovations between public research organizations, farmers, private sector and other stakeholders. The specific objectives envisaged are:

a) To build the critical capacity of the ICAR as a catalyzing agent for management of change in the Indian NARS (Component-1).
b) To promote production to consumption systems research' in priority areas / themes to enhance productivity, nutrition, profitability, income and employment (Component- 2).
c) To improve livelihood security of rural people living in the selected disadvantaged regions through technology-led innovation systems, encompassing the wider process of social and economic change covering all stakeholders (Component- 3).
d) To build capacity to undertake basic and strategic research in frontier areas of agricultural sciences to meet challenges in technology development in the immediate and predictable future (Component- 4).

Global Environment Facility Grant (SLEM CPP)

Strengthen institutional and community capacity on sustainable land and ecosystem management approaches and techniques for restoring and sustaining the natural resource base, including its biodiversity, while taking account of climate variability and change

Overall, the project progress is satisfactory as revealed through the performance indicators, viz. development of 91 public private partnerships, piloting of 50 rural industries, filing of 29 patent/intellectual property protection applications, publication of 222 research papers in high impact peer reviewed journals, international training of 386 scientists in frontier areas of sciences and 300 scientists in the consortia, establishment of ten BPDs, development of

69 production technologies, 80 processing technologies and 105 novel tools/ protocols/ methodologies for research and commercialization of 28 technologies.

In NEH region, **31 projects** are being undertaken in various sub-projects. The fund allocated for these projects are **Rs. 4930.77025** lakhs. Projects in all the four components are running in this region. Five sub-projects (three in Assam, one each in Meghalaya and Sikkim) are, being coordinated from this region.

S.No.	State	No. or Project	Funds (Rs. in lakhs)
1.	Arunachal Pradesh	1	81.79915
2.	Assam	13	1812.0718
3.	Manipur	2	414.7065
4.	Meghalaya	9	1927.8063
5.	Mizoram	1	129.9746
6.	Nagaland	1	134.3056
7.	Tripura	1	141.3087
8.	Sikkim	3	288.8514
Total		31	4930.77025

MAJOR ACHIEVEMENTS of NAIP COMPONENTS

COMPONENT-I

Component I of NAIP under zone III is working through 03 subprojects in Barapani. Some of the salient achievements are as follows:

1. **Developing, commissioning, operating and managing an online system for NET/ARS - prelim examination by ASRB. ICAR**

- Adequate infrastructure (servers, peripherals, power backups) at ASRB Headquarter and 23 Nodal Centers.
- ASRB| has a large database of Question Bank. Enlarging the database and digitizing it are under progress.

2. **Development and maintenance of rice knowledge management portal**

- After the launch of the Rice Knowledge Management Portal (RKMP) regular content updation, awareness and popularization activities are being undertaken.
- Regular updates on "Featured rice content", news and events related to rice, videos of seasonal importance, location-specific content in both English and local languages are being uploaded on regular basis.
- During this period, the total number of registered users has reached to thousand. To encourage more content upload, the content upload feature with single click was enabled and was aggressively campaigned through social networking in RKMP as a video course is being initiated and the course on hybrid rice production technology and System of Rice Intensification (SRI) is now available as a "E-learning Video Course".
- E-Books/ E-Manuals on 47th Annual Rice Group Meet, Proceedings, and Basmati Rice: Heritage of India, India Rice Revolution, A Farmer Friendly Handbook and 100 years of

rice science and looking beyond, Proceedings & Recommendations were prepared and uploaded in the portal.

3. **Mobilizing mass media support for sharing agro-information**
   Strengthening statistical computing for NARS

- Around 430 news features appeared in national and regional media in different languages (Hindi, English, Punjabi, Malayalam, Tamil etc.)
- 65 News published on ICAR Website in English/Hindi
- 11 Success Stories published on ICAR Website in English/Hindi.
- Facilitated 25 AIR/TV programmes in National and Regional media.
- Around 25 audio capsules aired on different radio channels in different regional languages.

COMPONENT-II

Component II of NAIP under zone III is working through 02 subprojects i.e. one in Assam and one in Manipur. Some of the salient achievements are as follows:

1. Value Chain on Novelty Pork Products under Organized Pig Farming System (Assam)

- Present herd strength of the farm is 533 Nos., total No. of piglets born during the period under review is 385 with an average litter size at birth of 6.64.
- Total nos. of pigs slaughtered during this period is 384.
- Feeding trial on crossbred pigs was completed to evaluate the carcass traits and meat quality of pigs maintained on water hyacinth incorporated feed and can be concluded that Water Hyacinth may be used without any deleterious effect on carcass characteristics and meat quality of pig.
- Regular disposal of slaughterhouse waste in the Aerobic Waste Disposal Pond maintain the environmental and social safeguard in the farm premises.
- Technology for production of Pork Tenderloin Butterfly, Pork Head Cheese and Pork Pickle with fermented bamboo shoot and bhoot jalakia has been developed.
- Technology for preservation of boar semen in GEPS extender up to 168 hours at 13-150C has been standardized.
- Establishment of Feed Mill Unit with a milling capacity of 8 qnt./ hour.
- Animals are regularly vaccinated against Classical Swine Fever (CSF) and Foot and Mouth Disease (FMD). Piglets are immunized at 4 month of age with locally available CSF vaccine prepared by the ICAR, National Fellow Project of Assam Agriculture University.
- The technologies for production of 14 pork products have been standardized.
- Adoption of artificial insemination technique for fertility enhancement and minimization of breeding cost. A total of 620 gilts/sows of the project farm have been artificially inseminated till date.

2. A Value chain on Selected Aromatic Plants of NE India (Sikkim)

- Under area expansion programme, plantation of citronella & lemon grass being done at farmer's field of different districts of Sikkim.
- Application of FYM @8-10 tonnes/ ha as basal dose and vermicompost @100 gm/ plant as basal as well as after each harvest in recommended. Application of neem cake @ 100 gm/plant and neem oil @ 3 % provides satisfactory control from pest attack. Training and demonstration on cultivation aspects of aromatic plants imparted to farmers at different sites of South Sikkim.

- Farmer's of Rey Mendu earned a profit of Rs. 10,000 by selling their produce (herbage) of Citronella and Lemon grass in wastelands within a period of six months and have produced more than a lakh of planting materials with an additional anticipated income of more than Rs. 50,000.
- Chemical components of citronella and lemon grass identified with GC MS. Citronella plantation at Namthang and area extension at Rey mendu.

COMPONENT- III

Component III of NAIP under zone III is working through 03 subprojects in Manipur, Arunachal Pradesh and Assam. Some of the salient achievements are as follows:

Livelihood Promotion through Integrated farming System in Assam

Targets districts: Lakhimpur, Kokrajhar and Karbi Anglong in Assam

- Following two IFS modules blending tested technologies are being implemented in the area
  a) Rice-Fish-Vegetable module
  b) Livestock (poultry/ pig)-fish-vegetable and
- The area covered and farmers benefitted under the two modules were 608.40 ha, 540HH and 132.3 ha and 540HH respectively.
- The total net income per household from Rice-Fish-vegetable, Poultry -fish-vegetable, Pig-fish-vegetable IFS module was Rs-29,000.00, Rs-63,300.00 and Rs-l,03,662.00 along with additional employment generation of 40,82 and 159 man days, respectively.
- 52 vermi compost of units established.
- Additional 90 and 114 farmers adopted Rice-Fish-Vegetable and livestock (poultry / pig)-fish-vegetable module, respectively.
- Beneficiary farmers realized increase in productivity as well as production of individual components from integration of agriculture (approx. 25% increase in rice production), fishery (approx. 35-40 kg fish from 2600 m2 rice fields)
- A noble approach was taken under the project to establish one Community Resource Centre (CRC) in each district which is supporting farmers in terms of technological & physical aspects.

Live better with the Flood-An Approach for Sustainable Livelihood Security in District Dhemaji, Assam

- Three farming systems namely **rice-fish-horticulture**, **pig-fish-horticulture and** poultry-fish-horticulture were demonstrated in an area of 4.227 ha covering 677 households giving an income of Rs. 93515.00, Rs. 61990.00 and Rs.32890.00, respectively.
- Keeping the flood pattern in view, the prevailing cropping system was restructured with suitable varieties. Technology like raising seedlings in polyhouse etc. and demonstrated in area of 496 ha covering 1426 households. The enhanced income ranged from Rs. 53000.00 to Rs. 90000.00.
- For increasing irrigation facility, 13 irrigation pumps (shallow tube well) and 20 low cost treadle were provided to cover an area of 55 ha of paddy and 20 ha of vegetables. An additional income of Rs. 10,000.00 - Rs.15, 000.00 per family per year was observed from paddy and Rs. 9000.00 - Rs. 14,000.00 from vegetable cultivation.
- Sixteen Rice Mills set up by 16 different women SHGs in the villages of cluster basis generating an additional income of `500.00-' 600.00 per month per member of SHG.
- Ten awareness cum training programs were conducted on IFS/ Restructuring of cropping pattern in new villages with 120 participants.

- By linkage with local Market of Dhemaji, Silapathar, Lakhimpur & Arunachal Pradesh, 7.3t/year of potatoes, other vegetables and mustard worth Rs. 9.7 lakhs per year were traded, benefitting 205 farmers.
- System for linkages with insurance company for insurance of livestock was established benefitting 78 farmers by Kisan Credit Card with Rs 7.8 lakhs
- Thirty eight vibrant VDCs were created. Three CRC have also been created for project sustainability.
- National Rural Livelihood Mission (NRLM) have taken up Livestock-Rice-Vegetable model for up scaling in Dhemaji and Sisiborgoan block and will provide input of Rs1.6 crores for the task.

Livelihood Improvement and Empowerment of Rural Poor through Sustainable Farming Systems in North East India

Target districts: Upper Subansiri (Arunachal Pradesh), Tamenglong (Manipur), South Garo Hills (Meghalaya), Saiha (Mizoram), Mon (Nagaland), North Sikkim (Sikkim) and Dhalai (Tripura)

- Covered 760.9 ha with HYV rice, maize and wheat involving 2776 beneficiaries; Average productivity of HYV rice was 3.8 t/ha and maize 2.97 t/ha as against 2.4 t/ha and 0.80 t/ha respectively, with local variety; Farmers earned a net income of Rs 22,800/ha/year by adopting improved method of rice cultivation.
- Covered 170.5 ha involving 2341 beneficiaries under vegetable cultivation (Potato, Tomato, Cucumber, cabbage, pea etc); The average yield of vegetables was recorded as 7.0 ton/ha as compared to 3.0 ton/ha with the local variety; Farmers earned a net income of Rs 70,000/ha/Year.
- Covered 204.5 ha under ginger and turmeric cultivation involving 722 beneficiaries; The average yield of turmeric was 6.9 t/ha as against 3.5 t/ha of local variety and average yield of ginger was 5 t/ha as against 3.8 t/ha of local variety; Farmers earned a net income of Rs 33,600/ha/year.
- Covered 39 ha under large cardamom cultivation in Mon and North Sikkim involving 262 beneficiaries; established 91 large cardamom nurseries in N. Sikkim (10 ha area).
- Seed Production: Area-163.5, HH-761, Production 3.8 t/ha (rice), 2.97 t/ha (maize), t/ha 1.5 (soybean); Additional area brought under irrigation:- 58 ha.
- Established 236 piggery units; Farmers earned a net income of Rs 15,000/HH/yr.
- At South Garo Hills, Pond + Pig + Duck based model established in 100 farmers' field; The farmers earned a net income of Rs 30,000/ - by selling fish, eggs, piglets, vegetables, fruits etc.
- 85 ha Agro-forestry based IFS involving Teak, gamari, alder, MPTs, developed in Dhalai, Mon and N. Sikkim.
- Established 26 vermi compost units; Farmers earned a net income of Rs 8000/unit. Established 69 Mushroom units with a production of 210 kg (approx)/unit/year; Farmers earned a net income of Rs 8000/unit/year @ Rs 75.kg.
- Impact**:** Apart from total 11047 beneficiary farmers, an additional 2500 farmers adopted different interventions

Linkages:

(i) North Eastern Regional Agricultural Marketing Corporation (NERAMAC), 28000, t yr oranges worth Rs 44000 was traded benefitting 20 farmers;

(ii) Sustainable Development Society. Department of fishery. KVK-Dhalai and DRDA, Govt, of Tripura; 1.21 tablesized fishes. 0.7 t fingerlings. 125 t oyster mushrooms. 6000 t spwan and 17 nos of piglets worth Rs 1.41.300.00 per year were traded benefitting 462 farmers.

COMPONENT -IV

Component IV of NAIP under zone III is working through 03 subprojects in Assam, Meghalaya and Shillong. Some of the salient achievements are as follows:

1. Standardization of selected ethnic fermented foods and beverages by rationalization of indigenous knowledge (Assam)

- Documented baseline information and collected suitable varietal samples of rice, blackgram and chickpea from states where idli and dosa are familiar and consumed as regional food.
- Predictive modeling of Leuconostoc mesenteroides and Candida versatlis population dynamics during Idli batter fermentation.
- In toddy, most predominant yeast was Saccharomyces sp. spoilage bacteria Acetobacter sp also isolated.
- In Rice Beer, one ITS sequence from yeast strain Al Isolated from starter culture of Ahom community submitted to NCBI.
- Idly prepared from idli dry mix and Varagu Millet dhokla prepared and stored well for 30 days at ambient condition in different packaging materials.
- A bacterial isolate (Bacillus sp.) identified to reduce odour in toddy; the culture is immobilized in polyurethane foam bits and packed in a column, information recorded and documented.
- A new culture identified to reduce idly dry mix fermentation time from 12 hours to 1 hour. The culture ferments the idly dry mix in one hour.
- Instant idly mix standardized; from this, within half an hour soft textured idly can be prepared, information generated on expected lines.
- Biogenic amines studies of idli and its batter has to be carried out.
- Membrane filtered and pasteurized toddy increased the shelf life by 2 months.

2. **Bioprospecting of genes and allele mining for abiotic stress tolerance (Meghalaya)**

- Conferment of stress tolerance by OsFBKI gene in Arabidopsis has been functionally validated.
- SNPs (120) found associated with NA content, productive tillers, filled grains, and yield related traits have been identified. SNPs were also identified across 4 genes for cold tolerance viz. DREBIA, DREB1B, NAC6 and LTG3 and 4 genes for phosphorous deficiency viz., PTF1, Pup 1 locus, PHR1 and PHR2.
- Twenty one ESTs similar to salt tolerance genes were annotated from the sequence data generated and documented at the GenBank, and 22 anoxia tolerant protein models were documented at Protein Model DataBase.
- Gene sequences for drought, acidity and temperature (chilling, freezing, heat and cold) stresses have been collated across the species and categorized under different gene pathway regulation such as hormone regulatory, transcription factors, molecular chapersons and late embryogenesis abundant.
- Maize transcriptomes have been annotated using Blast-2-Go tool and the GO (Gene Ontology) terms have been assigned to the differentially expressed genes under waterlogging stress condition. SSH cDNA library was prepared for heat tolerant (RMO 40) and heat susceptible (CZM 105)mothbean genotypes.

- Three novel genes have been partially characterized from *Dunaliella* sp. (isolate S-89) SSH library (under salinity stress), which potentially confer tolerance to the survivability of microalgae under hyper saline conditions.

3. Biosystematies of the Genera Vigna, Cucumis and Abehnoschus (Shillong)

- Described species distribution, variation, eco-geographic specificity and identity for 22 Vigna, 12 Cucumis and 11 Abehmoschus speices from India in a total of 380 accessions augmented.
- The correct species identities of the 3 genera enumerated with essential illustrations for the key taxonomic traits including their morphology/ micro-morphology, cytology. DNA sequence variations and crossability behavior.
- Three Cucumis sativus collections field resistant to Alternaria fruit rot augmented from Tripura, A&N Islands and Kerala. F2 derivatives of a cross; Cucumis melo x C. callosus, were found field resistant to Alternaria fruit rot and leaf blight.
- Seven carotenoid rich collections of Cucumber augmented from North East India.
- Ornamental value F1 hybrids between A crinitus x A. moschatus subsp. tuberosus with bright red double flowers produced, which could be propagated through cuttings and perennating tubers.
- Described a new species, Abelmoschus enbeepeegearense J John, Scariah, Nissar, KV Bhat et Yadav, from the low elevation Western Ghats of India (Kerala, Karnataka and Tamil Nadu). Also described two other new Vigna species (V. indica T. M. Dixit, K. V. Bhat & S. R. Yadav and V sahyadriana). Two novelties of Abelmoschus have been discovered.
- Molecular phylogeny in the 3 genera analysed using matK and rbcL in addition to rpoC1, trnC-D, psbA-trnH, its1, its2 sequences in 380 samples for all species occurring in India.

Human and International Trainings

Human Resource Development is an integral part of NAIP. Two Scientists of this zone were trained abroad in frontier areas of agricultural Sciences. About 06 scientists have been trained abroad in various consortia of NAIP Sub-projects running in this zone.

Environmental Safeguards Aspects

The environment friendly technologies like agro-forestry, water harvesting, organic farming etc. are being encouraged wherever required and possible. In case of the interventions with negative impacts such as excessive use of farm machines, use of insecticides, pesticides etc, and methods to mitigate their effects is recommended, planned and implemented.

E&S framework for all the approved proposals of Component- 2, 3 & 4 were prepared, revised in consultation with the World Bank and these are on NAIP website.

The purpose of various sub- projects of component-3, is to improve the livelihood without adversely affecting environment existing in the target districts. The screening of environmental issues has been done to enhance positive impacts and minimize negative impacts through appropriate mitigation measures. Some of the environment friendly interventions are use of bio pesticides, promotion of vermicompost, emphasis on conservation agriculture, training on use of IPM and INM.

Under component-2, waste disposal is major concern for environmental pollution. This is properly addressed through waste utilization and making value added products.

Under Component-4, adequate preventive measures are being taken according to the well set bio-safety rules/norms of the Govt, of India. Safe use and disposal of chemicals is being ensured.

As estimated, the use of bio-pesticides (6 sprays per year) would result in saving of chemical pesticide to the tune of Rs 3000/= per ha per year. This is besides reducing chemical contamination.

Social Safeguards

Under the project, interests of poor and disadvantaged groups, indigenous people and other stake holders as relevant to various components are being adequately addressed. The sub-projects are also intervening for women empowerment. Proposed interventions are either through augmenting or making adjustments in the indigenous livelihood system of the people without causing any major changes in their way of life.

B-29: EDUCATION DIVISION

The Region III comprises of the States of Arunachal Pradesh, Assam, Meghalaya, Manipur, Mizoram, Nagaland, Sikkim and Tripura. The Education Division of the Indian Council of Agricultural Research (ICAR) coordinates, guides and supports activities related to agricultural education and training in the country. ICAR as such does not enjoy any statutory power to regulate agricultural education but it has the mutually shared goal and commitment for improving the agricultural education that binds ICAR, State Agricultural Universities and other institutions together in a close professional relationship. Financial support provided by the ICAR for strengthening and development of agricultural education helps in firming up this tie up. The Education Division jointly with State Agricultural Universities and others has taken a number of steps for institutionalizing reforms for streamlining and improving agricultural education in the country. Serious efforts have been made on strengthening quality and relevance of agricultural education through accreditation, periodic course curricula revision, in-service training and necessary infrastructure development etc.

The Education Division of ICAR co-ordinates the operation of following schemes/activities for strengthening, development and quality assurance of agricultural education.

(1) Development and Strengthening of SAUs, DUs, CUs
(2) Rural Agricultural Experience
(3) Best Teacher Award
(4) Emeritus Scientist Scheme
(5) University Level Text Book writing
(6) National Talent Scholarship
(7) Summer/Winter School
(8) Centre of Advanced Faculty Training
(9) Admission of Foreign Students
(10) National Fellows
(11) National Professor
(12) Admission in UG and PG programmes through All India Competitive Examination in Agriculture.
(13) Accreditation Board
(14) Niche Areas of Excellence
(15) Experiential Learning Unit
(16) Indo-Africa Fellowship
(17) Indo-Afghanistan Fellowship
(18) ICAR International Fellowships Programme

Although investment by ICAR on effective improvement in agriculture education is supplementary in nature and has helped in removing major inconsistencies in educational norms and standards necessary to sustain uniformly high quality of agricultural education in the country. The funds released during last two years under the various activities including Development Grant, International and Girls Hostels, Educational Museum, RAWE, Niche Area of Excellence, Experiential Learning, Human Resource Development, provision of students amenities, quality assurance scheme are as under:

Development Grant
(Rs. in lakhs)

State	University	2010-11	2011-12	2012-13
Assam	AAU, Jorhat	2054.00	3005.00	1000.23
Nagaland	NU, Medziphema	300.00	275.00	250.00

Hostels and Educational Museum Grant (No. Sanctioned and grant released)
(Rs. in lakhs)

University	No. of boys hostels	Grant released (2008-09 to 2012-13)	No. of girls hostels	Grant released (2008-09 to 2012-13)	Inter-natio-nal Hostel	Grant released (2008-09 to 2012-13)	Educati-onal Museum	Grant released (2008-09 to 2012-13)
AAU, Jorhat	2	300.00	2	300.00	1	150.00	1	100.00
NU, Medziphema	--	--	1	150.00	1	50.00	--	--

Rural Agricultural Work Experience (Rs. in lakhs)

State	University	2010-11	2011-12	2012-13
Assam	AAU, Jorhat	6.30	7.83	4.01
Nagaland	NU, Medziphema	--	6.60	5.76

Niche Area of Excellence (Rs. in lakhs)

University	Name of the Niche Area	2010-11	2011-12	2012-13
AAU, Jorhat	NAE on Biofertilizer enriched organics for sustainable agriculture	50.00	38.00	--
NU, Medziphema	--	--	--	--

Experiential Learning – Hands-on Training (Rs. in lakhs)

University	No. of Units	Name of Unit	2010-11	2011-12	2012-13
AAU, Jorhat	2	(i) Commercial Horticulture (ii) Production of Quality Carp Seed	--	50.00	110.00
NU, Medziphema	--	--	--	--	--

Modernization of AU Farms

Under the sub-scheme "Modernization of AU Farms", the Council has provided financial support for the works related to farm structures and facilities including up-gradation/renovation and procurement of farm implements/equipments to the agricultural universities as detailed below. The scheme was for a period of three years which ended in 2010-11.

(Rs. in lakhs)

State	**University**	**2010-11**
Assam	Assam Agricultural University, Jorhat	221.00
Nagaland	Nagaland University, Medziphema	64.00

Human Resource Development

Education Division of ICAR conducts a common entrance test at All India level to fill up the 15% seats at UG level and 25% seats at PG level available in all State Agricultural Universities.

Number of students who have secured JRF and SRF during 2010-11, 2011-12 and 2012-13 in the entrance examinations

Name of Universities	**2010-11***		**2011-12****		**2012-13*****	
	JRFs	**SRFs**	**JRFs**	**SRFs**	**JRFs**	**SRFs**
Assam Agricultural University, Jorhat	2	Nil	7	Nil	6	--
Nagaland University, Medziphema	Nil	1	1	Nil	Nil	--
CAU, Imphal	21	Nil	26	Nil	25	--
Total	**23**	**1**	**34**	**Nil**	**31**	**--**

*Examination conducted 12.12.2010, **Examination conducted 04.12.2011, ***Examination to be conducted on 21.04.2013

Accreditation

Assam Agricultural University, Jorhat has already been accredited by the ICAR in the year 2010 and due in July 2015.

ANNEXURES

C1- PROCEEDINGS OF THE XX ICAR REGIONAL COMMITTEE MEETING OF ZONE-III HELD AT ICAR RESEARCH COMPLEX FOR NEH REGION, UMIAM, MEGHALAYA FROM MAY 5-7, 2011.

The 20th meeting of the ICAR Regional Committee No. III was held at ICAR Research Complex NEH Region, Umiam, Meghalaya from May 5-7, 2011. His Excellency, the Governor of Meghalaya, Shri R.S. Mooshahary was the chief guest in the inaugural ceremony of this meeting.
Dr. S.V. Ngachan, Director, ICAR Research Complex for NEH Region, Umiam welcomed and expressed his gratefulness to His Excellency, for gracing the occasion. Dr. Ngachan also welcomed Dr. S. Ayyappan, Secretary DARE and DG, ICAR, New Delhi; Hon'ble Deputy Chief Minister of Meghalaya, Dr. B.M.Lannong; Hon'ble Minister of Agriculture, Horticulture and Soil conservation, Govt. of Mizoram, Shri. H. Lianosailova; Hon'ble Minister for Agriculture and KADA Govt. of Manipur, Shri. Parijat Singh and Hon'ble Minister for Vety. and A.H., Govt. of Nagaland, Shri. T.R.Zeliang. He also welcomed the Vice-Chancellors, DDGs, ADGs, Directors and Joint Directors and Heads of Institutes located in the ICAR region, Senior officials of state Department of Agriculture, Govt. of India, Universities and all other scientists and participants present in this meeting.

Dr. Arvind Kumar, DDG Education, ICAR after welcoming the dignitaries, highlighted that in NEH region, conservation of bio-diversity and its multiple effective use, effective water management, amelioration of acid soils; crop diversification and improving the productivity under Jhum cultivation, improving the productivity of crop and livestock sector are the key issues which require utmost priority to improve upon the socio –economic status and livelihood security of the people. He contemplated the need for establishing close linkage between different institutions in this region.

Dr. S. Ayyappan, Secretary DARE and DG, ICAR, expressed great satisfaction and pleasure with the presence of His Excellency, the Governor of Meghalaya and Hon'ble Ministers representing various states. Since, the formulation of the 12th five year plan is in processes, he felt that the recommendations emerging out of this regional committee meeting shall be of immense value in developing research, education and extension strategies in this region. In terms of food grains, the country has witnessed record food grain production of about 235 million tonnes during current year and in future, Eastern and NE region shall have to play significant role in order to maintain the pace of green revolution in the country. The NE region is severely threatened by abrupt climatic changes, and therefore the conservation and development of climate resilient agriculture needs to be stressed upon to meet the future challenges. He stated that the NE is very rich in biodiversity, both in plant and animal dimensions but the concern is how to use it effectively. The introduction of speciality agriculture with special reference to horticultural crops, value addition, agro eco-tourism and allied aspects, diversification in farming and livelihood systems need immediate attention and the key issues like acid soils, water stress low and imbalance fertiliser use, non-availability of quality seed and planting materials, difficult terrains, poor connectivity, language barrier and a dominance of resource poor and marginal farmers need to be adequately addressed . One of the potential areas of livelihood in this region is livestock sector particularly piggery, which need substantial support. The organic farming has great scope in this region but fortification of site specific nutrients is essential to build up the fertility status of soils. Improving the productivity and development of superior cold tolerant rice varieties and cultivation of quality protein maize be given due emphasis. Degraded

Jhum lands should be reclaimed or fertility restored through agro-forestry interventions in conjunction with crop diversification including pulse crops. To counter all these potentially inhibiting forces of NE agriculture, the project on climate resilient agriculture (NICRA) has also been initiated along with due emphasis on post harvest processing and value addition. He advocated for more international cooperation in NE region and stressed the need for harnessing potential of NE to become an agro-export processing zone and in that direction involvement of leading entrepreneurs was felt necessary. Regarding the veterinary college to be established in Nagaland, he mentioned that the ICAR is already taking necessary action in this direction.

Hon'ble Minister of Agriculture, Horticulture, Soil Conservation Govt. of Mizoram Shri H. Liansailova emphasized that the state is not having self-sufficiency in food production. He expressed his happiness at the establishment of 7 KVK's in the state by the ICAR. He gave an overview of the Agricultural and socio-economic aspects of the state and desired that further ICAR help can play major role in changing the scenario of agriculture in Mizoram. He pointed out that the Kolasib centre should have more scientists in various agricultural disciplines to strengthen the centre and help in effective technological guidance. He shared that the visit of Hon'ble Union Minister of Agriculture and Food Processing Industries, Sri Sharad Pawar has been very fruitful and requested for setting up of colleges of agriculture, horticulture and post harvest technology.

Hon'ble Minister of Agriculture & KADA, Shri Parijat Singh, Manipur, praised the ICAR Manipur centre for providing technologies which has helped the farming community. He desired that sufficient of high yielding rice varieties suitable to hilly ecosystem, cold tolerance, marshy areas need to be provided. He sought the establishment of two rice research stations in high altitude area as well as in low lands. It was also desired that the unemployed youths be given opportunities for agri-based trainings to develop entrepreneurship. In horticulture sector, he stated, that some of the neglected indigenous crops like Water chestnut, Taro, Water mimosa need improvement and should be popularised in wetlands, resulting in enhancement of employment and productivity. The potentially rewarding tree bean that is a major source of income is on the verge of decline and research be formulated to reverse the trend. Indigenous fish species are on the verge of extinction and need to be saved by experimental breeding and stock enhancement. Establishment of disease diagnostic lab, micropropogation, Project Directorate of swamp buffalo, pig production to bridge the gap between demand and supply, posting of a animal health scientist at the ICAR centres to work on the animal diseases were the other issues raised by him.

Hon'ble Minister of Vety. and Animal Husbandry, Nagaland, Shri T.R. Zeliang stressed that meat and fish production needs to be enhanced in the state and desired that there should be enough fish so as to prevent import of the same from other states Emphasis be also given on high altitude cold tolerant crops , improvement in French bean, water harvesting structures, large scale fisheries, poultry and piggery development. He indicated that Nagaland is a landlocked state and attention need to be given for building the road and communication network. The need for establishing a veterinary college in Nagaland on priority was highlighted by him since. Nagaland does not have any national project as well as any central university. He stressed on establishing such facilities in Nagaland, also, on priority.

Hon'ble Deputy Chief Minister of Meghalaya, Shri B.M. Lannong, indicated that due to population growth, land transformation like reduction in forest areas and orchards, agricultural lands are rapidly evident. The concern is largely due to accelerated urbanisation. Therefore, proper land use planning including road and transportation mechanism should be given due importance. Mining is another severe threat to agricultural production chain since most of the productive arable lands have

been transformed into mined areas, therefore restoration of soil health in mine spoiled soils, intervention of agro-forestry approach, initiation of soil and water conservation measures should be taken on a large scale. ICAR should devise hill agricultural technology with due emphasis to horticultural sector by introducing new fruit cultivars from other parts of India having similar and comparable agro-climatic conditions. He stressed the need for farm mechanisation, development of livestock sectors, emu and turkey farming, etc.

The programme KIRAN (Knowledge Innovation Repository in Agriculture for Northeast) an exclusive hub for knowledge transformation and dissemination to various stakeholders related to agriculture and allied sectors was inaugurated by His Excellency the Governor of Meghalaya Shri R.S. Mooshahary on 5th May, 2011 at ICAR Research Complex for NEH Region, Umiam, Meghalaya. In his inaugural remarks, he stressed upon the need for proper utilisation of cattle population not only in N.E Region but also throughout India, since cattle is considered as one of the animals having multiple uses in the form of meat, milk, urine, dung, hide, hoofs, etc. which ultimately supports human food as well as other needs for sustenance. In his remarks, His Excellency also pointed out that since majority of the population of NE Regions are non-vegetarian (meat eaters), therefore, it is the need of the hour to look into the improvement of cattle population with respect to both quantity and quality through scientific breeding programmes.

His Excellency the Governor of Meghalaya also cited the example of ***Strawberry Festival*** where poverty changed to prosperity in a village of Ri-Bhoi district, Meghalaya due to the adoption of straw berry (Red Gold) cultivation. He emphasized that it is high time for agricultural researchers to think adoption of specific technology in best suited conditions across NE region keeping in mind the improvement of livelihood of the most neglected sections of the society i.e. marginal and small farmers.

His Excellency the Governor of Meghalaya made a remark **that *no security is above food security*** which can be achieved through knowledge transfer from lab to land programmes. Therefore, he stressed all stakeholders for bringing food security first and then the other securities will subsequently follow on, in the present day context. He referred that the region NE India was self reliant in every aspects of life, particularly in food grains even during 17th Century, then why not now! At the same time, he also addressed that the major threats to natural resource sustainability in NE region, particularly land degradation by severe soil acidity, depletion of nutrients through leaching, ground water depletion, pollutions etc need adequate attention. Since the land holding is decreasing day by day due to burgeoning population growth in NE India, therefore, it is imperative to device strategies involving all the stake holders including students and *farming community* under the banner of ICAR Research Complex for NEH Region in order to conserve as well as make efficient use of precious resources while maintaining / meeting the demands of food grain needs of the existing population. In this regard, he also emphasised several important approaches like crop intensification, diversified farming, value addition to agricultural products etc. for achieving ***2nd Green Revolution*** in NE region of India for prosperity and happiness through self reliance in food and nutritional security. The programme ended by vote of thanks by Dr. Ravinder Kumar, ADG, Co-ordination, ICAR,

The technical sessions started with presentation from the representatives of Govt. of Assam, Arunachal Pradesh, Manipur, Meghalaya, Mizoram, Nagaland, Tripura, Sikkim. The agenda items (As listed) were taken and the responses were given by Dr. S.N. Puri, Vice-Chancellor, CAU, Imphal; Dr. K.M. Bujarbaruah, Vice-Chancellor, AAU, Jorhat; Jt. Directors and Director of ICAR

Institutes; Heads of Various regional Centres of ICAR Institutes located in NE region; ADGs and DDGs.

The response of various subject matter divisions to various issues has been summarized below:

Dr. T.P. Rajendran, ADG (PP) while responding made the following observations:

- Fortification of crop production in land-locked states in which cultivable area is itself a challenge due to forest cover needs priority in the region. Safe-storage of crop inputs such as seeds of desirable crop varieties, bio-fertiliser, biopesticides and fertilisers and other agro-chemicals need to be ensured.
- The states may take up seed production programme through farmer participatory mode and develop storage facilities. Short-duration Mungben, urdbean, field pea, pigeonpea, chickea have good scope for being intercropped or used as catch crop in rice fallows.
- Food basket analysis is necessary for the to follow cropping patterns in NE states.
- Suitable rice varieties indentified for *jhum* cultivation be grown. Farmers be encouraged to grow pulses that would give them food security.
- The cropping plans with agro-forestry that could be profitably used along with spot-amelioration with lime or fly ash. Designer cropping systems with amelioration as one goal could reduce the intensity of crop damage. Aluminium and iron tolerant rice varieties and vegetable crops could provide livelihood support and food security to the populations.
- Short season rice varieties, vegetables, floriculture and maize could fit into the rain-catching seasons. It is imperative to encourage traditional knowledge in tackling unexpected weather changes.
- The problem of broken rice in hybrid rice milling, raised from Tripura, can reduced to affordable levels if the hulling is delayed till grain is dry. 3-4 months of storage after harvest is good interval before milling is done.
- Short duration pulses like **Mungbean** (Samrat, Meha) **Urdbean**: (IPL 94-1, WB 4109); **Lentil**: (WBL 77, HYL 57) and Short duration oilseeds like **Mustard**: (Pusa Agrani, JD 6, NPJ-112;) and **Toria** – (PT 507) be popularised.

Dr. H.P. Singh, DDG (Horticulture) while responding emphasized that the NE States including Sikkim has larger potential for horticulture to enhance the livelihood of people living on hills and Horticulture mission has an excellence impact on production and productivity of horticultural crops. Therefore, it would be appropriate to adopt improved technologies and utilization of quality planting material to sustain the gains. Instead of thinking in terms of political boundary, it would be appropriate to work out the technology for agro-climatic zone since wide variation exists within the state itself. It was also emphasized that seed production chain, including planting material need to be strengthened, which require diagnostic system and access to the nucleus material from ICAR. The dip stick for virus of potato has been developed which is effective in diagnosic of potato viruses, and dip stick for other viruses of potato, banana, tuber crops is also in the process of the development, the requested the Vice Chancellor, AAU, Jorhat, Assam to provide 10 acres of land at Kahikuchi so that the regional station care serve the state for plantation crops, spices and floriculture. Meghalaya Govt. was also requested to provide 20 acres of land, since available land is not sufficient to produce designed quantity of breeder/ foundation seed. If land is provided, work on core crop would also be strengthened.

Dr. K.M.L. Pathak, DDG Animal Science indicated that the Animal Science Division has National Research Centre on Pig located at Rani, Guwahati. The Institute is also coordinating

AICRP on Pig and Mega Seed on Pig. The Institute, thus, can provide training and piglets to the farmers / pig rearers for setting up both backyard (indigenous strains) and commercial piggeries (crossbreds) through the centres located in different regions of NE regions. He also desired that NRC on Pig could be given indents for swine fever vacancies. In addition to this, the NRC also has a well established slaughter house and core processing facility which can provide training to various levels of entrepreneurs in both pork processing and value addition. The centre has also standardized artificial insemination technique in pigs and is extending the services to pig breeders in the field area.

The centre on AICRP on Poultry Breeding located at ICAR Research Centre at Agartala is involved in development and testing of suitable rural poultry strains and training of poultry rearers, and along with the centres of poultry seeds (new initiative in XI Plan) is also making available chicks of strains suitable for rearing under backyard system.

Characterization of Animal Genetic Resource of NER is being undertaken through the Core Lab (New initiative in XI Plan) established at AAU, Guwahati, Assam under the Network Project on Animal Genetic Resources**.** This would help in understanding the diversity and variability of genetic resources in the region and device suitable strategies for their conservation and improvement.

Large and small ruminant production being addressed through the centre of AICRP on Cattle (New initiative in XI Plan) at ICAR Research Complex for NEH Region, Gangtok, Sikkim for field progeny testing of Frieswal cattle (HF x Sahiwal crossbred). The semen of Frieswal is being used to produce improved crossbred progeny and testing of frieswal bulls in the state of Sikkim at present. Frieswal semen can be used for production of improved progenies from the existing population of crossbreds in NE states to improve milk production. The germplasm of Swamp Buffaloes in the state of Assam are being improved and conserved through the centre of Network Project on Buffalo Improvement at AAU, Khanapara, Assam. Further, the riverine buffaloes in other states of NER, cryo-preserved semen of Murrah breed can be used for improving their productivity. The NER has a sizeable population and large variability of goats. This area at present is being addressed through the centre of AICRP on Goat Improvement (Field Unit of Assam Hill Goat) at AAU, Guwahati, Assam which is a new initiative in XI Plan. Similar approach can be followed by the other states of the region having sizeable goat population.

Similarly, the centres of AICRP on Improvement of Feed Resources and Nutrient Utilization in Raising Animal Production at AAU, Khanapara, Assam and at NRC on Yak, Dirang, Arunachal Pradesh are working at farm-gate level for the development of requisite technologies for strategic supplementation of limiting nutrients (macro & micro) through locally available feed resources and have been instrumental in developing. Region specific resource based feeding schedules, Mineral mapping, Area-specific mineral mixture and assessing, Locally available feed resources. The information generated and facilities at the two centres can be effectively utilized to generate information for effective in guidance to the states in NER in developing suitable feeding modules based on available feed resources and requirements throughout the year.

Dr A.K. Singh, DDG (NRM) emphasized on issues relevant to the North East Region, namely, enhancing the productivity of acid soils through an integrated approach focusing on amelioration, application of organic matter and cultivation of acid tolerant varieties. He also emphasized upon the fact that water is the key requirement for enhancing the productivity which is in abundance in this region. But the actual rain water harvesting being done is minimal. There are number of options and technologies developed for rain water harvesting like *jal kund*, which could

be easily adopted depending upon the local situations. There is also scope for developing groundwater resources as it is highly under-utilized in most of the states. It was also stated that both ICAR-RC NEH, Barapani and Assam Agriculture University (AAU) have been provided funds by ICAR to train 100 state officials and 1000 farmers each year on any issue related to water management. The sponsoring agencies have to only take care of the travel cost. The rest of the expenses involved are taken care by the ICAR. These trainings can also be conducted at the research stations or KVKs, etc. It was also stressed that agroforestry as a component is very essential for improving the livelihood of the farmers, providing fodder and feed to the animals, and building resilience to climate change. This need to be scaled up as several agro-forestry models have been developed by the institutions located in the North East. It was also mentioned that ICAR is involved in preparing district wise contingency plans for extreme climatic events. The ICAR-RC NEH, needs to increase the pace of these plans as they would be very useful to implement the National Initiative of Climate Resilient Agriculture (NICRA) for which ICAR-RC NEH is the nodal institution.

Dr. M.M. Pandey, DDG (Engg.) mentioned that two issues were flagged by NE states.

1. Requirement of farm tools and equipment for mechanization of small farms, hill agriculture and horticultural crops.

Good efforts have been made for development and introduction of need based farm tools and equipments suitable for different crops in NEH region through cooperating centres of AICRPs at ICAR Research Complex for NEH Region, Barapani; AAU, Jorhat; NERIST, NIRJULI and College of Agricultural Engineering and Post Harvest Technology, Ranipool. He suggested that the designs of suitable farm tools and equipment are available, however, the availability of the equipment in north-eastern region is very poor for want of local manufacturing facility, lack of dealership network and difficulty in transportation of tools and equipments from manufacturing hubs in different parts of the country. To overcome these problems, the following suggestions were made.

(i) The prototype manufacturing workshop of AICRP on FIM at ICAR Research Complex for NEH, Barapani, should be strengthened by providing additional technical man power and machine tools. Sufficient working capital also needs to be provided for prototype manufacturing. The Revolving Fund Scheme of AICRP on FIM at Barapani should be strengthened to facilitate inventorisation and supply of need based equipment and tools to farmers and State Governments of the NEH region.

(ii) A separate manufacturing facility for farm tools and equipment suitable for NEH regions may be set up at Guwahati with modern manufacturing and batch testing facility. The centre shall manufacture need based tools and equipment and supply to different NEH States. The centre shall be industrial extension unit of Central Institute of Agricultural Engineering, Bhopal. The proposed centre shall also inventorise and supply need based commercially available farm tools and implements to different States of NEH region.

2. Processing and value addition of agricultural produce particularly horticultural crops in production catchment.

Storage of onion was a problem flagged by Mizoram. Processing of ginger and yam and pressing of perishable horticultural crops were the problems flagged by Meghalaya. Other states also expressed need for processing and value addition in production catchment. Need for development of secondary agriculture in the region to make the region competitive against inflow of processed foods from neighbouring countries was also raised.

The roadmap for processing and value addition of perishables in NEH region has been prepared and it was presented along with the agenda items in the meeting. This document, however, is based on secondary data for setting up of agro-processing centres in production catchment. The accurate information on the crops and their quantities to be processed and also the type of end products to be achieved and marketed is required. Based on these, the business models of agro-processing centres to be run by entrepreneurs can be suggested along with the details of equipment to be set up and their sources of availability.

Dr. B. Meenakumari, DDG(Fisheries), replied to be queries of different states.

- Dept. of Fisheries Arunachal Pradesh informed that *Wallago attu* is decreasing drastically in their state and asked for preventive measures and breeding technique to be developed. It was informed that CIFA, Bhubaneswar will be asked to look into this aspect.
- Dept. of Fisheries. Manipur stated that propagation of *Lepidocephalus spp*. must be taken up. It was also inquired if the probiotics are effective in fish culture. It was informed that institutes like DCFR and CIFA will be instructed to carry out these programmes. Use of probiotics depends on the water quality and nutritional requirements of a particular cultured fish species. The performance may vary from species to species.
- Dept. of Fisheries, Meghalaya wanted to strengthen the biodiversity resources of coldwater fishes which will improve the income of fishermen and fresh fish will be available to the consumers. Biodiversity conservation is being taken on priority basis for the protection of fish germplasm. It was suggested that if state require any help or guidance, this can be provided by fisheries research institutes.
- Fisheries Officials of Mizoram wanted to know about *Pungasius* culture in pens. They desire to rear and breed ornamental fishes also. It was suggested that Mizoram may seek help from CIFRI for pen culture who has developed technology. For breeding and rearing of ornamental fishes, officials can get know how from CIFR Centre at Kolkata and CIFA, Bhubneswar.
- Sikkim Fisheries Department wanted to make assessment of water bodies through remote sensing CIFRI, Barrackpore; DCFR Bhimtal and CIFE, Mumbai are working on these aspects from where information can be received.
- Fisheries officials from Tripura wanted to know about quality and suitability of mahua oil cake. They wanted that officials of the state departments to visit other states , central institutions and central departments. It was informed that NFDB is providing funds for training to state officials and fish farmers to undergo training at central institutions. States may send their request to NFDB, Hyderabad and Fisheries Institutes may provide the training.

DDG (Fisheries) informed that CIFT has established solar fish dryer in Arunachal Pradesh and technology can be extended to other states of NEH region. Different state-wise training programs on fish processing and value addition can be prepared as per the requirements of the states. She emphasized that States must also extend their holistic support and co-operation for these programmes.

Dr. Arvind Kumar, DDG (Edn.), ICAR, elaborated on the support provided by ICAR to AAU and Nagaland University. He felt that college of Agriculture at Medziphema (Nagaland University) need to pay more attention for strengthening the experiential learning units and upgrading the infrastructural facilities for quality assurance. The status of another central Agricultural University proposed to be established in Meghalaya was mentioned. On the issue raised regarding deemed to be University status for ICAR Research Complex for NEH region,

located at Umiam, it was observed that the campus was having multidisciplinary faculty and the facilities can be effectively utilized. It was pointed out that the issue of the Central Agricultural University and its area of jurisdiction may be finalized in consultation with respective state Governments. He felt that more interaction was necessary amongst various institutions for addressing key issues related to agricultural research and education in NEH region. The Niche Area of excellence on bio-fertilizer at AAU, Assam have given good results and need to be further expanded for the benefit of all stake holders. Giving the account of other ongoing schemes he highlighted the future strategies for improving the quality of higher agricultural education. It was pointed out that number of JRFs qualified in the entrance examination from CAU, Imphal during the last two years was quite encouraging.

In response to the issue related to Agriculture Extension, Dr. KD Kokate, mentioned that, presently in the region 71 KVKs have been established and establishment of 12 more KVKs in the region are in process. In Nagaland, the establishment of 3 new KVKS viz. Paren, Kiphire and Longlegs are in process and after obtaining the proper land and other essential documents from the Host Institution, the KVKs will be considered. In KVK Papumpare, Arunachal Pradesh, the proposal for construction of administration building and demonstration units are in process. However, boundary fencing has already been approved. In regard of filling up of KVK staff in Meghalaya, due consideration will be given in future, so that local eligible candidates get opportunities for better convergence with farming committee of the region. In case of the staff positions in two KVKs of North Tripura and Dhalai, presently, only programme Coordinators are appointed for which mandated activities are suffering to a great extent. It is suggested to the Director of Agriculture, Tripura to fill up the vacant positions immediately. Director of Agriculture, Tripura ensured that post have been already advertised and process will be completed soon.

The higher costs of construction of infrastructure facilities in the region, it is suggested that proper cost standards of concerned organization need to be considered and accordingly funding will be provided. It is also suggested that ZPD should scrutinize the all land related documents for finalization of sites of new KVKs in the region. Presently, in five KVKs in the region are having e-connectivity facilities and during XII plan more KVKs be included in this programme.

Dr. Bangali Baboo, ND NAIP, while giving the response mentioned that the North East Region has a large proportion (about 80%) area under forest and mountains and thus needs a focus on enhancing the interventions in agro-forestry as also the forest engineering which could facilitate development of forestry and agro forestry both. The also pointed out that the majority of population in the region is non-vegetarian and pork meat is the very common. It is also true that the region is susceptible for swine fever and avian influenza. Therefore, the infrastructural and technological support for producing and maintaining the required vaccines in the region along with a package for care to be taken by the human being need to be circulated to all the concerned departments. The seed storage for most of the crops grown in the region requires special care and structure due to high humidity. Therefore, the modifications in seed storage technology suitable for the region are required to be developed and facilities the seed storages of important food crops within the region itself.

Dr. S. Mauria, ADG (IP&TM) referred to the immense contribution of ICAR in general and of ICAR Research Complex for NEH Region for development of the North East in particular. However, he emphasized on the need for specific impetus to facilitating access in the region to ICAR's resources, to allow sharing of ICAR's goods and services for the benefit of the local people in the region. Referring to the Technology Park being created in the Complex, he also desired focus on agri-eco-tourism in the Technology Park so that both education and entertainment are possible for the public. For ensuring the reach of useful knowledge and technologies to the

needy, he highlighted two basic issues viz. i) nurturing entrepreneurship through hand holding with potential individuals or companies; and ii) positive action on ICAR's and farmers' varieties as also on indigenous traditional knowledge in agriculture for their effective utilization.

Dr. KA Singh, Director, IGFRI, Jhansi mentioned that need based trainings in Forage technologies can be provided even at ICAR Research Complex for NEH region at Umium of any of its regional station. It was also added that AICRP centres on forage crops located at Imphal and Jorhat have similar agro-climatic conditions. He requested VC, CAU to locate at about 900-1000m altitude within its various institutions.

C1.1- RECOMMENDATIONS OF THE XX ICAR REGIONAL COMMITTEE NO. III HELD AT ICAR RESEARCH COMPLEX FOR NEH REGION, UMIAM, MEGHALAYA FROM MAY 5-7, 2011.

The recommendation emerged based on the deliberations have been given below:

- In view of the importance of climate monitoring in the region, ICAR, through VC, AAU, shall facilitate establishment of a NE Regional Climate Forum involving all the stakeholders as the region is more fragile and vulnerable to effects of climate change **[VC AAU, Jorhat/ DDG (NRM)].**
- Formation of regional bio-diversity boards be pursued through National Bio-diversity Authority, as many states do not have bio-diversity boards to take care of documentation and conservation of bio-diversity **[Director NBPGR/NBA].**
- The possibilities of establishing a cell be explored with post-quarantine facilities in one of the regional universities or research institutes, to monitor trans-boundary crop and animal diseases, considering exposed border of NE region to many other countries **[DDG (AS)].**
- Establishment of a research centre for wetland areas of the region be explored by ICAR in XII Plan. Programme for effective utilization of marshy land in Assam be undertaken **[DDG (NRM); DDG (CS); VC AAU, Jorhat].**
- In order to address the issue of non-availability of swine fever vaccine, ICAR together with DAHD&F, shall make necessary attempt to establish one swine fever vaccine production centre at AAU, Khanapara. Meanwhile, NRC-Pig, Guwahati shall make arrangements to store the swine fever vaccine after collecting from IVRI to meet the large scale demand and for timely availability. The need for FMD vaccine in Arunanchal Pradesh was also projected. It was mentioned that respective State Govt. should submit their demand to IVRI, immediately **[VC AAU, Jorhat; DDG (AS); DDG (NRM); Director NRC (Pig); Director IVRI].**
- Establishment of AICRP units on Pig, in Manipur and Arunachal Pradesh may also be explored in XII Plan by ICAR. Similarly NRC Mithun may be expanded during XII plan. The cultivation of QPM Maize in NEH region be promote to enhance availability of nutritional feed to Pigs **[Director NRG Pig; Director NRC Mithun; DDG (CS); Director DMR, New Delhi].**
- For production of quality semen, facilities at AAU should be strengthened by State Govt./ ICAR. Import of superior bulls may be undertaken **[DDG (AS)].**
- Opening of a research centre on Duck in the region be considered during XII plan under CARI, Izatnagar. Three major missions on Pig (NE region), Duck (Eastern region) and Goats (in central region) should be given emphasis during XII plan **[Director CARI; DDG (AS); Director NRC (Pig); Director CIRG].**
- Considering the need to introduce peri-urban agriculture concept in the region, ICAR may consider funding such project for Guwahati and the proposal for the same may be submitted by AAU, Jorhat **[VC AAU, Jorhat; DDG (NRM).**
- Some final year students of the universities be also exposed to leading Institutions abroad and budget provision for this purpose be made during XII plan. The HRD programme during XII plan be strengthened **[DDG (Edn.)].**
- One Veterinary college at Nagaland may be established by ICAR as soon as the necessary formalities are completed **[DDG (Edn.)].**
- The scientific man power in NE region be filled on priority basis by the universities and ICAR. In NE region. The SMS from animal science sector should be increased in view of the known potential of livestock sector in NE region **[VC AAU, Jorhat; VC CAU, Imphal; Dean Medziphema; DDG (AS); DDG (AE)].**

- On the issue of establishing Central University in NE region, it was felt to have various options including deemed to be university/ university status to ICAR Research Complex located at Umiam, Meghalaya. A policy decision involving all state Governments be taken in their regard. The Meghalaya Govt. shall take necessary action for providing land for expansion of P. G. College, as requested earlier **[VC CAU, Imphal; Govt. Of Meghalaya; Director ICAR Research Complex for NEH, Umiam; DDG (Edn.)].**
- In view of the opening up of East-West corridor through NE Region, a need to build competitiveness in Agro-Food Processing and value addition was felt and accordingly, strengthening of this sector in existing universities and ICAR Institutes was needed **[Director CIPHET; DDG (Engg.); VC AAU, Jorhat; VC CAU, Imphal].**
- ICAR Research Complex together with other universities shall take up research on Bird EYE Chilli, evaluate good varieties of grape for wine making and diseases of Anthurium for Mizoram State **[Director ICAR Research Complex for NEH, Umiam; DDG (NRM); DDG (Hort.); VC CAU, Imphal].**
- Acid soil amelioration measures should be taken up in an integrated manner by proper combination of locally available organic and inorganic amendments. The problem regarding acid soil amelioration needs to be addressed, with feasible technological options that are to be immediately disseminated to the farmer's field **[VC AAU, Jorhat; VC CAU, Imphal; Director ICAR Research Complex for NEH, Umiam; DDG (NRM)].**
- Concept of Agri-incubators be gradually introduced by the universities and ICAR Research Institutes in the region. The agro-entrepreneurship be encouraged in the Research institutes and universities of the region **[ADG (IP& TM); VC AAU, Jorhat; VC CAU, Imphal; Director ICAR Research Complex for NEH, Umiam].**
- Package of practices for different crops to be grown organically be developed by the research institutes and universities of the region. Production of quality seed and planting material be also given emphasis **[VC, AAU, Jorhat; VC CAU, Imphal; Director ICAR Research Complex for NEH, Umiam].**
- Agriculture is not boundary specific but climate specific. Therefore, institutes/ centers located at similar altitude need to find out appropriate technologies instead of establishing new research centers in each state **[Director ICAR Research Complex for NEH, Umiam; VC AAU, Jorhat; CAU, Imphal].**
- In order to address the issue of high altitude research, ICAR may consider strengthening the research base at Sikkim or in any other suitable area. Research on high altitude cold tolerant rice need to be strengthened **[DDG (CS; DDG (NRM); VC CAU, Imphal; Director ICAR Research Complex for NEH, Umiam].**
- Stakeholder workshop on "Jhum Cultivation" be arranged with focus on addressing the issues related to enhancing the productivity and alleviating farm income and suggesting alternatives **[Director ICAR Research Complex for NEH, Umiam].**
- ICAR Research Complex, Tripura centre may strengthen research to evaluate early season mango varieties, high yielding rice varieties and also develop suitable INM Packages for pineapple. The viable agro-forestry options and ways to enhance coconut production in Tripura be suggested **[Director ICAR Research Complex for NEH, Umiam; DDG (NRM); DDG (Hort.)].**
- Central Potato Research Station at Shillong may take up the issue of generating sufficient quantities of Kufri Megha Potato seeds required for the region **[DDG (Hort.); Head CPRI Research Station, Shillong].**

- Fisheries Division of ICAR Research Complex, at Umiam, Meghalaya be strengthened further to take up research on indigenous small and endangered fish species, fish processing and packaging studies **[Director ICAR Research Complex for NEH, Umiam/ DDG (Fy.)].**
- The hostel facilities at CAU be enhanced to accommodate more number of students, in view of growing demand. The CAU may also have its central Instrumentation facility **[VC CAU, Imphal/DARE].**
- Extensive utilization and popularization of farm tools and implements should be initiated among the farmers in various states of the North East region. Storage facilities also need adequate attention **[Director ICAR Research Complex for NEH, Umiam; DDG (Engg.)].**
- Research on paddy-cum-fish culture may be taken up by CIFRI/CIFA centers located in the region and field demonstrations be also undertaken. These institutes along with DCFR Bhimtal may take necessary measures to address various issues related to Fisheries in NE region **[Director CIFRI/CIFA/DCFR/DDG (Fy.)].**
- The programme KIRAN (Knowledge Innovation Repository in Agriculture for Northeast) an exclusive hub for knowledge transformation and dissemination to various stakeholders related to agriculture and allied sectors programme launched during the RCM be nurtured and supported by all concerned **[Director ICAR Research Complex for NEH, Umiam].**
- ZPD office should preferably have a station at CIFRI, premises Guwahati for easy access and co-ordination **[Director CIFRI; ZPD Zone III; DDG (Fy.)].**
- In view of the need to have Jt. Director at ICAR Research Complex, Umiam, Meghalaya, the placement of the Jt. Directors in Centers be reviewed and a policy decision taken. The centres where the number of scientist is inadequate, the need for having Jt. Director be reviewed. The extent of original and adaptive research which needs to be carried out by ICAR research Complex and its Centres in NEH region be defined **[Director ICAR Research Complex for NEH, Umiam/Director (P)].**
- VCs and ICAR Institutes Directors/Regional Heads are required to undertake six monthly reviews to assess implementation process of the decisions taken in the regional committee and feedback given in this meeting. The above committee shall also deliberate on "complimentary Agriculture, Speciality Agriculture and Secondary agriculture for the region. The Director ICAR Complex for NEH region at Umiam shall take necessary actions, accordingly. The scientists should also visit various sub-centres and build up net work to address regional problems. Location specific and Viable research options should be exercised after mutual discussion **[Director ICAR Research Complex for NEH, Umiam/VC AAU, Jorhat/VC CAU, Imphal/All Regional Heads/DDG (Edn.)/ DDG (NRM)].**

C.1.2- PROCEEDINGS & RECOMMENDATIONS OF THE XX ICAR REGIONAL COMMITTEE MEETING OF ZONE-III (KVK INTERFACE MEETING) HELD AT ICAR RESEARCH COMPLEX FOR NEH REGION, UMIAM, MEGHALAYA FROM MAY 5-7, 2011.

During the 20th ICAR Regional Committee Meeting of Region III, the Regional KVK Interface Meeting was held on 6-7 May 2011 at ICAR Research Complex for NEH Region, Umiam, Meghalaya under the chairmanship of Dr. S. Ayyappan, Secretary DARE and Director General, ICAR, New Delhi. The meeting was attended by all the Deputy Director Generals of ICAR, New Delhi, Shri. S. Bharghava, Member of ICAR Governing Body, Vice-Chancellors from Central Agricultural University and Assam Agricultural University, Assistant Directors General, Director DKMA, Directors and Project Coordinator from ICAR Institutes, Deans and Directors of Research and Extension from State/Central Agricultural Universities, Programme Coordinators of KVKs under region III and special invitees of Regional Committee. (List of participants attached in Annexure –I)

Dr. K.D. Kokate, DDG (Agril.Extn.), ICAR, New Delhi, welcomed the dignitaries and participants of the meeting. In his welcome address DDG (Agril.Extn) briefed about various activities performed and salient achievements made by KVKs in the region and indicated the linkages developed between commodity-based ICAR institutes and KVKs. He indicated that joint DAC and DARE policy document on Convergence between Agricultural Research and Extension need to be referred by all KVKs to further strengthening of Convergence. . Further, he also informed the house that keeping in view of the challenges related to climate change, 100 KVKs in the country have been identified on pilot basis under National Initiatives on Climate Resilience Agriculture (NICRA) project for addressing the needs of the farmers. Also, he emphasized that KVK resources and infrastructure have to be fully utilized for welfare of farming community. He asked the Programme Coordinators as well as host institutes of KVKs for ensuring maintenance of proper land records, data base related to district, state and on KVK activities. He further expressed the need for filling up of all the vacant post of the KVK's within three months. He conveyed his appreciations for their contribution in implementing the Pulses demonstration and Kisan Mobile Advisory programs in the region.

Dr. S. Ayyappan, Secretary DARE and DG ICAR in his opening remark stated that main motto behind conducting KVK interface during Regional Committee Meeting is for building confidence and learning by sharing experiences by Programme Coordinators. He thanked all the Programme Coordinators and Zonal Project Director for identification of district level farm innovators in the region and for their successful participation in the *Farm Innovators meet- 2010* at Mysore, which was appreciated by the Hon'ble Prime Minister. The DG, ICAR expressed that the ZPD has to examine the feasibility of starting an all 'Women KVK' in the region and also urged various host institutes in the zone to explore the possibility. He suggested that the eligible KVKs in the region to submit their application for KVK Award (Zonal) within 15 days for which the Zonal Project Director has to take the initiative.

He further desired to see the KVKs to function effectively as knowledge management centre having convergence and partnership with different stakeholders of agricultural development in the region. He opined that effective monitoring and evaluation of the KVKs are to be done by ZPD so as to ensure that KVKs are working on the mandated activities. KVKs need to develop various extension models suitable to their districts and function as Agricultural Intelligence Centre.

While presenting the achievements of the Zone-III, Dr A.K.Gogoi, Zonal Project Director said that emphasis was given to enhance productivity of rice, Quality Protein Maize, promotion of pulses

and oilseeds, fishery, SRI, backyard poultry, bee-keeping and mushroom cultivation. In view of climate change, initiative has been taken up for climate change adaptation/mitigation strategies through 17 selected KVK's in the region. Kisan Mobile Advisory (KMA) is being implemented by the KVK's for timely dissemination of information to the farmers. He suggested that e-connectivity, Soil Water Testing Labs, Rain Water Harvesting Structures are to be provided to all the KVKs remaining under the zone during the XIIth plan. Also he raised the issue of filling-up of the vacant posts of the KVK's by the host institutes.

The Programme Coordinators of various KVKs expressed their views on the various issues related to KVKs as given below:

1. There is a need for KVK foundation course for PCs as well as for SMSs.
2. Regular refresher training and in service training course for SMSs of KVKs .
3. PC, KVK Cachar, Assam requested for one additional technical staff for assisting in soil testing.
4. Director of Agriculture, Tripura informed that they are in the process of recruiting the staff for the KVKs Dhalai and North Tripura.

This was followed by views from various dignitaries from National Agricultural Research System present during the interface meeting and the details are placed below.

Dr. K. M. Bujarbaruah, Vice Chancellor, AAU, Jorhat expressed that all the KVKs under AAU were involved in technology showcasing program, and as a result there is increase in production of rice in the state of Assam. He requested the ICAR for administrative approval of three KVKs viz., Dhubri, Darang and Morigaon for the new sites. Also, he expressed his views that acid soil management using micro- organism is important in the region and AAU can provide the technology to farmers within a year.

Dr. S. N. Puri, Vice Chancellor, CAU, Imphal opined that timely reach of recently developed technologies to farmers are to be strengthened through better extension linkages, trainings, FLDs and orientation programmes through the college of Horticulture, Pasighat, CAU, Imphal and College of Veterinary Sciences, Aizawl.

Dr. Sudhir Bhargava, Member, ICAR Governing Body suggested that the KVKs have to provide a well demarcated picture of district map with the area covered under FLDs and other KVK activities so that third party monitoring can be done for the impact assessment. He also requested the ICAR for training of KVK personnel either at CAU, SAU or ICAR institutes for scaling up of the latest technology available.

Dr. H.P Singh, DDG (Horticulture) indicated that KVKs may prepare the database of changing cropping patterns in the respective districts and are to be analyzed for planning research and extension programs. He also expressed that KVKs need to have 'targeted plan' for different crops including horticulture. KVKs under Horticulture Technology Mission can strengthen the linkage with the host institutes for enhancing productivity in horticulture and each KVK can focus on any specific horticulture crop depending on the priority of the concerned district. KVKs can play an important role in germplasm preservation and IPR issues.

Dr. M.M Pandey, DDG (Agril. Engineering) informed that 50 KVKs has been identified on pilot basis for demonstration of production processing, value addition and fabrication of the equipments. He highlighted the need of custom hiring and entrepreneurship training for custom hiring so as to promote farm mechanization. Users of farm machinery along with SMSs of KVKs may attend safety training at CIAE, Bhopal. He stressed importance on primary processing by having information on the surplus produce and the price in the district.

Dr. K.D. Kokate, DDG (Agril.Extn.) suggested for orientation of newly SMSs of KVKs. He emphasized that KVKs have to send Kisan Mobile Advisory regularly to the farming community as well as conduct the impact assessment of different interventions made in the district during the last

ten years. Further he added that KVKs have to promote entrepreneurship, farm mechanization, ground water recharge, rain water harvesting and diversification towards horticulture crops.

Dr. A.K Singh, DDG (NRM) indicated that the KVKs need to prepare the district-wise contingency plan for agriculture and allied activities to face climate change in agriculture. He also suggested the recommendation of crop management practices based on testing of technologies in extreme climatic conditions. Resource conservation technologies have to be given priority and conservation of locally available germplasm of major crops need to be done by KVKs.

Dr. B. Meenakumari, DDG (Fisheries) stressed on Integrated Fish Farming that could increase the socio-economic status of the farmers of the region and suggested the KVKs of the region to promote fisheries by organizing need-based training to fish farmers as North Eastern region is having enough potential for Fish Farming.

Dr. T. P. Rajendran, ADG (Plant Protection) advised the KVKs to make use of maximum resources available for exploration of agricultural technologies. E.g. *Trigona carbonaria* (Stingless bee) for honey production in North East region. He added that in case of any outbreak of pest or diseases in the district, KVKs to send SMS alerts to the farmers and ZPDs.

Dr. V. Venkatsubramanian, ADG (Agril.Extn.) suggested the KVKs to analyze the output, outcome and impact for their activities. He emphasized to concentrate on mandated activities and thrust areas of the district. KVKs provided with e-connectivity facilities to develop both static and dynamic content according to the need of the farmers.

Dr. Bengali Babu, Director, NAIP highlighted that KVKs to have documentation of resource profile of the district and their utilization for overall productivity in the district. He also emphasized that KVKs to have contingent measures in case of outbreak of diseases, pests in agriculture and allied sectors.

Dr. S.V. Ngachan, Director, ICAR RC for NEH Region briefed about the achievements of KVKs under the institute at different districts of the region in terms of increase in production and productivity of major crops like rice, maize, sesamum and groundnut including poultry and livestock. He also emphasized on the infrastructure development for better performance by the KVKs in the region.

Dr. K. C. Bansal, Director, NBPGR, New Delhi made a presentation on the role of KVKs in germplasm collection in the North East region.

The following are the recommendations and action points emerged during the interface meeting:

1. Foundation course need to be organized in NAARM for newly joined Programme Coordinators and Subject Matter Specialists to provide orientation about mandates and activities of KVKs. **(Agricultural Extension Division,ZPD-III and Host Institutes, NAARM).**
2. Filling up of vacant positions in all the KVKs. The State Government of Meghalaya and Tripura have tofill up all the posts within 3 months. **(VCs of CAU/AAU, Directors of ICAR Complex Barapani, Director Agriculture/Veterinary, Government of Meghalaya/ Tripura/ Arunachal/ Nagaland/ Manipur.)**
3. Construction of approved infrastructures of KVKs have to be completed during 11th Five year plan. **(VCs of CAU/AAU, Directors of ICAR Complex Barapani, Director Agri/Veterinary, Government of Meghalaya/ Tripura/ Arunachal/ Nagaland/ Manipur and ZPD)**
4. Director of ICAR Institute, Zonal Project Director, Directors of Extension Education of SAU and CAU have to visit KVKs frequently for proper monitoring and feedback collection. **(DEEs of AAU and CAU/ZPD/Director, ICAR and ICAR Research Institutes in the region)**
5. Feed back about technologies generated by ICAR institutes, SAUs and other Research Institutes should be provided for modification/ refinement required in the technologies.

(DEEs of AAU and CAU /ZPD/Director, ICAR and ICAR Research Institutes in the region)

6. Technological backstopping is to provided to NGO KVKs by ICAR institute and Director of Extension Education of CAU/ AAU***(*Director, ICAR/ DEEs and ZPD).**
7. KVKs have to consult nearby institute, SAU/CAU/ICAR organizations for technology backstopping. ***(PCs of all KVKs)***
8. Administrative approval for changing site for 3 KVKs of Assam i.e. Dhubri, Darrang, Morigaon has to be approved from Site Selection Committee. **(VC, AAU, DEE and ZPD)**
9. Staff of KVK Wokha should shift to KVK Site (Lonsachung) within a month i.e. June 2011 ***(*KVK Wokha, Director, ICAR Research Institute and ZPD)**
10. SAC meeting has be conducted regularly in addition to interface meeting with SAU/CAU/ICAR and other Agriculture and allied organizations. **(ZPD and PCs of all KVKs)**
11. Studies on impact assessment of KVK activities should be conducted for last 10 years. **(KVKs/ZPD)**
12. KVKs may take-up programmes on Acid soil Management, Resource conservation Technology and Agri-Intelligence. **(PCs of all KVKs)**
13. Due importance has to be given on livestock, fodder production and fisheries while assessing and demonstrating technologies *(PCs of all KVKs and ZPD).*
14. The Host Institutes have to ensure the placement of SMS in Animal Science and need to release funds in time. **(All the Host Institutes in the Zone/ZPD.)**
15. Exploring the possibility for establishment of Women KVK in the region **(ZPD)**
16. Submission of application for the Best KVK Award (Zonal Level) within 15 days **(ZPD, PCs of all KVKs).**
17. Ensuring for proper maintenance of land records of KVKs**(PCs of all KVKs/Host institutes/ZPD)**
18. Establishment of Crop cafeteria and Technology Park for bringing more visibility of technologies. (**PCs of all KVKs/DEEs and ZPD)**

The meeting concluded with the vote of thanks to the Chair, all the dignitaries from the Council, Agricultural Universities/ICAR institutes of the region, State Govt. officials and other participants from Zone-III.

Annexure –I

KVK Interface during 20th Regional Committee Meeting-Region III on 07-05-2011

List of participants

Sl. No.	Participants
1.	Dr. S. Ayyappan, Director General, ICAR & Secretary, DARE. GOI, New Delhi
2.	Dr. S. N. Puri, VC, CAU, Imphal
3.	Dr. K. M. Bujarbaruah, VC, AAU, Jorhat
4.	Dr. K.D. Kokate, DDG (Agrl.Extn.), ICAR, New Delhi
5.	Dr. H.P. Singh, DDG (Hort), ICAR, New Delhi
6.	Dr. Arvind Kumar, DDG (Edn) ICAR, New Delhi
7.	Dr. M. M. Pandey, DDG (Engg.), ICAR, New Delhi
8.	Dr. A. K. Singh, DDG (NRM), ICAR, New Delhi
9.	Dr. K. M. L. Pathak, DDG (Animal Sc) ICAR, New Delhi
10.	Dr. T. P. Trivedi, Director, DIPA, ICAR, New Delhi
11.	Dr. Bengali Babu, ND (NAIP) ICAR, New Delhi
12.	Dr. V. Venkatsubramanian, ADG (Ag. Extn) ICAR, New Delhi
13.	Dr. T. P Rajendran, ADG (Plant Protection), ICAR, New Delhi
14.	Dr. Sudhir Bhargava, GB Member (ICAR), New Delhi
15.	Dr. S. V. Ngachan, Director (ICAR NEH), Umiam
16.	Dr. A. K. Gogoi, ZPD (Zone III), Umiam
17.	Dr. Anubrata Das, Director, NRC on Pig, Rani, Guwahati
18.	Dr. Kishore Baruah, Director, NRC on Yak, Dirang
19.	Dr. Chandan Rajkhowa, Director, NRC on Mithun, Jharnapani, Nagaland
20.	Dr. B. C. Bhowmick, Director (Extn), AAU, Jorhat
21.	Dr. K. C. Bansal, Director, NBPGR, New Delhi
22.	Dr. M. Premjit Singh, Director (Extn), CAU, Imphal
23.	Dr. S. N. Sen, Director (Agri), Govt. of Tripura
24.	Dr. O. P. Singh, Director (Agri), Govt. of Mizoram
25.	Dr. J. S. Lyngdoh, Director (Agri), Govt. of Meghalaya
26.	Director (Agri), Govt. of Sikkim
27.	Dr. A. K. Mishra, Joint Director I/c, ICAR Complex, Nagaland Centre
28.	Dr. Narendra Prakash, Joint Director I/c, ICAR Complex, Manipur Centre
29.	Dr. Rupankar Bhagawati, Joint Director, ICAR Complex, Arunachal Pradesh Centre
30.	Dr. M. Dutta, Joint Director, ICAR Complex, Tripura Centre
31.	Dr. S. K. Verma, Incharge, Regional Centre, NBPGR, Umiam
32.	Dr. V T Raju, Dean, PG College, CAU, Umiam
33.	Dr. Utpal Baruah, Head, NBSSLUP, Jorhat Centre
34.	Dr. A. K. Tripathi, Nodal Officer-KVK, ICAR Complex, Umiam
35.	Dr. A. K. Singha, SS, ZPD, Zone-III, Umiam
36.	Dr. U. S. Saikia, SS, ZPD, Zone-III, Umiam
37.	Dr. Ranjit Sarma, PC, KVK, Barpeta
38.	Dr. Kameswar Das, PC, KVK, Cachar
39.	Dr. Sunil Kr Paul, PC, KVK, Bongaigaon
40.	Dr. T. P. Saikia, PC, KVK, Darang
41.	Dr. M. K. Chauhan, SMS, KVK, Dhemaji
42.	Dr. P. P. Neog, PC I/c, KVK, Dhemaji

43.	Dr. Sarat Saikia, PC, KVK Dhubri
44.	Dr. Aradhana Baruah, SMS, KVK, Dibrugarh
45.	Dr. Uttam Kumar Baruah, PC, KVK, Dudhnoi
46.	Dr. Samiran Dutta, SMS, KVK, Khumtai
47.	Dr. Rupam Borgohain, PC, KVK, Jorhat
48.	Dr. Dhirendra Nath Kalita, PC, KVK, Kamrup
49.	Dr. Akhil Kr. Deka, PC, KVK, Karbi Along
50.	Mr. Mohan Kumar Sarma, PC, KVK, Karimganj
51.	Dr. Yogendra Prasad, PC, KVK, Kokrajhar
52.	Dr Niranjan Deka, PC, KVK, Lakhimpur
53.	Dr. T. P. Saikia, PC, KVK, Shillongaoni
54.	Dr. Manoranjan Neog, PC, KVK, Nalbari
55.	Dr. Phuleswar Nath, I/c PC, KVK, Sivasagar
56.	Dr. Pramod C Deka, PC, KVK, Sonitpur
57.	Dr. Amal Chandra Sarmah, PC, KVK, Tinsukia
58.	Dr. Shamsher Singh, PC, KVK, Hailakandi
59.	Dr. Sanjoy Borthakur, PC, KVK, East Kameng
60.	Dr. M. Pathak, PC, KVK, East Siang
61.	Dr. Jiten Rajkhowa,SMS, KVK, Lohit
62.	Dr. T. J. Ramesha, PC, KVK, Lower Dibang Valley
63.	Dr. Manik C. Debnath, PC, KVK, Lower Sobansiri
64.	Dr. T. Heli, PC, KVK, Papumpare
65.	Dr. (Ms) Deepanjali Deori, SMS, KVK, Tawang
66.	Dr. Narendra Kumar, PC, KVK, Tirap
67.	Dr. Narendra Deo Singh, PC, KVK, West Kameng
68.	Dr. Indrajit Barman, SMS, KVK, Upper Siang
69.	Dr. Anjana Nand Tripathi, PC, KVK, Upper Subansiri
70.	Dr. Rupankar Bhagawati, PC, KVK, West Siang
71.	Dr. R.K. Imotomba Singh, PC, KVK, Bishnupur
72.	Mr. G. P. kabui, PC, KVK, Chandel
73.	Dr. W. Rajen Singh, PC, KVK, Churachandpur
74.	Dr. T. Medhabati Devi, PC, KVK Leitanpekpham
75.	Mrs. S. K.Raman, PC, KVK, Imphal West
76.	Mr. David Kamei, PC, KVK, Senapati
77.	Dr. A. Surech Kr. Meitei, PC, KVK, Tamenglang
78.	Dr. S. Sumangal Singh, SMS, KVK, Thoubal
79.	Dr.L. Loken Singh, PC, KVK, Ukhrul
80.	Dr. R. Bordoloi, PC, KVK, Ri-bhoi
81.	Mr. A. S. Singh, PC I/c, KVK, Tura
82.	Dr. R. B. Dympep, PC I/c, KVK, East Khasi Hills
83.	Mr. N. S. Nongbri, PC, KVK, West Khasi Hills
84.	Mr. G. Dohling, PC, KVK, Jaintia Hills
85.	Dr. K. P. Chaudhary, PC, KVK, Aizawl
86.	Dr. O.P Singh, PC I/c, KVK, Champhai
87.	C. Lalthlamuana, PC, KVK, Kolasib
88.	Dr. Lalmuanzovi, PC, KVK, Lunglei
89.	Vanlalhruaia Hnamte, PC, KVK, Lawngtlai

90.	R. K. Nithanga, PC, KVK, Mamit
91.	Mr.Lalhimngmuana, PC, KVK, Saiha
92.	Lalnunpuii Parte, PC, KVK, Vanlaiphai
93.	Dr. (Mrs) Anamika Sharma, PC, KVK, Medziphema
94.	L. Yanger Pongen I/c PC, KVK, Kohima
95.	Mr. Samuel Sangtam, SMS, KVK, Mokokchung
96.	Dr. N. Phom, PC, KVK, Mon
97.	Dr. Raj Karan Singh, PC, KVK, Phek
98.	Dr. Keviletsu Khate, PC, KVK, Tuwenchang
99.	N.Khumdemo Ezung, I/C PC, KVK, Wokha
100.	Dr. Y. K. Sharma, PC, KVK, Junheboto
101.	Dr. A. K. Mohanty, PC, KVK, East Sikkim
102.	Dr. P. K. Dewan, PC, KVK, North Sikkim
103.	Mrs. Sherab. L. Dorjee, PC, KVK, South Sikkim
104.	Mr. N.T Bhutia, PC, KVK, West Sikkim
105.	Dr. Arvind Kumar Singh, PC, KVK, South Tripura
106.	Dr. Pranab Dutta, PC, KVK, West Tripura
107.	Dr. Sentu Acharya, PC, KVK, North Tripura
108.	Dr. Anjan Debnath, PC, KVK, Dhalai

C2- PROCEEDING OF THE MID-TERM REVIEW MEETING OF THE RCM - III HELD ON 10TH SEPTEMBER 2012.

The mid-term review meeting was held on 10th September 2012 under the chairmanship of Dr. Arvind Kumar, DDG, Education, after one year of the Regional Committee Meeting to review the action taken on the recommendations during the last RCM Zone III meeting. Dr. S.V. Ngachan, Director, ICAR RC NEHR, in his welcome address presented a brief scenario of food production in NEH region and highlighted significant interventions undertaken by the ICAR Research Complex for NEH and the Agricultural Universities. He pointed that food grain deficiency had come down to 2.98% in 2010-11 from 23% in 2006-2009. Horticulture sector was in surplus particularly in vegetable and fruits but the areas of concern are animal husbandry and fishery sectors, inspite of the growth, the production of meat, milk, egg, fish etc., are far from the requirement. He informed the house that the institute has taken up three flagship programmes namely 1) Jhum improvement 2) Temperate horticulture 3) Trans-boundary diseases of animals and poultry birds. The research programmes are also being reoriented in the farmer's field and focused on secondary, complimentary, specialty and climate smart agriculture. Para wise recommendation and action taken were reviewed. Dr. Arvind Kumar, DDG (Edu.) appreciated the improvement in agri-hoti sector but expressed concerned about the facts and challenges in livestock, poultry and fishery sector where the gap for production and requirements are still very weak. The mid-term meeting is convened to take the stock of the progress on the recommendations of the last Regional Committee meeting and hence anymid-term course corrections might be required for the action to be taken before the next Regional Committee Meeting of Zone III to be held in May 2013 in Tripura. The following action points were adopted or recommended.

Action Point 1: Dr. Arvind Kumar suggested that that work of NICRA should be included in the ATR. The work on Climate resilient Agriculture may be reported in a quantifiable terms, he added.

To this Dr. S.V. Ngachan, Director, ICAR RC NEHR, replied under NICRA state of infrastructure facilities such as FATE, CTGC, Biochar etc., are being created. Strategic research on screening for heat tolerance in rice and maize, identification of hill traits in pig, poultry in relation to climate measures for adaptation to climate change have been initiated. Through TOT, demonstrations and training on water harvesting, contingency plans for risk prone agriculture (flood and drought), natural resource conservation, conservation agriculture, rice farrow programmes enhance food grains production etc., have been undertaken. Altogether 8054 farmers have been directly benefitted in the North eastern hill states.

Dr. A. K. Gogoi, ZPD Zone III, also informed that 17 KVKs are involved in transfer of technology under NICRA.

On the issue of the Regional Climate Forum, Dr. K. M. Bujarbaruah, VC, AAU, informed that the Chief Minister of Assam was approached to lead the North East Climate Forum. The honorable Chief Minster suggested to approach the DONER Minister. The DONER Ministry was approached and the reply is awaited. Dr. Bujarbaruah, also highlighted the good works done by the BNCA (AAU) under NICRA which was appreciated by a team from CRIDA.

Action Point 2: The agenda on the recommendation of formation of Regional Biodiversity Board and the ATR

Dr. K. M. Bujarbaruah, VC, AAU, clarified that state biodiversity Board is in the purview of the states. The idea was to have a regional board to serve as a coordinator among the state boards. Therefore a person with control over all the regional states like minster DONER, Secretary NEC,

might head the board. It was decided that some implementable action may be taken in consultation with the National Biodiversity Board.

(Action: Director NBPGR/ NBA)

Action Point 3: Post quarantine facilities for surveillance of Trans boundary diseases on regional basis, the PD-ADMAS at Bangaluru has its various centers in north east in tandem with High Security Animal Disease Laboratory, Bhopal (HSADL)

Since the exotic or trans-boundary diseases are under the jurisdiction of DAHDLF, Ministry of Agriculture and it has its own mechanism of surveillance. Hence DDG, Animal Science may tie up with the ministry. Dr. M. Dutta informed that the animal disease diagnostic lab in Tripura is very weak. During the discussion, it came out that the diagnostic lab at Bhopal and Bangaluru are well equipped, however sending samples to those laboratories from remote areas of North East is more challenging. Therefore there should be some regional labs. It was decided that DAHDLF may be requested to establish BSL-III Labs in Tripura and Arunachal Pradesh. Also DDG, Animal Science is requested to convene a meeting to decide how to take up the issue in a project mode.

Action Point 4: The ICAR Research Complex, Eastern region has proposed to open a regional centre on wet land in Assam. The QRT of the Institute has also recommended. However the member secretary may write to the SMD for inclusion in the EFC. The VC AAU has kindly agreed to provide land for the sender in wet land area.

(Action: Director ICAR Research Complex, Patna, VC, AAU and Director, ICARRCNEHR)

Action Point 5: On the issue of the availability of swine fever vaccines, Director NRC Pig, Dr. A. B. Das, stated that lifting of vaccines is a problem in maintaining cold chain from Bareilly to respective states. Adding to this the VC, AAU stated that the university has developed a cell culture vaccine which will be produce in PPP mode. Meanwhile the culture has been provided to DAHDLF for production of 1m doses per year at their Kolkata lab. It was also decided that member secretary should write to the states to place indent and lift the materials in time either from Kolkata (IAH & VB) Bareilly (IVRI).

Action Point 6: The recommendation of AICRP Units on Pig in Manipur and Arunachal Pradesh. Dr. A.B. Das informed the house that AICRP is being closed instead mega seed project on pig and mission mode project on AI will be initiated in the 12th five year plan. Mission mode project will be implemented by CAU, Mizoram, AAU, Jorhat while mega seeds project will be with respective states departments.

As regard opening of the centre of NRC Mithun in Arunachal Pradesh, Director, NRC Mithun, informed that an extension unit has been proposed in the 12th Plan EFC. In this regard it was brought to the notice of the house that the Honorable Minister for Agriculture along with the Chief Minister of Arunachal Pradesh has already announced about a decision on opening a centre on Mithun in Arunachal Pradesh. It was decided that the matter should be brought to notice of DDG (AS) by the Director, NRC Mithun officially.

Dr. S. V. Ngachan, Director, ICAR RC NEHR, informed the house that ICAR RC has provided HQPM – 1 Seed across NEH state to the tune of 77MT during last one year.

DDG (Edu.) suggested quantifying the report on distribution and demonstration of QPM by ICAR Complex and ZPD and a comparative performance evaluation report of Vivek-9 and HQPM-1 might be prepared.

Action Point 7: In addition to the ATR submitted by College of Veterinary Sciences, Guwahati AAU on superior bulls / quality semen. Dr. K. M. Bujarbaruah, VC, AAU, informed that a provision has been made under RKVY to procure superior bulls.

Action Point 8: On the agenda of three major missions on Pig (NE Region), Duck (Eastern region), and Goats (Central region) during the 12th plan, the house suggested Member Secretary, Dr. S.V. Ngachan to write to the Director, CARI and CIRG with intimation to DDG (AS) informing them that the RCM has taken a decision on the major mission on Duck and Goat in the NER. The action should be completed before next RCM scheduled to be on 2013 May.

(Action: Director, ICARRCNEHR, Director CARI; DDG (AS); Director NRC (Pig); Director CIRG)

Action Point 9: Since the VC, AAU has submitted the project on peri-urban agriculture to the DDG, NRM and Govt. of India, member secretary in this regard may also write to the DDG, NRM.

Action Point 10: On the recommendation of exposure visit of Agriculture University final year students to leading institutions abroad. DDG (Edu.) informed that there is no project provision for sending students abroad in the 12th Plan. However it has been proposed under NAIP which has been agreed in principle but formal approval is yet to be received with clearance from Department of Economic Affairs, Govt. of India.

Action Point 11: The Veterinary College in Nagaland under CAU will be a part of new Central Agricultural University, Meghalaya for which the house was informed that the EFC has been prepared and the matter is with the standing committee of the parliament.

Action Point 12: The scientific manpower to be filled on priority basis in the north eastern region by the university and ICAR Institutes. In addition to the ATR by the institutes and universities, Dr. A. K. Gogoi, ZPD, Zone III informed that there are 51 Animal Science SMS in 74 KVKs of the north east. It was decided that Animal Science SMS in the rest of the KVKs in the 12th plan may be proposed. The Assam Agriculture University, Jorhat has initiated taking interviews and the process of recruitment is in progress.

(Action: ZPD, Zone III)

Action Point 13: The deemed University status to the ICAR research Complex for NEH Region is yet to be granted.

For extension of PG College (CAU), 20 acres of land was earmarked. However, in this, some encroached areas were included. Therefore, it needed further corrective measures.

(Action: Director, Agriculture, Meghalaya has been requested to expedite the matter.)

Action Point 14: On the issue of competitive agro food processing and packaging in NE Region.

VC, CAU informed activities for orchid packaging and preparation of pineapple powder in the CAE & PHT, CAU, Ranipool is in progress. The processing facilities, training programmes to build competitiveness has been done by CAU.ICAR RC NEHR has also further strengthened, providing facilities for packaging technology for ginger and turmeric in collaboration with DBT. The technology for passion fruit powder, sohiong (prunusnepalensis) etc., has been standardized in addition other technologies on value addition in fruits, spices have been developed; training is being imparted through KVKs for small scale processing and value addition.

Action Point 15: Research on Bird EYE Chilli and management of anthurium is being undertaken by the ICAR RC NEH, Mizoram centre and has been approved in IRC.

As regards Grape cultivation in Mizoram, it was suggested that the varieties should be chosen based on the purpose of use and only NRC-Grape recommended varieties should be introduced. NRC-Grape may be requested to pursue the matter more actively. In this regard, Director NRC (Grapes) may be contacted with DDG (Hort.).

(Action: Director, Horticulture, Mizoram, Director, Director, NRC on Grapes, Director, ICARRCNEHR)

Action Point 16: In addition to the works undertaken by the CPGS, Umiam on acid tolerant rice varieties though generation of physical map of tolerant genes and QTLs for acidity and cold tolerance in rice, VC, AAU informed that a lot of research results on acid soil amelioration are already available, paper sludge application in acidic soils, however implementation of the results by the line departments are required. The AAU working on soil microbes suggested that the possibility of finding solutions through microbial interventions.

DDG (Edu.) requested ICAR RC NEHR,to give update on the work on acid soil amelioration. He also suggested that the bulletin already prepared might be updated and circulated to the concerned stakeholders.

Action Point 17: At present there are no agri-incubators in the institute. The house suggested that each institute should have an agri-incubator.

(Action: Director of all ICAR Institutes; VC, AAU; VC, CAU)

Action Point 18: In addition to the ATR on development of package of practices in organic farming and production of quality seed materials by research institutes and universities, VC, CAU, informed that about 30,000 virus free grafted khasi mandarin would be available for distribution and interested states were requested to put their indents. He also informed that 1000 ha area in Manipur would be taken for demonstration of Mustard cultivation and the entire produce will be processed for seeds.

VC, AAU, Dr. K.M. Bujarbaruah suggested that development of rice varieties as flood tolerance/escape at different stages of growth may be developed. He also suggested that since seeds for potato, oilseeds & pulses are in short supply and the respective ICAR Institutes may provide the same.

As informed by the station I/c, CPRS, Shillong, for potato seed supply, they require additional 60 ha land in order to supply the indented quantity of potato seeds. VC, AAU offered 10 ha of land in Assam for potato seed production and Director, NRC Orchid agreed to provide the fund under National Horticulture Mission. In this regard, technical support is needed from CPRS.

(**Action: VC, CAU; VC, AAU; CPRS, Shillong; Director, NRC Orchid)**

Action Point 19: Dr. S.V. Ngachan informed that a roving team constituted by Honourable DG recommended establishment of Regional station CITH, J & K in Arunachal Pradesh in the 12thfive year plan. Accordingly the institute has taken action proposing regional station at Dihrang in Arunachal Pradesh. It was also suggested that in the 6 monthly review meetings, members from research Institutes/Centres located in the Hills/similar altitude conditions may be invited. The land requirement for varietal evaluation of oilpalm may be looked into by the Department of Horticulture, Mizoram.

(Action: Director, CITH; Director (Hort.), Mizoram; Director, ICARRCNEHR)

Action Point 20: Action is appropriate direction.

Action Point 21: Approval of IRC on Jhum Improvement Research Programme. An initiative under different programmes such as NAIP, NICRA &TSP has been initiated. Atleast 50ha in each state will be undertaken by the institute located in different regional stations/states. In addition workshop on jhum improvement was organised in Nagaland on29th-30thJune 2012.

(Action: JD, Nagaland Centre, Director, ICARRCNEHR)

Action Point 22: Dr. M. Dutta, J.D., Tripura Centre, was requested to developed viable agro-forestry options with coconut based farming system at Tripura The V.C., AAU, has offered to provide planting materials.

(Action: JD, Tripura Centre; VC, AAU, Jorhat)

Action Point 23: The problem of potato breeder seed may be taken up for Meghalaya with DDG (Hort.).

(Action: Director (Hort.), Meghalaya; Station I/c, Head CPRS, Shillong, DDG (Hort.))

Action Point 24: The Director, ICAR RC NEHR, may request the Council to recruit more fishery scientists for the Institute.

(Action: Director, ICARRCNEHR)

Action Point 25: VC, CAU informed that constructions work for hostel to accommodate more number of students is under progress. However due to some bottlenecks construction work has been slow. DDG (Edu.) requested all stakeholders to cooperate.

Action Point 26: Action in the right direction. However, effort may be made for modernization of the Agri-engineering workshop at the ICAR Research Complex (if possible in a project mode) and the Agril. Engg. Division required strengthening.

(**Action: Director, ICARRCNEHR; DDG Engg.)**

Action Point 27: Action taken in the right direction.

Action Point 28: The house expressed its satisfaction over implementation of KIRAN. All ICAR Institutes and Agricultural Universities were requested to provide information for regular updating.

(**Action: All VCs in the region, All Directors of ICAR Institutes/centres in the region**)

Action Point 29: The proposal was submitted to the Extension Division at the Head Quarter. The ZPD, Zone III was requested to pursue the matter.

(**Action: ZPD, Zone III**)

Action Point 30: Creation of Joint Director's post at the Head Quarter and review of Scientific Cadre posts in the regional centres should be discussed with DDG (NRM).

(**Action: Director, ICARRCNEHR; DDG, NRM; Director (P), Head Quarter**)

Action Point 31: Regular six monthly review meetings are held and DDG (Edu.) congratulated the Vice-chancellors of CAU and AAU and the Director, ICAR RC NEHR, for smooth and regular review of progress.

VC, AAU, Dr. K.M. Bujarbaruah, in his concluding remarks said that there is a great improvement attracting local talents in the region. Both the VC's reiterated that enhancement of funds for KVKs, especially for construction was required urgently. Dr. S.N. Puri, VC, CAU, said that Ph. D. programmes of CAU were initiated at CPGS, Barapani and Veterinary College in Mizoram and in fisheries; Tripura College of Fisheries will be initiated next year. The DBT is also providing support to Tripura.

In his remark, the Commissioner of Fisheries, Assam said that there was a lot of scope in fishery sector in the state and many are interested to invest in the fishery sector. However, technical support from ICAR and Universities was required.

The meeting ended with a vote of Thanks by Director, NRC Pig.