Quinquennial Review Team Report: ICAR-RCER

REPORT OF THE QUINQUENNIAL REVIEW TEAM

(1st January, 2006-31st March, 2012)

ICAR Research Complex for Eastern Region,

ICAR Parisar, P.O. B.V. College, Patna- 800 014, Bihar

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Preface

In eastern states, agriculture is the mainstay of economy for more than 80 per cent population as compared to 67 per cent population at the national level. However, frequent floods and droughts like situation, small and scattered landholdings, lack of quality seed and planting materials, inaccessibility to the credit facilities, lowest per capita income, 28 per cent Below Poverty Line population, poor extension mechanism and services, energy crisis in the agricultural sector, soil acidity etc. are some of the major constraints for agricultural development in the eastern states and, therefore, agriculture has remained, by and large, Complex, Diverse and Risk prone. Livelihood of the landless farmers is another major challenge ahead which needs to be addressed sincerely on priority basis.

The sizes of farms are continuously getting smaller even at national level leading to risk in the production and non-remunerative returns. Smaller land holdings having large family size, shrinking natural resources, aberrant weather conditions etc. continuous increasing input costs and diminishing net returns, are gradually proving agricultural vulnerability of small, marginal and poor farmers. According to one estimate, about 40 per cent of the farmers would give up farming and shift to other options for their livelihood. It is also evidenced experiencing the shift of agricultural labour force to the schemes like MNAREGA for their employment generation mission.

First Green Revolution was able to achieve the food security in the country. However, it resulted into over-exploitation of natural resources, particularly land and water. During second Green Revolution, therefore, we must keep intact the natural resource base of farming in Eastern Region. Thus, prepositioning of various institutions of the region including ICAR Research Complex is need of the hour in order to play an important role to address diverse researchable issues in ushering second green revolution.

The marginal and sub-marginal farmers of the eastern states need to be linked with the business-industries system, research institutions, open market/ global scale and unlimited partners (known and unknown). Research - extension linkages need to be viewed in terms of research-extension-farmer-civil society linkages. Trained youth including progressive groups can also establish and operate climate risk management centres in order to help farmers to maximize the benefits of good monsoon and minimize the adverse impact of unfavourable weather. Educated youth can help to introduce the benefits of information, space, nuclear, bio-and eco-technologies. These eco-technologies involve blending of traditional wisdom and frontier technologies for sustainable agriculture and food security including agrarian prosperity.

Today the public extension system is generally seen as inadequate to meet the enormous challenges of the new development needs in agriculture. Evidently, the simple, single purpose extension system is unable to handle the multiplicity of problems, therefore, required to be addressed in the context of a fast changing

scenario of agriculture. The agriculture sector at present is seen to be made up of two distinct segments - the farming segment where the production activity takes place; and the non-farming segment which embodies a range of backward and forward linkages, providing the essential pre-production and post-production services to farming.

Since, ICAR Research Complex for Eastern Region, Patna is responsible to cater to the needs of R&D for seven eastern states, it need to concentrate, facilitate and promote coordination and dissemination of appropriate agricultural technologies through network/consortia approach involving other ICAR institutes, SAUs, and other agencies for generating location-specific agricultural production technologies through sustainable use of natural resources.

I am delighted to observe that the complex is planning, formulating and developing appropriate and affordable technologies to make this vast high potential and low productive area into high productive and sustainable zone.

(R. P. Singh)
Chairman,
Quinquennial Review Team

Dated : June 3, 2012

ACKNOWLEDGEMENT

The Members of Quinquennial Review Team (QRT) and I myself with profound regards express indebtedness to Dr. S. Ayyappan, Director General, Indian Council of Agricultural Research and Secretary, Department of Agricultural Research and Education, Govt. of India, Ministry of Agriculture, New Delhi for his kind faith and trust in the leadership of the undersigned and capabilities of the members while appointing them as Chairman and members of the QRT, to review the working of ICAR-RCER, Patna for the period 1st January, 2006-31st March, 2012.

It is a indeed a matter of great pleasure to meet and interact on several critical issues with Dr. Mangala Rai, Agriculture Advisor to the Hon'ble Chief Minister, Govt. of Bihar and Former, Director General, ICAR and Secretary, DARE, Govt. of India. QRT is extremely grateful and express gratitude to Dr. Rai for his valuable suggestions, guidance and encouragement for completing the task successfully.

The Chairman and the members of the QRT are grateful and express their special thanks to Dr. A.K. Singh, esteemed Deputy Director General (NRM), ICAR, New Delhi for his guidance and keen interest taken during the preliminary meetings held with him in his good office at Delhi for identifying the members of the QRT and given appropriate directions for the process of conducting the visits of QRT to different institutions, centers and organizations for effective review of the achievements of ICAR-RCER and its research centers. The QRT is also thankful to Dr. P.S. Minhas, Asstt. Director General for his useful discussion and suggestions during the meetings.

The members of QRT are obliged and express their regards and thanks to the Hon'ble Vice-Chancellors of different SAUs; Dr. M.L. Chaudhary, BAU, Sabour, Dr. M.P. Pandey, BAU, Ranchi, Dr. K.M. Bujarbaruah, AAU, Jorhat, Dr. A.K. Das, UBKV, Cooch Bihar and Dr. C.S. Chakrabarti, WBUAFS, Kolkata and their Dean, Directors and Scientists who took the pain for attending the meetings and giving valuable advice and guidance. QRT members deeply appreciate and express thanks to the Secretary agriculture/Agriculture Production Commissioners and other senior officials of line departments for their valuable suggestions and assurance given for development of agricultural research and extension activities in eastern region in collaboration with ICAR-RCER.

The QRT sincerely expressed thanks for the assistance and cooperation rendered by Dr. A.K. Singh, Zonal Project Director, Zone-II and Dr. S.K. Singh, Head, NBSS & LUP, Regional Station, Kolkata for taking the troubles in arranging the successful meeting at Kolkata and giving their valuable inputs and suggestions.

The Chairman is extremely grateful to all the Hon'ble members of the QRT for their kind cooperation, assistance and useful contribution for completing the task successfully. He appreciated the participation of the members who are also senior officers and holding important positions in their respective organizations, could make it possible to attend the QRT meetings despite of their very busy schedules. The Chairman is also thankful to Dr.

R.D. Singh, Head, RCMS and Member Secretary QRT for his sincere support and interest taken in organizing the meetings.

The Chairman, QRT is extremely grateful to Dr. B.P. Bhatt, Director of ICAR-RCER for his very personal, cordial and respectful touch given to the members of QRT and to provide desired facilities and working atmosphere. QRT expressed sincere thanks for his overall involvement and excellent cooperation. The QRT also gratefully acknowledged with appreciation to all the Head of Divisions, Scientists, Technicals, Administrative and Supporting staff of the Complex and its Centres including Mr. Sarfaraj Ahmad for his hard work and secretarial assistance rendered during the finalization of the report.

Dated: 3rd June, 2012

(R. P. Singh)
Chairman,
Quinquennial Review Team

CHAPTER-1

INTRODUCTION TO THE REPORT

Conceptual Background of Eastern Region

Eastern region of India is located between latitudes of 17^0N and 29^0N and longitudes of 80^0E and 97^0E. The region includes Assam plains (7.84 million ha), Bihar (9.416 million ha), Chhattisgarh (13.52 million ha), Eastern Uttar Pradesh (8.64 million ha), Jharkhand (7.97 million ha), Odisha (15.57 million ha) and West Bengal (8.87 million ha) states. Out of the total geographical area of 71.84 million ha (m ha) in Eastern Region, 7.5 m ha area is under acidic soils. Likewise, sodic soils occupy an area of 3.81 m ha. According to one estimate, more than 30 per cent of the total geographical area of eastern states suffers from one or the other degradation problem.

Assam, Bihar, Chhattisgarh, eastern UP, Jharkhand, Odisha and West Bengal (Fig. 1) is inhabited by about 33.64 per cent of the country's population, and occupies about 22.5 per cent of the country's geographical area. The average population density is 604 persons/km^2 area, which is almost 2-fold higher than the national average and more than 80 per cent population is rural. In general, the region can be divided into 3 distinct physiographical units namely (i) plains of eastern UP, Bihar, West Bengal, and Assam; (ii) hilly and plateau regions in eastern UP, Bihar, Jharkhand, West Bengal, Odisha, Chhattisgarh, and Assam; and (iii) coastal plains of West Bengal and Odisha.

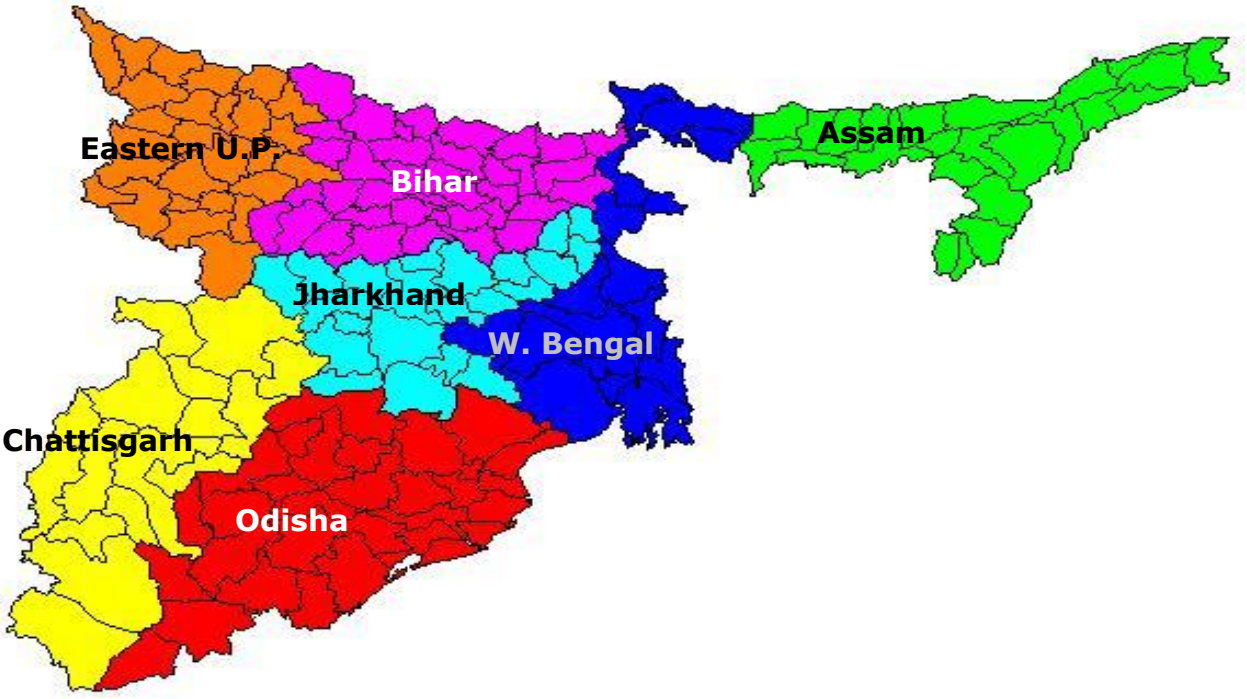


Fig. 1 Geographical spread of eastern states

The eastern region is inhabited by resource poor people with small land: human ratio. The climate of the region is tropical, hot and humid except in hilly areas with high rainfall. The average annual rainfall varies from 1025 mm to 2823 mm. Even though the region

receives high precipitation, surface and ground water resources are utilized to a minimum level and, therefore, large proportion of the cultivated area does not receive any irrigation water. The farmers still depend on the vagaries of the monsoon for crop production.

Livestock production is becoming the prioritized area in agriculture and land use planning. The demand driven growth would also benefit the millions of landless and marginal land holders who possess three fourth of the livestock wealth.

The eastern region has a rich resource base for intensive and diversified agriculture. Average size of farm holding ranges from 0.7 to 1.6 ha, while for small and marginal farmers, it ranges from 0.3 to 0.5 ha. As most of the cultivated area in the region does not have provision for assured irrigation, even a short spell of drought adversely affects the stability of agricultural production, thereby resulting in low productivity. The coastal areas are also vulnerable to sea-water intrusion and cyclones. So far in soil types are concerned, eastern region has highest area under alluvial soils (40.5 per cent), followed by red and yellow soils (25.45 per cent), red and sandy soils (13.60 per cent) and tarai soils (6.05 per cent).

Out of total geographical area of 71.84 million ha, the net sown area is 31.40 million ha in eastern region. The average productivity of rice, varies from 1.20 t/ha in Chhattisgarh to 2.53 t/ha in West Bengal. The gap between present and potential yields ranges between 1.0 t/ha in Chhattisgarh to 2.92 t/ha in eastern Assam. In case of wheat, average productivity varies from 1.54 t/ha in Jharkhand to 3.0 t/ha in eastern UP indicating that wheat productivity is 30 per cent less in eastern region than the national figures. The maize productivity, however, is at par with the national average of 2.41 t/ha. The pulse productivity has been recorded to be 0.7 t/ha in eastern region compared to national average of 0.66 t/ha. Climate change scenario has indicated that, by the year 2080, there would be sharp decline in rice yield, however, rabi maize yield is anticipated to increase by more than 30 per cent.

Agriculture is the mainstay of economy of eastern region since 82 per cent population lives in rural areas. However, agriculture is, by and large, Complex, diverse and risk prone with vast area being rainfed, facing various constraints with respect to resources, infrastructure, technology outreach and institutional mechanisms. Though major amount of rainfall (about 80 per cent) is received during *kharif*, it has large spatial and temporal variation which leads to immense uncertainty and instability in agricultural productivity and production in the eastern states. Occurrence of long drought spells during critical growth periods of crops are quite common in the region. Further, heavy spells of rains lead to water congestion and flooding, making crop cultivation almost impossible, even during the *kharif* season. In spite of above mentioned constraints, the region has great potential for crop production besides livestock and fisheries development.

In view of above mentioned scenario and production, productivity gaps of different enterprises besides the potential of this region could not be exploited and therefore, on the initiation of the Govt. of India, ICAR decided to establish ICAR Research Complex for Eastern Region, Patna which came into existence on the 22nd February, 2001.

Constitution and Composition of the Review Panel

The Director General, Indian Council of Agricultural Research constituted the 2nd QRT vide F.No.18-7/2011-IA.II dated 25.08.2011 to review the work of ICAR Research Complex for Eastern Region, Patna and its two Research Centre for the period 01.01.2006 to 31.03.2012. The composition of QRT is as follows:

1. Prof. Ram Pratap Singh, — Chairman
   Former Vice Chancellor, Maharana Pratap University of Agriculture and Technology, Udaipur, Rajasthan and Chairman, Narendradeva Institute for Development of Agriculture & Rural-upliftment, Barabanki
   B-5/5, Vinay Khand, Gomti Nagar,
   Lucknow – 226 010 (UP)

2. Dr. N. Sarangi, — Member
   Former Director, Central Institute of Freshwater Aquaculture, Bhubaneshwar, 501, Nilchakra Appartments, L.B. Shahtri Marg, Cuttack Road, Bhubaneshwar- 751 001 (Odisha)

3. Dr. Gautam Goswami, — Member
   Director, Technology Information, Forecasting & Assessment Council, Department of Science and Technology, Govt. of India.
   Vishwakarma Bhawan, New Delhi- 100 016

4. Dr. I.S. Singh, — Member
   Former Director (Horticulture), Govt. of Tripura
   13, Devlok Vishnoo Puri, Church Road,
   Aliganj, Lucknow- 226 022 (UP)

5. Dr. K.N. Tiwari, — Member
   Professor (Soil andWater Conservation Engineering)
   Department of Food & Agriculture Engineering,
   Indian Institute of Technology,
   Kharagpur- 721 302 (WB)

6. Dr. S.S. Randhawa, — Member
   Director of Research cum Dean (Post Graduate Studies),
   GADVeterinary and Animal Sciences University,
   Ludhiana- 141 004 (Punjab)

7. Dr. N. Parsuraman, — Member
   Social Scientist & Project Manager, M.S. Swaninathan Foundation
   Taramani, Chennai-600 133 (Tamilnadu)

8. Dr. R. D. Singh, — Member Secretary
   Principal Scientist & Head, Research Coordination and Management Section, ICAR Research Complex for Eastern Region,
   ICAR Parisar, PO: B.V. College, Patna-800 014 (Bihar)

TERMS OF REFERENCE AND OTHER RELEVENT INFORMATION

A. Institute/unit

I. Research achievements and their impact

- To examine and identify the research achievements of the Institute, Projects/KVKs its Regional Stations, AICRPs operated by them vis-a-vis sectoral programmes since the previous QR and critically evaluate them. Commensurate with the objectives, mandates and resources of the organization, the socio-economic impact of research on farmers/beneficiaries and transferability of results to farmers through extension should be critically reviewed.
- The research and its impact should be brought out in quantifiable benchmarks wherever possible.
- To know the value for money, QRT should assess and bring out the physical outputs and outcomes vis-a-vis the budget spent during the period under report. If the likely outcomes are going to take considerable time, the projected outcomes should be indicated.
- The socio-economic impact of research on farmers/beneficiaries and transferability of results to farmers being an important aspect of research outcome the transferability should be mandatory for major research projects.

II. Research relevance and budget allocation

- To examine the objectives, scope and relevance of the research programmes and budget of the Institute for the next 5 years in relation to overall/state/ regional national plans, policies and long and short-term priorities. The Committee may also draw its attention to the EFC/SFC Memo in relation to recommendations of the previous QRT and also the Perspective Plan and Vision 2030 document of the Institution.

III. Relationship/collaboration with SAUs and other stakeholders

- To printout whether the research programmes of the past and proposal for future are in harmony with the Vision of ICAR (HQ) and the programme of related centres of research and Agricultural Universities, state government, private sector, and IARCs.

IV. Linkages with clients/end users

- To examine the kinds of linkage established with the clients and end-users of research results, i.e., farmers /fishermen and the extent of interest displayed in conducting "on-farm research", on farmers' fields and in organizing demonstrations/training courses for the transfer of technology to extension agencies and KVKs of the ICAR.

V. Proposed changes in organization, programmes and budget

- To examine whether any changes in the organizational setup are called for manpower and funds allocation. The decentralization in day-to-day working and the transparency should be highlighted. Further, the committee may also examine the resource generation efforts and implementation of Project-based Budgeting.

VI. Constraints

- To examine constraints hindering the Institute in achievement of its objectives and implementation of its programme and goals and to recommend ways and means of minimizing or eliminating them.

VII. Looking forward

- To look into any other points considered relevant by the Committee or referred to it by the ICAR, the Institute Director or the Management Committee, in respect of future project development, research prioritization and management changes.

  The above terms of reference may be modified at the suggestion of Director of Institute/Project/Management Committee of Institute/Project/ICAR Headquarters/ GB keeping in mind any specific problems of the Institute.

KVK

- To examine the functioning of KVK sanctioned by the ICAR under ICAR-RCER, Patna.
- To assess the performance of the KVK against assigned task and responsibilities.
- To undertake critical review of the research-extension linkages at the district, block and panchayat level and suggest remedial measures for focusing extension services for women farmers and agricultural development projects.
- To obtain and analyse responses from the beneficiaries about the impact of the KVKs on agricultural production, productivity and socio-economic upliftment of the identified areas/sections under the KVK.
- To examine problems/constraints, if any, requiring policy decisions, legal, institutional or administrative actions of the KVK.

The details of the venue of each visit with date of visit of the QRT are indicated in table below:

Date of visits of the QRT

S.No.	Venue & Host Organizations	Dates	Division/ Centre (s) visited	QRT members attended/ activities
1	ICAR New Delhi	August 1st , 2011	Nomination of Chairman	Dr. R.P. Singh was nominated as Chairman of QRT of ICAR-RCER, Patna by Director General, ICAR.
2	ICAR New Delhi	August 8th, 2011	Identification of members and Secretary as member	Identification of members and Secretary as Member of QRT by Dr. A.K. Singh DDG (NRM), Chairman, Prof. R.P. Singh QRT and Director, ICAR-RCER, Patna.
3	ICAR New Delhi	August 25th ,2011	Constitution of QRT	DG, ICAR constituted QRT team (01.01.2006-31.03.2012) as follows: Dr. R.P. Singh, Chairman Dr. N. Sarangi, Members Dr. Gautam Goswami, Members Dr. I.S. Singh, Members Dr. K.N. Tiwari, Members Dr. S.S. Randhawa, Members Dr. N. Parsuraman, Members Dr. R.D. Singh, Member Secretary

4	NRM Division New Delhi	September 15th , 2011	Preliminary meeting with DDG (NRM)	Preliminary Meeting with DDG (NRM), ADG (SWM), Director, ICAR- RCER, Chairman, Members and Secretary as Member of QRT. • A document on background information and research achievements (2006-11), Annual report 2010-11, Vision 2030 and guidelines for QRT was handed over to Dr. R.P. Singh, Chairman QRT, ADG (SWM) and all the members of QRT. • Dr. A.K. Singh, DDG (NRM) apprised the Committee about the genesis and research activities of ICAR-RCER. • Dr. B.P. Bhatt, Director, ICAR-RCER gave a brief presentation on status and constraints of agriculture of Eastern region in general and research achievements of the complex for last six years (2006-11) in particular. • Dr. R.P. Singh, Chairman, QRT suggested the dates 13th to 15th October, 2011 for conducting first meeting of QRT at Patna.
5	ICAR-RCER, Patna	October 13th-15th , 2011	DLWM, DCR, DLFM and DSEE divisions of ICAR-RCER and RAU, Camp office, Patna	Dr. R.P. Singh, Chairman and members Dr. N. Sarangi, Dr. Gautam Goswami, Dr. I.S. Singh, Dr. K.N. Tiwari and Dr. R.D. Singh, Member Secretary attended the meeting. Dr. S.S. Randhwa and Dr. N. Parsuraman could not attend the meeting due to prior commitments. • Dr. R.D. Singh presented Action Taken Report of last QRT (2001-05). • All the Heads of Division/Research Centre presented the research achievements of their Divisions for last six years (2006-11). • Chairman and QRT members along with Director and Scientists of the Complex visited all the experimental farms of the Complex, including laboratories and farmers' fields.
6	Research Centre for Makhana (RCM), Darbhanga	November 3rd-6th , 2011	Research Centre for Makhana of the ICAR-RCER;	Dr. R.P. Singh, Chairman, three members namely Dr. N. Sarangi, Dr. I.S. Singh, Dr. S.S. Randhwa and Dr. R.D. Singh, Member Secretary attended the meeting.

			NRC, Litchi, NAIP site and their activities in the fields	• Chairman and QRT members visited Research Centre for Makhana (RCM) Darbhanga and interacted with the Scientists. • Dr. V.K. Gupta, Head, RCM, Darbhanga briefed the QRT about research activities, achievements and transfer of technology programme of the Centre. • The committee also visited farmers' field, NRC, Litchi, Muzaffarpur and NAIP site at Vaishali.
7	Research Centre , Ranchi	December 4^{th} -7^{th}, 2011	Research Centre of the ICAR-RCER	Dr. R.P. Singh, Chairman, four members namely Dr. N. Sarangi, Dr. G. Goswami, Dr. I.S. Singh, Dr. K.N. Tiwari and Dr. R.D. Singh, Member Secretary attended the meeting. • Dr. S. Kumar, Head, RC, Ranchi apprised the committee about the the activities of the Centre. • The committee along with Scientists of the Centre visited the experimental farms of the Centre and Farmers' fields. • A meeting was also organized with the progressive farmers, NGOs, NABARD, State Govt. Officials and Scientists of the Centre.
8	ICAR-RCER, Patna	February 22^{nd}-24^{th} , 2012	Prepared draft report for Ranchi Centre	Dr. R.P. Singh, Chairman, QRT visited ICAR-RCER, Patna and had meeting with Dr. B.P. Bhatt, Director and Dr. R.D. Singh, Member Secretary. During the meeting draft report for Ranchi Centre was prepared.
9	ICAR-RCER, Patna	March 3^{rd} - 5^{th}, 2012	Prepared draft report on aquatic crop	Dr. R.P. Singh, Chairman, two members namely Dr. N. Sarangi, Dr. G. Goswami, and Dr. R.D. Singh, Member Secretary attended the meeting. During the visit draft report on aquatic crop was finalized.
10	ICAR-RCER, Patna	March 19^{th}-22^{nd}, 2012	Draft report on agriculture in Hill and Plateau prepared	Dr. R.P. Singh, Chairman, five members namely Dr. N. Sarangi, Dr. I.S. Singh, Dr. G. Goswami, Dr. K.N. Tiwari, Dr. N. Parsuraman and Dr. R.D. Singh, Member Secretary attended the meeting. During the visit draft report on agriculture in Hill and Plateau was finalized.

11	Assam Agriculture University, Jorhat	May 1st - 3rd, 2012	Assam Agriculture University, Jorhat (Assam)	Dr. R.P. Singh, Chairman, QRT, Dr. I.S. Singh, member QRT along with Dr. B.P. Bhatt, Director and Dr. D.K. Kaushal, I/c Member Secretary visited Assam Agriculture University, Jorhat and had meeting with Dr. K.M. Bujarbaruah, Vice-Chancellor and Deans, Directors and other faculty members of A.A.U.
12	NBSS & LUP, RC, Kolkata	May 4th - 5th, 2012	Meeting with Vice-Chancellor, UBKV, Cooch Bihar, Vice-Chancellor, WBUAFS, Kolkata, ZPD, Zone-II and Heads of ICAR Regional Research Stations,	Dr. R.P. Singh, Chairman, five members namely Dr. N. Sarangi, Dr. I.S. Singh, Dr. G. Goswami, Dr. K.N. Tiwari, Dr. S.S. Randhwa and Dr. R.D. Singh, Member Secretary and Dr. D.K. Kaushal attended the meeting with Dr. Asit Kumar Das, Vice- Chancellor, UBKV, Cooch Bihar, Dr. C.S. Chakrabarti, Vice- Chancellor, WBUAFS, Kolkata, Dr. A.K. Singh, ZPD, Zone-II, Heads of ICAR Regional Research Stations, representative from line departments to identify researchable issues in the field of agriculture, horticulture, livestock and fisheries development in West Bengal.
13	ICAR-RCER, Patna	May 23th - 27th , 2012	Compilation of the final draft of report.	Dr. R.P. Singh, Chairman, QRT visited ICAR-RCER, Patna and had meeting with Dr. B.P. Bhatt, Director and Dr. R.D. Singh, Member Secretary. During the meeting, the Chairman QRT compiled the draft of the report.
14	ICAR-RCER, Patna	May 30th- 3rd June, 2012	Finalization of the draft of report.	Dr. R.P. Singh, Chairman, QRT visited ICAR-RCER, Patna and had meeting with Dr. B.P. Bhatt, Director and Dr. R.D. Singh, Member Secretary. During the meeting, the Chairman QRT finalized the final draft of the report.

CHAPTER-2

THE PROCESS

The process started with the first meeting held in the ICAR followed by visit to the concerned states and discussion held there with the Director of the Institute and scientists of the different divisions. After the nomination of Chairman for the second quinquennial review report on 1st August, 2011 by the ICAR, Prof. R.P. Singh, was communicated through a letter sent by the Deputy Secretary, Division of NRM, ICAR, for his consent to serve as a Chairman of the proposed QRT. Dr. Singh was also requested to give some date for the meeting at New Delhi with the Deputy Director General (NRM), Division of NRM, and Director of the ICAR Research Complex for Eastern Region to review the work of ICAR Research Complex for Eastern Region, Patna and its two Research Centres for the period from 01-01-2006 to 31-03-2012. In response to above communication, Prof. Singh sent his consent to serve as Chairman of the QRT and also proposed the dates for said meeting subject to convenient to Dr. A.K. Singh, DDG, Division of Natural Resource Management (NRM), ICAR, New Delhi.

Accordingly, the first meeting was fixed on August 8, 2011 for identification of expert members of different disciplines related to ICAR-RCER and secretary as members from the ICAR-RCER, Patna, the meeting was attended by Dr. A.K. Singh, DDG (NRM), Dr. P.S. Minhas, ADG (SWM), Dr. B.P. Bhatt, Director ICAR-RCER, Patna and Prof. R.P. Singh, Chairman, QRT. The composition of the QRT was made as per the latest guidelines issued by ICAR. Scientists having eminence of working within the national agriculture system (NARs) were identified for the QRT in question having specialisation in the relevant fields to the division and programs of the ICAR-RCER. Selected members have not only wider experiences of the research, education, extension, socio-economic, impact analysis and management but also have been recognised scientist in their respective fields. With the above action and consideration and looking the guidelines for the composition of the QRT, the list of the identified members was passed on to the DDG (NRM) for consideration and obtaining the final approval from the Hon′ble Director General, Indian Council of Agriculture Research.

Finally the order of the constitution and composition of the QRT was conveyed vide letter No. **F.N. 18-7/2011-1A2,** dated August 25, 2011.The first meeting of QRT was called by the Deputy Director General (NRM) after taking some dates from Chairman. The meeting was scheduled on September 15, 2011 in the Conference room of the NRM division. The said meeting was attended by the Chairman Prof. R.P. Singh, along with 6 expert members: Dr. N Sarangi, Dr. Gautam Goswami, Dr. I.S. Singh, Dr. K.N. Tiwari, Dr. S.S. Randhawa and Dr. N. Parshuraman including Dr. P.S. Minhas, Asstt. Director General (SWM), Division of NRM and Dr. B.P. Bhatt, Director of ICAR-RCER and Dr. R.D. Singh, member secretary. Dr. A.K. Singh, DDG (NRM) requested the QRT to have critical review of the research and development activities and achievements of the institute for the period 1st Januar 2006 to 31st March 2012 and wanted to have concrete recommendations for the next five years (during the period of XII Plan). DDG (NRM) made a request to the Director of the Institute to make a presentation. Dr. Bhatt apprised the members about research activities of the institute and emphasized that monocropping requires to be supplemented by farming system approach for increasing the productivity and income. The role of the Complex as a Nodal Research Institute, especially for the eastern region was also highlighted. According to him, there is an urgent need to have complementarities between the Complex and SAUs

operating in the eastern region to address the researchable issues of all the eastern states. QRT Chairman and members interacted on some of the points and appreciated the comprehensive presentation made by Dr. Bhatt.

The QRT visited at ICAR RCER, Patna on October 13 to 15, 2011. QRT started its visit at Walmi Research Farm of the Complex and interacted with the scientists on various activities being carried out to maximize the productivity of the water logged areas. The scientists of the institute also highlighted the components of multiple water use system in rice-fish system and trenches-cum-bed system. Net profit from integrated farming system with secondary reservoir was reported to be Rs. 1.23 lac per hectare. QRT member Dr. I.S. Singh felt that appropriate varieties of the vegetable and banana crops were not used at bund of the ponds which must have affected the productivity. Dr. Sarangi another QRT member similarly suggested how to improve fish culture. Dr. Gautam Goswami suggested that all the minor components should be included while calculating the cost of cultivation. The QRT also visited to Sabajpura research farm. Scientist in-charge along with his team explained the various activities being conducted by the institute and also in collaboration with international agencies for screening of rice varieties for drought tolerance. QRT further visited CSISA site and could observe some of the experiments which were being conducted on resource conservation technologies for food securities. However, this was the second year of the experimental trial.

After the field visits, the presentation were made by the secretary as a member on action taken report, Heads of the divisions and research centres on research activities. The details are given in chapter 5 and 6. Some of the critical observations of the QRT were also shown and highlighted there. During the deliberations, it was felt that involvement of social scientist is essential in different projects so as to study the impact assessment, monetary gains and viability of the technology. Eastern region has the potential to bring the second green revolution through implementation of established technologies which are available with the institute. However, the institute needs to be strengthened in terms of additional manpower, particularly in scientific, administrative and supporting staff.

During the visit, a good number of villages at a radius of 70-80 km. from the institute were covered in some parts of the Patna district. The demonstrations were carried out on rice crops, small livestock and dairy cattle but in a very limited numbers. Interactions were made with the farmers and stakeholders. Somehow, those demonstrations and farming systems shown to QRT could not impress the members. The specific impacts of the integrated farming/ diversified farming systems were not visible. Observations were also not recorded by the concerned scientists for improving the field activities. The QRT further observed that there is a lot of demand from the farmers to replace their existing practices of the farming with the integrated farming system models developed by the institute on its research farm. In the villages, very little interventions of horticulture and vegetable crops were seen during the field visits.

Meeting with Dr. M.L. Choudhary, Hon′ble Vice-Chancellor of RAU, Pusa and Bihar Agriculture University, Sabour, Bhagalpur was also arranged. Dr. Choudhary assured to QRT for providing all the support to the ICAR-RCER. Director of Research and Dean, Veterinary College also interacted with one of the QRT members, Dr. Randhawa. It was also decided to work out the modalities of partnership pertaining to R&D between ICAR and SAUs.

The meeting of QRT was held at Research Centre for Makhana, Darbhanga during 3rd - 6th November, 2011. The meeting was attended by Prof. R.P. Singh, Chairman, QRT along with 3 QRT members: Dr. N. Sarangi, Dr. S.S. Randhawa, Dr. I.S. Singh and Dr. D.K. Kaushal, Head, DLFM, Patna. In the forenoon of 3rd Nov., 2011 QRT member Dr. N.

Sarangi interacted with Dr. D.K. Kaushal, Head and scientists of fisheries science attended in place of Secretary as Member Dr. R.D. Singh regarding the mandate, achievements, transfer of technologies, farmers' response towards fisheries and status of aquaculture research planned by the division for eastern region. He appreciated the role of institute in initiating the various activities of fisheries research and extension. Dr. Sarangi also suggested that, further refinement and demonstration are required for popularizing prawn farming in Bihar.

On second day the QRT members visited the Vasudevpur farm and office of Research Centre for Makhana, Darbhanga. A review discussion was held between the Scientists of the centre and QRT members on various research activities of the centre. Dr. V.K. Gupta, Head of the centre briefed on the projects and achievements and makhana based farming systems. Economics of these farming system were reviewed by the Chairman, Dr. R.P. Singh who gave some suggestions for working out the economics. It was also informed by the scientists that cultivation of makhana is highly labour intensive so farmers expect some Govt. subsidies for its cultivation. Makhana-basmati rice cultivation, makhana-chestnut cultivation, screening of makhana germplasm and mechanical processing system were shown to the members. After visiting the farm, the Chairman, QRT met KVK scientists and suggested them to work in collaboration with the research centre and to demonstrate the new technologies developed by the centre as well as to give skill oriented training to the farmers. The QRT also visited farmers' field/makhana processing centre village, i.e., Chuk Bhavani and interacted on various aspects of makhana processing with the farmers, processors and stakeholders.

On third day, 5th November, 2011 QRT members visited NRC for Litchi, Mushahri, Muzaffarpur. They made detailed discussion on status and prospects of Litchi cultivation in eastern region with Dr. Vishal Nath, Director & Scientists of NRC and appreciated the efforts made by the scientists under the leadership of Dr. Nath in promoting the litchi cultivation among some of the farmers of eastern region. Prof. R.P. Singh emphasized that effective linkages and co-ordination should be among the various ICAR institutes is the need of hour.

QRT also visited NAIP sites covering some of the villages including Chakramdas village of Vaishali district where the programs being implemented by the institutes. Different demonstrations conducted with different enterprises were shown to the QRT members. They felt that some awareness about different technologies have been generated but not upto the extent it was desired, therefore, some more attention, guidance and supervision are required. The QRT members also interacted with Incharge and SMSs of KVK, Buxar after reaching to Patna. They suggested them for the transfer of available technologies including livestock and integrated farming system models and to work out economics of IFS by collecting data from farmers' field.

On 6th November, 2011 a review meeting on the research achievements was held with the QRT members; Dr. S. S. Randhawa and the scientists of DLFM at Patna. The brief achievements of the Division were presented by Dr. A. Dey followed by the discussion with the concerned scientists. Dr. B.P. Bhatt, Director of the institute emphasized on the importance of livestock and fishery sector(s) as part of the farming system in the region and assured to provide all facilities for the research. Dr. Randhawa appreciated the good work done by the Scientists pertaining to Animal Sciences and gave some valuable suggestions.

The meeting of QRT was held at Research Centre, Ranchi from 4-7th December, 2011. Dr. R. P. Singh alongwith Dr. I. S. Singh, Dr. G. Goswami, Dr. K. N. Tiwari, Dr. N. Sarangi and Dr. R. D. Singh visited the Research Centre Ranchi. Dr. S. Kumar, Head and scientists of the centre accompanied them to visit the Farm No.1 and technology demonstration block of water management. Dr. Kumar explained in detail about the Doba

and Pitcher Irrigation technology to the Hon′ble members of QRT. Dr. K. N. Tiwari gave suggestions to increase permeability of the soil and minimize the evaporation loss. Further, they proceeded towards the Drip Irrigation and Plastic Mulching technology unit on cucurbits; resource conservation technology trials, long-term vegetable based cropping system trials, hybrid seed production of tomato and brinjal under AICRP, ultra-high density orchard of guava, integrated farming system and unit of agricultural waste management. They made queries related to the trials and discuss the problems and gave solutions. Different research activities being carried out at farm No. 2 were also shown which includes high density mango orchard of Amrapalli.

After the fields visit a meeting of QRT with 65 farmers, Govt. officials of line departments, field functionaries, members of different organizations and representative of different association was organized by the Centre. A very comprehensive interaction among the farmers and other participants with QRT and scientists of the centre took place. Dr. R.P. Singh, appreciated the fruitful contribution made by the scientists and requested the farmers to frequently visits to the centre so as to take benefits of the services of scientists.

On the next day i.e. 5th December, 2012, the members of QRT and scientists of Research Centre, Ranchi visited the farmers' fields and advised the nursery men regarding efficient management of water by adopting the sprinkler irrigation system instead of flood irrigation being used by them. They also visited villages Kuchu and Zeerabar, KVK, Rukka, to review the water management problems. For overcoming the water problems, QRT members suggested to construct deep wells through community participation.

On the 6th December, 2012 a meeting with members of QRT along with all the staff of Research Centre, Ranchi, was conducted at the Centre to sought the opinion and suggestions for improvement and betterment of the Centre. They suggested for taking more externally sponsored projects for solving the problems of shortage of technical staff. They emphasized the need of research on integrated farming system, nutritional analysis of fruits & vegetables, post-harvest for value addition of horticultural produce. QRT also visited Birsa Agricultural University, Ranchi and had a meeting with Hon'ble Vice-Chancellor Prof. M.P. Pandey. Chairman QRT apprised Hon'ble Vice-Chancellor about the visits made to the Centre and farmers' fields. He elaborated the necessity of collaboration and coordination of the institute with the University for undertaking some of the projects jointly for technologies generation and transfer of the available technologies to different parts of the state. QRT also emphasized the involvement of Krishi Vigyan Kendras (KVKs) functioning under the university. Prof. Pandey assured the QRT to provide full support to ICAR for technology generation and its dissemination.

On 7th December, 2011 all the QRT members visited different laboratories of the Centre and discussed with the scientists about current projects, facilities available and future requirements and suggested that more facilities are required for specific work in the field of post-harvest technology and the experiments done in the centre should be replicated in the farmers' fields. Dr. Ramani, Director IINRG informed that IINRG and RC Ranchi has initiated joint work on development of Lac based horticulture production system.

From 22nd to 24th February 2012, March 3rd to 5th 2012 and 19th to 22nd March 2012 Dr. R.P. Singh Chairman, Dr. N. Sarangi, Dr. Gautam Goswami, Dr. K.N. Tiwari, and Dr. N. Parasuraman, visited to ICAR-RCER Patna and had several meetings, interactions, verification and clarification pertaining to facts & figures including aquatic crops & Hill Plateau for the preparation of draft report of the QRT. Chairman along with his team of review panel had several meetings and interaction with Dr. B.P. Bhatt, Director and the Divisional Heads and scientist including Dr. R.D. Singh Secretary Member regarding several observations made on various issues related to the development of eastern region during their

visits as referred above. Besides, Chairman and QRT members also had meetings and interactions regarding development of eastern regions with Dr. Mangala Rai, Agriculture Advisor to the Hon'ble Chief Minister, Govt. of Bihar and Former, Director General, ICAR and Secretary, DARE, Govt. of India. Chairman and members QRT were happy to have his valuable advice during the fruitful discussion. Some of the important issues regarding the development of eastern region were suggested by him such as water saving strategies from the loss of water taking place around the canals and in many other forms from different unproductive water bodies. Dr. Rai and some other officials of the Department of Agriculture suggested that ICAR-RCER should make sincere and continuous efforts for partnership mode approach through effective co-ordination and collaboration with the university scientists, Government, line departments and other organizations functioning in different states of eastern region for the development.

On 3rd May, 2012 Dr. R.P. Singh, Chairman, Dr. I.S. Singh, member QRT along with Dr. B.P. Bhatt Director and Dr. D.K. Kaushal, In-charge Secretary as member (in place of Dr. R.D. Singh) visited Assam Agriculture University, Jorhat and had meeting with Dr. K.M. Bujarabaruah, Vice-Chancellor including Dean, Director and other faculty members of the university and officials. Several suggestion were made during the deliberation in the meeting pertaining to Harnessing of water linking of rivers canals and ground water recharge programmes, hitech horticulture with the thrust on mixed cropping system, resource utilization, indigenous technology value addition etc. It was decided in the meeting that a centre of ICAR-RCER near Gowahati will be established for which Hon'ble Vice-Chancellor, Dr. K.M. Bujarbaruah has very kindly agreed to provide 25ha of land and infrastructure support for establishment of the centre. QRT members deeply appreciated his kind gesture of considering very important centre of the ICAR-RCER and expected that the ICAR authorities will take no much time to establish this important centre.

On 5th May, 2012 a meeting was held at Regional Research Station of NBBS & LUP, Kolkata, which was attended by Dr. R.P. Singh, Chairman, QRT, Dr. N. Sarangi, Dr. Gautam Goswami, Dr. I.S. Singh and Dr. K.N. Tiwari (Members of QRT), Dr. R.D. Singh, Secretary-Member, Dr. D.K. Kaushal Head, DLFM, Patna and participated by Vice-Chancellors, Zonal Project Director, KVK, Zone-II, Heads & representatives of different institutions of ICAR located in Kolkata and different parts of West Bengal, Regional Research Stations, Representatives Govt. Line Departments, Dean, Directors & scientists of SAUs to identify Researchable & Development issues in the field of agriculture, horticulture, livestock and fisheries development and decision were taken on various issues pertaining to agriculture, horticulture, livestock, fisheries and transfer of technology for different parts of West Bengal. Recommendations of this meeting have been incorporated in different related chapters of the QRT Report.

On 23rd to 27th May and 30th to 3rd June, Dr. R.P. Singh, Chairman QRT Visited ICAR-RCER, Patna for compilation of the draft report and also had a meeting with the members of the committee to finalize the final draft of the report. In this connection, several meetings and discussions were held with Dr. B.P. Bhatt, Dr. R.D. Singh and some of the Divisional Heads & scientists including members of the Institute Management Committee before finalize the final draft.

In addition, some of the members of QRT and Chairman himself had the opportunities to meet the Hon'ble Vice-Chancellor, Dr. D.P. Ray and Deans, Directors of OUAT, Odisha and Chattisgarh, besides, the line department officials and universities such as BHU, Varanasi & NDUAT, Faizabad of eastern U.P in some other meetings in Delhi and other places and their feedback & suggestions were received.

CHAPTER-3

BRIEF HISTORY, MANDATE AND OUTSTANDING ACHIEVEMENTS OF ICAR-RCER, PATNA

ICAR-Research Complex for Eastern Region was established on the 22nd February, 2001 having the merger of Directorate of Water Management Research, Patna with the Complex. On April 1, 2001, Central Horticultural Experimental Station, Ranchi and Central Tobacco Research Station, Pusa were also merged in the complex. Since its establishment persisting constraints of facilities, infrastructure and manpower could not allow to create its visible impact in all the seven states falling under the eastern region. The ICAR- RCER, Patna has basically a broad based approach to address diverse agricultural issues related to water and land resource management, crop husbandry, horticulture and agroforestry, livestock and fisheries management, aquatic crops, socio-economic and extension research and development programmes in a holistic and integrated manner for promoting research capability in order to enhance production and productivity potential.

ICAR Research Complex for Eastern Region (ICAR-RCER), Patna is multi-commodity and multi-disciplinary institute. It is created on the lines of an approved format, collates all the basic information on mission, mandate, achievements, impact, future scenario, emerging issues, perspective and strategies of the institute.

The complex has broad based mandate in view of emerging opportunities of research in frontier areas, initiatives for regional cooperation, globalization, and cost competitiveness. In order to achieve 4 per cent growth rate in agriculture, emphasis is being given on multi-disciplinary research in a program matrix. A network and consortium approach is envisaged to achieve mission of the complex through partnership and collaboration with SAUs, ICAR Institutes and NGOs.

The Complex is comprised of four divisions, two research centres and one KVK as depicted below:

1. Division of Land and Water Management (DLWM), Patna
2. Division of Crop Research (DCR), Patna
3. Division of Livestock and Fisheries Management (DLFM), Patna
4. Division of Socio-economic and Extension (DSEE), Patna
5. ICAR-RCER Research Centre, Ranchi, Jharkhand
6. ICAR-RCER Research Centre for Makhana, Darbhanga, Bihar
7. Krishi Vigyan Kendra, Buxar, Bihar

Mandate of the Institute

"To undertake strategic and adaptive research for efficient integrated management of natural resources so as to enhance productivity of agricultural production systems comprising of field and horticultural crops, aquatic crops, agro-forestry, livestock, avian, and fisheries in different agro-ecological zones of the eastern region".

The Modalities to Achieve the Mandate Are

- To facilitate and promote coordination and dissemination of appropriate agricultural technologies through network/consortia approach involving ICAR Institutes, State Agricultural Universities, and other agencies for generating location-specific agricultural production technologies through sustainable use of natural resources.
- To provide scientific leadership and to act as a centre for vocational as well as advanced training to promote agricultural production technologies.
- To act as repository of available information and its dissemination on all aspects of agricultural production systems in the eastern region.
- To collaborate with relevant national and international agencies in liaison with state and central government departments in achieving the above objectives for enhanced technology dissemination.
- To provide need based consultancy and advisory support for promoting agriculture, horticulture and livestock in the eastern region.
- Socio-economic evaluation and impact assessment of agricultural technologies.

Mission

- *Transform* "**Low Productivity-High Potential**" eastern region into high productivity region for food, nutritional and livelihood security in a manner that is environmentally sustainable and socially acceptable.
- *Tap* unutilized potential of vast seasonally waterlogged and perennial water bodies for multiple uses of water and aquatic crops for social upliftment.
- *Suggest* poverty alleviation, livelihood improvement and women empowerment through income and employment generation through on-farm and off-farm job opportunities.
- *Promote* network and consortia research in the eastern Region.

Priorities, Programmes and Projects (PPP)

In order to disseminate agricultural technologies to farmers, socio-economic constraints for the adoption of biophysical solution need to be identified and principles & policy guidelines have to be blended for the effective integration of production technologies with socio-economic environment. Major emphasis has to be given for socio-economic characterization of the region for the identification and overcoming production constraints.

Based on fresh SWOT analysis, commitments in recent EFC, recommendations of RACs, QRTs, SRCs, Regional Committee meetings, system priorities and sub-priorities of CGIAR, National Agriculture Policy, Government Policies, the Vision: 2030 Perspective plan document prepared by ICAR-RCER, Patna were taken into consideration for finalization of PPP.

The necessity to grow enough food, feed, fuel and fibres to meet requirements of the ever-increasing population has put tremendous pressure on natural resources and their management. There is degradation of resource-base in the form of large scale soil and water erosion in the hill and plateau areas, appearance of wide-scale secondary salinization and waterlogging in the irrigated and flood-affected area, deterioration in water quality, diminishing forest cover and inaccessibility to the costly inputs in agriculture.

Soil is a vital natural resource. This resource is under competitive demand for industrial growth and urban expansion. Since pressure on available soil resources are increasing with time, its effective and rational use will be the core strategy to increase the productivity on sustainable basis. Soil health and fertility must also draw immediate attention of all concerned, especially when organic matter content has gone down (0.3-0.5 per cent), and several micro nutrient deficiencies are now surfacing prominently. Thus, there is a strong need for conserving soil and land resources and preserving natural ecosystem in proper equilibrium so that short-term exploitative measures on soil resources do not jeopardize long-term sustenance of soil productivity and health.

Water is also a scarce resource in some parts of the region. It is estimated that even after achieving the full irrigation potential, nearly 50 per cent of the total cultivated area will remain rainfed. Such low level of water availability is considered a severe constraint to socio-economic development and maintenance of environmental quality. This would not be out of place to mention that the water productivity is 0.37 kg/m^3 in the region as compared to 1.01 kg/m^3 in Punjab. Likewise, groundwater utilization is hardly 33.0 per cent in eastern region compared to 58.0 per cent at national level. The ICAR-RCER, therefore, envisages increasing the water productivity by 3-folds so as to achieve the target of food production by 2030.

No doubt in continuation of such limitations and bottlenecks as stated earlier, the ICAR-RCER had made some outstanding achievements as depicted below:

- **Varieties/ Hybrids of Vegetable Crops Released:** During the period under report, 13 varieties of vegetables viz. Brinjal: Swarna Abhilamb, Swarna Neelima, Swarna Mohit; Tomato: Swarna Sampada; Pumpkin: Swarna Amrit; Garden pea: Swarna Mukti; Snowpea: Swarna Tripti; Cowpea: Swarna Harita, Swarna Mukut and Swarna Suphala; Dolichos bean: Swarna Utkrist and Swarna Rituvar; Vegetable soyabean: Swarna Vasundhara; were developed and released. Apart from this, two promising lines of faba bean (*Vicia faba*), one of makhana (*Euryale ferox Salisb*), two of bottle gourd, two of chili and one of processing type tomato has been developed and likely to be released.
- **Area Covered Under Released Varieties of Vegetable Crops:** The institute released varieties are being grown in more than 7000 ha area in Jharkhand alone. Besides, seed production of these varieties has also been taken up in participatory mode. Details given in Annexure-II.
- **Seeds and Planting Material Produced:** A total of 34.9 tonne seeds of quality seed material of different vegetables and about 3.07 lakh nos. of quality saplings of different fruit plants like mango, litchi, guava, aonla, sapota, papaya, bael, citrus, jackfruit, custard and apple were propagated and planted in Jharkhand, Bihar, Chhattisgarh, West Bengal and Odisha. The seed and planting material have been grown covering an area of about 4500 ha in vegetables and about 400 ha under fruit crops.

- A total amount of 46.44 tonnes of truthfully labelled seeds of different vegetable crops have been produced during the period of report.
- Nearly, 72 thousand numbers of rooted cuttings of pointed gourd and 5.5 tonnes of corm of elephant foot yam have been produced by the institute.
- A total of 250.4 quintal of mushroom spawn has been produced during the period.

- **Development and Evaluation of Economic Ration Based on Locally Available Feed Resources**: A chemical composition of feeds and fodder resources in Bihar has been analysed. Four types of homemade concentrates have been prepared for dairy cows. Homemade concentrate can increase 30 per cent milk yield and save 20 per cent feed cost over traditional method. The technology has been communicated to the Livestock Research Station, Govt. of Bihar.
- **Crop-Livestock Based Farming System Model:** One acre crop dairy based farming system model was developed in irrigated condition employing 60 per cent area for crop production and 35 per cent area for fodder production. A total of Rs. 1.2 lakh was earned with employment generation of 576 man days/yr. from the system.
- **Management Strategy for Maximization of Productivity of Water Bodies through Makhana Based Integrated Farming System:** Makhana, waterchestnut and fish integration has been found most successful for livelihood improvement of resource poor farmers. This technology has spread in more than 100 acres of water bodies in Darbhanga and Madhubani (Zone I & II) districts of Bihar. Now, it is also spreading in other makhana growing areas such as Katihar and Purnia districts.
  - Promising strains of Makhana were identified, which showed the seed yield of 2.84 t/ha compared to local check (1.56 t/ha).
  - In case of makhana, instant makhana *kheer* mix product has been prepared in collaboration of CIPHET, Ludhiana. Licensing for manufacturing instant makhana *kheer* mix has been assigned to M/s Vijay Raj & Co., Darbhanga, Bihar. Likewise, dried instant mushroom *soup* mix has been developed, which is gaining popularity among stakeholders keeping in view its keeping quality and flavour.
- **Development of Integrated Farming System Model**: Developed one and two acre Integrated Farming System model for small and marginal farmers in irrigated ecosystem. The technology has been demonstrated on farmers' fields in Vaishali district and also adopted by Bihar Govt. with provision of subsidy of Rs. 10,000/farmer covering 534 blocks.
- **Crop Diversification**: Five cropping systems have been developed which includes rice-tomato-bottle guard, rice-coriander-lady's finger, rice-mustard-tomato/sponge gourd, rice- carrot/cabbage-cowpea and rice-potato-onion. These cropping systems have potential to increase cropping intensity by 300%, particularly in irrigated ecosystems.
- **Fish culture in trenches under multiple water use system for waterlogged area:** Waterlogged areas having water stagnation 0.3-1.0 m were utilized for effective fish culture by further digging of the area in the form of trenches and raising a portion above highest flood level using excavated soil to cultivate vegetable or horticultural crops.
  - In meandering type of trenches, the fish yield was recorded to be 1.97 t/ha.
  - In case of continuous trenches, the fish yield was estimated to be 1.92 t/ha.
  - Waterlogged areas, modified with alternate deep trenches of 2 meter depth and beds of 1 to 1.5 meter width, offered the scope of horticulture and vegetable crop cultivation in waterlogged areas.
  - Rice-fish-makhana, makhana-fish-barseem and makhana-fish-water chestnut farming systems have been developed for waterlogged areas. The technology has also been standardized for makhana cultivation in rice fields.

- **Rice-fish culture:** Rice-fish culture, quite useful in productive utilization of seasonally waterlogged lands was undertaken to grow fish in the rice fields with central pond type fish refuge. The fish yield was recorded to be 1.4 t/ha.
- **Breaking the Seasonal Barrier in Scampi farming:** In northern India, the freshwater prawn, scampi (*Macrobrachium rosenbergii)* is normally cultured during June to December, depending on the water temperature (18-34^0 C with an optimum range of 27 to 31^{0}C). Hence, the fresh water prawn-crop is not available to consumers after December. In Bihar, *Macrobrachiumrosanbergii* has been successfully cultured during the period stretching post-monsoon, winter season for the first time. Success could achieve in farming of scampi by providing suitable shelters in ponds and trenches, from August to February. This adaptive research work has paved way for scampi farming beyond December. The farmers and entrepreneurs will be highly benefited from the new approach of scampi farming in the seasonally waterlogged areas in other similar eco-systems.
- **Resource Conservation Technologies (RCTs):** RCTs were assessed, refined and demonstrated to the farmers in different districts of Bihar through on-farm research in participatory mode. Realizing the importance and impact of RCTs, Govt. of Bihar is giving 80 per cent (up to Rs. 40,000/-) subsidy on purchase of ZT drills/RCT equipments. ICAR-RCER started RCTs activities since 2000 and ZT wheat had been accelerated in 22 districts of Bihar covering an area of over 6000 ha and more than 7200 nos. of beneficiaries.
- **Technology for transplanting of winter maize:** Technology has been developed for transplanting of winter maize. In general, the rice is harvested by the end of November or mid of December, and therefore, the winter maize cultivation gets delayed (since the sowing for winter maize is recommended in the mid of October). Hence, transplanting of 5 weeks old seedlings of maize provides an opportunity to cultivate the winter maize with optimum yield (yield range 6.0- 8.0 t/ha) and saving of 12 cm of irrigation water, i.e., 2 irrigations. Further, the technology is helpful for waterlogged areas, particularly in north Bihar.
- **Development of Low Energy Water Application:** Low Energy Water Application (LEWA) device, developed by the institute, was further refined and standardised to meet the requirements of the region for better efficiency. This technology has been demonstrated in ICAR Institutes such as ICAR Research Complex for NEH Region, Barapani, SAUs such as KVK, Harnaut (RAU, Bihar), SBPUAT, Modipuram under CSISA project and farmers field in Patna district of Bihar covering an area of 1000 m^2 at each location.
- **Enhancement of Livelihood through Multiple Use of Water: S**tate government sponsored training programmes were organized at ICAR-RCER, Patna on the aforesaid subject. This technology has spread in 22 districts of Bihar such as East Champaran, Muzaffarpur, Saran, Patna, Arwal, Rohtas, Bhabhua, Aurangabad, Bhojpur, Nawada, Buxar, Banka, Munger, Bhagalpur, Lakhisarai, Saharsa, Purnia, Gopalganj, Siwan, Nalanda, Araria, Supaul, and Madhepura, covering an area of more than 10000 ha.
- **Low Cost Water Harvesting Structures (Doba):** The low cost technology on polythene lined *Doba* has been demonstrated covering an area of 35 ha in farmers' field in Jharkhand. Its horizontal expansion over 50 ha area in Jharkhand, West Bengal and Chhattisgarh has been taken up by the line departments during the period under report.

- **Rain Water Harvesting:** Rain water harvesting ponds of size 25 X 20m bottom dimension; 1:1 slide slopes and 2 m depth constructed on the sloppy region with LDPE film (250 micron) has been designed and found successful for giving life saving irrigation for horticulture crops and also potential for fish culture. In command area, litchi or mango based multi-tier system with guava as filler crop and vegetables as inter crop can be taken up. Irrigation in command area can be provided with gravity fed drip irrigation system to fruit trees and vegetables without any additional cost, particularly in Hill and Plateau region.

- **Development of Fodder Production Strategies for Rainfed and Irrigated Conditions of Bihar**: Under round the year fodder production project, in rainfed system, average green and dry biomass yield varied from 16-27 and 6-9 tonnes/ha, respectively for different combinations of perennial and annual fodder. In irrigated system, average green and dry biomass yield varied from 27-34 and 9-11 tonnes/ha, respectively for different combinations of perennial and annual fodder. The technology has been disseminated to farmers during training programmes.

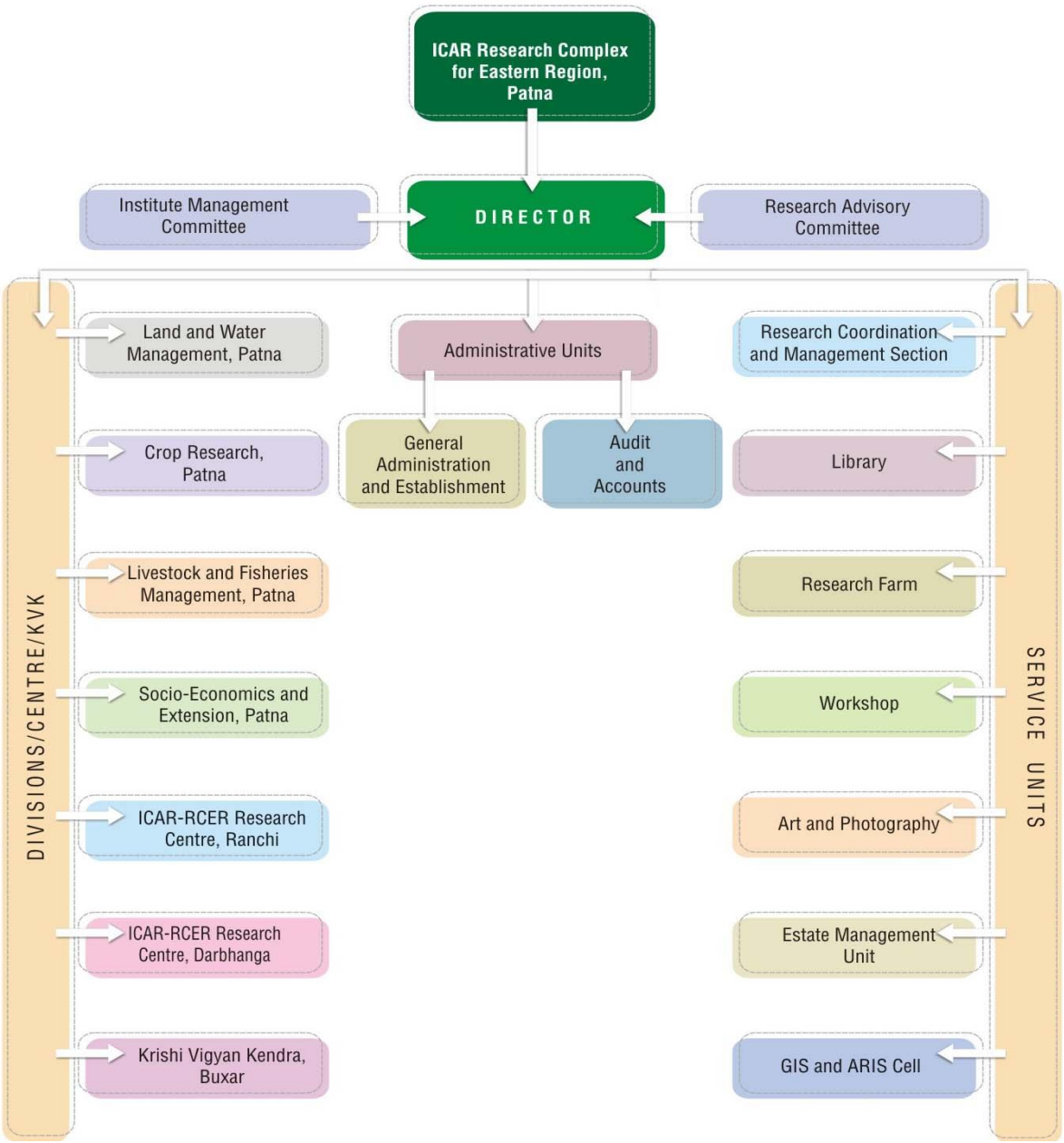
Animal Health

- Leptospirosis detected in the bovine population at 9.1% level implies that this re-emerging disease can have impact on public health. *Leptospira hardjo* is the main cause of human leptospirosis and it needs to be addressed to avoid public health consequences.
- Initial investigation using ELISA revealed a prevalence of 29% Blue Tongue antibodies in goat population. The over-all prevalence rate of PPR was 36.65% in Bihar indicating that there is emerging need for vaccination in small ruminant population.

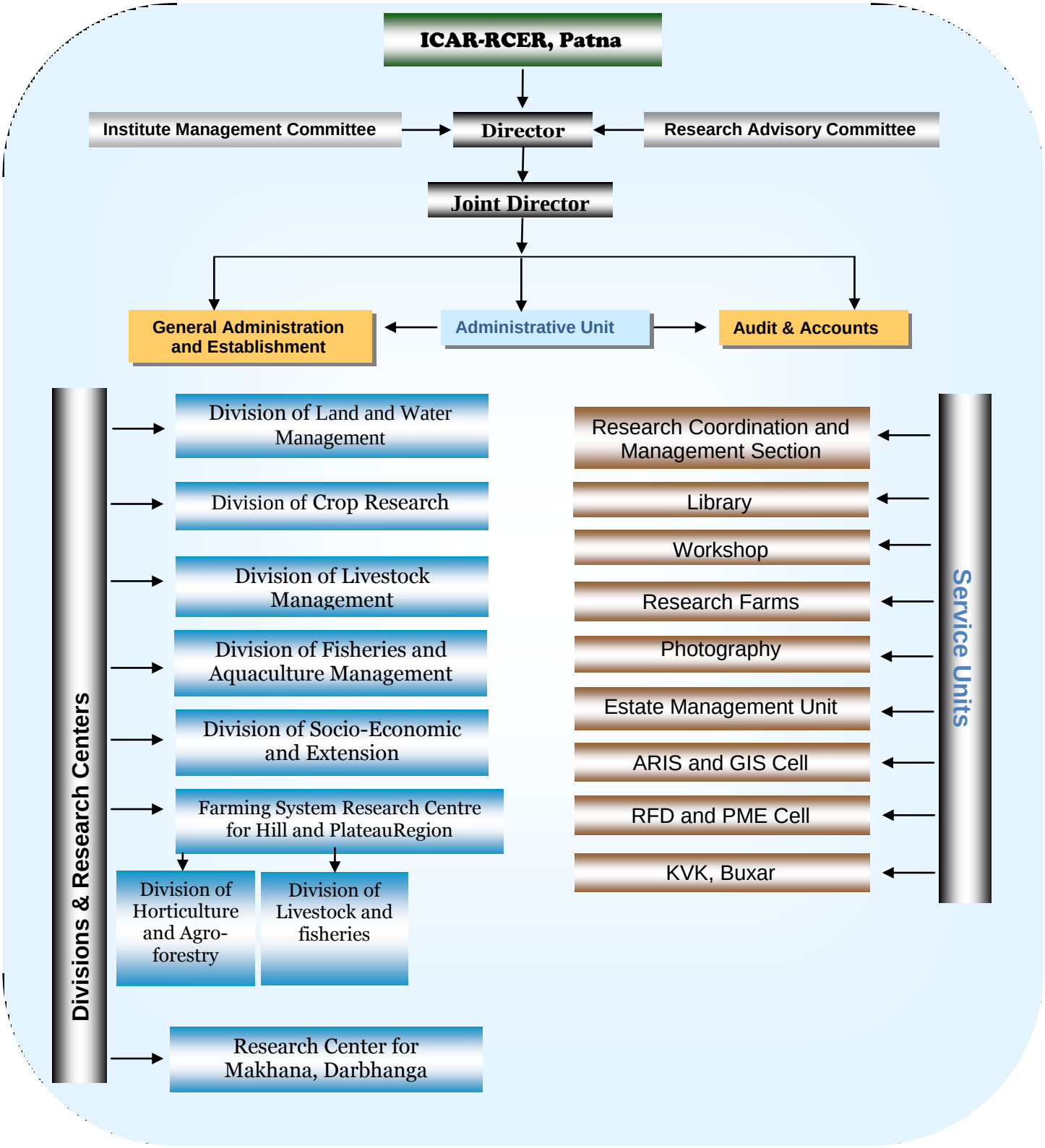
CHAPTER-4

ORGANISATIONAL STRUCTURE, IMC, RAC, HUMAN, PHYSICAL AND FINANCIAL RESOURCES MANAGEMENT

EXISTING ORGANIZATIONAL STRUCTURE- ICAR-RCER, PATNA



RECOMMENDED ORGANIZATIONAL STRUCTURE- ICAR-RCER, PATNA



Human Resources

The staff strength of the ICAR-RCER during the XI Plan is given in Table 1

Table 1. Staff Position of ICAR-RCER including Research Centre and KVK, as on March 2012

Sl. No.	Category	ICAR-RCER, Patna			Krishi Vigyan Kendra, Buxar		
		Sanctioned	In-position	Vacant	Sanctioned	In-position	Vacant
1.	Scientific	90	57	33	1	1	0
2.	Technical	61	60	1	11	11	0
3.	Administrative	35	31	4	2	0	2
4.	Supporting	172	105	67	2	2	0
	Total	358	253	105	16	14	2

The QRT observed that large number of positions remained vacant in the scientific, technical and administrative cadres at the complex. Manpower inadequacy at all levels became major bottleneck for effective and efficient implementation of research and development programmes, besides projects.

The manpower inadequacy at the ICAR-RCER as per norms of ICAR is presented in Table 2

Table 2. Manpower inadequacy at ICAR-RCER

Grade	Sanctioned	In position	As per norms of ICAR	Difference
Scientific	90	57	90	---
Technical	61	60	135	75
Administrative	35	31	68	33

As per norm of the ICAR, 55.55 per cent and 22.44 per cent posts have not been sanctioned by the ICAR in technical and administrative grades, respectively. Besides, 29.7 per cent post in the scientific grade is yet lying vacant. These factors have badly affected the progress of the institute and execution of the important projects, besides over all development of eastern region.

Physical Resources

Physical resources of the institute are depicted in Table 3

Table 3. Physical resources of ICAR-RCER including Research Centre and KVK

Sl. No.	Particulars	ICAR-RCER, Patna	Research Centre, Ranchi	Research Centre on Makhana, Darbhanga	KVK, Buxar
1.	Land (ha)	47.0	218.8	10.0	10.0
2.	Administrative building	1	1	1	Hired building
3.	Workshop	1	-	-	-
4.	Laboratories	10	5	2	-
5.	Seminar and conference hall	4	2	1	-
6.	Godown near thrashing floor	1	-	-	-
7.	Heifer & Dry cow shed	1	-	-	-
8.	Poultry shed	1	-	-	-
9.	Feed mill and feed and fodder store room	1	-	-	-
10.	Bi-cycle stand at Sabajpura farm	1	-	-	-
11.	Vehicle parking shed	1	-	-	-
12.	Goat shed	1	-	-	-
13.	Small livestock shed	1	-	-	-
14.	Sale counter	1	-	-	-
15.	Poultry Hatchery shed	1	-	-	-
16.	ARIS Cell	1	1	-	-
17.	Library	1	1	-	-
18.	Vehicles: • Four wheeler small vehicle • Bus • Motorcycle	 3 1 2	 1 2 4	 1 - -	 1 - -
19.	Implements: • Tractor • Power tiller • Thrasher	 3 3 3	 4 3 -	 1 - -	 1 - -
20.	Irrigation facilities: • Tube well • Pump set • Reservoir/pond	 9 4 7	 3 10 4	 1 1 4	 1 - -

Financial Resources

Apart from the Plan budget, the institute was able to receive the fund under various externally funded schemes to the tune of Rs. 654.93 lakhs during the period under report. The institute was also able to generate its resource fund worth for Rs. 267.14 lakhs. The financial resources have also been mobilized from external funding agencies through consultancy and adhoc research grants from the agencies namely MoWR, INCID, CBIP, DST, NHM etc.

Management Practices

The Head-wise expenditure at ICAR-RCER during X and XI Plan and statement of expenditure during the period under this QRT is presented in Table 4

Table 4. The head wise expenditure at ICAR-RCER, Patna

Heads	2006-07 (Rs. in lakhs)		2007-08 (Rs. in lakhs)		2008-09 (Rs. in lakhs)		2009-10 (Rs. in lakhs)		2010-11 (Rs. in lakhs)		2011-12 (Rs. in lakhs)	
	Plan	Non Plan	Plan	Non Plan	Plan	Non Plan	Plan	Non Plan	Plan	Non Plan	Plan	Non Plan
Estt. Charges	6.13	449.13	9.78	489.51	0.00	805.32	0.00	1160.59	0.00	1059.10	0.00	1209.72
TA	4.35	6.00	7.99	6.50	8.00	6.00	7.97	3.77	15.00	5.00	16.04	7.00
HRD	1.98	0.00	3.00	0.00	1.44	0.00	2.09	0.00	3.90	0.00	6.50	0.00
Contingencies	38.32	102.21	128.26	83.38	124.11	110.65	125.03	96.07	120.02	169.18	162.58	344.99
Sub Total	***50.78***	***557.34***	***149.03***	***579.39***	***133.55***	***921.97***	***135.09***	***1260.43***	***138.92***	***1233.28***	***185.12***	***1561.71***
Equipments	47.55	3.87	36.12	1.21	43.41	1.13	64.06	0.00	104.71	2.03	115.44	23.44
Works	214.99	18.99	170.50	14.76	172.49	11.26	280.02	2.15	250.54	34.95	259.89	100.25
Furniture	4.32	4.51	0.17	0.97	24.41	0.25	25.16	0.00	61.10	0.00	0.00	15.03
Vehicles	1.95	0.00	0.00	0.00	0.36	15.95	0.47	0.00	0.55	0.00	0.00	0.00
Livestock	0.00	0.00	2.49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.65	0.00
Library	4.89	0.05	19.82	0.00	23.25	0.00	20.00	0.00	25.03	0.00	21.89	19.94
Sub Total	***273.70***	***27.42***	***229.10***	***16.94***	***263.92***	***28.59***	***389.71***	***2.15***	***441.93***	***36.98***	***399.87***	***158.66***
G. Total	**324.48**	**584.76**	**378.13**	**596.33**	**397.47**	**950.56**	**524.80**	**1262.58**	**580.85**	**1270.26**	**584.99**	**1720.37**
BE	***334.27***	***585.00***	***379.15***	***599.20***	***400.00***	***956.00***	***550.00***	***1263.82***	***583.00***	***1271.00***	***585.00***	***1720.52***
%Expenditure	***97.07***	***99.96***	***99.73***	***99.52***	***99.37***	***99.43***	***95.42***	***99.90***	***99.63***	***99.94***	***100.00***	***99.99***

The complex was able to utilize 98.54 per cent of its Plan and 99.79 per cent of Non Plan Budget during the period under report. Since the Complex is ten years of old and its budget requirements are higher, the QRT **recommends** that the budget allocation for the Complex for the XIIth Plan period may be enhanced at least by 5 folds higher over the budget allocated during the XIth Plan, so that its infrastructural and laboratories facilities are adequately developed and furnished to provide desired working space for productive and efficient use of resources and mobility of the scientific, technical and project staff in eastern states to bridge the persisting productivity gaps between existing and available potential unexploited opportunities for contributing to the national growth.

Institute Management Committee (IMC)

During the year 2006-11, only nine IMC meetings were held. In fact in the series of the IMCs' meetings it was 7th meeting held on Nov 28, 2006 as the first meeting for the period of review and the last meeting was held on July 22, 2010. In the year 2007, IMC did not meet. QRT felt that some more and regular periodical meetings of the IMC required so that some of the important management issues which requires immediate attention of the IMC may be addressed in time. In most of the IMC meetings, the matters pertaining to the audit objections were discussed and their settlements got done, sanction for purchases of different items including instruments was accorded. However, before such sanction was given, the status of already purchased and available instruments / implements and their functioning statues should

have also been examined and recorded in the proceedings. The IMC has played important role to expedite the recruitment process of the staff under ADP and also KVK, Buxur, which was appreciated by QRT. During the year 2011, three IMC meetings were held i.e. **on 16/03/2011**, **16/08/2011** & **13/12/2011**. During these three IMC meetings, **prioritization** was given for **substitution of equipments/works** of **XIth Plan EFC** with new equipments/works. The matter pertaining to the **outstanding advances** were also discussed and their settlements got done. The institute utilized 100 per cent Plan Budget during 2011-12. Apart from this, disposal of **unserviceable items** lying at ICAR-RCER, Patna as well as its regional centres, **C/o Chain Link Fencing** with parapet wall of residential area at ICAR-RCER, Research Centre, Ranchi, **C/o of Residential quarters** at ICAR-RCER, Research Centre for Makhana, Darbhanga, **Digging of ponds** at Darbhanga Centre, **C/o Farmers' Hostel** at Ranchi Centre, Boundary wall fencing at Ranchi Centre, **Renovation of Sabajpura farm.** Approval for **Expenditure sanction** of **revised PE** for **C/o RCC Over Head Tank** at Ranchi Centre, Empanelment of Hospitals were also discussed and recommended by the IMC.

Institute Research Committee (IRC)

During the period 2006-11 under review, 10 IRC were conducted by the Institute. Based on the mandate of the institute and recommendations of Research Advisory Committee (RAC), scientists were advised to formulate their research projects. Accordingly, all the scientists of different divisions formulated their projects considering its practical utility, viability and strategic relevance. Most of the projects were formulated involving multi-disciplinary scientists for providing holistic solution to emerging problems with regards to food security and also for cost effective as well as efficient utilization of natural resources. Prior to presentation of the projects in main/mini IRCs for final approval of chairman IRC, these projects were discussed at length in the divisional IRC and also obtained comments across their divisions. As such, all the projects presented by the scientists were not approved, some of the scientists were advised to recast their projects and present in next IRC after proper modifications and incorporation of the comments made by the chairman. Based on the presentations by the Heads of Divisions and PIs of the projects, necessary actions were suggested. The QRT highlighted that while projects required to be extended in second or third years and so on, the progress and brief achievements need to be highlighted alongwith the cost and other details in the support for granting extension, if required. A definite periodical target should be fixed for review the achievements of the research and extension projects and should be made available to RAC for further consideration.

The LEWA tested at Darbhanga, IIVR Varanasi, ICAR Research Center Ranchi, and NAIP at Vaishali, Bihar required to be highlighted by giving brief comprehensive write up. Similarly, other research projects required to be undertaken looking the felt need on the priority for area need based projects. Division of socio-economic and extension required to formulate some projects on comprehensive cost of cultivation of various enterprises and also some Operational Research Projects (ORP).

Research Advisory Committee (RAC)

The 1st meeting of the RAC was held on June 19-20, 2006 followed by 2nd meeting on October 22-23, 2007 and 3rd meeting on October 13-14, 2009. No RAC meeting was conducted in 3rd and 5th years (during 2008 and 2010).

During these meetings, many important decisions and recommendations for several research projects submitted by the different divisions and its centers were made and implemented successfully. A few projects like; pertaining to integrated farming research through institute project on multiple use water for management of waterlogged areas, Water harvesting structures in water shed, Projects for assessments of soil quality in different agro-ecosystem for entire eastern region, Research towards livelihood improvement of the tribal community through resource based farming system models including social and institutional aspects and marketing linkages, Fields testing of projects for improving the performance of technology, Multitier planting high density system approach under NHM, Adaption of high density planting in mango involving NGOs, Some of the released varieties' trails Under NHM, Trails of the crop varieties under Farmers' field conditions, Integrated farming system research project having livestock and fisheries components, Revolving funded schemes for generation of quality seeds and planting materials, Standardization of package and practices for cultivation of makhana, identification of various edaphic and abiotic factors for successful makhana crop under different farming system models on large scale under field conditions, Survey and generation of data from prevailing farming systems / models, recommendations forwarded to ICAR for filling of 45 sanctioned posts, establishment of five new laboratories with modern equipments, Devolvement of infrastructure facilities for four fish ponds, Goat shed, farm produce storage shed, administrative–cum-Lab building and the research farm at its Makhana Centre Darbhanga etc were discussed and recommended for implementation.

During the year 2011, VIII RAC meeting on 17 February and IX RAC meeting on 12 December were conducted. The highlights of the recommendation were: Post-harvest management and value addition of fruits considering traditional system prevalent in the area need to be studied. Agro-forestry programme should be given emphasis. Water management including ground water for better agriculture production needs more studies. Diversification in freshwater aquaculture farming needs to be attempted. Emphasis should be for landless and marginal farmers while formulating research projects and at the same time research/technology and management of global level be also kept in view for progressive and rich farmers.

Critical Observations & Recommendations of QRT

- During the visits of different divisions of the institute and its centers, KVK, fields it was observed by the QRT that many of the purchased instruments in the past were not in use and lying in the corner of the different offices and workshops. It will be better if before giving the sanction for new purchases, the critical review of the old purchased equipments, machineries and other related items may be done. Specific recommendations of the Director of the institute may also be considered.

- Both IMC and RAC have done good jobs in finalizing and recommending for implementation of various activities including research projects, extension activities, transfer of technology, administrative and financial sanction, audit objections settlements, process of write off, purchases of instruments / implements, recruitments etc. In case of the write off losses for more than one lakh purchased items, some plausible reasons should have been recorded in the proceedings.

- The decision of IMC for replacement & purchase of new vehicles and purchase of tractor for Research Centers Ranchi were taken at appropriate time which was indeed required for smooth functioning.

- No doubt the construction work of buildings including guest house is under progress but with a very slow speed, it should have been completed by now, looking the pressure of various activities to be undertaken under changing scenario of agriculture development. IMC may play an important role and take necessary action for expediting the completion of the work on priority.

- The IMC and RAC meetings should be regularly held and at list two or three meetings at appropriate intervals in a year would be ideal. It is suggested that some of the meetings may be held at some of the institute's centers including KVK to review the progress of the activities as per recommendations given by IMC and RAC in the previous meetings, beside, have feedback of different activities on the spot.

- Recommendations on issues like delegation and decentralized administrative and financial powers, besides, for giving the responsibilities of coordination at different divisions/centers/units regarding technical, various activities related for research, extension, financial, administrative, management of said units, a departmental committees for each unit needs to be constituted by the Director and should be approved by the IMC/RAC. All the proposals from such units should come out from the coordinator of the said committees. Coordinators be appointed by the Director for the division and center. Needles to mention, decentralization of power is the best technique of management and for effective and smooth functioning of any unit.

- ICAR has laid down certain norms for allocation of funds to different projects and equipments, chemicals and consumable and non-consumable items which should be strictly followed and put up before the above mentioned esteemed IMC and RAC.

CHAPTER-5

SIGNIFICANT ACHIEVEMENTS OF ICAR-RCER DURING LAST SIX YEARS (1st January, 2006-31st March, 2012)

The ICAR Research Complex for Eastern Region is only ten years old institute. Ever since its establishment, despite constraints on facilities and scientific manpower, it has made significant achievements in the areas of natural resource management, crop improvement, horticulture & agro-forestry and socio-economic & extension. A modest beginning has been made in research and some of the salient research achievements of different divisions and its research centre for the period 01.01.2006-31.03.2012 are as under:

I. DIVISION OF LAND AND WATER MANAGEMENT (DLWM), PATNA

Soils, land capability, classes and various land forms in eastern region

- Thematic maps of soil and land capability classification of the eastern region were developed in a GIS environment and Google maps were processed to identify different landforms of flood plains like *tal, chaur, maun* and *diaras* of Bihar.
- Characterization of different land uses in old alluvium of agro-ecological region no. 9 of south Bihar was conducted on the basis of different indices of soil quality. Mango orchard was the best land use with high score of relative soil quality index value of 81, followed by rice-wheat-fallow (72), agro-forestry (68) and sugarcane (63). Two lands use namely maize-potato-fallow and red gram with relative soil quality index value of 59 and 53, respectively, were categorized under moderate category of soil quality.

Effect of tillage and water management practices on soil & crop under rice-wheat system of south Bihar

- Effect of Deep Summer Ploughing (DSP) and effective utilization of irrigation was assessed and the benefit of DSP every three year for higher yield and improving the soil health was documented.

Comparative performance of system rice-intensification under different plant geometry and water regimes with conventional rice management

- Studies on system of Rice Intensification (SRI) technique in rice indicate that maximum grain and straw yields (7.4 and 9.65 t/ha) were obtained when paddy was transplanted at 25 x 25 cm spacing and 6 cm irrigation was applied 3 days after disappearance of ponded water.

Alternative Land Use System (Agri – Silvi Postural) for rainfed in Bihar

- Subabul when intercropped with guinea grass+ cowpea/field pea/cowpea during Kharif, rabi and summer, respectively, yielded maximum with a fodder and fuel wood yield of 44 and 4.8 t/ha/yr, respectively and 2 t/ha of pod yield of green field pea for human consumption.

Strategies for enhancing land and water productivity through multiple uses of water

- Integrating fish in rice-wheat system gave net income of Rs. 29,694/ha, compared to net monetary returns of rice-wheat system (Rs. 27,965/ha/yr). Under seasonally waterlogged areas of 1m depth, a system of fish trenches-cum-raised beds based horticulture + fish system generated a net income of Rs. 80,951/ha/yr.

Low cost pressurized irrigation system

- The modified LEWA device has been tested and compared with a single nozzle sprinkler in the field on rice and wheat for water and energy saving. There is saving of over 50 per cent of water and over 60 per cent of energy (diesel) in case of rice, while incase of wheat, the water saving was 15 per cent against sprinkler, 50 per cent against surface methods of irrigation. Further, about 50 per cent of energy saved against sprinkler as well as surface method of irrigation.
- Irrigation nozzle has been developed which works satisfactorily over the operating pressure range of 0.6 to 1.0 kg/cm^2 with throw diameter range of 9.2-11.2 m, discharge rate of 1.8-2.6 m^3 /h, and application rate of 2.6 to 2.7 cm/h, respectively.

Development of Decision Support System for design and layout of pressurized irrigation system for different crops

- A Graphic User Interface Decision Support System in Visual Basic was developed for design and layout of Pressurized Irrigation System to facilitate techno-economic decisions.

Development of farmers friendly Decision Support Tools, for crop planning and optimizing crop yield

- A Decision support tool was developed in Hindi and English employing Visual Basic platform for helping farmers in decision making about selection of crop and crop sequences considering three important indicates i.e. Benefit-cost ratio, land productivity and water productivity.

Survey and surveillance of insect pest of rice and wheat cropping system of Patna district of Bihar

- Keeping in view the climate change scenario, two new Coleopteran beetles, *Haplochrus fasciatus* Fabricius (family: Melyridae) and *Gonocephalum* sp (family: Tenebrionidae) were identified in rice-wheat ecosystem. *Hapalochrus fasciatus* was not reported earlier in rice crop. Former beetle is known as vegetable beetle, it feeds paddy crop at very early vegetative stage.

Evaluation of IPM practices for hopper pest of rice crop

- IPM practices were found environmentally safer, economically viable and effective technique to manage hopper pests. The brown plant hopper (*Nilaparvata lugens)* and white backed plant hopper (*Sogatella furcifera*) did not appear during crop season in experimental plots. However, the incidence of green leaf hopper (*Nephotettix virescens*) was recorded at milking stage of the crop and ranged from 0.2-0.4 hopper/ hill and 2-3 hopper sweep in sweep net.

Characterization and classification of ground water quality of some parts of Maner Block of Patna district in Bihar

- Arsenic content increased from 1.65 to 2.20 ppm with the depth of the soil and accumulated from 2.0 to 5.0 ppm in vegetable and cereal crops. Spatial thematic maps were also developed for arsenic and iron distribution for this area.

Development of diversified cropping system for irrigated ecosystem in Bihar

Out of ten diversified cropping systems taken during experimentation for a period of four consecutive years, it has been observed that five cropping system viz. rice-tomato-bottle gourd followed by rice-coriander-ladies finger, rice-mustard-tomato, rice-carrot-cowpea and rice-potato-onion were more remunerative.

Development of vegetable based integrated farming system for marginal farmers of irrigated upland

- Under vegetable based integrated farming system for marginal farmers of irrigated upland, cultivation of rice-potato-greengram as food crop and bittergourd-tomato-bottle gourd as vegetable crop in integrated manner with goatry and recycling of vermicompost resulted into a net monetary return of Rs. 75,520 per acre.

Nutrient management in rice lentil cropping system

Nutrient management in rice- lentil cropping system showed maximum lentil seed yield of 9.64 q/ha with the application of 40 kg sulphur. Similarly, in case of rice, zinc application @ 6 kg resulted into 0.60 q/ha increase in yield.

Scaling up of water productivity in agriculture for livelihood through teaching cum demonstration

In vegetable-based-cropping system, crop yield of 5.0, 10.0 and 8.0 t/ha was recorded in okra, cauliflower and chillies, respectively, with drip irrigation which was higher by 40, 32 and 28 per cent over the surface irrigation. Water use efficiency was recorded to be 32, 22 and 27 kg/ha/mm, while water productivity under the drip irrigation system was recorded to be Rs. 16, 22 and 108/m^3 in okra, cauliflower and chillies, respectively.

Impact assessment of climate change on water resources and their productivity

- Climate change impact assessment on water resources availability in the Brahmani River Basin and Bhavani River basin under different climate change scenarios has been studied. Crop modelling study suggests decline in yield of *Kharif* maize and wheat in Bihar. *Rabi* sown maize, however, showed increasing trend in yield during different future time periods.

Critical observations by QRT on the above mentioned achievements

- The land capability classified thematic maps generated using GIS are important components for development of *tal*, *chaur*, *maun* and *diara* lands.
- Diversified cropping system experiments have enhanced the employment and regular income to the farmers besides increasing the nutrient status of soil. Developed decision support tool should be tested to the diversified cropping system experiments for its B-C ratio and land and water productivity.
- Techno-economic Design and layout of Pressurized Irrigation System can be done using the developed Graphic User Interface Decision Support System in Visual Basic. The software should be commercialized and made available to the users for implementation of pressurized irrigation system.
- The IHACRES model has been calibrated for different sub-basins of Brahmani river basin and watersheds of DVC Hazaribagh for development of regionalized parameters for watershed development plan. The model parameters should be tested and validated in other watersheds of Eastern region.
- Systematic and long term research plan be made for climate change impact assessment on water resources availability, vulnerability assessment, developing and strengthening adaptation measures, analysis of mitigation options, developing site-specific packages of technologies for adapting to current climatic risks and enhancing capacity in climate resilience research**.**

Recommendations of QRT

- Efforts should be made to make the inventory of all the natural resources (land, water and vegetation) of eastern region including its management.
- Development of plan for management of problematic degraded lands and water logged areas is essentially required.
- Preparation of data base for block wise aquifer characteristics and ground water potential in all the states of eastern region is needed.
- Development of ground water models and its field evaluation.
- Arsenic contamination is a big issue in Bihar and West Bengal. Research attempts made on quantifying arsenic accumulation in cultivated crops and in different soil depth is of significant importance. More significant research approach should be made for mitigation programme (using reverse osmosis, nano membrane technology etc.).
- Design and development of fertigation systems and automation of micro irrigation be tested and evaluated.
- Performance evaluation and improvement of canal systems be continued.
- Design of excess water removal through bio drainage, surface and sub surface drainage systems be developed in participatory mode.
- Participatory irrigation management, considering socio-economic, livelihood, employment generation, sustainability and environmental concern, programme be implemented with the help of state Govt. functionaries.

II. DIVISION OF CROP RESEARCH (DCR), PATNA

Long term tillage experiments in rice-wheat cropping system

- In rice, deep summer ploughing (DSP) once in 3 years was found most productive with significantly higher yield over non - DSP. Whereas, in wheat, all DSP treatments have been found significantly superior over non DSP.
- Zero Tillage (ZT) in wheat performed significantly superior over conventional tillage. In tillage combination of puddled transplanted rice in kharif and ZT wheat in rabi, DSP once in 3 year has been found best to restore soil health and consistent higher yield**.**
- Adaptive trial was taken to assess the suitability of molecules for weed control under Zero Till Direct Seeded Rice (ZTDSR) and it was observed that *Bispyriback sodium* was most effective molecule to control the weeds after 25-30 days under ZTDSR.

Crop and resource management practices for sustainable future cereal based system (CSISA-2)

- Under CSISA platform research, four Scenarios of cropping with different CA practices have been evaluated. Rice – wheat - cow pea has been found more productive and remunerative under zero till and residue retention practices.

Development of location specific integrated farming system modules for small and marginal farmers of Bihar

- Two IFS models (One acre for irrigated uplands and 2 acre for irrigated lowland and upland situations) have been developed for small and marginal farmers of eastern region. One acre IFS model resulted in a net profit of Rs. 1,35,418/yr, with integration of enterprises such as crop, horticulture, goat, poultry, mushroom and vermicompost. This system also produced and recycled 1.5 tonnes of vermicompost and 3.2 tonnes of goat manure/yr.
- Similarly, 2 acre IFS model, resulted in a net profit of Rs. 1,80,805/yr with integration of enterprises such as crop, horticulture, cattle (3), fishery, duckery and vermicompost. The model also produced 2.2 tonnes vermicompost and 22 tonnes FYM/yr.
- These models have resulted into 2.5 times increase in the income over the conventional method of farming. This technology has been accepted by Govt. of Bihar and being operated in 534 blocks of Bihar. Govt. of Bihar is providing subsidy of Rs. 10,000/- to each farmer for adoption of at least one enterprise with crop.

Evaluation of high yielding crop varieties

- One hundred and eighty entries of rice have been evaluated for aerobic condition and 10 entries showed the better performance with higher productivity (2.4 – 4.3 t/ha) in alluvial plains.
- One hundred and twenty advance breeding lines of rice have been evaluated for drought and sub-mergence tolerance. Ten lines (IR 55419-04, APO, IR 77298-14-1-2-10, IR82870-11, IR 83387-B-B-40-1, IR 83895-B-127-CRA-22-1-1, IR83895-B-127-CRA-4-1-1, IR 83895-B-127-CRA 4-1-1, Abhishek & Lalat), however, exhibited better tolerance to drought. In case of sub-mergence stress, Swarna Sub-1 performed better compared to other varieties.
- In case of wheat, Raj 4201 and Raj 4205 exhibited promising characteristics for heat tolerance compared to Ko 807 and Ko 808.
- In case of pigeon pea, 38 entries were evaluated. Based on the grain yield, BSMR-736 (3.72 t/ha), followed by ICPL-87 (3.65 t/ha) and Manak (3.62 t/ha) have been found most suitable for cultivation in irrigated ecosystem.

Performance of transplanted maize under varying age of seedlings and method nursery raising

- During winter season, low yield of maize is common phenomenon in eastern India due to late sowing of maize as harvesting of rice is delayed (November- December). Timely raising of maize nursery (5 weeks old seedlings) with sand culture in raised bed and transplanting in main field however, resulted in higher yield without any loss. It has also curtailed the crop period by 20-25 days with saving of one irrigation.

Survey and surveillance of insect pest of rice and wheat cropping system of Patna district of Bihar

- In Patna district, low insect populations build up was observed due to high ambient temperature and low humidity that inhibited the breeding of the hoppers in 2009 and 2010. However, in 2008 density of green leaf hopper population was recorded @ 1.7 hopper/ hill in milking stage. Brown plant hopper population was recorded to the tune of 2.5 and 4.6/ hill at flowering and milky stage. Heavy infestation of ear cutting caterpillar

(*Mythimna separata*) was observed at ICAR farm and Sabjpura farm to the tune of 40-60 per cent in 2008 and 2010. Gujhia weevil (*Tanymecus indicus*) was noticed at nursery stage in 2009 and 2010. Termite (*Odontotermes* sp) infestation was observed in BPT-5204 in 2009 and 2010.

Evaluation of IPM practices for hopper insect pests of rice crop

- IPM practices for hopper insect pests of rice crop under local conditions were evaluated and it was observed that two consecutive sprays of Neem oil and Beauveria within 15 days of interval suppressed the population of green leaf hopper and brown plant hopper at below injury level**.** Single spray with Imidacloprid insecticide also checked the hopper population effectively**.**

Eco-biology and rodent fauna of rice-wheat cropping system in gangetic plains of Bihar

- Six rodent species – lesser bandicoot (*Bandicota bengalensis),* field mouse (*Mus booduga*), soft furred field rat (*Millardia meltada pallidior*), house rat (*Rattus rattus*), five striped squirrel (*Funambulus pennant)* and white bellied rat (*Rattus niviventer*) were collected from different cropping systems. It was recorded that Bandicoot rat was predominant species (67.5 per cent), followed by *M. booduga* (23.5 per cent) and *M. meltada* (9.0 per cent).
- The Bandicoot rat caused higher damage (14.73 per cent) at maturity stage and moderate (3.86 per cent) at vegetative stage in paddy crop. In wheat, maximum tiller damage was recorded at milking and dough stage (16.69 per cent) followed by maturity (15.0 per cent) and vegetative stage (11.0 per cent). The efficacy of aluminium phosphide was higher (87.7 per cent mortality rate) followed by zinc phosphide (42.8 per cent) and Bromadiolone (7.14 per cent) against *B. bengalensis.*

Modelling the performance of few major cropping systems in eastern region in the light of projected climate change

- Under OTC experiment, 25 per cent increased level of Co_2 has resulted increase in duration of rice and wheat and higher yield by 15 per cent to 18 per cent. Increased temperature by 1^0C has reduced the yield as compared to normal condition. MTU 7029 produced higher yield with 25 per cent increase of CO_2. Least variability of yield has been noticed for Rajendra Bhagavati and MTU 7029 under different OTC treatments and open field conditions. Swarna sub1 and MTU 7029 took more total duration under control OTC and Rajashree and Rajendra Bhagavati took more duration under 25 per cent increase of CO_2 and 1^oC higher temperature conditions. Different varieties of wheat matured 3 days earlier in OTCs when compared to open field.

Promoting sustainable livelihood development (Rojiroti)

- A project funded by the Research into Use Programme, a major initiative of DFID was operative in 11 districts of three states viz- Bihar, M.P. and eastern U.P. To implement the project, four thousand five hundred sixty two (4562) SHGs were formed, covering 2300 villages and 50,880 beneficiaries. The project was having major coverage area in Bihar, particularly in Patna, Nalanda and Nawada districts. More than 95 per cent of Rojiroti SHG members were women belonging to BPL group (76 per cent).
- The institute tested KSKs (Kisan Soochana Kendra) as alternate sustainable institutional arrangement for quality information and input delivery through KSKs and its networking units Village Suchana Kendra. KSK's are situated in peri-urban areas. KSK's are source for accessing information by end-user through VSK's and also an outlet for quality agricultural inputs etc. Information to KSK's will be made available by National/State/ district/block level information hubs.

Critical observations by QRT on the above mentioned achievements

- Experiment with deep summer ploughing once in 3 years was found most productive. However, crop specific tillage practices are to be developed.
- Zero tillage in wheat cultivation may be advocated for late sown areas, however, deep ploughing with rotavetor should be advocated once in 3 years to break the hard pan develops in the systems otherwise.
- Green manuring should be promoted for the benefit of the farmers in order to maintain the soil health.
- During field visit, it was observed that crop demonstration trial in farmers' field was not impressive. Frequent monitoring and follow-up by the scientists of the institute would yield better impact. Otherwise percolation of technology to the end user does not become effective.
- During field visit, it was noted that lot of water bodies were available which can be roped in for demonstration of Integrated Farming System models.
- In many parts of the Bihar, medicinal and aromatic plants have potential to earn better income even in water stress condition. The institute should explore the possibilities to integrate the cultivation of medicinal and aromatic plants in farming systems.
- Cost economics of all the technologies need to be calculated before taking them to the farmers' field.

Recommendations of QRT

- The institute should identify the problems of any area and address those problems involving scientists from different disciplines. In other words, problem based approach would be more relevant than division based approach.
- It was observed that there is no horticulture scientist at present at ICAR-RCER Headquarters. Posting of horticulture scientist is essentially required, keeping in view the farming practices of marginal and sub-marginal farmers. The QRT team made several visits to the different farmers' field and it was felt that extension activities of the technology developed by the institutes needs to be strengthened sincerely.
- Rice being a major crop under cultivation in the region, more in depth studies are required for selection of suitable HYVs of rice to be grown under drought stress conditions.
- The linkage between research scientists and farming community needs to be strengthened through formation of Mitra Kisan group and frequent trainings to the farmers on different aspects of crop production technologies.
- The experimental findings pertaining to control of insects should be extended to the farming community.

III. DIVISION OF LIVESTOCK AND FISHERIES MANAGEMENT (DLFM), PATNA

I. Livestock

Assessment of livestock water productivity

- Assessment of livestock water productivity was conducted in Indo-Gangetic Plains at 3 sites covering WB, UP and Haryana. Milk water productivity for crossbred cows varied from 0.81 litre per M^3 in Hisar and Etawah (intensified system) and 0.34 litres per M^3 in Bankura (semi-intensified system). In case of buffalo, the milk water productivity ranged from 0.72 litres per M^3 in intensified system to 0.33 litres in semi-intensified system, respectively. For indigenous cows, the milk water productivity showed highest value (0.76 lites per M^3) in intensified system. Lowest value (0.19 litre per M^3) was however estimated in semi-intensified system.

Formulation of poultry broiler and goat feed using makhana by-products

- Makhana bran is a waste material and about 1700 tons/yr. is available in Makhana processing industry. Makhana bran contains 7.10 per cent protein. It may be included up to 6 per cent in broiler diet. Evaluation of acceptability of Makhana bran as goat and cattle feed revealed that it can be used in the concentrate mixture of goat and cattle up to 40 per cent replacing rice bran without affecting growth, feed intake and nutrient digestibility.

Development of fodder production strategies for rainfed and irrigated conditions of Bihar

- Under round the year fodder production project, in rainfed system, average green and dry biomass yield varied from 16-27 and 6-9 tonnes/ha, respectively for different combinations of perennial and annual fodder. In irrigated system, average green and dry biomass yield varied from 27-34 and 9-11 tonnes/ha, respectively for different combinations of perennial and annual fodder. The technology has been disseminated to farmers during training programme.

Development and evaluation of economic ration based on locally available feed resources

- A chemical composition of feeds and fodder resources in Bihar has been analyzed. Four types of homemade concentrates have been prepared for dairy cows. Homemade concentrate can increase 30 per cent milk yield and save 20 per cent feed cost over traditional method. The technology has been communicated to the Livestock Research Station, Govt. of Bihar.

Study of Peste des Petits Ruminants (PPR) and Blue Tongue (BT) in goat and sheep in Bihar

- Out of 55 sera samples collected from outbreak areas, 46 (83.63 per cent) were found positive whereas 79 samples out of 286 randomly collected samples were found positive (27.62 per cent). Morbidity in various flocks was from 65-100 per cent while mortality ranged from 55 to 71 per cent. The overall prevalence of PPR was found to be 36.65 per cent. The results have been communicated to the Govt. of Bihar and State Goat Farm, Purnea.

Studies on reproductive diseases in cattle under field conditions in Bihar

- Analysis of 500 serum samples collected from cows and buffaloes from Begusarai, Patna, Khagaria, Arwal, Darbhanga, Jamui and Saharsa districts showed 6.1, 12.2, 6.44 and 9.11 per cent samples positive for IBR, Brucellosis, BVD and Leptospirosis, respectively. The results have been communicated to Govt. of Bihar.

Genetic improvement of goat

- The performance of kids born from selective breeding of Black Bengal breed of goats was evaluated in terms of height at withers, body length, girth and body weight. The body weight at the age of 3 months in the base and selected populations were 5.6 ± 0.28 and 6.4 ± 0.32 kg, respectively.

II. Fisheries

Integrated Fish Farming

- Four different multiple water use systems namely i) Duck – fish farming, ii) Rice/ Wheat -fish farming, iii) Fish culture in service reservoir and iv) Fish culture in trenches were developed. The fish yield of 1.97 t/ha was obtained in trenches by stocking fries @ 15000/ha. In service reservoir, composite fish culture along with duck farming yielded 5 - 6 t/ha of fishes. Stocking of Khaki Campbell duck was done @ 300 /ha of water area. A total of 43 thousand eggs were obtained per ha of water area per year in addition to 24 thousand kg fresh duck droppings as manure to the pond. Rearing of duck reduced the feed and manure cost by 25 per cent while foraging in pond reduced the feed cost of duck by 20 per cent.
- The fish-duck farming technology was disseminated in 10 villages among 50 farmers.
- Integrated aquaculture is suitable for agro-climatic conditions of South Bihar and experiment on Jayanti rohu showed its adaptation as one of the species in polyculture. The higher growth rate of Jayanti rohu could be attributed to its possible adaptation to cold weather conditions prevailing during winters at Patna.

Monoculture & Polyculture of prawn

- Prawn after 240 days of rearing in monoculture attained an average weight of 24 g and size of 127 mm. In polyculture, it attained average weight of 27 g and size of 130 mm. Silver carp, catla and rohu attained an average weight of 800, 650 and 550 g, respectively. In monoculture, prawn yield was 610 kg/ha and survival rate was 50 per cent. Polyculture yielded 730 kg/ha of prawn with survival rate of 69 per cent, alongwith fish yield of 3321 kg/ ha. The adaptive research on culture of scampi (*M. rosenbergii*) has paved way for its farming beyond December. Keeping this fact in view, four districts in Bihar have been adopted for prawn-fish culture by the State Government.

Restoration of chaur area for livelihood improvement

- Demonstrated fish culture in trenches, rice-fish culture, horticulture and livestock production in fish pond system, Cage culture & Pen culture under FPARP Project in chaur area of Vaishali district. Eco-hatchery operations were also demonstrated. It offers scope for its wider adoption in rural India. This will definitely enhance the fish seed availability *vis-à-vis* increase in fish production in Bihar. This technology has a significant impact which is evidenced from the fact that one of the farmers' opted commercial hatchery with the capacity of producing 45 crores of spawn in a breeding cycle.

Critical observations by QRT on the above mentioned achievements

I. Livestock

- Animal health is a foundation for animal production. Despite increased relevance and importance given to various livestock development programs, livestock diseases have severely impeded the growth of the industry due to heavy economic loses to the dairy farmers. A road map may be developed in Bihar state depicting season wise incidence of gastrointestinal parasitic diseases, tick borne including other haemo-protozoan diseases as well as other common infectious diseases especially HS, FMD and PPR and Blue Tongue, thus, appropriate treatment, where ever applicable, and control measures to be recommended for these diseases.
- It is also suggested that sero-positive animals identified for Brucellosis, Leptospirosis, IBR and BVD should be monitored for the development of clinical signs and more specific and sensitive tests including isolation of pathogens from Reference Diagnostic Laboratories in India should be undertaken.
- Brucellosis and Leptospirosis are zoonotic diseases and dairy farmers must be made aware regarding their spread to human beings. Female Calf-hood vaccination against brucellosis should be recommended to check the spread of disease. Comprehensive vaccination schedule against FMD and HS should be recommended to farmers to be undertaken twice a year to prevent the occurrence of these two important diseases.
- Awareness may be generated to produce clean milk, keeping in view the human health. Diagnosis of mastitis especially sub-clinical mastitis may be emphasized by using standard SLST and BTB tests and farmers may be trained for this purpose and advised to adopt control measures like teat dipping etc. (Betadine – Glycerine teat dip) to significantly minimize losses due to mastitis. As antibiotic resistance against common mastitis causing bacterial organisms have markedly increased, thus; also identify common bacteria associated with mastitis through cultural sensitivity test (CST) and their antibiogram studies in collaboration with concerned scientists from Bihar Veterinary College for its effective treatment.
- Degnala like disease, also very commonly recorded in dairy animals in Bihar, usually occurs due to prolonged feeding of wheat and paddy straw especially feeding them during winter and rainy season. This condition mainly occurs due to growth of fungus, *Fusarium* spp. which multiplies in improperly stacked moist straw. The toxins of this fungus when ingested by dairy animals results in Degnala disease. Thus, proper drying of the straws in sunlight prior to feeding can markedly prevent the development of the disease. Standard treatment measures can be recommended to the dairy farmers also.
- Most of the breeding technologies applicable for improving the productivity of cows and buffaloes are well documented but needs to be fine tuning and put in practical shape by coordinating with various dairy development agencies of the region.
- Crossbreeding program needs to be strengthened by using semen of proven crossbreed bulls. Similarly, improving the productivity of buffaloes by using germplasm of progeny tested buffalo bulls needs to be undertaken.
- There is breeding policy in the state of Bihar based on the agro-climatic region. However, the norms of breeding are not being maintained at field level. Semen from proven progeny may be brought and AI card of individual dairy animal may be maintained.

- The performance of indigenous animals may be recorded at different agro-climatic situations and suitability of different species and breeds of livestock may be modulated based on the available resources of different categories of farmers. Jersey cross in performing well in field conditions, Farmers in certain regions have preference on Jersey crossbred cows due to its higher fat content, more resistant to diseases, less feed intake and better adaptability in the environment, may be promoted.

II. Fisheries

- **F**our systems were developed for harnessing water and land productivity with integration of fish, duck and crop components for seasonally waterlogged areas. The experiment elucidates production of various agricultural produce and utilization of poorly used land and water in judicious manner. However, this model has not percolated to the farming community as observed except its' demonstration at Jandah village near Patna. It is thus essential to further refine the technology to focus on the selection of species of fish, stocking density, size at stocking for stream lining the production in sustainable manner for acceptance by larger farming community.
- Depending on the water retention period in trench, fingerling and yearling raising programme may be undertaken for production of healthy seed for stocking in the service reservoirs and ponds for increasing productivity and profitability.
- Culture of species like *Cyprinuscarpio* (common carp) may be avoided in this system to save the embankment and the structure from being damaged.
- Scientific information like: organic matter generation, nutrient recycling and cost sharing the production of different components may be generated. Economics of each production system needs to be calculated for larger acceptance by the farmers.
- The experimental trials undertaken on mono and poly culture of fresh water prawn (*Macrobrachium rosenbergii)* are good beginning and also the observations made on the performance of this fishes in winter months in Patna. Since the experiment was suspended due to non-availability of prawn seed as reported during the visit of members, it is felt that prawn being a high value species it is essential to revalidate the observation on the survival, growth and production of prawn and carps in mono and poly culture systems to standardize the technology for developing economic model of package of practices for the region. Field level demonstration can be initiated in different states to validate the technology as well to generate interest among the farming communities.
- Experiment undertaken on poly-culture with rohu and genetically improved rohu (Jayanti rohu) needs further evaluation in a scientific and systematic manner. To make a growth comparison of fishes in aquaculture, attention should be paid for maintaining uniformity in location of experiment, size of water bodies, stocking density, species composition, size of seed at stocking, duration of culture, management practices including replication of the experiments for obtaining tangible result.
- Breeding and seed production of carps in the institute and technical guidance provided for establishment of carp hatchery in the farmers' field by the division with limited manpower is appreciated. This would facilitate mass seed production and improve carp farming in the area and motivate development of entrepreneurship in seed farming. For effective operation, farmers need to be trained with well formulated training course for maintaining good and healthy brood stock and successful fry rearing with high survival rates.

Recommendations of QRT for livestock

- Many of the research studies especially related to monitoring and sero-prevalence of important livestock diseases in the region could be undertaken in collaboration with Bihar Veterinary College, Patna, with that RCER has linkages. It is recommended that a centre of PD AD-MAS be established at Patna in collaboration with the scientists of Bihar Veterinary College Patna who has young faculty to undertake research on important diseases of ruminants with reference to epidemiology, sero-prevalence, etc. Sero-prevalence of important animal diseases is important particularly for better control and Prophylactive measures. Economic losses due to important infectious and parasitic diseases, mastitis, anoestrous and repeat breeding may be assessed.
- Productivity of dairy animals is directly related to their reproductive efficiency. It is strongly felt that one post of Senior Scientist in the discipline of Veterinary Gynaecology be created for improving the reproductive potential and for effective management of various reproductive disorders in dairy animals.
- Management practices may be developed to minimize losses due to acute heat stress in livestock by providing economical shelter management including growing of shade trees and adopting therapeutic measures.
- Minerals mapping to be undertaken on the basis of agro-climatic zones and development of area specific mineral mixture for supplementation to ruminants to improve their production, reproduction and health.
- Balancing the ration in terms of energy and protein alongwith mineral mixture/area specific mineral mixture thus improving the utilization of poor quality fibrous crop residues.
- Urea-Molasses Mineral Blocks (UMMB) which provides energy, nitrogen and minerals is one such option which should be evaluated on cost effective basis and their impact on improving production, reproduction and health be compared to locally available concentrate roughage rations supplemented with mineral mixture.
- Making of feed block and supply of balanced concentrate mixture at subsidized rate is an another important issue.
- Mineral mixture feeding is also important to improve production and reproduction performances.
- Improvement of straw by urea ammonization may be introduced in any adopted village. Urea mineral molasses block may be prepared and evaluated in the institute herd and also in two adopted villages.
- Research on complete feed blocks especially as scarcity feed during flood and drought needs to be undertaken.
- Studies may be conducted on baling of wheat and paddy straw for easy transportation and its urea treatment.
- Strategy may be developed to produce green fodder for dairy animals round the year especially growing Napier grass to be available during lean periods.
- Package of practices for intensive rearing of black Bengal goat, which is very prolific breed, should be developed.
- Collaboration between SAU's and ICAR institutions may be strengthened.

Recommendations of QRT for Fisheries

- The division has undertaken research in some of the very relevant aspects of aquaculture technologies for addressing the issues of enhancing fish production, utilization of waterlogged areas in integrated manner and rural livelihood development programmes. The achievements are appreciable as the division functioned without proper infrastructure and man power. Considering the resources available, demand for food and nutritional security, need for livelihood support in eastern region and the mandate of the Institute, following research activities are recommended by QRT:

Enhancing aquaculture production

- Aquaculture has become one of the first growing and highly profitable practices for farmers and entrepreneurs with development of many technologies by ICAR institutes for increasing fish productivity up to 10-15 tons/ha/year. In order to make these technologies acceptable in various states of the eastern region, adaptive research on seed production and culture of some commercially important fishes like IMC, selected Chinese carps, magur and fresh water prawns should be undertaken to enhance productivity from all cultivable water areas of the region. Suitable technology refinements may be made depending available resources and agro-climatic conditions to utilize various available aquatic resources (ponds, tanks, water logged areas including chaurs and mauns and newly created water bodies) to maximize production and productivity. Special emphasis to be given to utilize the vast unutilized water area available in the form of chaurs, mauns, Tal and Diara for suitable management of fishery resources and pen and cage culture as per suitability. Inter-institutional linkages may be developed as per need with CIFA, CIFRI and CIFE for specific technologies.
- Genetically improved rohu, 'Jayanti' was cultured in the Institute farm pond for evaluation and comparatively higher growth has been reported than normal rohu. This is a good option for improving fish production. The technology need to be further evaluated and transferred to the farming community to harness the benefit. Mass rearing of Jayanti rohu fry from the spawn procured from CIFA may be undertaken for its propagation among the farmers of the region. This may be initiated in Bihar, Jharkhand and eastern U.P. in the beginning in collaboration with CIFA under a network project for its percolation to a wider area in future.

Aquatic ecosystem monitoring, climate change and Fisheries management

- A basic study on aquaculture pond ecosystems of the region is most essential for management changes in production system for development of economically viable and sustainable package of practices. A systematic and routine study on various aquatic ecosystems may be initiated in the division for generation of base line information on water, soil and biological entities which would be helpful in monitoring fish culture, fish breeding and seed production in diversified species including management of ecosystem in the climate change regime. In addition, it would generate baseline information on aquatic ecosystems for use in climate change experiments in fisheries and aquaculture.

Quality fish seed production

- Quality fish seed availability is one of the major challenges for aquaculture in the eastern region. Institute should develop good, healthy, genetically pure brood stock and produce breeder seed for distribution to the hatcheries for further propagation. Induced breeding and hatchery management need to be further refined at the institute level, considering the changing climatic condition, for its demonstration to the farmers. Proper technical support from the divisional scientists is to be extended to the hatchery owners, as per need, to make the programme successful.

- Fry and fingerling production of all cultivable species still suffers badly with low survival rate which is also true for eastern region. All management measures including the critical aspects (pH, total alkalinity, temperature, disease incidence etc.) related to low survival in the local conditions must be detected and possible alterations need to be made and incorporated for increasing fish seed survival.

Aquaculture diversification

- Diversification in aquaculture with high value species is very much essential to meet the changing consumers' demands as well as to address the local preferences. Culture of locally available species like *Puntius sarana, Ompak pabta, Ompak bimaculatus* and *Labeo gonius* (a preffered species in Assam) to be included in research programme followed by development of brood stock, breeding and seed production.
- Air breathing fish species magur (*Clarias batrachus)* is a high value and preferred fish of the country and likely to compatible with makhana cultivation. Effort should be made for breeding, seed production and culture of the species and its' propagation among farmers. A magur hatchery should be installed and fingerling development programme be initiated with farmers participation on priority basis. Magur culture may be initiated in shallow water makhana fields to see the possible integration and development of packages of practices. Identification of location, renovation and conservation of natural breeding ground of magur in the states should be one of the priorities for availability of natural magur seed in eastern states.
- Freshwater prawn culture is a profitable enterprise and the success achieved in the Institute on its' culture across winter season makes it feasible for further evaluation and propagation of the mono and poly-culture technology in some suitable locations of the region making arrangements with some hatcheries for quality seed. Feasibility of establishment of prawn hatchery in Bihar state may be studied.
- Ornamental fish constitutes an important component for aquaculture and livelihood programme. This also constitutes an important fish genetic resource of the country. Culture, brood stock development and seed production of some selected locally available ornamental fishes may be undertaken for technology development. However, for self-employment programme, breeding and culture of common species of commercial importance to be refined to meet the need of farming community for immediate benefits. A modulated training and entrepreneurship development programme may be organized for greater acceptance.

Integrated aqua-farming and water management

- Culture of Murrels, *Channa striatus, Channa morulius, Anabas testudineus* in water logged and derelict waters is one of the new options for making productive use of the less used water bodies. Experiments are to be undertaken on these fishes for its introduction with makhana cultivation in low water depth, to study the compatibility in the ecosystem, production improvement and monitoring mechanism for technology development.
- Aquaculture has been one of the important components of integrated farming system. Emphasis should be given to evaluate the technology developed in the Institute in different states and make suitable alteration if required based on available resources, social acceptance and economic viability for large scale implementation in the region.

- The water use pattern in the integrated farming system in the available technology of the Institute is mostly for irrigated system where each component is dealt independently for water use. This system may not be suitable for the plateau and rainfed areas. A trial should be made to utilize pond water for irrigation and accordingly compatible crops and fish species may be selected for integration. Studies should be made to optimize water use through all available mechanisms, evaluating nutrient cycle and production of each component under the available conditions.

Fish health management

- Information on various types of disease incidences due to parasite, bacteria, virus and fungus may be identified and document with relation to species, season, water bodies and aquaculture practices followed. Based on the information, necessary prevention and remedies may be adopted for integrating with aquaculture management programme of the region. State-of-art fish disease diagnosis laboratory with all modern facilities and manpower may be created in this institute for disease diagnosis and undertaking remedial measures.

Organic aquaculture

- Organic farming is gaining importance in all commodities. Institute may develop technology for integrated farming system including fish and animal components under organic protocol for producing multiple commodities from the single management system. Standards specified by authorised certifying agency should be adopted while undertaking experimental trials.

Coordination of fisheries and aquaculture research at Ranchi and Darbhanga research centres

- Efforts should be made to involve the Scientists of Fisheries Division in the research programmes related to management of aquatic ecosystem and fish culture in integrated farming system models with horticulture/agroforestry/makhana etc. for generation of scientific information for technology development.

IV. DIVISION OF SOCIO-ECONOMIC AND EXTENSION (DSEE), PATNA

Value chain study of selected commodities-case of milk and vegetables in Bihar

- A maximum of nine (9) marketing channels observed in milk with a price spread ranging from zero to 40 per cent.

Development of a composite crop yield forecasting system for rice and wheat in Bihar

- Composite crop forecasting model consisting of Logistic model, weather-based regression model and ARIMA model of order 0.1.1 found suitable for zone-wise forecasting of rice and wheat yield in Bihar.

Socio-economic analysis of access to farm credit in Patna and Vaishali districts of Bihar

- Large farmers borrowed from institutional sources while small and marginal farms borrowed from non-institutional sources. Crop failure/low yield found most important reason for non-repayment.

Socio-economic parameters affecting makhana production and livelihood system of makhana

- *Sahani* community involved in traditional makhana farming with no ownership of ponds. Pond rent varies between Rs. 2000-3000/ per year/acre from private sources. Fishery societies help in procurement of inputs and marketing and make available government ponds to its members.

Status and performance of SHGs in disadvantages areas of Bihar

- Group members of below 45 years of age had positive attitude towards SHG activities, got most information from progressive farmers and borrowed mostly for short term needs.

Critical observations by QRT on the above mentioned achievements

- The extension system with the involvement of Govt. agencies, NGOs, farmers organizations, private sector agencies, para workers etc. are going to be more effective and dynamic. The division should involve these organizations for speedy transfer of technology in different parts of eastern region.
- The agriculture extension system will have to transform itself with the capacity building to meet the challenges arising out of farming system approach. As such efforts are required to plan the strategy keeping this direction into practice.
- Prior to transfer the technology, farm economist should calculate the variable cost of inputs and ratio of output since increasing cost of inputs is most limiting factor in adoption of modern methods of cultivation.
- The necessity of targeting women to receive information related to their work required to be highlighted considering main-streaming of women in agriculture. Special programme for access to extension and training of rural women and redesigning of extension services for women farmers is required.
- Increased use of information technology and communication in agriculture extension need to be advocated and pinpointed even for extension pertaining to marketing.
- The extension system has to be set on a "System Management" mode, since the goal of extension required a shift from technology to system management which was not initiated during the period under report.

Recommendation of QRT

- Based on considerations of ecology, economics and employment generation, the ICAR-RCER has developed the technologies to enhance opportunities for sustainable livelihoods in biodiversity-rich areas such as eastern region
- **Livelihood security:** In the case of the Bihar floods, the immediate challenge will be agricultural rehabilitation, since agriculture including crop and animal husbandry, fisheries, agro-forestry and agro-processing comprise the backbone of the livelihood security system in over 80 per cent of the areas affected by the Koshi.
- **Proactive action for agricultural rehabilitation**: will involve the building of buffer stocks of appropriate seeds, planting material, manures and implements. The flood-affected areas will have excellent aquifer recharge. Therefore, the tapping of groundwater during October to April will become possible.

- **Bihar farmers were the pioneers in inventing the Bamboo tube well:** which is a low-cost indigenous method to pump groundwater for agriculture. Crops like sweet potato grow well after floods.
- We now have sweet potato varieties with yellow flesh, rich in Vitamin A. In addition, there are several short-duration varieties of maize, pulses and sunflower, and a wide range of vegetables and fodder crops, legumes and annual variety of moringa (drum stick) bred at the Tamil Nadu Agricultural University, Coimbatore, grows well in Bihar under water stress conditions. It is an excellent source of micronutrients that are essential for eliminating hidden hunger. Such a long-term plan can be implemented with labour provided under the National Rural Employment Guarantee Programme.
- Unfortunately, coordinated action is difficult, particularly where several Ministries and Departments of both Central and State governments are involved. While money becomes available easily to help families where calamities have occurred due to floods, funds are scarce to eradicate the root causes of such situations and sufferings.
- Bihar can increase production and minimise the cost of production during the flood-prone season by the use of organic manures such as compost, green manures and bio-fertilizers, and the adoption of cereal-legume crop rotation. Fortunately the cultivation of organic rice, tea, fruits and vegetables is spreading. The challenges of floods can then become an opportunity also to promote high-value organic farming.
- Thus, both short and long term measures are required for mitigation of floods in Bihar, Assam and in other parts of eastern region where similar ecological situations is prevailing.

CHAPTER–6

SIGNIFICANT ACHIEVEMENTS OF THE RESEARCH CENTRES OF ICAR-RCER, PATNA DURING LAST SIX YEARS (1st January, 2006-31st March, 2012)

I. RESEARCH CENTRE RANCHI, JHARKHAND

Genetic resource management and improvement of fruit and ornamental crops

- Collected, characterized and conserved eight mango genotype from different parts of Jharkhand, West Bengal and Bihar
- The mango varieties Mallika and Himsagar were recommended for cultivation under Eastern Plateau and Hill conditions.
- Litchi genotypes CHES-2, Shahi, Deshi, China and Rose Scented; guava genotypes Allahabad Safeda and Sardar; sapota genotype Murrabba have been found promising for cultivation under Eastern Plateau and Hill conditions
- Out of 109 genotypes of mango being maintained in the experimental farm at Ranchi, Himsagar and ICAR-RCER-R 3P2 have been found most suitable keeping in view the fruit qualities.
- Late Bedana variety of litchi has also been found the promising cultivar based on the fruit quality. Likewise, in case of Sapota, Murabba cultivar has been found most suitable so far in fruit quality and yield was concerned.

Intensification of research on bael (*Aegle marmelos* Correa.) with special reference to medicinal value

- Based on fruit quality, one genotype each collected from Hazaribagh district of Jharkhand and Purulia district of West Bengal was found promising.
- Studies on storage indicated that bael can be stored up to 35 days with minimum 40 per cent spoilage at ambient temperature in news paper wrapping or CFB box packing.

Evaluation of advance breeding lines and maintenance breeding in Solanaceous and Cucurbitaceous vegetable crops

- Brinjal variety Swarna Abhilamb, hybrids Swarna Neelima, Swarna Mohit, tomato hybrid Swarna Sampada, pumpkin variety Swarna Amrit, have been developed and released for cultivation under protected condition.

Management of plant genetic resources and improvement of leguminous and minor vegetable crops

- The powdery mildew resistant garden pea varieties Swarna Mukti, snowpea variety Swarna Tripti, cowpea varieties Swarna Harita, Swarna Suphala have been released.
- Performance evaluation of pea genotypes under Netarhar conditions (higher altitude) indicated that sowing of the lines, CHP-1 (14.10 t/ha), CHPMR-2 (15.63 t/ha), Swarna Mukti (15.47 t/ha), and Swarna Amar (13.93 t/ha) and the edible podded snowpea lines Oregan Sugar (28.11 t/ha) and HASP-1 (21.31 t/ha) resulted in market availability of pods during 1st fortnight of April.

Management of plant genetic resources and improvement of leafy and underutilized vegetable crops

- Dolichos bean variety Swarna Utkrist and Swarna Mukut and vegetable soyabean variety Swarna Vasundhara have been released
- Diverse genotypes of leaf amaranth, palak, methi, coriander, Malabar night shade/Poi, Chinese cabbage, Chenopodium/Buthua, Ipomoea/Kalimsag, drumstick, ivy gourd, spine gourd, cho-cho, faba bean, winged bean, lima bean, sword bean, velvet bean, jack bean, yam bean, vegetable pigeon pea have been collected and evaluated
- One genotype of drumstick with round the year fruiting has been collected

Development of sustainable production and utilisation in fruits and ornamental crops

- Under 12 year old mango based multitier cropping systems grown under rainfed conditions of eastern plateau and hill region, the maximum cumulative paddy equivalent yield of 51.24 t/ha was recorded in case of Mango+ Guava+ French bean. After 12 year of planting, drastic reduction in the yield of intercrops could be noticed which indicated shift towards other shade tolerant crops
- Under 10 year old aonla based multitier cropping system grown under rainfed conditions of eastern plateau and hill region, the maximum cumulative paddy equivalent yield of 41.89 t/ha was recorded in case of aonla + guava + deenanath grass.

Development of Ultra-High Density orcharding in guava under Jharkhand conditions

- In case of ultra-high density orcharding in guava cv. Sardar, pruning three times a year (March, May and October) + irrigation 60 per cent PE + Application of 100 per cent of recommended dose of nutrient + soil application of 2 kg FYM + 50g Trichoderma + 50g Azotobactor + 50g Mycorrhiza + Foliar application of ZnSO4 (0.1 per cent) and Boric acid (0.3 per cent) resulted maximum gross income (Rs. 5.56 lakh per ha).
- Technology has been standardized establishment of ultra high density guava orchards. Pruning up to 50% of shoot length thrice in a year could enhance the yield in cv. Allahabad Safeda by 28.04%.
- Ultra high density guava orchard (cv. Sardar) developed by the institute is gaining popularity among progressive farmers in eastern states, due mainly to higher productivity (38 t/ha compared to 16 t/ha in traditional system) and thereby higher net monetary returns.

Regulation of growth and development and nursery management of fruit crops

- Foliar application of NAA (200 ppm) can be recommended for crop regulation of guava cv. Allahabad Safeda and Sardar through chemical method under rainfed uplands of eastern plateau region. Removal of 50 per cent of rainy season crop through manual de-blossoming can be recommended as an alternative to chemical method of crop regulation in guava under rainfed conditions of Eastern Plateau agro-ecological zone.
- In mango cv. Amrapali, rejuvenation pruning at 1.5m with 120 cm length of primary shoot and 60 cm length of secondary shoot have been found promising with respect to canopy size, light penetration in underneath of canopy and yield.

Strategies for enhancing land and water productivity through multiple uses of water

- A rainwater harvesting reservoir has been constructed on the mid-land of the plateau region and lined by LDPE (low density polyethylene) film. The outlet of the reservoir

was connected to water conveyance pipe such that irrigation may be provided gravitationally in the command area having multi-tier horticulture system comprising of litchi as main crop and guava as filler crop.

- Net income of Rs. 25209.0 was obtained from the litchi based multitier unit by sale of vegetables, fruits, paddy, groundnut, maize, arhar and fish after two years of planting.

Evaluation of substrates and assessment of water requirement for commercial production of oyster mushroom

- Assessment of water requirement for commercial production of oyster mushroom indicated that 4.16 to 5.0 litre water is required for one kg of *Pleurotus florida* mushroom production and 4.16 to 5.5 litre water is required for one kg blue oyster mushroom (*Hypsyzigus ulmarius*) production.

Economic assessment of horticultural technology through participatory research

- Cost of cultivation of cowpea varieties Swarna Sweta and Swarna Harita were estimated to be Rs. 46398 per ha and Rs. 44924 per ha, respectively whereas the benefit cost ratio were accounted for 1.81 and 1.93, respectively.
- The employment opportunities generated under these varieties ranged from 851 to 1048 labour days per ha among different categories of farmers. The labour cost except indigenous variety worked out varied from 73 to 62 per cent higher than the material cost.
- Assessment of the economic viability of improved varieties indicated benefit cost ratio of 3.79 in case of Swarna Pratibha (brinjal) and 2.95 in case of Swarna Lalima (tomato).

Critical observations by QRT on the above mentioned achievements

- **Management of genetic resource in horticultural crops:** Genetic resource management is the most important aspect for increasing productivity and improving quality. Research work carried out on this aspect resulted in characterization, classification, conservation and identification of superior genotypes of fruits and vegetable crops. Among different fruit crops; 108 mango, 42 litchi, 38 guava, 12 sapota and 10 bael genotypes have been characterized and conserved in field gene bank. Varieties of mango, litchi, jackfruit and sapota have been evaluated for commercial growing. In vegetables, germplasms of bottle gourd (27), chilli (50), exotic tomato (8) and exotic capsicum (2) were introduced. Improved lines of tomato, brinjal, cucumber, ridge gourd, pumpkin, sponge gourd, pointed gourd, bottle gourd, bitter gourd, chilli, pea, beans and soyabean have been evaluated and gaining popularity among farmers'.
- **Development/standardization of agro-techniques:** Agro-techniques play an important role in improving quality and productivity of the produce. Work done in fruit crops are high-density orcharding in guava (5000 plants/ha) and mango (1600 plants/ha) for increasing the productivity in these crops. Rejuvenation of unproductive old and senile mango orchard has been demonstrated. Pruning in guava and thiouria application in pear have been found to increase productivity and profitability. Fruit based multi-tier cropping system have been developed for rainfed plateau conditions. In vegetable crops, vegetable based cropping sequence (bottle gourd-cowpea-tomato) for higher productivity in Eastern plateau hill conditions, intra spacing (50cm) with fertilizers dose of nitrogen (80 kg/ha) and phosphorus (30 kg/ha) for improving productivity in pointed gourd have been worked out. Manure and fertilizer requirement for higher productivity of bottle gourd has also been worked out. Calcium chloride treatment was found effective in improving seed generation in chilli and onion.

- **Basic and strategic research:** The centre has conducted work on root distribution pattern of litchi under litchi based multi tier cropping system. Information on light infiltration in canopy has also been recorded in rejuvenated mango plants.
- **Post-harvest management:** Horticultural crops are highly perishable in nature. Increasing production in these crops necessitates proper handling and growth of processing industry for preservation, conservation and value addition. Research work on post-harvest management is very little. Works on litchi harvesting and bael storage have been conducted. In order to minimize the post-harvest losses and to obtain better income, there is an urgent need to start research programme in post-harvest management with appropriate infrastructure and manpower.
- **Capacity building:** In the fast changing socio – political and economic situation, capacity building hold promise for global competitiveness and in qualitative improvement.
- **Bottlenecks/constraints:** The centre has pointed some bottlenecks particularly shortage of scientific man power in area of bio- technology, agro- forestry, Floriculture and related area, inadequate lab facilities and shortage of supporting and technical staff.

Recommendations of QRT

- Exploration, collection, conservation and evaluation of genetic resources in both fruit and vegetable crops for high yield, quality and resistant to biotic and abiotic stress need to be continued.
- Development/selection of colored mango (yellow or green with red blush) and guava (with red or pink surface) varieties, which have high potential for both internal and external market need to be initiated.
- Development/selection of vegetable varieties for processing particularly tomato variety with high lycopene and chilli varieties (pickle) with high anthocyanin content for quality products is need of the hour.
- The work on hi-tech orchard management practices such as integrated nutrient management, water management, mulching and plant protection in commercial fruit and vegetable crops should be taken for improving quality and productivity towards increasing income for farmers.
- Since tribal communities of the region rely heavily on forest resources for their subsistence, institute should explore, collect and evaluate the potential wild edibles/ underutilized crops including tuber crops so as to domesticate the promising ones in the farming system.
- Research work on root distribution pattern and light infiltration in ultra- high density plantation of guava and tree- based cropping system should be worked out.
- Insect pest and diseases in horticultural crops should be monitored in relation to climate change. Research work on harvesting practices, grading, treatment, packaging, pre-cooling and storage of commercial fruits and vegetables should be standardized for reducing the losses.
- Need based and skill oriented training programmes in Hi- Tech horticulture, food laws and safety and related issue are required for scientist and extension functionaries so as built their capacity.

- Scientific manpower support in critical area and technical at middle and lower level should be strengthened.
- Lab should be adequately equipped and transport facility should be strengthened for effective management of experiments/ research work.
- A unit for post-harvest management including processing unit with required facilities should be established for effective research work and capacity building.

II. RESEARCH CENTER FOR MAKHANA (RCM), DARBHANGA BIHAR

Collection, characterization, evaluation, documentation of makhana (*Euryale ferox Salib*) germplasm

- An exploration was undertaken in north eastern Hill region and 29 diverse germplasm of economic importance have been collected from a dozen of villages of Imphal East, Imphal West, Bishnupur and Thoubal districts of Manipur.
- Total number of 36 germplasm (29 from Manipur and 7 from Bihar) were evaluated in a field condition at RCM, Darbhanga. Four elite individual plants having a good potential of seed yield (1325 g, 1112 g, 1027 g, and 926 g) were selected on the basis of individual plant performance.

Management strategies for maximization of productivity of water bodies through makhana based integrated aquaculture farming system

- The makhana growing pond has resulted into improved fertility status of pond soil. The available nutrient status of pond soil was comparatively higher than the non makhana pond soil. The biological characteristics of makhana ponds indicated a rich diversity of phytoplankton, periphytons, zooplanktons and benthic organisms. The integration of fish with makhana farming thus offers greater efficiency in resource utilization and provides additional food and enhances income to the makhana growers.

Sustainable livelihood improvement through need based integrated farming system models in disadvantaged districts of Bihar has been found quit furit full

- Identified the specific sites for different farming system models/technologies, i.e., makhana cum fish alongwith the horticultural components, vermi-composting, mushroom, poultry and bee keeping, etc.

Critical Observations by QRT on the Above Mentioned Achievements

- Makhana is a pride aqua-cultural product of Bihar. It is very nutritious and has vast potential in industries like pharmaceuticals and textiles. Apart from monetary returns, makhana cultivation is a village based and welfare oriented industry providing a gainful employment to the backward fisherman landless of the region.
- **Management of genetic resources in makhana:** out of 36 germplasm of makhana, four suitable genotypes have been identified and propagated by the centre.
- Harvesting and processing of makhana are difficult process and required a lot of skill and expertise hence, there is need to develop/standardize harvesting techniques.

Recommendations of QRT

- The work on survey, collection and evaluation of germplasm should continue since there is need for developing high yielding and good quality varieties for processing and export.
- A pond of divided blocks (conservatory) should be designed in the field to maintain the germplasm. There is need for establishment of seed gene bank as well.
- Makhana germplasms should be evaluated for detail composition including vitamins, antioxidant properties and disease/insect resistance/tolerance.
- Complete package of practices need to be developed for makhana production including varieties, spacing and cropping system for improving livelihood of the resource poor farmers.
- Economics of various makhana based cropping systems should be worked out for efficient transfer of technology.
- Non-availability of seed is a major problem in spread of makhana cultivation. Seed production technique of both in shallow and deep water should be developed and standardized.
- Possibility of micro propagation of elite germplasm in makhana be explore.

CHAPTER – 7

TRANSFER OF TECHNOLOGY

1. KRISHI VIGYAN KENDRA (KVK), BUXAR, BIHAR

Though the KVK has been sanctioned and established in the year 2008 (07.11.2008), it is still running in the rented house. QRT felt that sincere effort be made to develop the required infrastructures on priority for proper functioning of KVK. It is also desirable that the demonstration units including animal sheds and fisheries ponds etc. be established in the experimental farm. It will facilitate the production of quality seed & planting materials which could be made available to the farmers through KVK nursery farm. Mobilities of the subject matter specialists within these two years of its functioning were satisfactory as per the farmers' feelings. Water is a scarce resource and management of natural resources have the highest priority among the other activities of this KVK. Resource conservation technologies to quote a few; as Zero till, drip and sprinkler irrigation, rain water harvesting etc required special efforts.

Activities Carried out by the KVK

- Three hundred farmers from 11 blocks of the Buxar district were trained on technologies for *'Scaling up of water productivity in agriculture for livelihoods'*. The trainings included visits of participants at research farms and farmers' fields. To spread the message of water use efficiency, 40 farmers from the district had an exposure visit to ICAR-RCER, Patna and to know various technologies of Low Energy Water Application (LEWA), organized by the KVK.
- Participatory Rural Appraisal of a few villages in the district was conducted to find out the scope for further improvement of agriculture and allied fields in the district. Need based training programmes both off campus (155 nos.) and on campus (21 nos.) were conducted for practicing farmers, rural youth and extension functionaries. Four thousand five hundred eighty eight participants were benefited from these trainings.
- Front line demonstrations were conducted on 48.45 ha covering agriculture and allied fields on innovative and improved technologies (Zero till), varietal replacement of (oilseeds and pulses crops), biofertilizers (Rhizobium in legumes), Phosphorus Solubilizing Bacteria (PSB) culture, *Azotobacter* in cereals, introduction of tissue culture for horticultural crops (Grand Naine banana), disease resistant varieties of vegetable crops (Okra, Arka Anamika), and high yielding tomatoes (Swarna Lalima).
- Farmers were trained to grow mushroom, now 20 farmers in Buxar district are growing mushroom and generating additional employment and income.
- Women were supplied improved seeds of vegetable crops for kitchen gardening to supplement their daily nutritional requirements.
- KVK Scientists provided diagnostic services (882 nos.) for diseases and suggested remedial measures 'besides' large number of farmers visited KVK to get solution for their problems.
- KVK scientists has organized some vaccination camps for animals against Haemorrhagicsepticemia and Black quarter animal diseases at Kaithi village.

- KVK maintained active linkage with the Agriculture Technology Management Agency (ATMA) of the district and has organized "*kisan Pathshala*" on fodder, mushroom, poultry, wheat production, guava and post harvest processing technologies for rural farmers as 'experiential learning'.
- The media personnel of the vernacular dailies made extensive coverage about the different activities of the KVK and spread remedial measures of insects' pests and diseases as well as improved technologies to the farmers.
- Low cost, knowledge rich leaflets on improved practices were developed and distributed to the farming community for enhancing know-how.
- Agriculture in the Buxar district has been adversely affected by the consecutive occurrence of drought for the last two years. Buxar is the rice-bowl of the state, however, area of paddy decreased during the drought year. Information on contingent actions were given to farmers' under such adverse climatic situation viz. late varieties of paddy and wheat, early varieties of potatoes, vegetables, *Toria* and alternative crops of fodder were diffused at the appropriate time. This action brought significant increase in acreage under non traditional crops.
- Extension efforts of the KVK have resulted in to formation of Self-Help Groups (SHGs) in good number of villages. Taking the clue from the women folk, the men folk have also formed their SHGs. One of the SHG was so much encouraged by the RCT, that the SHG purchased a Zero till for wheat cultivation.

2. THE DIVISIONS OF ICAR-RCER, PATNA

During field visits, it was observed that crop demonstration trials on the farmers' fields were not impressive. Perhaps frequent supervision monitoring and follow-up action by the scientists working in different divisions of the institute were not taken 'therefore'; impact of transfer of technology was not visible. Besides, percolation of the technology to the end user could not be seen. During the field visits it was noted that lot of water bodies were available which could not be roped in for conducting demonstrations on Integrated Farming System.

Activities carried out by the divisions

- For capacity building of farmers and field functionaries for scaling up of water productivity, more than 2500 farmers and 25 field functionaries were trained. Significant gain in knowledge on water management practices with a strong information seeking pattern among trainees was claimed by the scientists.

3. RESEARCH CENTRE RANCHI, JHARKHAND

Research centre Ranchi has done excellent work with respect to Transfer of Technology Particularly on Farmers' Participatory Action mode, demonstrations of water harvesting technology, Technology transfer/ popularization of newly evolved varieties including hybrids of vegetable crops & fruits and rejuvenation of unproductive mango plants.

Activities Carried Out By the Research Centre

- Demonstration on direct rainfall collection in *Doba* (small water storage tanks) for horticulture establishment in uplands of eastern plateau region was carried out on 135 farmers' fields. This technology has been already adopted by sizable number of farmers in Jharkhand, Bihar and Chhattisgarh. Besides, technology has been included in State plan of NHM, Jharkhand. Apart from this, the technology has been adopted by different NGOs, wall entry originations, SHGs etc.

- Rain water harvesting technique covered 40 ha of land in the state of Jharkhand.
- High – density plantation covered 10 ha. Likewise, rejuvenation of old and senile mango orchard was carried out in 25 ha in West Bengal and Chhattisgarh.
- Two hundred farmers of Jharkhand adopted technique of mushroom production round the year.
- Technology of fruit based multi-tier cropping system covered 400 ha area in Jharkhand.
- Varieties and hybrids developed/ selected in vegetables and fruits at the centre have been adopted by the farmers in the state of Bihar, Jharkhand, West Bengal and Chhattisgarh. An area of 2850 ha has been covered under vegetable crops.
- Public private partnership and institutional networking has been attempted to popularize the developed technologies.

4. **RESEARCH CENTER FOR MAKHANA (RCM), DARBHANGA**

The success of makhana cultivation depends on post-harvest practices. The works on these aspects are very much lacking. A popping machine is only available at the centre which is also not in working condition. Training and demonstration on shallow/low water cultivation of makhana have been given to the farmers. The seed of promising/elite strain of makhana has been given to only five farmers for on farm testing.

Activities Carried Out By the Research Centre

- Makhana -cum- fish farming system models was replicated at 38 different sites and found ecologically and economically most viable required for concerted efforts for transfer of technology in deferent ecosystems suiting for further replications covering majority of farmers.
- Establishment of processing unit at the centre with facilities of seed grader, popping machine, cleaning/finishing machine and packing containers need to be looked into. These equipments will also be used in training programmes for entrepreneurship development.

I. Training programmes organized on Human Resource Development at ICAR-RCER, Patna

2006-07			
Topic of training	**No. of trainings**	**No. of Participants**	**Duration of training**
Farmers training programmes on water management, resource conservation technologies, mushroom cultivation, improved package of practices in Rice-Wheat system, makhana cum fish cultivation etc.	23	1300	1 day
National level programme on "Advances in natural Resource management for Sustainable Agricultural Production in canal commands"	1	36	7 days
Winter school on "Recent advances in Horticulture for Development of watershed"	1	26	21 days

One-month Entrepreneurship Development programme on food processing.	1	18	30 days
2007-08			
Farmer training			
Water management and integrated farming	4	120	3 days
Zero tillage direct seeded rice	5	285	1 day
Drum seeded rice	2	77	
Zero tillage wheat	4	431	
Leaf colour chart	4	350	
Brown manuring	3	81	
Apiary	1	20	
Poly House	2	43	
Mushroom cultivation	3	107	
Makhana cum fish cultivation	2	57	1 day
Winter school			
Winter school on "Recent advances in Horticulture based farming system for Development of watershed"	1	25	21 days
Winter school on " Improving land, water & energy through micro irrigation	1	26	21 days
2008-09			
Winter School on Recent advances in rainfed Horticulture based farming systems in plateau and hilly region"	1	26	21 days
Farmers training			
Mushroom production	1	15	1 day
Seasonal vegetable cultivation	2	50	
Direct seeded rice	6	394	
Drum seeded rice	1	59	
Leaf colour chart	4	265	
Brown manuring	2	110	
Zero tillage wheat	2	252	
Seven days training programme on "Scaling of water productivity for livelihoods"	3	150	7 days
Mixing cropping in tal area	1	100	1 day
Training programme for Agril. Officer and field functionaries.			
Resource conservation technologies.	2	95	1 day
Entrepreneurship training on Skill development on repairing and maintenance of zero tillage drills Hybrid seed production in vegetables	2	76	1 day
2009-10			
Winter school on RCTs – "Conserving resources for enhancing productivity, sustainability, food security and improvement of rural livelihoods"	1	30	21 days

"Scaling of water productivity for livelihoods"	5	350	7 days
Wheat seed production	1	85	1 day
2010-11			
"Scaling of water productivity for livelihoods"	15	750	7 days
Vegetable cultivation in *rabi* season	6	137	1 day
Mushroom cultivation	2	36	
Drip Irrigation for master trainers	1	100	
Rejuvenation of old orchards	1	30	
Training on ZT Direct seeded rice	1	35	
Residue management	2	56	
Modern training on information and communication technologies and improved agricultural practices for enhancing productivity under changing climate situation"	1	25	8 days
2011-12			
'Trainers for trainees' training programme on IFS for District Agriculture Officers and other officers of Govt. of Bihar	1	25	2 days
Workshop on Policy dialogue on Sustainable Rural Livelihoods in Disadvantaged Areas of Bihar	1	25	1 day
Consortium Advisory Committee (CAC) meeting of NAIP Component-3	1	20	1 day
Training programme on Integrated Farming Systems for Para Extension Workers and SMS, Govt. of Bihar	1	25	1 day
Training programme on "Scaling Up Water Productivity in Agriculture for Livelihood"	1	50	14 days
Training on "Integrated Fish Farming"	1	25	7 days
Training program entitled "Scaling Up of Water Productivity in Agriculture for Livelihoods" sponsored by Min. of Water Resources (GOI) at KVK, Saraiya, Jamui, Sitamarhi, Madhepura, Bhojpur and RCM, Darbhanga, Bihar	6	50	7 days
Farmers' Training Programme on "Improved Agriculture"	1	25	3 days
training programme on "Makhana processing clinic" was conducted in collaboration with Makhana Processor and Development Society, Baheri	1	25	1 day
training program entitled "Improved agricultural practices" sponsored by NABARD	1	25	3 days

II Training programmes organized at ICAR-RCER, Research Centre, Ranchi

2006-07			
Topic of training	**No. of trainings**	**No. of Participants**	**Duration of training**
Fruit Based Multitier Cropping System	4	80	3 days
Sustainable Horticulture Development	1	25	3 days
Orchard Management Practices	1	25	3 days
Seed production in vegetable crops	1	13	3 days
Plant propagation	4	82	3 days
Winter School			
Recent Advances in Horticulture for Development of Watershed	1	24	21 days
2007-08			
Mushroom production	2	114	2 days
Production of horticultural crops	1	21	3 days
Seasonal vegetable cultivation	1	26	3 days
Winter School			
Recent advances in horticulture based farming system for development of watershed	1	25	21 days
2008-09			
Seasonal vegetable cultivation	2	52	3 days
Hybrid Seed production in vegetables	2	58	5 days
Mushroom cultivation	5	125	3 days
Winter School			
Recent advances in rainfed Horticulture based farming systems in plateau and hilly region	1	16	21 days
2009-10			
Fruit Production/ Fruit based multitier system	1	20	3 days
Seasonal and off season Vegetable Cultivation (*Kharif & Rabi*)	1	24	6 days
Seasonal Vegetable Cultivation (*Kharif*)	1	23	3 days
Seasonal Vegetable Cultivation (*Rabi*)	4	100	5 days
Vegetable Production (*Rabi*)	1	17	3 days
Rejuvenation of New and Old Orchard	1	30	5 days
Mushroom Production and vegetable	1	18	3 days
2010-11			
Vegetable Cultivation (*Rabi*)	2	62	2 days
Mushroom Cultivation	1	18	3 days
Drip Irrigation	1	100	10 days
Cultivation of seasonal vegetables	1	20	5 days
Improved production technique in fruit &vegetables.	1	25	5 days
Improved production technique in fruit &vegetables.	1	25	3 days

Expansion of area under vegetable cultivation	1	14	5 days
Hybrid seed production in vegetables crops.	5	127	3 days
Processing and value addition of fruits & vegetables.	2	47	2 days
2011-12			
Cultivation of seasonal vegetables	1	20	3 days
Improved production technique in fruit & vegetables	5	123	5 days
Expansion of area under vegetable cultivation	1	14	5 days
Hybrid seed production in vegetables crops.	5	127	3 days
Processing and value addition of fruits & vegetables.	2	47	2 days
Establishment of Wadi.	4	76	
Mushroom cultivation	1	26	3 days

III Training programmes organized at Krishi Vigyan Kendra, Buxar

Training programme conducted for in service extension functionaries

2009-10			
Discipline	**No. of trainings**	**No. of Participants**	**Duration of training**
Crop Production	02	36	2 days
Horticulture	02	39	2 days
Livestock	02	31	3 days
Fisheries	--	--	--
Home Science	02	39	3 days
Agril Engg	--	--	--
Agroforestry	--	--	--
Others (Soil Science)	01	17	2 days
Plant Protection	--	--	--
2010-11			
Crop Production	02	37	2 days
Horticulture	02	22	2 days
Livestock	01	11	3 days
Fisheries	--	--	--
Home Science	02	36	3 days
Agril Engg	--	--	--
Agroforestry	--	--	--
Others (Soil Science)	01	15	1 day
Plant Protection	01	22	5 days
2011-12			
Crop Production	02	20	2 days
Horticulture	--	--	--
Livestock	01	13	3 days
Fisheries	--	--	--

Home Science	--	--	--
Agril Engg	--	--	--
Agroforestry	--	--	--
Others (Soil Science)	--	--	--
Plant Protection	02	40	5 days

Training programme conducted by KVK for farmers/farm women

2008-09			
Discipline	**No. of trainings**	**No. of Participants**	**Duration of training**
Crop Production	05	113	2 days
Horticulture	05	124	2 days
Livestock	04	113	2 days
Fisheries	--	--	--
Home Science	05	120	2 days
Agril Engg	--	--	--
Agroforestry	--	--	--
Others (Soil Science)	06	180	2 days
Plant Protection	02	49	2 days
2009-10			
Crop Production	15	386	2 days
Horticulture	20	644	2 days
Livestock	16	436	2 days
Fisheries	--	--	--
Home Science	20	487	2 days
Agril Engg	--	--	--
Agroforestry	--	--	--
Others (Soil Science)	21	508	2 days
Plant Protection	--	--	--
2010-11			
Crop Production	--	--	--
Horticulture	20	579	2 days
Livestock	18	444	2 days
Fisheries	--	--	--
Home Science	13	388	2 days
Agril Engg	--	--	--
Agroforestry	--	--	--
Others (Soil Science)	21	469	2 days
Plant Protection	13	272	2 days
2011-12			
Crop Production	--	--	--
Horticulture	18	526	2 days
Livestock	18	399	3 days
Fisheries	01	28	2 days
Home Science	16	431	3 days
Agril Engg	--	--	--
Agroforestry	--	--	--
Others (Soil Science)	20	438	1 day
Plant Protection	24	518	5 days

Training programme conducted by KVK for rural youths

2009-10			
Discipline	**No. of trainings**	**No. of Participants**	**Duration of training**
Crop Production	01	12	7 days
Horticulture	02	22	5 days
Livestock	01	15	5 days
Fisheries	--	--	--
Home Science	03	31	7 days
Agril Engg	--	--	--
Agroforestry	--	--	--
Others (Soil Science)	01	15	5 days
Plant Protection	--	--	--
2010-11			
Crop Production	--	--	--
Horticulture	02	21	5 days
Livestock	02	20	5 days
Fisheries	--	--	--
Home Science	02	15	5 days
Agril Engg	--	--	--
Agroforestry	--	--	--
Others (Soil Science)	02	25	5 days
Plant Protection	01	10	5 days
2011-12			
Crop Production	--	--	--
Horticulture	03	31	2 days
Livestock	02	21	3 days
Fisheries	--	--	--
Home Science	02	20	3 days
Agril Engg	--	--	--
Agroforestry	--	--	--
Others (Soil Science)	--	--	--
Plant Protection	--	--	--

5. NATIONAL AGRICULTURAL INNOVATION PROJECT (NAIP)

NAIP sub-project entitled "Sustainable Livelihood Improvement through Need Based Farming System Models in Disadvantaged Districts of Vaishali, Bihar".

Activities Carried Out Under the NAIP

- Integration of Makhana + Fish + Horticultural Crops.
- Pens were fabricated, installed and seeds were released in pen. Cages were fabricated & installed and brood stock management was initiated to prepare the fish for breeding. One eco-hatchery was installed for breeding of carps and fisheries management in open water was initiated.
- Introduced low cost bamboo pits **(10'×3'×2.5')** for vermicomposting at large scale**.** Till now, 74 vermipits have been constructed in project area which generated employment of 3952 Mandays/Year. The annual income has been estimated to be Rs. 600/pit/yr.

- One entrepreneur in neighbouring village Pokhraira has started Vermicompost plant having the capacity of 300 t/yr.
- Introduction/popularization of improved technologies for seed potato production in 6.0 ha area has been done and the production of 112.64 tones foundation seed was achieved.

I. In order to increase production, cropping intensity and employment, 30 new varieties of different crops and 12 cropping systems were introduced among the farmars of the project area:

Wheat (6-varieties)	:	PBW- 343, HUW- 234, PBW-373, PBW-502, HD- 2733, HD- 282
Maize (3- varieties)	:	Devki, Lakshmi, Shaktiman -4 (*QPM hybrid*)
Pea (3- varieties)	:	Ajad, Harbhajan, Arkel
Potato (3- varieties)	:	K.Pukhraj, K.Kanchan, Chipsona-1
Rice Scented (4- varieties)	:	Sughandha-4, Sughandha-5, Raj. Subhasni, Improved, Pusa Basmati 1
Unscented (6- varieties)	:	PNR 381,Prabhat , Pusa 44, Turanta, Sweta, Rajshree
Tori (2- varieties)	:	Pusa Tarak, Pusa Mahak
Mustard (1- variety)	:	Ankur yellow mustard
Lentil (1- variety)	:	Arun
Moong (1- variety)	:	Pant moong-1

II. The following 12- cropping systems were followed:

Rice- Potato-Vegetable (Bhindi/Brinjal etc.) , Rice- Potato- Moong, Rice – Potato + Maize- Moong, Rice- Maize- Moong, Rice- Wheat-Vegetables (Bitter guard/bottle guard/Bhindi/ sponge gourd etc)., Rice- Maize+Pea-Moong/Seasmum Vegetables, Rice- Wheat –Dhaincha, Rice- Maize +Bakla –Dhaincha, Rice- Pea- Vegetables, Rice- Lentil- Vegetables, Rice- Tori - Wheat/Potato, Rice- Mustard- Vegetables

- With the varietals replacement and introduction of the above mentioned cropping system, it was observed that the cropping intensity which was 200 per cent in the cluster increased upto 300 per cent.

Critical Observations by QRT on the Transfer of Technologies Achievement

- Strategies for enhancing land and water productivity through multiple uses of water low cost pressurized irrigation system, Development of diversified cropping system for irrigated ecosystem in Bihar, Development of vegetable based integrated farming system for marginal farmers of irrigated upland, scaling up of water productivity in agriculture for livelihood through teaching-cum demonstrations and Impact assessment of climate change on water resources and their productivity have shown better scope to execute them in the farmers' fields.
- Participatory integrated watershed management with emphasis on rainwater harvesting in different parts of eastern region needs special attention of the scientists.
- The KVK has been sanctioned to ICAR-RCER, Patna with some special mandate and expectation to create awareness among the farming community and equipped them with the latest technology through holistic approach taking into main consideration of natural resource management aspects while selecting the villages and farmers of different socio-economic background and located in different ecological set up required priority.

- Under irrigated condition, in rice- wheat cropping system, two models viz. farmer's practice and intensified with crop & dairy were studied and an income of Rs. 36800/- and Rs. 125700/- was obtained from one acre in farmer's practice and intensified system with dairy, respectively. Employment generation (Man days) was observed to be 226 and 757 in model I & II, respectively, indicating 3.35 fold increase in employment generation. The model has been demonstrated to farmers' during farmers training programme sponsored by Ministry of Water Resources and NABARD. But has no impact in fields and income shown per area seems to be higher side.
- Under round the year fodder production project, in rainfed system, average green and dry biomass yields varied from 16-27 and 6-9 tonnes/ha, respectively for different combinations of perennial and annual fodder. In irrigated system, average green and dry biomass yield varied from 27-34 and 9-11 tonnes/ha, respectively for different combinations of perennial and annual fodder. The technology required to be disseminated among the large number of farmers during course of training programmes.
- Scientists with specialization in Veterinary and Animal Sciences from the RCER, Patna should interact with livestock farmers twice a year at the Pashu Palan Melas to be organized at the KVK, Bihar to provide latest technological interventions for reproduction, feeding and health of the animals especially control measures for prevention of many of the diseases, vaccination programmes to improve the productivity of the animals required to plan at appropriate time.
- Animal Husbandry is one of the important components in integrated farming system along with crops/ horticulture/ aquaculture/ poultry/ duckry/ makhana etc. Though 1 acre and 2 acre models of integrated farming system have been developed in the Institute, its large scale adoption has not been observed. Technological gaps including economic impact and social acceptability may be reviewed to make technology sustainable.
- Eastern region is a poor because scarce economic resources, such condition results in rampant incidence of malnutrition cases which fill the kitty of the human health practitioners'. The poor village women can have access to nutritious supplements prepared by incorporating cheap millets in the weaning food and preparation of Soya-Sattu etc. at household level.
- Commercialization of the latest technologies be market oriented rather than increase the productivity alone.
- Location specific integrated farming system modules for farmers in general and for sizeable number of small and marginal farmers in particular needs to be developed by the ICAR-RCER, Patna in some of the selected areas of different eco-system of the districts of eastern states. Also it is essential to work out the economics to convince the farmers for their profits.
- Onion (Agra Found Light Red) performed well in some of the districts of eastern region. There is large scale production of onion in those districts. However, farmers are forced for distress sale. Introduction of AFLR on the large scale have enabled the farmers to keep the produce for longer time and to protect them from the post-harvest loss of the variety and thereby getting better price.
- Anoestrus animals can be brought under estrus following injection of $PGF2_{\alpha}$ analogue viz. cloprostenol sodium injection. With proper timing of artificial insemination and progesterone injections 'a calf a year' can be achieved. Farmers have reported

successful conception of their animals. It requires massive efforts to cover a good number of clusters of villages in different parts of the eastern states.

- Improved animal health through recommended technologies viz, enhancing nutritive value of dry fodder by urea treated straw, regular de-worming of animals, feeding balanced nutrition, treatment of reproductive problems (Herbal and hormonal treatment), proper timing of artificial insemination to achieve " a calf a year" need to be demonstrated and trend the farmers.
- QRT expressed concern over the performance of transfer of technology which has not come out to the expectation during the period of review for ICAR-RCER Patna. The Director of the complex should take care of this important task pertaining to transfer of technology by involving research and extension scientists and assigning them some of the specific areas for their involvement and consultation in participatory mode with SAUs, govt. line departments, NGOs etc.

Recommendations of QRT

- Participatory integrated watershed management with emphasis on rainwater harvesting in different parts of eastern region.
- Design, development and promotion of Pressurized irrigation system including micro irrigation suitable to small and marginal land holders.
- The modified Low Energy Water Application (LEWA) device saves energy and water as compared to for conventional surface irrigation and overhead sprinkler irrigation system, is a significant contribution of the division. Commercialisation of such device is needed and should be popularised for wider field adoption.
- Drip irrigation experiments have been carried out in vegetable and mentha-okra-potato cropping system. Higher yield, water productivity and economical returns have been reported. Such system should be demonstrated in farmer's field for wider adoption.
- The current need for covering large number of farmers and stakeholders including industries, NGOs and agencies dealing with the input and output including marketing management aspects through organizing Kisan Melas, field days, scientists-farmers interactions covering all the blocks and sub-divisions levels through participatory approach involving the SAUs and govt. line departments, district administration and NGOs
- Hybrid Napier grass as perennial fodder required to be promoted through trainings and demonstration to promote the livestock production in different parts of the district. Also it should be initiated in the cafeteria (KVK Farm) for awareness among the visiting farmers
- Year round fodder production can be made by making fodder crop rotation. Berseem, cowpea, M.P. Chari, alongwith Hybrid Napier can be incorporated for demonstration in eastern regions wherever possible.
- Diagnosis of mastitis by California Mastitis test, other diagnostics of plant and animal diseases required to undertake close contact with the farmers in collaboration with involving district line department concerned.
- Animals purchased from *haats* (local cattle market) often suffer from various communicable diseases. Farmers were made aware of the quarantine measures to be undertaken so as to check the spread. Later on, the state government has made animal vaccination available at farmers' doorstep in every panchayat by the vaccinators.

- Large scale demonstrations and trainings for Grand Naine Banana in different parts of the district to enable the farmers to get better productivity and enhancing the income of the farmers.
- Kishan Club may be created comprising of 5-6 villages in cluster under each club and the leader of the club should be trained for the application of relevant and latest technologies developed by the institute and hence he will become the main extension agent of the club.
- The potential Information Communication Technology (ICT) needs to be explored for better communication of agricultural technology.
- Package of practices may be developed for management of anoestrous/infertility in dairy animals. Awareness may be created among dairy farmers on the importance of mineral supplements including use of concentrate balanced ration for the management of anoestrous.
- Interventions of technologies in at least one adopted village near the institute and evaluate their impact in improving economy of the dairy farmers' specially marginal and small farmers.
- It is suggested to transfer all the technologies, developed by the institute and also technologies already available especially in livestock sector, to the livestock farmer's field for improving their livelihood.
- Demonstration of fish culture in trenches, rice-fish culture, horticulture and livestock production in fish pond system including cage and pen culture in chaur land requires further refinement and demonstration for wider acceptance and large impact on the target group.
- Partnership mode should be strengthened for transfer of specific agri-horti technologies to benefit tribal and primitive tribal groups of eastern states.
- Adaptive research on production of advanced fingerlings and yearlings should be undertaken in collaboration with progressive farmers for technology evaluation and standardisation to support adoption of the pond culture practices with stocking of advanced fingerlings/yearlings. This also may be introduced in suitable water logged *Chaur* and *Maun* areas for commercial production of advanced fingerling and yearlings and make fingerlings available for reservoir stocking programme providing employment opportunity for farmers and unemployed youth including women.
- Packages of practices should be developed for very small holdings of 0.2 to 0.5ha for its demonstration to interested farming community in eastern region.

CHAPTER–8

COLLABORATION AND LINKAGES WITH SAUs AND OTHER RESEARCH INSTITUTIONS

During the period of report (01.01.2006-31.03.2012), the Complex has developed several national/international linkages in order to achieve its mandate. Effective linkages exist as depicted below:

Table 5. Linkages with National and International agencies

SL. No.	Theme	Existing linkages with	
		National Organizations	International Organizations
1.	Resource inventorisation	NBPGR, NIH, MoWR, CIFA	IWMI, IRRI
2.	Development of quality cultivars of agricultural, horticultural and aquatic crops	NBPGR, NBFGR, CRRI, CIFRI, Directorate of Rice Research, Hyderabad, ICAR IIHR, CIFA, IVRI, CRRI, DMR, DRMR	IRRI, IPGRI
3.	Integrated location specific, multi- commodity farming system involving field crops, horticulture, aquatic, livestock, fisheries, crops and other enterprises.	RAU, PDFSR, NABARD, Water Resource Department, Govt. of Bihar, NHB, CIFA	ACIAR, CIMMYT
4.	Production techniques for field, horticultural agro-forestry and aquatic crops like *makhana*	BAU, CIPHET, Ludhiana	World AF Centre
5.	Integrated Water Management	CADAs, NIH, CWC, Irrigation & Water Resources Department, Govt. of Bihar, NATP	IWMI, DFID (UK), IDE
6.	Multiple uses of Water	CIFRI, MOWR, CIFA	IWMI
7.	Rain water harvesting and watershed management	MOWR, SAUs, PRADAN	ACIAR
8.	Development, testing and popularization of resource conservation technologies	PDFSR, RAU, BAU	CIMMYT
9.	Management of flooded and flood prone and water congested areas	SAUs, MOWR, GFCC, NIH	IWMI
10.	Risk analysis and management	IIT, NIH, IMD	IWMI
11.	Animal husbandry and fisheries practices and potentials	NBPGR, NBFGR, IVRI, NDRI, CIRB	ILRI, World Fish Centre

12.	Introduction and evaluation of package for aquaculture	CIFA, CIFRI, RAU	WFC
13.	Livestock and Fish Production	CIFA, CIFRI, OUAT, CIRB, Hisar, CIFE, Govt. of Bihar, Haryana	ILRI, WFC
14.	Seed and Plant material production	BAU, IIVR, IIPR, IIHR	IRRI
15.	Technology assessment, refinement and dissemination	RAU, BAU	-
16.	Socio-economic and policy research	NCAP, NHM, ATMAs, NGOs	GY Assoc., UK
17.	Transfer of technology	RAU, BAU, VSFDA, Vaishali, IARI, KVKs, NABARD	-
18.	Human resource development	NCAP, NAARM, IASRI, SAMETI, Jharkhand, R.K. Mission	CG Centers
19.	Networking Research	RAU, BAU, CSWCRTI, CRIDA	IWMI, IRRI, IFPRI

Linkages with Clients/ End Users

The Complex will have a full-fledged programme on Networking and Consortium with objective of providing research and developmental support to (i) Integrated Research System, (ii) Policy Issues, (iii) Service Delivery System (iv) Public-Private Partnership (v) Agri-Business & Agro based Development Industry. The programme will further emphasize on planning, coordinating & implementing research and development programmes which will cater to the need of the stakeholders in agriculture including agro-industry & entrepreneur of agri-Business. The modalities of establishment of a consortium of ICAR-RCER with other ICAR Institutes, SAUs, Private Organizations, NGOs, Public Sectors will:

- **Provide** guidance/direction for identifying researchable issues and setting of priorities.
- **Enable** formulation and Implementation of networking/ mission mode research project for addressing critical issues of common interest.
- **Encourage** resources mobilization & financial management.
- **Coordinate** administration, harmonize, promote team spirit and capacity building.

Programme will undertake NRM research, development and consultancy assignments in all the aspects of agriculture including horticulture, livestock and fisheries etc. involving multidisciplinary team of scientists.

CHAPTER–9

NEW INITIATIVES FOR NEXT FIVE YEARS (2012-2016)

Eastern region of India endowed with natural resources but its potential opportunities could not be harnessed in terms of improvement pertaining agricultural productivity, poverty alleviation and livelihood. There is large gap persists between potential and existing productivity of major crops including, horticultures, vegetables, livestock, fisheries and aquatic crops in the eastern region. The region has more than 69 per cent marginal farmers having small and fragmented land holdings which come in the way of the adoption of latest technologies available for different farming systems. The region has more than 7.5 m ha area under acidic soils and 3.81 m ha sodic soils. Plateau area, characterised by nutrient-poor red, yellow and lateritic soils, undulating topography and high rainfall are subjected to run off, soil erosion and land degradation.

Ground water utilization in this region is also meagre, therefore, more than 70 per cent area is rainfed. The region also suffers from various bio-physical constraints such as water congestion and flooding during kharif. No doubt the eastern region has the potential for carrying out the Second Green Revolution through holistic management of land, water, biomass, horticulture, livestock and human resources. For this, focus would be on sustainability, crop diversity and community based management of natural resources. It is, therefore, required to look forward for a very comprehensive holistic approach using collaborative mechanism that take account of the social, economic and environmental aspects of natural resource management on priority.

During coming five years some of the desirable initiatives have been projected For 12^{th} Five Years Plan based on the QRT visits to different states and organizations functioning in eastern regions and also taking into consideration vision 2030.

1. DIVISION OF LAND AND WATER MANAGEMENT (DLWM), PATNA

- Agro-ecological approaches combined with institutional innovations concentrated on farmers as first with special consideration for women empowerment. This would lead to better livelihood for farmers and their food security, besides, environmental sustainability. Scientific research has already identified a good number of appropriate technologies that can be helpful in reducing adverse impacts of the natural resource base (drought and flood) while increasing productivity. However, there is urgency for large scale validation, refinement and testing of developed technologies in order to mitigate such effect of natural resource base.
- Priorities to increase the water productivity per unit area, in different agro-climatic situations of eastern states through advanced technologies available by fixing the target for the period in question.
- Rehabilitation of different water ecologies through determent community involvement both for generation of employment and developed livelihood improvement of resource poor farmers particularly those having surplus man power idle.
- Harnessing the potential of pressurised irrigation systems for improving water use efficiency and reducing the input cost through technology up-scaling with the involvement of multi institutional machinery.

- Adequately planned with fixed targeted areas for sustained agricultural intensified activities for higher productivity and quality output from shrinking land and water resources through use of non-conventional energy sources to meet out the cheap energy requirements through developed and duly identified infrastructural support .
- Seventy per cent of the total geographical areas are rainfed in the eastern region; therefore, most effective harvesting techniques for rain water collection and storage besides proper utilization needs to be promoted and given top priority during coming five years.
- The rainfed areas required special consideration for diversification with most appropriate identified varieties of crops suiting to the local conditions and natural resource conservation. Resource conservation technologies (RCTs) and organic farming needs to be promoted in order to meet out the emerging challenges of sustainability in upland eco-systems.
- Economic based crop diversification in rain fed agro-ecosystem, organic farming and water management in flood prone areas required to be addressed in order to increase the agricultural production.
- Appropriate technologies are available for integrated farming system which needs to be replicated in similar agro-climatic zones to achieve the food and nutritional security, besides, integrated watershed management and restoration of degraded lands through intensive efforts of agroforestry interventions in the plateau areas of hill region.
- Amelioration of acidic and saline soils, judicious use of ground water and rainwater harvesting are other important aspects. Natural resources data base at farm, local catchment and regional scales need to be developed with a continuous process for development of sound policies and programmes for better management of natural resources.

2. DIVISION OF CROP RESEARCH, PATNA

- More than 40 varieties of rice, 20 varieties of wheat, 1 each of jute, sunflower, castor, safflower, have already been developed and released for eastern region, besides, Swarna sub-1 has shown its good impact in irrigated ecosystems. However, during the visits of the QRT, it was felt that state agriculture departments of different states need to be motivated to select appropriate varieties suiting to their states which need to be promoted for enhancing the production and productivity.
- Precision farming is also an emerging area of research for resource conservation and improving productivity, new technologies on value addition, fruit safety and greenhouse gas mitigation have great scope in the region.
- The technologies are also available for production, nutrient management, insect-pest management and also for post-harvest management of major crops of the region. The efforts required to be made to popularize these technologies in the fields.
- Pest management packages need to be developed so as to harness the high yield potential of improved varieties.
- There is an urgent need of quality and in large quantity of seeds and planting materials production required to meet the requirements of the farmers through initiating seed production programme by involving farmers and other stakeholders through participatory mode.

- Integration of traditional breeding programmes with frontier technologies on genetic resource management like gene pyramiding, marker assisted selection are some of the emerging areas required to be addressed.
- Exploration, collection, conservation, evaluation and utilization of genetic resources of horticultural crops, particularly of lesser known wild edibles including tuber crops need to be conducted.
- Identification of genetic markers for economic traits in established breeds of the region required.
- Looking the small and scatter land holdings, very little ground water utilization and lack of infrastructure particularly energies are some of the major constraints preventing enhancement of crop production. These issues need to be addressed by forming small and marginal farmers association to procure the inputs jointly in order to reduce the cost of production and through institutional linkages, besides, educate the farmers for water harvesting on cooperative basis around their small holdings.

3. ICAR-RCER RESEARCH CENTRE, RANCHI, JHARKHAND

- Keeping in view the mandate of the institute, Ranchi Centre should focus on agroforestry, farming system and diversified cropping system research in Hill and Plateau region. Horticulture alone can not be sole research agenda of the Centre.
- In horticulture sector, in spite of the fact that numerous varieties of fruits and vegetables have been developed and are available with research centre, Ranchi. However, availability of seeds and planting materials is the major constraints in the horizontal expansion of horticultural crops. Ranchi centre had made a significant contribution in production of seed and planting materials but to fulfils the requirements of the eastern region, it is required to involve all the SAUs and Govt. farms including KVKs to meet the seeds and planting materials demands. There are good possibilities for promoting organic horticulture, particularly in the states of Assam, parts of Bihar, Chhattisgarh, eastern UP, Jharkhand, Odisha, and West Bengal.
- Widening genetic base of fruit crops through sexual reproduction and development of cultivars for processing industries and protected cultivation
- Creating technologies for effective economic utilization and value addition of fruits, vegetables and other underutilized crops of eastern region.
- More number of vegetable varieties should be developed and released for protected cultivation.

4. ICAR-RCER RESEARCH CENTER FOR MAKHANA, DARBHANGA

- Suitable makhana varieties be developed for higher productivity. Nutrient requirement of makhana crop including fertility status of makhana growing water bodies and agricultural fields need to be addressed.
- Identify and management the weed’s in makhana ponds affecting the production requires special attention to save farmers from their monetary losses.
- Development of harvester, seed grader and popping machines to reduce the drudgery of fisherman community.

- Technology assessment and refinement in integrated farming system mode of makhana cultivation for identifying the sustainable technology and enhancing the income of the poor farmers.

5. DIVISION OF LIVESTOCK AND FISHERIES MANAGEMENT, PATNA

I. Livestock

- The eastern region having 116 million populations below poverty line depend mainly on livestock including avian (birds) for their subsistence but the large number of non-descript livestock limits the productivity to a great extent. Special efforts required to manage the effective breeding methods such as artificial, natural and through selection depending upon the suitability to the animals and avian, besides, feeding and disease management are other important components need to be given priority for future.
- For control and prevention of emerging diseases such as Swine flu, bird flu etc., development of new generation vaccine is the need of the today.
- Evolving managemental modifications for livestock to improve the productivity especially for eastern Indian agro-climatic conditions.
- The region has the privilege of having more than 48 per cent cattle population followed by goat (31 per cent) and buffaloes (13.3 per cent), respectively. Efforts should be made for genetic improvement of these animals to make region self-sufficient in milk and meat production.
- Similarly, genetic improvements in pigs, especially in tribal areas, besides, backyard poultry production is need of the hour for livelihood improvement and nutritional security.
- Availability of green fodder is another challenging constraint which requires immediate attention of research and development scientists so as to meet the requirements of green fodder round the year.
- Formulation of feed based on locally available ingredients and enrichment through mechanical, chemical and biological means for optimum utilization of nutrients.
- Strengthening of base line data on livestock diseases prevalence by surveillance and monitoring.
- Validation of developed molecular disease diagnostic tools against location -specific animal health issues of eastern Indian states.
- Assessment of impact of climate change on livestock and fisheries performances and its mitigation.
- Conservation and exploration of genetic potential of native animals and fishes of eastern India.

II. Fisheries

- The eastern region receives high rainfall (1200-2000) and has a large number of water bodies, there is tremendous potential for fisheries development. Technologies are available for fish production and its management. However, seed availability of ornamental fish breeding and standardization of breeding techniques for indigenous fishes are some of the issues which need to be addressed in order to increase the fish production.
- Integration of cat fish (*Clerius batrichus*); Murrels (*Chnna straitus* and *C. morlius*), *Anabas testeduneous, Ompak pabta* and *O. Bimaculatus* with makhana need to be experimented.

- Evaluation and demonstration of technology for production and breeding for availability of all season quality seed of Indian Major Carps, Catfishes, and prawns, besides important ornamental fishes and their conservation which are endemic to eastern region .
- In service reservoir, composite fish culture along with duck farming yielded 5 - 6 t/ha of fishes. Stocking of Khaki Campbell ducks, @ 300 /ha of water area, could yield 43 thousand nos. of eggs, besides 24 thousand kg fresh duck droppings, which served as manure to the pond. This integrated model need to be demonstrated and adopted on large scale in the similar situations, ecology and where the service reservoir opportunities available, in different parts of the eastern region, as one of the most potential, economically feasible and socially acceptable model.
- Formulation of cost-effective supplementary feed with locally available ingredients for different species of fishes and standardization of feeding practices.
- To conduct basic, strategic and applied research with respect to fresh water aquaculture by development of brood bank & seed bank, diseases diagnostics and integrated fish farming for optimizing production and enhancing the production efficiency and sustainable utilization form fisheries and aquaculture in eastern region.

6. DIVISION OF SOCIO-ECONOMIC AND EXTENSION (DSEE), PATNA

- Socio-economic and impact assessment studies on agricultural technologies- there is need for re-envisioning research on extension approaches including appropriate training modules, capsules/modules of extension practices for the emerging areas like implication of WTO, preparedness of extension experts and farmers in dealing with issues related to intellectual property rights and availability of hybrid seeds and other inputs in IPR regime, use of transgenic, bio-regulation including bio-security, etc.
- Accelerating resource-conserving technology (RCT) adoption to improve food security and rural livelihoods.
- Development of location specific IFS models for food and nutritional security.
- In depth studies on climate resilient agriculture.
- Use of ICT for crop weather advisory services, development of expert system etc.
- Inculcating targeted research for the welfare and upliftment of disadvantaged sections of the society to achieve inclusive growth and economic stability.
- Capacity building of the stakeholders for agriculture development.
- Market intelligence in the field of agriculture development.
- Strengthening of seed production channel to meet out the seed requirement of improved varieties of agri-horticultural crops.
- For dissemination of technologies, there should be more scientist-farmer interaction at village level.
- The institute should contribute towards capacity building of trainers/supervisors of NGOs working with the farmers at grass root level.

CHAPTER-10

OVERALL ASSESSMENT

Conceptually ICAR-RCER, Patna was established looking into the necessity for multi-disciplinary institutional setup, efficiently managed and address to the diverse basic problems pertaining to natural resource management such as land and water along with crop husbandry, horticulture, poultry, livestock and fisheries, including food and nutritional security in a holistic approach. Facts remained ever since ICAR-RCER came into existence, inception of sanctioned staff strength which was originally envisaged to be met by redeployment but it could not be possible and the Complex is still facing acute shortage of scientists, technical and administrative staff. Nevertheless, some significant achievements have been made by the Complex, which is evidenced from the facts and figures given in the Chapter 3, 5 and 6 of the QRT report.

- There were expectations that the Complex would be able to contribute with the strategic and adaptive research for efficient integrated management of natural resources to enhance productivity of agricultural production systems comprising of field and horticultural crops, aquatic crops, agro-forestry, livestock, avian, and fisheries in different agro-ecological zones of the eastern region. However, strategic research did not get the desired level of momentum.
- During the meetings interactions with the senior govt. officials including Principal Agricultural Secretary/ Agricultural Production Commissioner of state Govt., Directors and officials of govt. line departments, besides, Vice Chancellors, SAUs including their head of the departments and offices, field functionaries and farmers and stakeholders of almost all the seven states falling under the eastern region, QRT concluded that thinking of the officials of state Govt. and other organizations were no doubt showing their concerns on positive side for the requirements both in terms of institutional supports and infrastructural necessity for strong linkages in order to have collaborative, partnership with the ICAR-RCER. However, some of the senior official from the State Govt. mentioned that they have not been approached and contacted properly and frequently for working out the modalities of state Govt. involvement.
- The facts remain that the activities of development through effective system of transfer of technology could not be diverted towards holistic approach to serve the farmers, clienteles and stakeholders of different parts of eastern region having diverse ecological setups but it was localized to serve mainly Bihar and Jharkhand states.
- Deep summer ploughing has been found useful in improving yield in rice and wheat. Zero tillage in wheat with DSP once in three years has also improved soil health and crop yields. Crop rotation of rice-wheat-cow pea under zero tillage with residue has been found productive and profitable due to reduction of cost of the ploughing and provided better scope for strengthening. These should be popularized among large number of farmers.
- Two models of integrated farming systems one for irrigated upland on one acre land and second on two acres land for irrigated low land have been developed. These models seem to be viable for small and marginal farmers. However, these models required to be demonstrated at farmers' fields as a viable option for these categories of farmers. It would have been better to develop such models on land holdings less than acre which would have been suited to a large number of farm families of this category living in eastern region. The models which were developed were not seen on the farmers' field for

whom these were developed. It is, therefore, strongly recommended that any integrated model developed/developing require, simultaneously to be demonstrated on farmers' fields for appropriate testing and to work out its economical feasibility and suitability before recommended for transfer of technology.

- Transplanting of maize seedling increased yield during rabi season and curtailed the crop period 20-25 days with saving of irrigation water. Economics of seeded and transplanted maize cultivation should be worked out after collecting reliable data for transfer of technology.
- Varietal development in makhana need to be taken up on priority basis since the traditional cultivars have very low productivity (1.0 to 1.6 t/ha).
- Makhana processing is a labour intensive activity and largely handled and performed by the poor women and children. The efficiency of makhana processing unit developed by the centre in collaboration with CEPHET, Ludhiana appears to be not satisfactory. Hence, further improvement/designing of the instrument is urgently needed. It is suggested that attempts may be made in PPP mode to design the machine for harvesting of seed, processing and pop finishing as soon as possible for reducing the drudgery of farmers/women involved in these activities.
- Balancing the ration in terms of energy and protein along with mineral mixture/area specific mineral mixture, thus, improving the utilization of poor quality fibrous crop residues. Urea-Molasses Mineral Blocks (UMMB) which provides energy, nitrogen and minerals is one such option which should be evaluated on cost effective basis and their impact on improving production, reproduction and health be compared to locally available concentrate roughage rations supplemented with mineral mixture.
- According to SWOT analysis which was undertaken to find out the persisting strengths and opportunities could not be activated to achieve the target because of the continue prevailing weaknesses and threats faced by the ICAR-RCER and its centre which were basically established to serve the eastern region. SWOT analysis with some a few important contents for consideration in action depicted below:

Strengths	***Weaknesses***	***Opportunities***	***Threats***
Rich natural resource endowed region	Significant number of vacant scientific positions	High potential, low productivity region	Large area with lack of sub-centres
Well defined mandate and programmes	Inadequate technical manpower	A large yield gap of crops, fish and fruits	Handling of surplus due to increase in production
Adequate provision of multi-disciplinary manpower	Poor physical and electric connectivity	Abundant untapped natural resources	Shift of agriculture labour to non agricultural sector employment opportunities
Adequate budget provision	Inadequate infrastructure in the region	Large farm workforce	Unfavourable ponds leasing policy for *makhana* cultivation and shrinking water bodies
Good laboratories and infrastructure facilities	Absence of effective value chain management	Complementarity due to existence of ICAR institute, SAUs and NGOs	Alarming growth in population and widening land: human ratio

Recognised by national /international funding agencies	Inadequate transfer of technology mechanism (ICTs), service delivery system	Possibility of multi-disciplinary research through public-private partnership	Genetic erosion of native germplasm in horticulture crops due to crop substitution by commercial horticultural species
Outreach extension activities	Lack of residential accommodation	Potential for national and international bidding for competitive grants	Transboundary disease incidence in livestock

- The policy makers in general and ICAR in particular decided to establish the ICAR-RCER for agricultural development of eastern region. Nearly, decade has past and till the complex is not able to show its impact to the extent it was expected. During the first five years, the activities for the establishment of the Complex were being carried out which might have not given adequate opportunities for research and extension priorities. However, from 2006-11 there were significant achievements but somehow the impact was not much in the fields which required attention of the research scientist to move in the villages to demonstrate integrated farming system model and bring out an elaborate roadmap by identifying major challenges and bottlenecks.
- Keeping in view the strategic importance of the institute for providing research support for agriculture development in the eastern region, the Brainstorming session on "Second Green Revolution: Strategies for Agricultural Transformation in Eastern India" was held on 11-12th December, 2010 at ICAR-RCER, Patna. The programme was attended by stakeholders, farmers and official of line departments of different states and scientists. The technologies available for immediate popularization were found in good numbers covering major domains of natural resource management (63 nos.), horticulture (90 nos.), crop science (72nos.), animal science (08 nos.), fisheries (16 nos.) and PHT/mechanization/natural products (47 nos.). QRT observed that these technologies have not been popularized among the farmers as yet. So, some of these technologies need to be identified and popularized by different divisions/centres including KVK of ICAR-RCER and also create awareness covering a large numbers of farmers' belonging to different categories and operating in different agro-ecological zones through integrated and participatory mode in eastern region in different phases.
- Looking the impact of some technological breakthrough efforts made and demonstrated among the farmers of Bihar and Jharkhand could not be replicated to other states of the eastern region. When these states have also potential opportunities to contribute in bridging the productivity and yield gaps.
- Since the complex has to play the role of a nodal research institute for the eastern region, networking of the research is needed for which provision has to be made in the budget.

  There has to be complementarities between the Complex and SAU's since the SAU's have inadequate funds and adequate manpower whereas the Complex has inadequate manpower and adequate facilities. Under such situation, both the organizations jointly plan and formulate some strategy for complementary and supplementary role in order to bridge the existing production and productivity gaps, covering quite large number of areas in eastern region.

- Innovative integrated models and technology developed by ICAR-RCER found lack of awareness among the farmers which was observed by the QRT. However, the Ranchi centre has made a commendable and significant achievement in serving the farmers of the Jharkhand and other states of this region. The state departments and that too even secretary agriculture/agricultural production commissioner was expressing his ignorance about such efforts made by the Ranchi centre when Chairman Dr. R. P. Singh and members of the QRT met in the office of the Agricultural Production Commissioner for discussing the possibilities of the desirable coordination and collaboration with the state government and the liner departments. It is, therefore, QRT felt that innovative research needs to be highlighted not only among the farmers but also to reach policy makers through print and electronic media even by inviting them to show the impact on the farmers' fields.
- Division of socio economic and extension required for coordinating and collaborating with other divisions and line departments, however, resources were not matching to carry out their such important activities by the scientists of the complex. KVK's, reliable NGO and other research and development organisations in the region can also play important role through participatory approach, self-help groups etc.
- Under scaling up water productivity project, 50 farmers' in each training programmes of one week duration covering 2500 farmers/women/youths and trainers' training programme covering 25 extension functionaries of Bihar were conducted. A **Knowledge Test** developed to assess the impact of training in terms of enhancing the knowledge level due to training programmes. During the course of discussion with the concerned divisions it was felt that such training programmes should be organized for the skill developments through adequate planning including relevant course contents and finally a training manual should have been brought out for the trainees as a reference material during their field activities.
- QRT observed that the cost of cultivation taking all minor components into account should be workout to know the economic benefits of each technology for convincing the farmers and stakeholders for their further adoption.
- In the absence of desired large scale public contact by ICAR-RCER have not been able to make required contributions for the last six years. The involvement of Division of Socio-economic and Extension, Patna with different scientists could have been possible through active role played to create the awareness pertaining to ICAR-RCER functioning and by highlighting their achievements through success stories.

As far as concerned about the rating of the ICAR-RCER, Patna and its two centres located at Ranchi, Jharkhand and Darbhanga in Bihar, QRT interacted for a quite long time on various issues related its contributions and achievements made individually by the complex and its centres. QRT sincerely identified some of the bottlenecks like non-availability of desired land and recourses for planning the different research experiments and looking the task and mandate given to serve eastern states for overall agricultural development through generated and tested technologies and their transfer through limited frontline demonstrations. It could not be made possible to the extent it was expected, may be also due to inadequate scientific, technical and administrative manpower. QRT also critically examined the significant and outstanding achievements made by the institute. **In view of the achievements, contributions and analysis done for rating the merits of the institute, QRT is pleased to recommend putting the ICAR-RCER, Patna under the category as "Very Good"**

CHAPTER-11

CONSOLIDATED RECOMMENDATIONS

The recommendations have been consolidated and reported based on the Research & Development activities carried out successfully during the period (01.01.2006-31.03.12) by the different divisions of the institute at headquarters, Patna and its research centres' including KVKs, besides, taking into considerations the vision and mission of ICAR-RCER.

Consolidated recommendations have been projected as under:

1. NATURAL RESOURCE MANAGEMENT

Weather based forecast for land use planning is essentially required keeping in view the frequent vagaries of monsoon in eastern region. Forming up of forward looking research agendas on bio-technologies and use of ICT in agriculture, besides, capacity building of the scientists and other stakeholders in the areas of innovative technologies generation needs to be addressed to increase food production.

A new model of development is required considering the urgency to copping with climate change. Apparently, successful adaptation will require not only new crop technology and increased investment on water security, but also policy backup to give small scale, subsistence farmers for better access for information, credit and market linking. Understanding this input will help clarify the specific adaptation to both policy makers and farmers.

- It is necessary to develop climate resilient agriculture including CA practices and efficient natural resource management to ensure food security in eastern region. There is urgent need to develop new and cheap farm machinery implements for performing agricultural operations economically due to shortage of labourers in this region. Linkage should be developed with ACIAR, ICARDA and DFID for effective implementation.
- For eastern region, urgency of drought combating action is required by establishing task forces partnership consortia of all the stakeholders, irrespective of their public and private status, to solve the drought problems involving Central and State Governments.
- There is a lot of variation in the soil fertility under different ecological setups in the region, therefore, it was desirable that soil fertility maps would be beneficial to the farming communities.
- The accelerating pace of research on natural resource management for sustainable agriculture being most important components for the region demands periodical review and updating of the knowledge of the extension functionaries.
- With the current emphasis on agricultural research for development (ARD) which includes conservation of agriculture with high yielding varieties, the priority requires to be given to the management of natural resources such as land, soil, water and biodiversity.
- Restoration of degraded lands through agro-forestry interventions and amelioration of acidic soils is essentially required so as to sustain the livestock population in the region.
- Harnessing of solar power to enhance agricultural production.

- Optimum use of water resources through improved water application and water conservation technologies.

- Raising productivity of rainfed agriculture through 'green water' management and watershed management research in uplands of eastern plateau and hills.

- Soil testing mobile van equipped with soil testing lab facilities can be launched with the involvement and assistance of scientists working in ICAR, SAUs and state Government combining together

- Development of appropriate models for conjunctive use of ground water and surface water and increasing awareness among farmers for its implementation.
- Development of plan for disaster management (Floods, droughts and climate change) need to be taken up.

2. CROP PRODUCTION AND HARNESING THE POTENTIAL PRODUCTIVITY

- A road map for sustainable agriculture having estimations of existing agricultural production/productivity and potential production/productivity which are not being exploited by the adoption of the available technologies in different districts of Eastern states showing the major bottlenecks and strategies to be adopted to reduce the gap exists.
- The potential productivity of rice among eastern states of rice can be achieved of the total additional production 6.46 m tonne could be achieved paying attention towards rain fed ecosystem giving maximum from only Chhattisgarh i.e. 3.19 m tonne and lowest 1.03 m tonnes from Assam.
- Similarly by exploiting potential productivity wheat, additional production of more than 1.94 tonne mainly from irrigated ecosystem. There is a potential scope to increase the production by increasing the area under maize cultivation in Eastern UP for which the efforts of ICAR-RCER required, however, even having the existing cultivated area under maize in West Bengal and from other irrigated ecosystem, additional production of 0.3 m tone can be achieved.
- Taking into consideration of above mentioned statistical data provided by the ICAR-CER and additional production of 14.6 m tonnes for cereals possible in the eastern region without increase in the area. Similarly, there is a scope of additional production i.e. 0.44 and 0.17 m tonnes of pulses and oil seeds, respectively. Needles to mention that rainfed ecosystem contribution can go up to 79 per cent of total pulse production. In case of oil seeds, the additional production could be achieved only from irrigated ecosystem.
- Insect pests of rice-wheat cropping system of Patna district of Bihar has been monitored in different years. Populations of various insects pests have been recorded. Similarly rodents species have also been identified which damages paddy and wheat crop at various stages. QRT felt that such work has already been done by the scientists of SAUs. It was observed that there is need to work and monitor insect pest in relation to climate change and develop suitable specific IPM practices for devastating insect pests in partnership with the farmers for field testing.
- Development of crop varieties having tolerance to biotic and abiotic stress under climate change regime.

- Ensuring intellectual protection of genetic resource through IPR strategies.
- Development of location-specific integrated pest and disease management technologies.
- Post-harvest management focused on value addition and shelf life.
- Crop-livestock and environment interactions including development of area specific mineral mixtures.
- Introduction of short duration pulses which are tolerant to heat and diseases, and kharif pulses in marginal lands to ensure nutritional security.
- Crop diversification in rainfed upland plateau from low productive rice to alternate cereal, pulses and oilseeds.
- Balanced fertilization including research on restoration of organic carbon pools.
- One acre and two acre IFS model developed by the institute seems profitable. Though Govt. of Bihar has adopted these models in 534 blocks and also giving subsidy @ Rs.10,000 to each farmer, similar models may be extended to other Eastern States.

3. HORTICULTURE AND AGRO-FORESTRY POTENTIAL

In case of fruit crops, West Bengal has highest productivity of pineapple, cashew, areca nut and coconut as compared to other eastern states. Jharkhand is famous for high productivity of mango, citrus and litchi. Similarly, Assam, Bihar and Eastern UP are popular states for higher productivity of guava, banana and papaya, respectively. By exploiting the potential of mango in states of eastern region, an additional of 4.97 tonnes is possible (from rainfed 2.85 m tonnes and from irrigated condition 1.99 m tonnes). In case of banana additional production of 1.80 m tonnes are possible. Likewise, additional production of 0.504 m tonnes of guava is possible.

- Citrus is planted almost in all states of eastern region and popularly known as lime or lemon, additional production of 0.23 m tonnes is estimated of existing level of production.
- In increasing the productivity of different fruit and plantation crops to their potential productivity level in respective production system, an additional production of 8.09 m tonne of total fruits could be achieved, which will be 57.28 per cent of the total existing fruit production. Enhancing the production for value addition, intensive efforts needed to reach the masses to convince them for effective processing both in rural and urban areas of eastern region covering all the seven states.
- Research on development of multiple stresses- tolerant and climate resilient agri-horti crops. Special attention could be given to introduce crops like barley and millets which are hardy and can be grown under harsh environmental conditions, particularly in plateau and hilly region.
- Export prospects are brighter with the adequate production of fruits and vegetables by small, marginal and large farmers in almost all the states of eastern region. Therefore, the production cannot be taken as favourably from the economical point of view unless and until emphasis on value addition is given through export promotion venture.
- Establishment of pack house with cold storage facilities for better handling of horticulture produce.

- In view of shrinking land resources, it is important to develop need based multistoried cropping system and high-density planting in other fruit crops like banana, litchi, sapota etc.
- Agro-forestry in the context of carbon trading programmes provides good opportunities for the region, particularly in hill and plateau region.
- **Agro-forestry:** Agro-forestry is the most efficient farming system to provide sustained return to the farmers hence, research work on agro-forestry should be initiated.
- Detail data on the effect of agro-forestry models on nature and magnitude of amelioration, hydrology, microclimate, soil erosion, environmental ecology, litter fall and its decomposition rate and nutrient recycling and carbon sequestration under agro-forestry models will be of immense practical value.

4. IMPROVED CULTIVATION AND MANAGEMENT OF VEGETABLE CROPS

Vegetables among various eastern states, eastern UP ranks first in productivity of brinjal, tomato, potato and spices. Similarly, Jharkhand has highest productivity of okra, peas and onion, whereas, WB has highest productivity of cauliflower. By improving the productivity level of different states, additional production of 3.54 m tonnes of potato is possible. Similarly, an additional production of 3.30 m tonnes of tomato is possible from rainfed and irrigated ecosystem. In case of brinjal, one of the most popular crops of eastern states, an additional production of 2.78 m tonnes is possible. Likewise, additional production of 1.43 m tonnes of cabbage and 0.67 m tonnes of cauliflower is estimated.

- In case of spices, increasing the productivity level, an additional production 0.14 m tonnes is possible.
- Hence, by increasing the productivity level of different states to the potential level under respective production condition additional production of 13.85 tonnes of vegetable is possible which accounts for 21.4 per cent increase in total current production without any increase in the area of vegetable and spices crops.
- Improved composite mechanical harvesters, graders, packing machine and popping machine required to be developed in collaboration of CIAE, Bhopal and CIPHET, Ludhiana.
- Research on organic production and protected cultivation of high value vegetables should be taken up.
- There is need to modernize nursery for mass propagation of quality/genuine plant materials of fruit crops and quality seeds of commercial vegetables so as to meet out the requirements of the stakeholders

5. INTEGRATED CULTIVATION AND MANAGEMENT OF MAKHANA

Makhana cultivation may be integrated with suitable fish species specially, air breathing fishes (Magur/Singhi) and periphyton feeding small fishes like *Ompak pabta* to utilize the available space, feed, and nutrients. However, proper environmental requirements for fish need to be provided in such integration. It was also suggested to incorporate animal components alongwith makhana cultivation and study the feasibility and economics.

- The performance of all the collected germplasm of makhana should be characterized, evaluated and tested against different input requirement for higher productivity.

- Survey on diseases affecting makhana cultivation should be initiated to identify and documentation for taking the remedial measures and treatments to be recommended for the control of diseases.
- Formulation and implementation of long term leasing policies on water bodies for promotion of aquaculture and aquatic plants (eg. makhana, water chestnut etc.) are also needed.
- Chemical composition of makhana with special reference to Vitamin A, B, C, and anti-oxidant should be assessed for preparing a nutritional profile including medicinal scope of makhana on priority basis with close collaboration of CFTRI, Mysore and NIN, Hyderabad.
- Economics of different inputs and integrated farming system of makhana cultivations viz. makhana-paddy, makhana-fish, makhana-water chestnut required to be worked out.

6. LIVESTOCK PRODUCTION AND MANAGEMENT

Awareness may be generated to produce clean milk, keeping in view the human health. Diagnosis of mastitis especially sub-clinical mastitis may be emphasized by using standard SLST and BTB tests and farmers may be trained for this purpose and advised to adopt control measures like teat dipping etc. (Betadine – Glycerine teat dip) to significantly minimize losses due to mastitis. As antibiotic resistance against common mastitis causing bacterial organisms have markedly increased, thus; also identify common bacteria associated with mastitis through cultural sensitivity test (CST) and their anti-bio gram studies in collaboration with concerned scientists from Veterinary Colleges of eastern region for its effective treatment.

Most of the breeding technologies applicable for improving the productivity of cows and buffaloes are well documented and only needs to be fine-tuned and put it in practical shape by coordinating with various dairy development agencies of the region. Crossbreeding program needs to be strengthened by using semen of proven crossbreed bulls. Similarly, improving the productivity of buffaloes by using germplasm of progeny tested buffalo bulls needs to be undertaken. Productivity of dairy animals is directly related to their reproductive efficiency.

Degnala like disease, also very commonly seen in dairy animals in Bihar, usually occurs due to prolonged feeding of wheat and paddy straw especially feeding them during winter and rainy season. This condition mainly occurs due to growth of fungus, *Fusarium spp.* which multiplies in improperly stacked moist straw. The toxins of this fungus when ingested by dairy animals' results in Degnala disease. Thus, proper drying of the straws in sunlight prior to feeding can markedly prevent the development of the disease. Standard treatment measures **recommended to** the dairy farmers also.

- Each eastern state needs a strong breeding policy for livestock in order to increase milk and milk product availability. Veterinary service delivery systems also need to be strengthened.
- Livestock production system, especially goat husbandry needs special attention keeping in view the livelihood of marginal, sub-marginal and landless farmers.
- Looking the change of food habits and existing availability of avian (birds), Van Raja, Giri Raja, Dibyan, quail etc. required large scale adoption in general and especially for resource poor and landless farmers not only for their livelihood but also for nutritional security.

- Boron application has been found useful in enhancing the seed setting in barseem. This technique needs to be standardized for commercial adoption by the farmers in order to meet the requirements of milking animals in eastern region which is the basic requirements looking the advance process of livestock sector.
- Scientists with specialization in **Veterinary and Animal Sciences** should interact with livestock farmers twice a year at the Pashu Palan Mela's to be organized at the KVKs to provide latest technological interventions in the production, reproduction, feeding and health of the animals especially control measures for prevention of many of the diseases including vaccination programmes to improve the productivity of the animals.
- It was recommended that scientists pertaining to Animal Sciences should adopt significant number of dairy farmers in the region following integrated farming system and provide technological interventions to improve their profitability and evaluate the impact.
- Livestock sector today accounts for 26.5 per cent of our total agricultural output and dairy being one of the important components for livelihood security for all categories of farmers. It is, therefore, recommended that it should be included in all integrated farming systems along with crops/ horticulture/ aquaculture/poultry/duckry/makhana etc.
- Animal health is a foundation for promoting animal products. Despite increased relevance and importance given to various livestock development programs, livestock diseases have severely impeded the growth of the industry due to heavy economic loses to the dairy farmers.
- A roadmap required to be developed for eastern region depicting season wise incidence of gastrointestinal parasitic diseases, tick borne including other haemo-protozoan diseases as well as other common infectious diseases especially HS, FMD and PPR and Blue Tongue, thus, appropriate treatment, where ever applicable, and control measures need to be recommended for these diseases.
- Brucellosis and Leptospirosis are zoonotic diseases and dairy farmers must be made aware regarding their spread to human beings. Female calf-hood vaccination against brucellosis should be recommended to check the spread of disease. Through a campaign on vaccination schedule against FMD and HS need to be popularized among farmers to be undertaken twice a year to prevent the occurrence of these two important diseases.
- Survey and characterization of indigenous livestock breeds in eastern region by conventional as well as molecular approaches need to be done.
- Development of area specific mineral mixture required for effective planning of livestock development programmes. Division of livestock and fisheries management should develop mineral mapping on the basis of agro-climatic zones of eastern region.
- Inventorisation of feed resources and identification of herbs and plant extracts as growth enhancers and as anti-methanogenic agents.
- Package of practices on the development of management strategies for anoestrous/infertility in dairy animals required to be documented. Awareness may be created among dairy farmers on the importance of mineral supplements including use of concentrate balanced ration for the management of anoestrous.

- Management practices may be developed to minimize losses due to acute heat stress in livestock by providing economical shelter management including growing of shady trees and adopting therapeutic measures.
- Strategy may be developed to produce green fodder for dairy animals round the year especially required to create awareness among the dairy farmers for growing Napier grass that will supplement green fodder availability during lean periods.
- Package of practices for intensive rearing of Black Bengal goat, which is very prolific goat breed, should be developed and given to the small and marginal farmers for improving their livelihood with a small investment.
- Many of the research studies especially related to diseases of livestock could be undertaken in collaboration with the scientists of Veterinary Colleges, with whom ICAR-RCER has linkages.
- Most of the breeding technologies applicable for improving the productivity of cows and buffaloes have been well documented and needs to be assessed for fine tuning and refining them for coordinating with various dairy development agencies of the region. Crossbreeding programmes need to be strengthened by using semen of proven crossbreed bulls. Similarly, improving the productivity of buffaloes by using germplasm of progeny tested buffalo bulls needs to be undertaken.
- There is breeding policy in the state of Bihar based on the agro-climatic region. However, the norms of breeding are not being maintained at fields level. Semen from proven progeny may be brought out and AI card of individual dairy animal may be maintained.
- Jersey cross is performing well in field conditions. Farmers in certain regions have preference on Jersey crossbred cows due to its higher fat content, more resistant to diseases, less feed intake and better adaptability in the environment. Division of livestock and fisheries along with the scientist of Veterinary Colleges by involving division of socio-economic and extension need to be associated to workout economics of Jersey breed and other cross breeds maintained by the farmers to compare the additional monetary gain.
- Improving feed utilization employing scientific techniques.
- Conservation and genetic evaluation of indigenous breeds of livestock using conventional and modern techniques.

7. INTEGRATED FISH FARMING SYSTEM

- Technological interventions for improving livestock and fishery health and production management.
- Aquaculture is linked with fish health management to protect production loss and quality assurance, a study may be initiated to know the disease prevalence in the eastern region in collaboration with the fish health management scientists.
- Development of agricultural, horticultural and aquatic crops based location specific fish farming system models and diversification of fish species with locally available important species for commercial production and genetic stock conservation.
- Conservation and genetic evaluation of indigenous breeds of fishes using conventional and modern techniques.

- The propagation of technology of hatchery seed production among the farmers is appreciable as this will ensure the fish seed availability to the aquaculture practicing farming community who are likely to make use of water bodies for enhancing the fish production.
- Carps were cultured successfully for the first time in makhana ponds. Govt. of Bihar declared incentive for promotion of scampi farming.
- Through the efforts of the institute, the State Govt. was convinced to declare magur (*C. batrachus*) as State Fish of Bihar.
- Change in leasing policies of ponds has been implemented by the Govt. of Bihar.
- Demonstrated Aquaculture interventions under FPARP project for enhancing livelihood of small farm holders in a floodplain wetland.
- Eastern Region has abundant seasonal water bodies particularly in north Bihar, their potential has to be utilized by enhancing the aquatic productivity for livelihood improvement.

8. SOCIO-ECONOMIC AND EXTENSION MANAGEMENT & POLICY INTERVENTION

In the light of spatial and sectoral changes in agri-rural environment, adequate evidences are available to suggest that agricultural growth rate can be further boosted up if appropriate extension policies and strategies are adopted. Adequate attention needs to be paid to agriculture sector for promoting inclusive growth through technology transfer. The transfer of technology is a complex and continuous process. Thus, there is no alternative but to increase and develop trained professionals in the field of transfer of technology to achieve desired goal.

Today the public extension system is generally seen as inadequate to the enormous challenges of the new development needs in agriculture. Evidently, the simple, single purpose extension system is unable to handle the multiplicity of problems and needs that require to be addressed in the context of a fast changing agriculture. The agriculture sector at present is seen to be made up of two distinct segments - the farming segment where the production activity takes place; and the non-farming segment which embodies a range of backward and forward linkages, providing the essential pre-production and post-production services to farming.

Young Farmers can establish and operate climate risk management centers which will help farmers to maximize the benefits of good monsoon and minimize the adverse impact of unfavorable weather. Educated youth can help to introduce the benefits of information, space, nuclear, bio – and eco – technologies. Eco - technology involves the blend of traditional wisdom and frontier technologies. This is the pathway to sustainable agriculture and food security, as well as agrarian prosperity. If educated youth choose to live in villages and launch the new agriculture movement, based on the integrated application of science and social wisdom, our untapped demographic dividend will become our greatest strength.

- There is a need to have strong linkage among farmers-agricultural marketing-agro-industries-consumer and agricultural production system as 'what to produce', 'how much to produce', 'how to produce' and 'for whom to produce'.

- Eastern region has great potential for expanding its export of processed products in view of the increasing production of fruits and vegetables, dairy products, meat, and marine products etc. The practice of contract farming is coming up around such processing centres. More and more processing facilities for such commodities need to be augmented.
- In view of tremendous potential for export of fruits and vegetables, it is necessary to give greater attention to grading and Packaging of these commodities by creating required infrastructural support.
- Eastern region has enormous inherent potential for diversification and scope to introduce new areas in agricultural production such as hi-tech horticulture, precision farming, organic farming, integrated farming etc.
- A strong infrastructural support has to be developed in terms of cold storage chains, transport, credit support, market information and insurance to fully exploit opportunities for export.
- Agriculture has to become more cost effective to meet the growing challenges and opportunities arising out of WTO agreements and the consequent globalization impacts. For this, future growth of agriculture has not only been yield based but should be tilted towards ensured demand in the national and international markets.
- Division of socio-economic and extension (DSEE) should work out the strategy for population that can be adequately fed and also helped reducing hunger without adversely affecting the natural resources such as land, water and environment. It requires collective efforts of scientists from different disciplines of the institute and coordinated by social and extension scientists from ICAR-RCER including its centre located at Ranchi and Darbhanga.
- Carrying capacity of Indian agriculture, science based estimates, for sustainable carrying capacity (CC) of agriculture for different agro-climatic zones of eastern states for fast upgrading to fulfil the gaps. Such estimates can be advanced at block levels through participatory approach for planning sustainable agricultural development.
- Awareness required to be created for the concept of carrying capacity through media and extension personnel of states falling under eastern region required to take action after having firm policy decision for agricultural advancement to reduce the productivity gaps.
- During the visits of the QRT to some of states and after having interactions with the officials of the state government including Principal Secretaries/Agricultural Production Commissioners and their line departments, besides, SAUs including Vice-Chancellors, HoDs, their dean Directors and scientists, QRT felt that in some of the state's technology works well and its impact is visible in the fields. However, there are some states where technology is there but it does not work well.
- ICAR-RCER and its centres along with KVKs, State Governments, SAUs interface meeting required to be held at periodical intervals jointly and collectively interacted on different issues urgently required for decision. It needs to be identified a few states from the eastern region. For each state to coordinate, review the progress and to assess the factors affecting adoption of technologies, one of the scientists be made incharge of the state for coordination and to give feedback for further research to solving the problems faced by the farmers and stakeholders.
- Models of integrated farming systems suiting to different parts but for some parts of the region it requires high level coordination between the state governments, SAUs and

ICAR research institutes including NGOs, farmers' organisations and farmers' representing to each categories of small, marginal, medium and large farmers to meet pre and post crop production to review the progress and identify the factors affecting production and productivity.

- It was observed that livestock and animal husbandry development is coming out in the states and appears to be economically sound for sustainable livelihood and nutritional security. There are some colleges of veterinary and animal sciences under SAUs but the states governments have not taken the benefits of their services for promoting livestock development. Moreover, their desired involvement in research and extension lacking behind and as such extension education activities are not up to the desired level.
- In view of the shortage of labour availabilities for the completion of timely operation of crops and livestock production and disposal, mechanisations became only the alternative and now consider fundamental needs of the hour.
- Though, a number of technologies are available, institutional mechanism for bringing about paradigm shift in agriculture production is necessary. Infrastructure for post-harvest management and establishments of cold storage facilities should receive greater attention for promoting fruit, vegetable and commercial floriculture in the region.
- The inter-institutional linkages, training to stakeholders to address multitude of natural resources management problems and increasing agricultural productivity in a sustainable manner need target setting and mission approach for addressing the problems.
- Efficient cropping system rice-wheat-cowpea and rice-maize-potato have been developed with CIMMYT and IRRI as futuristic food production system for food security, natural resource saving and increase income. There is a scope to standardize the findings and statistically tested for its economic benefits to the farmers before transferring the technology to the farmers.
- Development and popularizing resource conservation technologies for enhancing total factor productivity and input use efficiency.
- Evaluation of ITKs and plant bio-molecules in livestock and fisheries health and growth promoters.
- Identification of potential indigenous farming system for its horizontal expansion in similar agro-climatic zones.
- Capacity building of stakeholders including farmers and extension workers.
- Large scale outreach programmes in partnership with stakeholders in the region.
- Commercialization of technologies through organized intellectual property rights and benefit-sharing system.
- In age of WTO, on farm research and participatory technology or extension methodology needs to be worked out for dissemination of practices based on various standards like Good Management Practices (GMP).
- There is need to shift from conventional approach of transfer of technology to multi-stake holders prospective with major focus on farmers group, association and related civil society organization.

9. STRENGTHENING ORAGNIZATIONAL SETUP & SUPPORT FOR HUMAN, PHYSICAL AND FINANCIAL RESOURCES

- **Creation of Fisheries and Aquaculture Division in ICAR-RCER, Patna:** Eastern region comprises of 7 states having a total 2.922 m ha water with a total production of only 2.440 m tonnes with an overall productivity of only 0.806t/ha. Whereas, there is tremendous scope for enhancing the productivity and production of this region having vast unutilized water bodies available for management and aquaculture development. This can only be achieved through region specific research and extension program. Proper scientific study as well as documentation of natural fisheries resource of commercial importance of the region has to be done. Studies on fishery resource, growth and reproduction, physiological alteration, evaluation of culture potential of many commercially important species of this region, existing environmental parameters and climate resilient studies are some of the major thrust areas of this region which need to be promoted. ICAR-RCER being nodal research institute of this region, can play a significant role in generating a database and refining and developing technologies suitable for this region on the above mentioned areas. **This is only possible if separate division is created to work in this region** for the better development of the fisheries, aquaculture and fisher-folk. Keeping these facts in view, **QRT recommends for creation division of fisheries and Aqua Culture Management** with full strength of scientists for dealing with research, technology generation/refinement and its proper propagation in the eastern region. As per the mandate of the institute and to improve overall productivity of aquatic bodies following discipline has to be created with scientific cadre strength: Discipline of Pathology and microbiology; Fish and fisheries resources; Fish genetics/ Biotechnology and Fishery Extension/ Fishery Economics. To address the Fish health management and recommendations for all seven states of eastern region. Following scientific staff is to be provided in addition to the existing strength. Association of Social scientist, soil water conservation engineer and economist of the Institute with provision of adequate budget and infrastructure would be essential for smooth operation of the proposed activities:

Scientist-Aquaculture	**-**	**2 Nos.**
Fisheries Resource Management	**-**	**2 Nos.**
Fish health management	**-**	**2 Nos.**
Extension	**-**	**1 No.**

- The Institute may be made part of ICAR seed project covering crop seeds, fish seeds and animal and poultry improvement programmes.
- **Creation of Division of Livestock Management:** There is a great demand for development of livestock looking the potential scope in eastern region. Dr. A.P.J. Abdul Kalam, former president of India, in one of his recent visits to Bihar (which earlier used to be one of the underdeveloped states in India) noted that the dairy cooperatives in Bihar were a roaring success and could show the way ahead for addressing regional imbalances. The importance of traditional milk products also need to be recognized and other livestock species including goat & sheep must also be given prominence. A more deep-diving developmental effort in agriculture must go beyond this point, seeking improved resource productivity. These goals are to be pursued through improved managerial productivity.
- It is recommended that scientists pertaining to Livestock management in DLFM should adopt significant number of dairy and goat farming units in the region following

integrated farming system and provide technological interventions to improve their profitability and evaluate the impact in the fields. Keeping in view the importance of livestock sector accounting for about 29 per cent of over total agricultural output, **creation of livestock division** with full strength of scientists, technical, laboratory staff and budget for dealing with research, technology development/refinement and its proper transfer to the stake-holders in the Eastern Region.

- **One post of Scientist in the discipline of Veterinary Gynaecology may be sanctioned** for improving the reproductive potential and for effective management of various reproductive disorders in dairy animals.
- Since the ICAR-RCER has also mandate for agricultural development of eastern region spread over five different agro-climatic zones, for effective implementation of outreach programmes, some **new KVKs may be allotted to the ICAR-RCER in some of districts of the states under eastern region**.
- Extension of administrative building may be given priority during 12^{th} plan as there is space constraint for laboratories and staff rooms in the present building.
- Since the region has very high area (> 4.5 million ha) under wetlands, the **QRT strongly recommends that a Centre required to established on Wetland eco-system rehabilitation**. After thorough discussion during the meeting at AAU it was decided that the centre on Wetland ecosystem rehabilitation be established in Assam in collaboration with Assam Agriculture University. Hon'ble Vice-Chancellor, AAU, **Dr. K.M. Bujarbaruah, has kindly agreed to provide 25 ha of land and some infrastructural and technical support for establishment** of the proposed Centre under ICAR-RCER around Guhawati.
- QRT during its visit and hearing the genuine demands from the farmers, stakeholders, Govt. officials including policy makers and SAUs for utilizing the excellent facilities and land availability at Research Centre, Ranchi for conducting strategic and adaptive research on different enterprises for diversification and innovative integrated research model by assessing the requirements of the different farming systems for different states of eastern region. In view of above facts, QRT strongly recommends that the research centre, Ranchi may be named as "**Farming System Research Centre for Hill and Plateau Region"** comprising of three sections namely:

    i. **Horticulture and Agroforestry**

    ii. **Livestock and fisheries**

    iii. **Underutilized/lesser known crops**

- Keeping in view the jurisdiction and geographical area of eastern states, QRT recommends for the **sanction of the position of Joint Director to the Complex** so as to implement monitoring of various research and extension programmes effectively.
- For appropriate supervision, inspection, technical guidance and monitoring the research work at Ranchi, besides, to persuade the senior officials of the state Govt. for their effective linkages and allocation of some rural/agricultural development projects sanctioned from the Govt. of India to different state, QRT felt that the **Director of the ICAR-RCER requires to devote more time and additional visits to Ranchi Centre**.

- Looking the requirements of financial support for the ICAR-RCER in order to bridges the gaps between existing status and available unexploited potential opportunities for enhancing the profitability covering different enterprises of eastern states and thereby contributing to the national growth in 12th Plan. Members of **QRT interacted critically and recommended for at least five (5) times extra financial support** required for the most efficient functioning and coordination with different states of eastern region, also for the mobility of the scientific, technical and project staff in eastern states for significantly contributing in the agricultural development of eastern region.
- **There is a need to increase the scientific manpower** in the ICAR–RCER and its canters for efficient and better coordination with the states and other agencies operating in the eastern region. It will be also helpful in formulation of strategies to each state by allocating scientists who will coordinate with the concerned state from the complex.
- **Division of socio economic and extension needs to be strengthened** and be actively involved by different departments to arrange skill oriented training courses and frontline demonstrations with different enterprises and integrated farming systems including animal clinic for the sustainable development of production. There is generation of new technology and innovative integrated models but due to lack of good communication skills and resources have not come out from the labs to farmers' fields and to other stakeholders.

LIST OF RELEVANT ANNEXURES

Annexure-I

PROCEEDINGS OF THE QRT MEETINGS AND FIELD VISITS

PROCEEDINGS OF THE PRELIMINARY MEETING OF QRT, ICAR-RCER WITH DDG (NRM) AT NEW DELHI ON 15th SEPTEMBER, 2011

The first meeting of QRT of ICAR-RCER was held in the conference Hall of N.R.M. under the chairmanship of Dr. A.K. Singh, D.D.G. (N.R.M.) on 15.09.2011. Following members attended the meeting:

1. Dr. A.K. Singh, Dy. Director General (NRM), ICAR, New Delhi
2. Dr. R.P. Singh, Chairman, QRT
3. Dr. B. P. Bhatt, Director, ICAR-RCER
4. Dr. N. Sarangi, Member, QRT
5. Dr. G. Goswami, Member, QRT
6. Dr. I.S. Singh, Member, QRT
7. Dr. K.N. Tiwari, Member, QRT
8. Dr. S.S. Randhawa, Member, QRT
9. Dr. N. Parsuraman, Members, QRT
10. Dr. P. S. Minhas, Asstt. Director General (Soil & WM), ICAR, New Delhi
11. Dr. R.D. Singh, Member Secretary, QRT,

Some important document as background information including research achievement of ICAR Research Complex for Eastern Region, Patna for the period 01.01.2006-31.03.2012, Annual Report 2010-11 and Vision 2030 of the Institute were presented to the DDG (NRM), Chairman and all the members of QRT.

Dr. B.P. Bhatt, Director gave a brief presentation on status and constraints of agriculture of eastern region in general and research achievements of the Complex for last six years (01.01.2006- 31.03.2012) in particular. Dr. Bhatt emphasized that the mono cropping needs to be supplemented by Farming System Approach to increase resource productivity and enhancement of income. Rice cultivation may be integrated with rice-fish/ Makhana/ Singhara farming. There is a potential to increase land productivity of rice in uplands up to 3 t/ha as per a recent publication of IRRI. For non-consolidated small holdings, productivity can be increased by arranging quality seed, timely supply of critical inputs like fertilizers, chemicals and water. Further, the region needs adoption of diversification in an aggressive mode. There is a strong possibility of replacing wheat with winter maize whose productivity in Bihar is highest in the country. Since the complex is to play the role of a nodal research institute in the eastern region, networking of the research is needed for which provision has to be made in the budget. There has to be complementarities between the Complex and SAUs for agricultural development. Since the Eastern Region has abundant seasonal water bodies particularly in north Bihar, their potential has to be utilized by enhancing the aquatic productivity for livelihood improvement.

Dr. R.P. Singh, Chairman, QRT along with team members appreciated the ICAR for giving them an opportunity to review the work of ICAR-RCER, Patna. Responding to Dr. A.K. Singh's remarks, Dr. R.P. Singh expressed that the Eastern Region has lot of potential and natural resources, which are still remain un-tapped in the region though the people are intelligent and hardworking but the local conditions are not conducive.

Dr. B.P. Bhatt, Director and Dr. R.D. Singh, Member Secretary interacted during the meeting and provided inputs to the queries made by the Chairman, QRT & other. Chairman after hearing members of QRT and officials of ICAR realized the necessity to visit the eastern states beside the Patna and its research centre including KVK. Chairman also tentatively fixed the visit of QRT on 13th – 15th October, 2011 for first meeting at Patna and

requested secretary member to mail the Report of Quinquennial Review Team (2001- 2005) and ICAR Guidelines for QRT to all QRT members for their perusal and interaction.

The meeting ended with vote of thanks proposed by Dr. P.S. Minhas, Assistant Director General (Soil & WM), ICAR, New Delhi.

PROCEEDINGS OF THE QRT MEETING OF ICAR RESEARCH COMPLEX FOR EASTERN REGION, PATNA DURING 13-15TH OCTOBER, 2011

Dated: 13.10.2011

The following QRT members attended the meeting:

1. Dr. R.P. Singh,Chairman, QRT
2. Dr. N. Sarangi, Member, QRT
3. Dr. G. Goswami, Member, QRT
4. Dr. I.S. Singh, Member, QRT
5. Dr. K.N. Tiwari, Member, QRT
6. Dr. R.D. Singh, Member Secretary, QRT

The other two members Dr. S.S. Randhawa and Dr. N. Parsuraman could not attend the meeting due to some urgency of their institutions.

Visit to Institute Research Farms

1. WALMI Farm

The following scientists from the institute along with the QRT team and Dr. B.P. Bhatt, Director ICAR-RCER, Patna, visited the farm at 09.30 a.m.
List of Scientists attended:

1. Dr. A. Upadhyaya, Head, DLWM
2. Dr. D.K. Kaushal, Head, DLFM
3. Dr. S.S. Singh, Head, DCR
4. Dr. Abdul Haris, Sr. Scientist
5. Dr. B. K. Chaudhary, Scientist
6. Er. P.K. Sundaram, Scientist

Dr. A. Upadhayaya, Incharge Farm (WALMI) explained the activities currently being carried out in the farm. He highlighted the experiments to maximize the productivity of the waterlogged areas. Dr. D.K. Kaushal and Dr. A. Haris explained in detail the different components of multiple water use system. Dr. Haris mentioned that primarily the secondary reservoir system, rice-fish system and trenches-cum-bed system for multiple use of water were focused in this farm. The members also interacted and discussed the research activities being carried out. Dr. I.S. Singh, QRT member mentioned that improved varieties of banana and vegetable crops should have been used on the bunds of ponds to maximize the productivity. Dr. Sarangi, QRT member gave some input on how to improve fish culture. Dr. R.P. Singh, Chairman critically reviewed economics part of the integrated farming system and information regarding its utilities to the farmers for generation of additional employment and income. Upon query, Dr. Kaushal explained that in rice-fish system fish component gives an additional income of Rs. 3000/- per ha. Dr. Haris also mentioned that per ha net profit of integrated farming system with secondary reservoir is about Rs. 1.32 lakhs. Dr. Goswami, QRT member suggested that all minor components should be taken into account while calculating the economics part. The QRT is of the opinion that this model needs to be shown to as many farmers as possible by conducting adequate number of demonstration on farmers' field and skill oriented trainings. Chairman also urged to review the net profit, which will affect the adoption and diffusion of the model.

2. **SABAJPURA Farm**

The QRT visited Sabajpura Farm at around 11.30 a.m. Dr. S.S. Singh, In-charge Farm, explained various activities being carried out at farm. He showed the R&D experiment for screening rice varieties for drought tolerance. After that the QRT team visited CSISA site, where different experiments on resource conservation technologies for food security are being carried out. Dr. Singh mentioned that this is the second year of the experimental trial. He said that two components are also being taken up at farmers' field as a part of adaptive trial. Members of QRT remarked that the demonstrations on the farmers' field may be shown and if some other demonstration under ORP is there, may also be included.

Presentation on the Progress of activities

After the field visit, the QRT team along with all scientists and technical officers were assembled in the auditorium to take stock of activities during last five years (2006-10) of different Divisions.

Dr. R.D. Singh, Member Secretary, QRT welcomed the Chairman and all the members of QRT. The members were apprised of the programmes of the meeting. The Director, Dr. B.P. Bhatt in his welcome speech said that the institute is very keen to have the guidance of the QRT team to streamline the research activities for the benefit of the farmers. He also mentioned that Eastern India has the potential to bring Second Green Revolution with the implementation of established technologies and this institute will be happy to contribute to the maximum extent possible. The QRT Chairman in his address stressed that the QRT is an important activity for review for five years activities carried out by the institute for research and development and also submitting recommendation to the ICAR pertaining to research and development activities for next five years based on the latest developed advanced innovative research and development findings experience during the review period. He referred to his discussion with the DG, ICAR and DDG (NRM) in what way QRT should give the suggestion for the better functioning of the institute with focus towards XII Plan document.

Thereafter, Dr. R.D. Singh read out the Action Taken Report of the last QRT. The Chairman expressed that the action so far presented are qualitative in nature. There is a need to present quantified data to the extent possible so that the impact is more visible. The Chairman, QRT then requested Dr. S. Kumar, Head, ICAR-RCER, RC Ranchi to present the research and development achievements of the centre for last five years.

Welcome address of QRT Chairman and members

Interaction of QRT Chairman and members with Director and Heads of Division

1. Presentation by Head of Division, Ranchi Centre

Dr. S. Kumar, Head, ICAR RCER, RC Ranchi informed that among different fruit crops, 180 mango genotypes, 42 litchi genotypes, 38 guava genotypes, 12 sapota genotypes and 10 bael genotypes have been characterized and conserved in the field gene bank at

Ranchi. The technologies related to productivity and profitability enhancement being carried out in the institute were highlighted with focus on horticultural crops.

Dr. Kumar also presented staffing pattern of the existing and sanctioned with the Research Centre. He also presented the technologies transferred to the farmer's field. Dr. Kumar informed about high density orchard in mango, litchi and guava, rejuvenation of senile mango orchards, rain water harvesting and its multiple use around the year and the production of Mushroom, in Jharkhand condition are the star technologies. The linkages developed with different agencies were also presented. He mentioned that the institute has earned about Rs. 63.00 lakhs out of selling of planting material as well as seed.

The QRT in general was happy to see the progress made by the Ranchi Centre of the Institute and informed that the detailed evaluation of activities will be done when the team will visit Ranchi during early December. Dr. Kumar was requested to be ready with economics of all the technologies developed/replicated by the centre.

2. Presentation by Head, Crop Research Division, Patna

Dr. S.S. Singh, Head, presented the activities of the Division of Crop Research. He said that development of integrated farming system model was the major focus of the division. The results of the trial show that in one acre IFS model (for Irrigated midland, crop/ horticulture/ goat/poultry/ mushroom / vermin compost) could earn an annual net income of Rs. 1.35 lakh and that form 2 acre land net income could be Rs.1.8 lakh which were according to QRT members on much more which required re-checking of variable costs and relative output.

He also expressed that division is working to identify promising crops and variety for the region. In this respect in wheat, promising entries (Raj 4201, Raj 4205, K807, K808) were identified as better variety for terminal heat resistance over check varieties. Rapeseed promising line TCN 09-06 (18 q/ha) in 94 days and mustard promising line TCN 09-17(26q/ha) in 119 days have been found to give better yield. Mustard variety RCM – 145 yielded highest (21.4 q/ha) at normal irrigation and RDF. In Pigeon pea, promising entries for short duration (ICPL 87 & Manak), mid duration (BSMR 736, 835 & WRP 1) and late duration (NDA 1 & MAL 13) were found promising for eastern region. Dr. Singh also presented staffing pattern of the existing and sanctioned of the division and the technologies which were transferred to farmer's field and the linkages established with different agencies.

The QRT team expressed its satisfaction for the research in progress and directed that before it is transmitted to the farmers field economic viability of projects need to be analysed in detail before giving recommendation to farmers.

3. Presentation by Head, Makhana Centre, Darbhanga

Dr. V.K. Gupta, Head, presented the work done in ICAR-RCER, RC, Darbhanga. He said that 154 Germplasms of makhana were collected from different parts of north Bihar and Manipur and are being maintained at the centre. The elite germplasm of makhana (04 nos.) has been identified and propagated. These promising lines are giving 100-150% more yield than the local cultivars. The technology has also been standardized to cultivate makhana at shallow water depth. Hence, rice, wheat, barseem could be cultivated besides makhana in agricultural fields. Besides, makhana-fish-water chest nut farming system has been developed and propagated in farmers' field.

The QRT members suggested to further strengthen the work on makhana fish culture as the technology is being accepted by the farmers. They also suggested to submit one document on package of practices of makhana cultivation with economics both from the research farm as well as farmers field data. QRT mentioned that detailed impact would be ascertained during visit to the centre and interaction with the farmers.

4. Presentation by Livestock and Fishery Division

Dr. Kaushal informed that the division has actively participated in demonstration of productive utilization of water logged areas through different models developed by the institute. The fish yield of 1.97 t/ha was obtained in trenches by stocking fries @ 15000/ha. In service reservoir, composite fish culture along with duck farming yielded 5 - 6 t/ha of fishes. Stocking of Khaki Campbell ducks, @ 300 /ha of water area, could yield 43 thousand nos. of eggs, besides 24 thousand kg fresh duck droppings, which served as manure to the pond. Carps were cultured successfully for the first time in makhana ponds. Govt. of Bihar declared incentive for promotion of scampi farming. Through the efforts of the institute, the State Govt. was convinced to declare magur (*C. batrachus*)as State Fish of Bihar. Change in leasing policies of ponds has been implemented by the Govt. of Bihar. Demonstrated Aquaculture interventions under FPARP project for enhancing livelihood of small farm holders in a floodplain wetland.

Thereafter, Dr. J.J. Gupta, Principal Scientist (DLFM) presented the highlights of projects and activity related to animal husbandry. He also presented the data on availability, demand and projected shortfall of milk, meat, eggs and feed in different states of eastern region. Under irrigated condition, through integration of livestock components in Rice- wheat cropping system, net monetary gain was found to be Rs. 1,25,700/- compared to traditional practices where the net monetary gain was only Rs. 36,800/- per ha. The employment generation (Man days) was observed to be 757 man-days in crop-livestock system compared to only 226 man-days in traditional systems.

Dr. Gupta also apprised the QRT members that the Division was also involved in CGIAR Challenge Program project on "Livestock water productivity" and milk-water productivity in Indo-Gangetic basin was assessed. The values for milk water productivity of crossbred cows varied from 0.81 litre per M^3 in Hisar and Etawah (intensified system) and 0.34 litres per M^3 in Bankura (semi-intensified system). In case of buffalo, the milk water productivity ranged from 0.72 litres per M^3 in intensified system to 0.33 litres in semi-intensified system. For indigenous cows, the milk water productivity showed highest value (0.76 lt. per M^3) in intensified system. Lowest value (0.19 litres per M^3) was estimated in semi-intensified system.

Survey of major disease was also carried out by the division in different districts of Bihar. The overall prevalence of PPR was found to be 36.65 per cent. Cows and buffaloes from Begusarai, Patna, Khagaria, Arwal, Darbhanga, Jamui and Saharsa districts were found 6.1, 12.2, 6.44 and 9.11 per cents positive for IBR, Brucellosis, BVD and Leptospirosis, respectively.

Members suggested to reorient the objectives of the division as per the requirement of the division. They also stressed on to further strengthen the research to develop chaur and maun through aquaculture. They emphasized to work on the natural breeding ground of magur rather than employing scientific breeding method. For breeding of ornamental fishes, locally available fish species may be utilized and propagated. The team was also other opinion for developing technology for prawn culture. Chairman felt that the activities initiated would be of great importance to the farmers of livestock and fisheries in participatory approach to cover all the eastern states having such types of ecological situation involving the SAUs, NGOs and line departments.

5. Presentation by Division of Land and Water Management

Dr. Upadhyaya, Head, presented the highlights of the research projects including information on data base designed for the storage of data regarding selected crops using MS-Access and MySQL software packages for developing user interactive web enabled multi-media based Crop Information System. A web enabled crop information system developed

for package of practices of cereal crops including rice, wheat and maize using PHP, Dreamweaver and MySQL software's. A Web Enabled Multimedia based Crop Information System on package of practices for rice, what, maize, pigeon pea, lentil, green gram.

Deep summer ploughing done after three years was found better than alternate year and beneficial effect of deep summer ploughing can be achieved especially under limited water supply.

The optimum pressure found for operating LEWA (Low Energy Water Application) device was in the range of 0.4 – 0.6 kg/cm^2. A Christiansen Uniformity (CU) value for this range of operating pressure was found between 55 to 70 per cent (Row-to-row and nozzle - 6 m). The modified LEWA device has been tested and compared with a single nozzle sprinkler in the field on rice and wheat for water and energy saving. It has been observed that there is saving of over 50 per cent of water and over 60 per cent of energy (diesel) in case of rice while in case of wheat the water saving was 15 per cent against sprinkler, 50 per cent against surface methods of irrigation, and around 50 per cent of energy saved against sprinkler as well as surface method of irrigation.

Characterization and classification of ground water quality in Maner block of Patna district showed that arsenic content increased from 1.65 ppm to 2.20 ppm with the depth of the soil and accumulated from 2.0 ppm to 5.0 ppm in vegetable and cereal crops. Spatial thematic maps were also developed for arsenic and iron distribution for this area.

The members suggested to up-scale the multiple water use system & LEWA and to find the bottleneck of LEWA technology. QRT suggested that efforts should be made to commercialize the LEWA techniques. The QRT also suggested to work on low cost sensor based irrigation and fertilizer application technologies in order to reduce and manage the increasing cost on input so that farmers in general small, marginal and medium in particular may come forward to adoption of technology on large scale.

6. Presentation by Division of Socio-economic and Extension

Dr. K. M. Singh, Head presented the achievements made under different projects during the period under report. In milk marketing, he found that there were altogether 9 un-organized marketing channels with price spread ranging from zero in the shortest to 40 % in the longest marketing channel. The constraints in milk marketing as elicited by milk producers were: costly feed, lack of capital and housing (animal shed), problem of insurance, conception of milch animal and credit in that order. The consumers faced two problems - milk adulteration with water & milking of cow with injection - reducing the milk quality. Training need assessments of farmers was done and it was found that in order to improve the efficiency of farmers' agricultural training programmes, the topic of farm training should be topical and need-based, and the same should be organized preferably near the village site itself, before the crop season as far as possible, with more emphasis on field visits and practical.

Performance of self-help groups in disadvantaged districts of Bihar was studied. Being the member of SHG, brought significant changes in the attitude of members in the areas of socio-economic upliftment, education and training, marketing and entrepreneurship attributes, technology adoption and participatory research, and banking /credit aspects, observed. SHG approach was useful for speedy transfer of agricultural technologies. Dr. Singh also presented staffing pattern of the existing and sanctioned of the division, publications and the linkages established with different agencies.

The members of QRT inquired about the impacts of different training programmes and suggested for stakeholders training and wanted to see impact of those trainings among the farmers of different state, if possible. The members were of the opinion that the publications

from the institute may be presented separately in order to avoid duplication by the division. It was also felt looking forward for use full involvement of the division to work out the economics of different models of integrated farming system besides important role of the division for transfer of technology to the farmers field and stakeholders.

The meeting was ended with the vote of thanks by Dr. K.M. Singh.

Dated: 14.10.2011

Field visits on 14.10.2011

The team visited the many villages and could covered 75 km radius from the institute.. The observation of QRT on the some of farmer's field visit are as follows:-

Field Visit Details

Name of the Farmers with Village/Blocks	**Activities**	**QRT remarks**
Kamakhaya Narayan Sharma, Sital Sharma, Sanjay Sharma and Simakhaya Sharma, at Simra village	Direct Seeded Rice	QRT suggested that technology for direct seeded rice needs further refinement and its economical viability aspects by covering reasonable number of farmers in a cluster of villages. Further the technologies which were perfected at research farm of the institute and contributing additional income to the fares only those technology should be consider for taking for adoption on the farmer's field otherwise wrong message would go the farmers about the technology developed by the institute. The field demonstrations needs determination of the research scientist to visit the farmers field to see the adoption of technology the farmers filed and find out the reasons why the potential productivity gap is persisting in comparison to the institute research farm. The members of QRT observed that there is a tremendous scope of replicating institute developed integrated farming system modules, in different villages for promoting the livelihood of the farmers. Very little intervention of horticultural and vegetable crops were seen which have a great demand among the farmers located at 75 km radius with whom QRT interacted. It is therefore required to promote horticultural and vegetable crops both for income and nutritional security in those areas. Institute to give more emphasis on transferring the technologies in more scientific way by involving all the research and extension scientists.
Omkar Sharma, at Azadnagar village	Double Zero Tillage	
Vijay Narayan Sharma, at Srivar Gopalpur village	Double Zero Tillage	
Umesh Mishra and Munna Sharma, at Taret village	Direct Seeded Hybrid Rice Fields and Reduced Tillage Fields	
Pawan Kumar, Ramjit Sharma, Santosh Kumar and Krishna Sharma, at Barah village	Laser Levelling and unpuddled transplanted rice fields	

Visit and interaction of QRT, Director, Heads of division and Scientists in the farmers' field at Simra, Azadnagar, Gopalpur, Taret and Barah village of Patna district of Bihar

Meeting with Dr. M. L. Choudhary, Vice-Chancellor, RAU,Pusa and BAU, Sabor, Bihar

The QRT had the pleasure of meeting Dr. M.L. Choudhry and obliged for his valuable suggestions and cooperation assured from the SAUs. The Chairman introduced the members of QRT and briefed him and his scientists about the propose of their visit. A lot of discussion took place on the possibilities of collaboration and coordination with the SAUs and Govt. of Bihar for utilizing the latest technologies available with ICAR-RCER for the development of eastern region as a whole. Dr. Choudhary was kind enough to give assurance for full support from the University and also directed the scientists of the university to discuss with the QRT members for collaborative and partnership activities and in order to push the technologies available amongst the farming communities in different parts of the state.

Dated: 15.10.2011

Visit to main complex building laboratories, animal sheds and research farm

The QRT members started visiting Headquarter Farm at around 10.30 a.m. They have visited and discussed with PIs of different research projects such as;

- Modelling the performance of a few major cropping systems in Eastern India in the light of projected climate change (NAIP-4)
- Management of submergence stress through biotechnological approaches in rice grown in lowland ecosystem

- Genetic variability analysis and development of mapping population for drought tolerance in rice
- Development of Integrated Farming System for Irrigated Areas
- Effect of different organic amendments on soil microbial biomass carbon in rice-wheat system, resource conservation, soil health and carbon sequestration as influenced due to tillage and nutrients management in organic farming
- Development of vegetable based integrated farming system for marginal farmers of irrigated upland
- Irrigation and nutrient requirement of diversified cropping system in irrigated eco-system of Bihar
- Exploring Growth Hormone Gene for improvement of growth performance traits in Black Bengal goat
- Performance potential of integrated aqua-culture having mono-culture of Indian magur and poly- culture of carps with special reference to Jayanti rohu
- Integration of *Makhana* in fish pond ,Ornamental fish hatchery and establishing of commercial fish hatchery
- Experimental dairy and goat units




Visit and interaction of QRT with Director, Heads of division and Scientists in the experimental field of main campus, laboratories and Museum

The QRT in general was happy to see the properly layout above mentioned experiments/research activities going on at the institute headquarter and suggested that it should be appropriately transmitted to the farmers' field for improving their livelihood by adopting the some of the new technologies developed by this institute particularly improved germplasm of rice crop, integrated farming system, different diversified cropping systems, livestock farming with improved breeds and fish culture. The members have also visited different laboratories and discussed with the scientists about current projects, facilities available, problems and future requirements. QRT members took the note of their problems and requirements for effective functioning of their projects.

The meeting ended with vote of thanks proposed by Dr. R.D. Singh, Member Secretary, QRT.

PROCEEDINGS OF THE QRT MEETING OF ICAR RESEARCH COMPLEX FOR EASTERN REGION, PATNA HELD AT RESEARCH CENTRE OF MAKHANA, DARBHANGA DURING 3-6TH NOVEMBER, 2011

Dated: 03.11.2011

The following QRT members attended the meeting:

1. Dr. R.P. Singh, Chairman, QRT
2. Dr. N. Sarangi, Member, QRT
3. Dr. S.S. Randhawa, Member, QRT
4. Dr. I.S. Singh, Member, QRT

The other three members Dr. G. Goswami, Dr. K.N. Tiwari and Dr. N. Parsuraman could not attend the meeting due to some urgent meeting to their respective institutions.

Interactions with scientists of fisheries science at Patna

Review of the research work carried out for this division was made by Dr. N. Sarangi on the forenoon of 3rd Nov.2011 had a detailed discussion with Dr. D.K. Kaushal and scientists regarding the mandate, achievements, transfer of technologies, farmers' response towards fisheries and status of aquaculture research planned by the division for eastern region.

Dr. Sarangi felt that the institute has played an important role by initiating the various following facilities for fostering the knowledge of aquaculture and fisheries for the eastern region.

- The success of prawn farming experiments covering winter months is new venture which may be largely acceptable by the famers. However, it requires further trial, refinement and demonstrations to make it successful technology for introduction in all the locations of the eastern region.
- In integrated farming system presently, water for irrigation for different components of farming is utilized from external sources without drawing any water from the aquaculture ponds. The water being the major component for all production systems and large areas in the region are water scarce zone. It is advisable to develop models of IFS where pond water to be used for irrigation of crop production /horticulture in small scale farming taking all precaution for minimizing irrigation and soil moisture conservation, water and nutrient recycling etc. and based on these conditions varieties suitable for farming to be decided. Involvement of scientists of different disciplines including aquaculture is essential for a tangible outcome.

Dr. D. K. Kaushal, Head, DLFM accompanied the QRT members to visit Research Centre for Makhana, Darbhanga in the afternoon 03.11.2011. Dr. Kaushal apprised the members about difficulties faced by Research Centre for Makhana ever since its inception. Since the sanctioned staff strength originally envisaged to be met by redeployment was not met out and the Centre is still facing acute shortage of manpower in the category of Scientists, technical and administrative staff.

Dated: 04.11.2011:

The following scientists along with the QRT team and Director ICAR RCER, Patna, started visiting the Vasudevpur farm and Office of Research Centre for Makhana, Darbhanga at 09.30 a.m onward.

1. Dr. D.K. Kaushal, PS & Head, DLFM, Patna
2. Dr. V. K. Gupta, PS & Head, RCM, Darbhanga
3. Dr. Lokendra Kumar, Sr. Scientist, RCM, Darbhanga
4. Dr. Indu Shekhar Singh, Sr. Scientist, RCM, Darbhanga

A review discussion was held between the QRT members and the Scientists of the centre in the office of the In-charge of the centre on various research activities being carried out for the period under report. Dr. V.K. Gupta, Head of the centre briefed on the projects completed, under operation and achievements including transfer of technologies. The productivity of makhana has increased from 1.5tons to 2.8 tons/ha in the region and total production of 50-70thousand tons are obtained from about 15thousand hectare. Some of the important activities are makhana mono- cultivation, integration with fish, chest nut, rice, wheat, barseem etc. Economics of such farming's was reviewed by the Chairman, Dr. R.P. Singh. Makhana being a single genus and single species existing in the world and declared as endangered, conservation of this precious germplasm has been given special attention. It was also informed by the scientists that farmers' expect some govt. subsidies to continue the cultivation of makhana as all activities are highly labour intensive and almost 150labours/ha are required for the harvesting.

A press meet was organized with the QRT members and all the members gave their comments on the prospects of makhana cultivation and research needs for further development to support farming community in enhancing the production in an integrated manner. The QRT along with scientists visited the farm and laboratories to take the stock of activities undertaken. Following activities were shown:

a. Makhana-Basmati cultivation
b. Makhana introduced in cropping system from pond and could be grown twice in a year.
c. Makhana-chestnut cultivation in field with 1.5m water.
d. Screening of germplasm of makhana integrated farming of fish-duck-horticulture.
e. Mechanical processing system being developed by the institute with the help of CIPHET, Ludhiana

Visit and interaction of QRT with Heads, Scientists and Farmers at ICAR RCER, Research Centre for Makhana, Darbhanga and farmers' field

During the visit of Vasudevpur farm and discussion with the Scientists, Chairman, QRT expressed to meet KVK Scientists and suggested that KVKs of the region should demonstrate the technology of makhana cultivation, developed by the Centre. He further stated that skill oriented training on various aspects of makhana cultivation, protection and production is needed to improve the livelihood of the farmers in the region.

The QRT also visited farmers' field/makhana processing centre village (Chuk Bhavani), located about 17 km away from Darbhanga and had interactions on various aspects of makhana processing centres with the farmers, processors and middle man those involved in collection of the raw material for processing and marketing of makhana fruit in the meeting organised and held in the Chuk Bhavani village where the processing was in action managed by the very poor ladies and their working was full of drudgery and

affecting badly their health. Members of the QRT were upset to see the drudgeries of female and male poor worker mostly were below the poverty line and also compelled to meet anyhow their livelihood.

Dated: 05.11.2011:

QRT members along with Dr. Kaushal and Dr. Gupta left to visit NRC for Litchi, Mushahri, Muzaffarpur at 9:30 am. They visited NRC Litchi and made detailed discussion on status and prospects of Litchi cultivation in eastern region with Dr. Vishal Nath, Director and Scientists of NRC besides members also visited farmers' filed and appreciated the efforts made by the Director, NRC, litchi and teams of his scientists. Prof. R.P. Singh, Chairman, QRT suggested that effective linkages among the various ICAR institutes is required for better working and sharing of the available appropriate technologies and infrastructural facilities.

After the visits of NRC, litchi QRT left for Chakramdas village of Vaishali district to visit NAIP sites for observations on the institute's technologies percolated through NAIP at farmers' field. The QRT was shown different demonstrations which were being conducted with different enterprises and obtained the feedbacks from the farmers' and stakeholders regarding the training programmes, communication aspects and other activities pertaining to extension education and transfer of technologies. Besides, PI of the NAIP was also given opportunities to explain the silent achievements after visiting villages and interaction meeting with farmers' and local progressive farmers at a few places. It was felt by the QRT that the initiatives taken through NAIP have generated some awareness about different technological breakthrough but the benefits of the activities undertaken were not to the extend desired and impact were not also visible in the areas. Needless to mention that the technologies had not reached to the majority of the farmers' adopted, except a few one. It required some more attention, guidance, supervision

Meeting with the staff of KVK, Buxar at Patna

QRT members reached Patna at 7:30 pm where a presentation was made about the KVK activities and achievements by the KVK, Incharge. And also interacted with the staff specially SMSs of KVK, Buxar. The QRT suggested for the transfer of available technologies which have been developed and tested its suitability by the institute for taking the technologies to the farmers field. It required active action of the KVK. Since the KVK have conducted some demonstrations and organised a few courses of trainings which were presented before the QRT were inadequate. Thus, KVK required to take up some of the integrated farming system models at the farmers field and work out its impact in the field after calculating the economics. It was further suggested that the complex had already technological breakthrough especially in livestock sectors which can be taken to the livestock farmers' field for improving their livelihood.

During discussions, following suggestions were given by QRT.

- IFS Models developed by the institute be replicated by KVK in Buxar distrct.
- Feedback from farmers' is needed to prepare 12th Plan.
- Prioritized the problems being faced by the farmers' in agricultural and livestock development.
- Nutritional security be insured from technological interventions particularly to pregnant women in remote villages.
- Depute some SMSs to KVK, Kota, for training on the preparation of different recipe's for value addition and ensuring the nutritional security of poor farmers.

Dated: 06.11.2011:

A review meeting on the research achievements of the division pertaining to animal sciences was held at Patna with the QRT member Dr. S. S. Randhawa and the scientists of DLFM. Dr. A. Dey presented the brief achievements of the Division which was followed by the discussion of the member with the concerned scientists. Dr. B.P.Bhatt, Director of the institute emphasized on the importance of livestock and fishery sector as part of the farming system in the region and assured to provide all facilities including infrastructure for the research.

Dr. Randhawa appreciated the good work being undertaken by the Scientists pertaining to Animal Sciences, even though with very limited scientific & technical staff, during the period under review as some of the Scientists have joined only in 2010 onwards. Dr. Randhawa suggested a few points to include in the current research programme which has already been given under Chapter 10:

The QRT in general was happy and impressed to see the experiments and research activities being initiated by Research Centre for Makhana, Darbhanga. The makhana Research Centre has done commendable job by developing technology for bringing makhana cultivation into cropping system mode and extending its' cultivation from pond to shallow water. Centre should make sincere efforts for adoption of technology among large number of farmers. As such it may be difficult to introduce low water makhana cultivation among the traditional makhana farmers. However, it may be possible to incorporate it in swampy/shallow water areas identifying some new farmer lots for starting cultivation of makhana under horticulture technology mission, a programme of Govt. of India to support farmers. Since makhana farmers are facing many constraints and they are the traditional makhana cultivators. Farmers' Rights Commission may be of help to strengthen the famers for makhana growing. In connection with the conservation programme, international funding support, if required, may be made available to support makhana faming.

Farmers expressed their satisfaction over the seed of makhana (Manipur germplasm) supplied by the centre as additional production has been obtained with its introduction.

Training has been provided by the centre on various aspects of makhana farming and integration models. However, demonstration of makhana cultivation in shallow water and its' integration with crops and fish could not be seen in farmers field. It is suggested to verify the feasibility, acceptability and economics of the technologies at the farmers' fields and suitably refinement for wider acceptance and propagation. To avoid the crop loss through necessary crop protection measures may be developed in the institute and properly transferred to the farmers.

Since farmers are facing major problem in investment during cultivation of makhana introduction of credit card would be helpful for the farmers. Social scientists may take initiatives to coordinate with local Govt. Deptt. and bank in this regard for encouraging the makhana farmers. Some initiation may also be made for crop insurance and facilitating marketing directly through formulation of society/association/SHGs to whole seller.

The meeting ended with vote of thanks proposed by Dr. R.D. Singh, Member Secretary, QRT.

PROCEEDINGS OF THE QRT MEETING OF ICAR RESEARCH COMPLEX FOR EASTERN REGION, PATNA HELD AT RESEARCH CENTRE, RANCHI DURING 4-7TH DECEMBER, 2011

Dated: 04.12.2011

The following QRT members attended the meeting

1. Dr. R. P. Singh, Chairman, QRT
2. Dr. I. S. Singh, Member, QRT
3. Dr. G. Goswami, Member, QRT
4. Dr. K. N. Tiwari, Member, QRT
5. Dr. N. Sarangi, Member, QRT
6. Dr. R. D. Singh, Member Secretary, QRT

The other members Dr. S.S. Randhawa and Dr. N. Persuraman could not attend the meeting due to prior commitments.

The following Scientists from the Centre along with the QRT visited the farm at 10.30 a.m.

List of Scientists attended:

1. Dr. S. Kumar, Head
2. Dr. A. K. Singh, Pr. Scientist
3. Dr. R. S. Pan, Pr. Scientist
4. Dr. A. K. Thakur, Pr. Scientist
5. Dr. B. K. Jha, Sr. Scientist
6. Dr. S. K. Naik, Sr. Scientist
7. Dr. S. Maurya, Sr. Scientist
8. Dr. B. R. Jana, Scientist
9. Dr. J. S. Choudhary, Scientist

The QRT members visited the farm No.1 and took the round of technology demonstration block of water management through Doba and pitcher irrigation system established for the litchi plants. Dr. S. Kumar explained in detail about the doba, i.e, low cost water harvesting structures and pitcher irrigation technology to the Hon'ble members of QRT. Dr. K. N. Tiwari gave suggestion to make a sloping bed of sand below the pitcher and around the litchi plant to increase permeability of the soil and even distribution of moisture around the root zone of the plants and stressed proper nutrient management with modified pitcher irrigation for the first two years. He also advised to grow creeper crop on the sides of doba to provide additional income and the creeper will also minimize the evaporation loss from the doba. Dr. I. S. Singh said there is need of optimization of water requirement for the establishment of fruit orchards.

The members proceeded towards the drip irrigation and plastic mulching technology unit on cucurbits. Dr. Kumar highlighted the cultivation of cucurbits in tunnel of plastic sheet to get early crop of cucurbits in order to fetch better market price. QRT also visited the experimental trial plots of the resource conservation technology comprising of plastic mulching and different methods of planting of vegetables. Dr. Tiwari suggested to provide one lateral between the two rows of vegetable (Cauliflower) instead of providing one lateral each to the line and advised that the placement of dripper in lateral in such a way that, one dripper should wet 4 plants to minimize the cost and flow of water in the lateral has to be regulated.

In the long-term vegetable based cropping system trial for maintenance of soil fertility and use micro sprinkler irrigation for efficient management of water. Dr. Kumar explained about the hybrid seed production of tomato cv. Swarna Sampada to the members. Dr. I. S. Singh advised to give the details of the parents of the hybrid on the display board.

QRT advised to calculate the percentage of ventilation in poly house during cultivation of different crops in different seasons. Hybrid seed production of brinjal under AICRP was also visited by the QRT. Dr. Kumar showed the grafted plant of susceptible tomato hybrid variety Swarna Baibhav on resistant brinjal root stock Swarna Pratibha and explained the resistance of the grafted tomato plants. Dr. I. S. Singh, wanted to know about the possibility of pruning on the grafted plant of tomato to yield more and stressed the need of quality assessment pertaining to tomato of grafted plant.

The members visited the ultra-high density orchard of guava and could see the technology treatment of 40 per cent pruning was best for getting the highest yield. Dr. I. S. Singh wanted to know about the instrument for pruning for large scale cultivation and was clarified by Dr. Kumar about the development of instrument for guava pruning in collaboration with CIAE, Bhopal.

The different components of integrated farming system were explained by Dr. B. K. Jha, to the members. Dr. Sarangi suggested to make embankment of pond to check soil erosion and also suggested to rear 1 year old stunted fingerlings to fetch better price from fishery. The QRT members visited the Unit of agricultural waste management and to know the cultivation of different types of mushroom for year round supply.

All the members along with the scientists of ICAR-RCER visited the Farm No. 2. The different research activities carried out at this farm were shown. In high density mango orchard of Amrapalli, the yield performance of mango was also shown to the QRT. Dr. I.S. Singh wanted to know about the insect pest and disease status on high density mango as compared to that normal spacing which was clarified by Dr. J. S. Choudhary.

After the field visits the QRT members were taken to the meeting hall where more than 65 farmers and a good numbers of stakeholder, officials of line departments, field functionaries, members of different organizations and representative of different association were present for interaction. Dr. Kumar welcomed the Chairman, members of QRT and the participants. Participants also introduced themselves. Dr. R.P. Singh, Chairman made a request to the audience to give their association with the centre and wanted to know the benefit they have availed from this centre. It will better if they give their critical observation about the functioning of the scientists and their contribution with respect to the transfer of technology to the farmers' and stakeholders. A very comprehensive interaction between the farmers and other participants with QRT and scientists of the centre took place. Most of the farmers' were repeatedly requested to visit QRT on their fields to verify the technologies adopted by them with the help of the centre. After hearing the farmers, stakeholders and other participants, the QRT deeply appreciated the fruitful contributions made by the scientist under the leadership of Dr. S. Kumar, Head of the centre. Chairman also requested the farmers to frequently visit the centre and technologies should disseminate among their neighbouring farmers. On the basis of overall presentations from different organizations and expression of views by the farmers, it emerged that all the stake holders have been benefitted in adoption of technologies developed by the centre and technical guidance received from time to time.




Visit and interaction of QRT with Heads of division and Scientists of Research Centre, Ranchi at experimental field of the Centre and farmers field at Ormanjhi village

Dated: 05.12.2011

The members of QRT along with scientists of Research Centre, Ranchi visited the farmers' fields. At Mahilong, members visited the nursery of mango, mahogany, guava, ber, litchi, pomegranate developed by the progressive farmer Mr. Shrawan Kumar, who has been trained by RC, Ranchi. QRT advised the nursery man regarding efficient management of water by adopting the sprinkler irrigation system instead of direct watering to the plants. Members also visited KGVK, Rukka and officials explained the different activities carried out with the intervention of RC, Ranchi like rejuvenation of old mango orchard, cultivation of pink pepper, plastic mulching and drip irrigation, tomato cultivation in poly house, growing of inter crops in fruit orchard, etc.

In the village- Kuchu, the farmer, Mr. Balak Mahato showed his different activities of agriculture like dairy farming, drip irrigation in vegetables, seed production of french bean, tomato and brinjal with the technical guidance of RC, Ranchi. The members of QRT asked about cause of late adoption of seed production of vegetables. Mr. Mahato clarified that now ICAR- RCER has given assurance for buy back of his seed, therefore, he had taken the seed multiplication programme.

Members of QRT visited the village- Zeerabar and the QRT was shown the cultivation of brinjal var. Swarna Shyamli in the village. There are 150 farmers in the village of Zeerabar and out of which 80 farmers had adopted the cultivation of Swarna Shyamli developed by Ranchi centre and their economic status has been improved to a great extent. Farmers of Zeerabar requested to solve the problem of fruit and shoot borer in brinjal. The Director, ICAR RCER has given assurance for solving the problems. The members of QRT gave suggestion for overcoming the water problem in the village by community approach for construction of deep tube well. Members also visited the mushroom farm of one progressive

farmer at Morabadi and the farmer was in touch of all kinds of support for the cultivation of mushroom with the help of RC, Ranchi.

Dated: 06.12.2011

A meeting with members of QRT along with all the staff of Research Centre, Ranchi, was conducted at the Centre to sought the opinion and suggestions for improvement and betterment of the Centre. The suggestions were mainly for the enhancement in cadre strength of the Centre, procurement of equipments, strengthening lab for nutritional analysis, organic certification laboratory, etc.

The Chairman and members of QRT suggested for taking more externally sponsored projects for solving the problems of shortage of technical staff and this will give impetus for quality research work also. Besides this, they suggested for better lab coordination among Scientists. They emphasized the need of research on integrated farming system, nutritional analysis of fruits & vegetables, post-harvest for value addition of horticultural produce.

The QRT visited Birsa Agricultural University, Ranchi and had a meeting with Hon'ble Vice-Chancellor Prof. M.P. Pandey. Dr. R.P. Singh, Chairman, QRT gave brief information on the objectives of visit and briefly narrated various research activities undertaken, developments made and technologies transferred by the institute and Ranchi Centre. He elaborated the necessity of collaboration and coordination of the institute with the university for jointly undertaking required generation of appropriate technologies and transfer of the available technologies to different parts of the state. QRT also emphasized the involvement of Krishi Vigyan Kendras (KVKs) functioning under the university for their effective contribution in transfer of technologies to the farmers and stakeholders in the state. Prof. Pandey assured for proper planning which would be done by the concerned scientists of the university. He emphasized on transfer of effective and proven technologies of the university and ICAR including post-harvest management and value-addition of fruits, vegetables and poultry. He also drew the attention on the BPD (Business Plan Development) introduced by the ICAR and emphasized to keep this in mind while transferring technologies for commercial purpose. Hon'ble VC assured to extend all possible co-operations from the university for the overall development of the agricultural activities, productivity enhancement and economic development in the eastern region.

Dated: 07.12.2011

All the QRT members visited different laboratories of the Centre and discussed with the scientists about current projects, facilities available and future requirements. They have suggested that more facilities are required for specific work in the field of post-harvest technology particularly for updating the quality of fruits and vegetables. The QRT in general was happy and impressed to see the experiments/ research activities going on at the Centre and suggested that it should be replicated to the farmers' field for improving their livelihood.

Dr. Ramani, Director IINRG informed that IINRG and RC Ranchi has initiated joint work on development of lac based horticulture production system, coating of fruits and vegetables with water soluble formulations of lac, and testing of lac derivatives as pheromone. He desired that further work in this regard and also hydrogel developed from lac will be useful and hence may be taken up in XII Plan also. Dr. I.S. Singh desired that fruit coating of mango, litchi, strawberry, guava and other commercial fruits should be taken up as experimental trial.

The meeting ended with the vote of thanks proposed by Dr. S. Kumar.

PROCEEDINGS OF THE QRT MEETING OF ICAR RESEARCH COMPLEX FOR EASTERN REGION, PATNA HELD AT ASSAM AGRICULTURE UNIVERSITY, JORHAT, ASSAM DURING 1-3RDMAY, 2012

The following were present

i. Dr. R.P. Singh,Chairman, QRT
ii. Dr. I.S. Singh, Member, QRT
iii. Dr. D.K. Kaushal, I/c Secretary-Member

The members of QRT assembled at Assam Agricultural University, Jorhat on 1st May, 2012 to participate in the interactions with the officials of AAU, Jorhat besides Govt. officials of Assam.

The meeting started under the chairmanship of Dr. K.M. Bujarbaruah, Hon'ble Vice-Chancellor, AAU, Jorhat. Besides the Chairman, Prof. R.P. Singh, Dr. Bhattacharya, Director Extension, Director Research, Dean and Head of various departments including scientists participated in the meeting. Dr. B.P. Bhatt, Director, ICAR-RCER, briefed about the agricultural scenario in eastern region and about the activities of ICAR-RECR, Patna. Chairman desired to look into the reasons for agricultural growth in Gujarat so that it could be accelerated on the same pattern in Eastern region, particularly in Assam.

Interaction with Vice-Chancellor,

Following suggestion were made during the deliberation in the meeting.

- Harnessing of water, linking of rivers and canal and ground water recharge programmes may be looked into.
- Since ICAR RCER, Patna is mandated to take up strategic and applied research, market intelligence need to be looked into and it should be linked to agri-business.
- Apiculture has great potential, particular in Assam and Odisha. Hence, High tech horticulture with the thrust on mixed cropping system, high density and fertigation should be adopted for higher productivity.
- One should also look into increase in water use efficiency for agricultural production. Stress should be made on indigenous technologies for the resource utilization and value addition to ITK's.
- One scientist, one village, one technology concept need to be adopted for validation of various technology *vis-a-vis* livelihood improvement of the farmers.
- Similarly focus should be made on the enhancement of production of underutilized crops.
- Sensitization for change in mind set needed.
- Market intelligence reporting/gathering needed to know the problem of stakeholders.
- Trust should be made on efficient use of solar energy.
- The QRT expressed there is a felt need to have a centre of ICAR-RCER in Assam, so as to cater to the need of agriculture development and utilization of advanced technologies generated by the institute with collaboration, coordination and in partnership of the SAUs and state Govt. Hon'ble Vice-Chancellor of AAU, Dr. K.M. Bujarbaruah, has very kindly agreed to provide 25 ha of land and some infrastructure for establishment of the Centre of the ICAR-RCER near Gauhawati. Dr. B.P. Bhatt, Director, ICAR-RCER, also assured to

work in Assam for addressing the agricultural issues of peoples of Assam, if an opportunity is given, since it is the mandate of the ICAR-RCER, to apply strategic and adaptive research in the eastern states. Dr. R.P. Singh, Chairman and Dr. I.S. Singh, Member, QRT, also supported the views of Director, ICAR-RCER.

The meeting ended with the vote of thanks by Dr. D.K. Kaushal.

PROCEEDINGS OF INTERACTION MEETING OF QRT MEMBERS TO IDENTIFY RESEARCHABLE ISSUES IN THE FIELD OF AGRICULTURE, HORTICULTURE, LIVESTOCK AND FISHERIES DEVELOPMENT IN WEST BENGAL

The meeting was presided by Dr. R.P. Singh, Chairman, QRT and started with the welcome address to Chief Guest, Dr. Asit Kumar Das, Vice-Chancellor, UBKV, Coach Bihar, Guest of Honour, Dr. C.S. Chakrabarti, Vice- Chancellor, WBUAFS, Kolkata, all the members of QRT and other dignitaries for ICAR Institute and line departments by Dr. R.D. Singh, Member Secretary, QRT, ICAR RCER, Patna. Dr. D.K. Kaushal gave a brief presentation on status and constraints of agriculture of eastern region in general and research achievements of the Complex in particular. The main purpose of the meeting was to identify researchable issues in the field of agriculture, horticulture, livestock and fisheries development in West Bengal to be included in XIIth Five Year Plan.

Visit and interaction meeting with Vice Chancellors, Directors and Heads of ICAR Institute and other dignitaries at Regional Research Station of NBSS & LUP, Kolkata

Dr. R.P. Singh, Chairman, QRT started the remaining proceeding of the meeting and requested all the participants to give self-introduction. Initially he has invited all the QRT members to express their views on different aspects of agriculture development in eastern region particularly in West Bengal. Most of the QRT members, Director of ICAR institutes, Heads of ICAR Regional Research Station, representative from line departments opined that we have already developed a lot of technologies in the field of agriculture, horticulture, livestock and fisheries but still it has not reached to end-user. Now, this is the time when we can think of developing strong linkages for collaboration, coordination in partnership between ICAR institutes, line departments and SAUs for dissemination of technologies to the farmers for improving their livelihood.

Dr. Asit Kumar Das, Vice- Chancellor, UBKV, Coach Bihar, in his deliberation suggested following researchable issues to be undertaken in next Five in West Bengal

- Development of Farming System Approach
- Development of strategies to combat climate change
- Development of Protected Agriculture for High Value Crops
- Location specific Export oriented programme
- Weather based crop module
- Isolation of native micro flora and development of mass production protocol of bio-control agents and bio-fertilizers
- Agro-ecosystem analysis and ecological engineering for pest managements
- Generation of prototype technology and verification of agro-forestry system

Dr. C.S. Chakrabarti, Vice- Chancellor, WBUAFS, Kolkata, also expressed his view based on the meeting of Vice-Chancellor's held at New Delhi during last February as follows:

- During XIIth Five Year Plan emphasis will be given on farmers' first in overall agricultural development in the country
- 2nd Green Revolution is expected to come from eastern states before moving forward we should consider the advantages and disadvantages of the 1st Green Revolution
- Fragmented and small land holdings are major concern for low productivity in eastern states so emphasis should be given on land consolidation.
- Emphasis should be given on the amelioration of problem and degraded soil.
- Development of post-harvest structures for storing perishable commodities for value addition products.
- Technologies for breeding and rearing of indigenous and exotic breeds and maintenance of pedigree of livestock, goats, sheep's, birds and fishes to be included in integrated farming system.
- Seasonal resource mapping development of species specific gear.
- Improvement of women's livelihood through rearing of ornamental fishes.
- Participatory approach should be followed to developed farmers friendly technology.

Dr. R.P. Singh, Chairman, QRT was pleased to make request to all the Director of ICAR institutes including Dr. A.K. Singh, Zonal Project Director, Zone-II, Heads of ICAR Regional Centres, representative from line departments for their critical observation about the functioning of the complex and valuable suggestions. A lot of discussion took place and officials concerned expressed their full cooperation and support to provide all possible assistance in generation and transfer of technology by involving their respective departments to coordinate and cooperate with the ICAR-RCER, Patna on many aspects for different fields such as amelioration of problematic soils particularly acidity and arsenic, water management, conservation agriculture, livestock and fish production management by utilizing the latest technology and integrated farming models of ICAR-RCER, Patna. Dr. A.K. Singh, ZPD assured full support of KVKs located in different part of the state West Bengal for effective transfer of technology to the farmers and stakeholders. The fruitful suggestions given by the official as mentioned above are really useful and have been recorded separately which will be incorporated in the QRT report

The meeting ended with vote of thanks proposed by Dr. S.K. Singh, Head, Research Station, N.B.S.S. & LUP, Kolkata.

LIST OF THE PARTICIPANT QRT MEETING OF ICAR RESEARCH COMPLEX FOR EASTERN REGION, PATNA HELD AT REGIONAL REARCH STATION OF NBSS & LUP, KOLKATA ON 4TH MAY, 2012

QRT meeting of ICAR Research Complex for Eastern Region, Patna, to identify researchable issues in the field of agriculture, horticulture, livestock and fisheries development in West Bengal held at Regional Research Station of NBSS & LUP, Kolkata on 4th May, 2012. Following dignitaries from SAU's, ICAR Institutes, Govt. & Non-Govt., attended the meeting:

1. Dr. R.P. Singh, Ex-Vice-Chancellor, MPOUAT and Chairman, QRT, ICAR RCER, Patna
2. Dr. Asit Kumar Das, Vice- Chancellor, UBKV, Cooch Bihar- 736165 (West Bengal)
3. Dr. C.S. Chakrabarti, Vice- Chancellor, WBUAFS, Kolkata- 700037 (WestBengal)
4. Shri Hridyesh Mohan, IAS, Secretary Agriculture, Govt. of West Bengal
5. Shri Bharat Chandra Saha, Director Fishery, Govt. of West Bengal
6. Dr. P.K. Parmanik, Director Horticulture, Govt. of West Bengal
7. Director (Agriculture), Govt. of West Bengal
8. Dr. B.P. Bhatt, Director, ICAR RCER, Patna
9. Dr. N. Sarangi, Former Director, CIFA and Member QRT, ICAR RCER, Patna
10. Dr. G. Goswami, Director, TIFAC and Member QRT, ICAR RCER, Patna
11. Dr. I.S. Singh, Former Director (Hort.) and Member QRT, ICAR RCER, Patna
12. Dr. K.N. Tiwari, Professor (S&WC Engg.), IIT, Kharagpur and Member QRT, ICAR RCER, Patna
13. Dr.S.S. Randhawa, Director Research &Dean (PG.), GADVASU and Member QRT, ICAR RCER, Patna
14. Dr. A.P. Sharma, Director, CIFRI, Barrackpore, 24 Parganas-700120 (West Bengal)
15. Dr. A.K. Singh, Zonal Project Directorate, Zone-II, Kolkata-700097 (West Bengal)
16. Dr. S.K. Singh, Head, NBSS&LUP, Regional Station, Kolkata-700097 (West Bengal)
17. Dr. B. Maji, Head, CSSRI Regional Research Station, 24 Parganas, (West Bengal).
18. Dr. A.K. Sit, Head, CPCRI Regional Station, Mohit Nagar, Jalpaiguri, West Bengal
19. Head, East Regional Station of IVRI, 37 Belgachia Road, Kolkata, West Bengal
20. Dr. B.K. Mahapatra, Officer Incharge, CIFRI Regional Station, MSO Building, Kolkata
21. Head &Incharge, Kakdwip Research Centre of CIBA, 24 Parganas, West Bengal
22. Officer Incharge, CIFE, Kolkata Station, Salt Lake City, Kolkata
23. Head, Regional Research Centre CIFA, Rahara, West Bengal
24. Prof. Tapan Kumar Ghos, DREF, WBUAFS, Kolkata- 700037
25. Prof. S.K. Senapati, Director of Research, UBKV, Coach Bihar- 736165 (West Bengal)
26. Prof. A.K. Chowdhary, Dean, F/Ag, UBKV, Coach Bihar- 736165 (West Bengal)
27. Dr. P. Mukhopadhyaya, DEE, UBKV, P.O- Pondabari, Coach Bihar- 736165 (West Bengal)
28. Dr. B. Saha, Pricipal Scientist, NIRJAFT, Kolkata- 700040
29. Dr. B.C. Jha, Head, CIFRI, Barrackpur, Kolkata
30. Dr. Sourav Chandra, Assistant Director (Ext. & Res.) WBUAFS, Kolkata- 700037
31. Dr. R.D. Singh, Member Secretary QRT & Head RCMS, ICAR RCER, Patna- 800014
32. Dr. D.K. Kaushal, Head, DLFM, ICAR RCER, Patna- 800014

Annexure-II

AREA COVERED UNDER RELEASED VARIETIES OF VEGETABLE CROPS

Through the seeds produced from the institute, the varieties of different vegetable crops have been grown in an estimated area of nearly 3657 ha. However, due to the popularity of the varieties among the farmers and being open pollinated an additional area of about 3500 ha must have been brought under these varieties through seed production by the farmers. Hence the vegetable varieties of the institute have been cultivated in an approximate area of 7157 ha.

Area under different vegetable varieties through seed produced

Crop	Cultivars	Area under cultivation (Ha)
Bitter gourd	Arka Harit	26.10
Okra	Arka Anamika	28.98
Cowpea	Arka Garima	63.49
	Swarn Harita	11.23
	Swarn Sweta	12.22
	Swarna Mukut	18.83
	Swarna Suphala	0.22
Watermelon	Arka Manik	23.74
Ridge gourd	Swarn Manjari	1.18
	Swarn Uphar	15.83
Sponge gourd	Swarn Prabha	18.42
Bottle gourd	Arka Bahar	109.70
French bean	HAFB-2	83.12
	HAFB-3	0.69
	HAFB-4	27.57
	Arka Komal	62.68
	Swarn Priya	16.60
	HAPB-3	2.26
Peas	Swarn Mukti	31.29
	Swarn Amar	4.21
	Swarna Tripti	7.80
Dolichus bean	HADB 4	0.80
	HADB 3	0.40
	Swarna Utkrist	39.80
Onion	Arka Niketan	62.67
Cucumber	Swarn Ageti	23.86
	Swarn Sheetal	20.07
	Swarna Poorna	0.11
Brinjal	Swarn Mani	41.67
	Swarn Shyamli	410.33
	Swarn Pratibha	739.25
	Swarna Shobha	2.75
	Swarna Abhilam	3.17
	Swarna Shatki F-1	24.63

	Swarna Ajay	2.50
	Swarna Shree	3.75
	Swarna Neelima	2.50
	Swarna Mohit	2.50
Tomato	Swarn Naveen	68.20
	Arka Abha	378.20
	Swarn Lalima	994.44
	Swarna Sampada	125.33
	Swarna Vijaya	2.22
Vegetable Soyabean	Swarna Vasundhara	133.53
Pointed gourd (Plants)	Swarn Rekha	4.45
	Swarn Alaukik	2.79
Elephant foot yam	Gajendra	1.39
Total		3657.47

Annexure-III

RESEARCH PAPERS PUBLISHED IN NATIONAL AND INTERNATIONAL JOURNALS

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Annexure-IV

PARTICIPATION OF SCIENTISTS IN CONFERENCE/ SEMINAR/ WORKSHOPS/ SYMPOSIA/ MEETINGS IN INDIA AND ABROAD

India

Scientist	Name of Seminar /Conference /Workshops/Symposia/Meetings	Place	Date
2006-07			
Dr. J.P. Sharma	National symposium on emerging plant diseases, their diagnosis and management	Univ. of North Benga, Siliguri	31 Jan. - 2 Feb., 2006
Dr P.R. Bhatnagar	40th Annual Convention of ISAE and Symposium	TNAU, Coimbatore	17–19 Feb. 2006
Dr.R.K.Batta	"Strategic Plans for Augmenting Development of Horticulture in Eastern Region" and "Efficient management of water for maximizing productivity of horticultural crops".	RAU, Pusa, Bihar	17–18 Feb., 2006
Dr.R.K.Batta	"Run for Development" rally organized	BIA and Govt. of Bihar	19 Feb., 2006
Dr. R.K. Batta	Research Organization	NAARM, Hyderabad,	23-28 Feb., 2006.
Dr. A. Islam Dr.B.Saha	"Assessing Impact of Changing Climate on Soil & Water Resources" under "ICAR Network Project on Impact, Adaptation and Vulnerability of Indian Agriculture to Climate Change"	C.S.W.C.R.& T.I., Dehradun	27 Feb.-1 Mar., 2006
Dr. J.P. Sharma	Brainstorming Session on Present Status and Future Strategies of Mushroom in India	NRC on Mushroom, Solan	18-19 Mar., 2006
Dr. A. Upadhyaya	National Convention on "Know-ledge Driven Agriculture Development: Management of Change".	New Delhi.	24-26 Mar., 2006
Dr. A.K. Sikka	Workshop of CPWF Project on "Legal policy and Institutional Framework for Integrated Water and Forests Management"	Dehradun	4-7 Apr., 2006
Dr. R.K. Batta	"Right to Information Workshop"	ISTM, New Delhi,	3-4 Apr., 2006.
Dr. S. Kumar Dr. Ranvir Singh Dr. J.P. Sharma Dr. A. K. Singh Dr. R.S. Pan	XXXIV Group Workers' Meeting, AICRP (VC)	UAS, Dharwad	22- 24 Apr., 2006
Dr. B. P. S. Yadav	Project inception workshop on 'Conservation Agriculture, Livestock and Livelihood Strategies in Indo-Gangetic Plains of South Asia Synergies and Trade off.	NAAS, NASC Complex, Pusa, New Delhi	24- 26 Apr., 2006

Dr Ujjwal Kumar	State level one day workshop on "Cultivation of medicinal & Industry association aromatic plants and its commercialization"	ATMA & Bihar	27 Apr., 2006
Dr. A.K.Sikka	Phase II inception workshop of the "Strategic analysis of the India's National River Linking Project (NRLP)"	IWMI South Asia Regional Office, BASC Complex, New Delhi	2-3 May, 2006
Dr. A.K. Sikka	Seminar on 'Sukhaevam Sambhavit Akal"	Patna	20 May, 2006
Dr. Bikash Das	XVII Group Workers' Meeting, AICRP (STF)	MPUAT, Udaipur	2 - 4 June, 2006
Dr. R. S. Pan	National Symposium on underutilized horticultural crops	IIHR, Bangalore	8 -9 June, 2006
Dr. A.K. Sikka Dr. D. K. Kaushal,	National Consultation on Water Management in Fisheries and Aquaculture.	NASC Complex, Pusa, New Delhi.	23-24 June, 2006
Dr.A.K.Sikka	Indo-US workshop on "Integrating Weather and Climate Information in Water Management"	Pune	4-6 July, 2006
Dr. A. Islam	"Integrating Weather and Climate Information in Water Management"	Indian Institute of Tropical Meteorology, Pune.	5-7 July, 2006
Dr. A.K. Sikka Dr. R.K. Batta Dr. A. Haris	International Workshop on "Advisory services in Environment Management"	Hotel Maurya, Patna, Bihar.	17-18 July, 2006
Mr. Manibhushan	Personnel Management Information System (PERMISnet) and Intelligent Reporting System (I.R.S.)	IASRI, New Delhi	21-22 July, 2006
Dr. A. K. Singh	A Scientific Advisory Committee, Meeting KVK Birauli	KVK Campus, Birauli	4 Aug., 2006
Dr. A.K. Sikka	Directors' Conference on NRM Division	KAB, New Delhi	8 Aug., 2006
Dr. A. Upadhyay Dr. A R Reddy Dr. A. Islam	Climate change Project Workshop	NDRI, Karnal	10-11 Aug., 2006
Dr. A. K. Singh	Workshop on All India Coordination Research Project on Micro Nutrient	RAU, Pusa, Bihar	16-19 Sept., 2006.
Dr. A.K. Sikka Dr. R.K. Batta Dr. A. Upadhyaya Dr. D. K. Kaushal Dr. A. Islam	ICAR-CWC joint workshop on "Efficient Water Management in Canal Command Areas".	NASC Complex, New Delhi.	18-19 Sept., 2006
Dr. A. Haris	Participated in Rabi Workshop	Dept. of Agriculture, Bihar State	19-20 Sept., 2006

Dr. A.K. Sikka	Indo-US Planning workshop on "Water management"	Delhi	20 -22 Sept., 2006
Dr. Ranvir Singh	Workshop on Intervention on Lac Research-Industry Partnership	ILRI, Ranchi	20 Sept., 2006
Dr. B. Saha	International symposium on "Geo-spatial databases for sustainable development"	Goa.	27-30 Sept., 2006
Dr. A R Reddy Dr. P. K. Thakur	Workshop on WTO Agriculture and NAMA Negotiation: Identifying Products of Concern to India	Bihar Industries Patna, Bihar.	17 Oct., 2006
Dr. J.P. Sharma	Xth Biennial workshop of All India. Coordinated Mushroom Improvement Project	Indira Gandhi Krishi Vishwavidyala ya Raipur (Chhattisgarh)	26-27 Oct., 2006
Dr. A. K. Singh	National Symposium on Conservation Agricultural and Environment.	Banaras Hindu University, Varanasi	26-28 Oct., 2006
Dr. A.K. Sikka	Directors' Conference of ICAR institutes	New Delhi	3-4 Nov., 2006
Dr. A.K. Sikka	International conference on "The Majestic River Ganga, Health, Integrity & Management"	Patna University, Patna	13 Nov., 2006
Dr. R. K. Batta	National Seminar on Technological options for improving water productivity. JNKVV, Jabalpur,	JNKVV, Jabalpur,	15-16 Nov., 2006.
Dr. S. Kumar	State Level Seminar on Agro and Food Processing	Udyog Mela, Ranchi	18 Nov, 2006
Dr. J.P. Sharma	Second Global Conference Plant Health	Rajasthan Agriculture University, Udaipur	25 - 29 Nov., 2006
Dr. P. Dey	National Symposium on Agroforestry for Livelihood Security, Environment Protection and Biofuel Production.	NRC for Agroforestry, Jhansi	16-18 Dec., 2006.
Dr. A.K. Sikka	Workshop of CGIAR-CPWF Project- "Improved Fisheries Productivity and Management in Tropical Reservoirs"	NASC Complex, Delhi	26 Dec., 2006
Dr. Md. Idris	"Faunal and floral diversity of Rajasthan: Importance and Conservation".	Salim Ali Interpretation Centre, Keoladev National port, Bharatpur	27-28 Dec. 2006
2007-08			
Dr. R.S. Pan	National Symposium on Legume Research-Recent Trends and Future	S.B.B. Patel Univ. of Agr.	Jan. 13-14, 2007

	Prospects in Post Genomic Era	and Tech. Meerut	
Dr. J.P. Sharma	International Symposium on Mushroom	NRC on Mushroom, Solan	Feb. 10-11, 2007
Dr. R.D. Singh Dr. Shivani	State level workshop-cum-training programme on "Micro level planning for agricultural development in Bihar"	Bihar Veterinary College, Patna	March 7, 2007
Dr P.K. Thakur Dr Ujjwal Kumar Dr. Abhay Kumar	Interaction workshop for preparation of full proposal for the project 'Sustainable Livelihood Improvement through Need Based	ICAR-RCER, Patna	March 24, 2007
Dr. A. R. Reddy Dr. A. K. Sikka Dr. Sanjeev Kumar	Integrated Farming System Modules in Disadvantaged Districts of Bihar' under NAIP National Academy of Agricultural Research and Management	ICAR-RCER, Patna.	March 24, 2007
Dr. B. K. Jha	Ecology and Fisheries of Wetlands in India in 4th Indian Fisheries Science Congress	ICAR-RCER, Patna, Bihar.	April 12-13, 2007
Dr. R.S. Pan Dr. B. K. Jha	2nd Indian Horticulture Congress	ICAR Research Complex for NEH Region, Barapani, Meghalaya	April, 18-21, 2007
Dr. S. Kumar, Dr. Ranvir Singh, Dr. J.P. Sharma, Dr. A.K. Singh, Dr R.S. Pan	Group Workers Meeting of AICRP on Vegetable Crops	HAU, Hissar	May 3 - 6, 2007
Dr. B. K. Jha	National Workshop on production and marketing of spices and aromatic plants.	RAU, Pusa, Bihar	May 9-10, 2007
Dr. R. Elanchezhian	Modelling Impacts of Climate Change on Key Crops of the Region	IARI, New Delhi	June 14-16, 2007
Dr. Abhay Kumar Dr. Ujjwal Kumar	Stakeholder's workshop of Agribusiness Infrastructure Development Project	Hotel Pataliputra Ashoka, Patna	Aug. 2, 2007
Dr. P. K. Thakur	RPC meeting of NAIP subproject under component 3	New Delhi	Aug. 27-28, 2007
Dr. Ranvir Singh Dr. Bikash Das	Weed Management Workshop	PRADAN, Purulia	Oct.1-5, 2007
Dr. Abhay Kumar Dr. Ujjwal Kumar	Seminar/ Workshop on World Food Day organized by Bihar State Productivity Council	Patna	Oct. 16, 2007
Dr. R.D. Singh	10th Inter-regional Conference on water and environment (ENVIROWAT)	IARI, New Delhi	Oct. 17-20, 2007
Dr. P. K. Thakur	RPC and Cost committee meeting of	New Delhi.	Oct. 23-26

Dr. Abhay Kumar Dr. Ranvir Singh Dr. Sanjeev Kumar	NAIP subproject under component 3 XXVII Rabi Research Council Meeting National symposium on "Integrated Farming Systems and its Role Towards improvement under Indian context" organized by PDCSR, Modipuram	BAU, Ranchi ARS, Durgapura, Jaipur, Rajasthan	2007, Oct.26, 2007 Oct.26-28, 2007
Dr. R.D. Singh	61st Research Council Meeting, Kharif-2007	RAU, Pusa	Oct. 29-30, 2007
Dr. B.K. Jha	Fishereis and aquaculture: Strategic outlook for Asia in 8th Asian Fisheries Forum	Kochi, India.	Nov. 20-23, 2007
Dr. P. K. Thakur	PMC meeting of NAIP subproject under component 3	New Delhi.	Nov. 25-27, 2007
Dr. R. Elanchezhian	Physiological and Molecular approaches for improving yield and quality of Agricultural, Horticultural and medicinal plants under changing environment	Dr.BalasahebSawant Konkan Krishi Vidyapeeth, Dapoli, Maharastra	Nov. 29 - Dec. 01, 2007
Dr. Abhay Kumar	61st Annual Conference of Indian Society of Agricultural Statistics	Birsa Agriculture University, Ranchi	Nov.30-Dec.2, 2007
Dr. M. S. Meena	Winter school on Improving land, water and energy productivity through micro-irrigation"	ICAR Research Complex for Eastern Region, Patna.	Nov. 30-Dec. 20, 2007
Dr. Abhay Kumar	XVth National Conference of Agricultural Research Statisticians	Birsa Agriculture University, Ranchi	Dec. 03-04, 2007
Dr. Abhay Kumar	Workshop on Geographical Indication (GI) for Regional Development: Identifying potential GI's for Bihar	Bihar Industries Association, Patna	Dec. 28, 2007
2008-09			
Dr. Sanjeev Kumar Dr. Shivani	State level meeting on "Integrated Development of Agric. in Bihar"	RAU, Pusa, Samastipur	Jan.5-6, 2008
Dr. Sanjeev Kumar	Meeting for constitution of an Expert group on "Integrated farming System and Effect on Climate Change on Bihar Agriculture" organised by State Farmers Commission, Bihar.	State Farmers Commission, Pant Bhawan, Patna	Feb. 12, 2008
Dr. Ranvir Singh Dr. A.K. Singh Dr. R.S. Pan	26th Group Meeting of AICRP (Vegetable Crops)	OUAT, Bhubaneswar	Feb. 23-27, 2008
Dr. A. Dey	Improving water productivity, reducing poverty and enhancing equity in mixed crop-livestock systemin IGB	ICRISAT Campus, Hyderabad.	March 6-7, 2008

Dr. R. D. Singh	Formation of state level task force.	Department of Agriculture, Govt. of Bihar	March. 25, 2008
All Scientists of the Institute	Meeting with Prof S. R. Hashim, Ex-Member, Planning Commission, Govt. of India &Dr.Prem S. Vashistha, Executive Secretary, India Water Partnership	ICAR-RCER Patna	April 07, 2008
Dr. Janardan Jee	National Seminar on Importance of Medicinal and Aeromatic plants in Bihar Economy.	Scada Centre, Patna	April 8-9 2008
Dr. B.P.S. Yadav	Preliminary review meeting for next XIX Meeting of ICAR Regional Committee No. IV scheduled in 2008	NBFGR, Lucknow	April 19, 2008
Dr. R. Elanchezian	Bangalore BIO 2008	Bangalore International Exhibition Centre	April 24-26, 2008
Dr. D.K. Kaushal	"National Conference on Aquatic Genetic Resources"	NBFGR, Lucknow	April 26-27, 2008
Dr. A.R. Khan Dr Sanjeev Kumar Dr S. S. Singh Dr. A.K. Jain	District Agromet Advisory Service Meeting by Meteorological Center, India for District Level Forecasting	ICAR-RCER, Patna	April 28, 2008
Dr. B.P.S. Yadav	Five Yearly Assessment Committee of Cat. III Technical Personnel under the functional group Field & Farm [especially for Dr. R.K. Verma, Vet.]	IGFRI, Jhansi	May 01, 2008
Dr. M.A. Khan	Divisional meeting of the Directors and Project Coordinators of NRM Division on under the Chairmanship of DDG (NRM), ICAR, New Delhi.	Conference Room, 2nd Floor, NASC Complex, New Delhi	May 14, 2008
All Scientists of the Institute	Workshop on Revival of Agricultural Crescent in Bihar by NAAS	ICAR-RCER, Patna	May 24 - 25, 2008
Dr. S. Kumar Dr. Bikash Das	National Seminar on Production, Processing, Marketing and Export of Litchi for Economic Prosperity	NRC for Litchi, Muzaffarpur	May 28-31, 2008
Dr. M.A. Khan Dr. R. D. Singh	62 Research Council Meeting, Kharif, 2008.	R.A.U. Pusa	June 3 - 4, 2008
Dr. M.A. Khan	National Seminar on 'Production, Marketing and Export of Litchi for Economic Prosperity" & 'All India Litchi Show-cum-KisanGosthi and Field Visits' at (Act as Member: National Advisory Committee)	Muzaffarpur (Bihar)	June 06, 2008
Dr. M.A. Khan	Climate Change Meeting	CRIDA, Hyderabad	June, 23-24, 2008

Dr. R.C. Bharati Dr. A.R. Khan Dr. Janardan Jee	Role of Infrastructure and communication technology in Agriculture, ICT and Internet connectivity of the institute with Dr T.P. Trivedi Director, DIPA & ADG (ARIS) cell, ICAR, New Delhi	ICAR-RCER, Patna	June 7, 2008
Dr. Mohd. Idris Dr. Janardan Jee Dr. A.K. Singh Dr. R.D. Singh Dr. B.K. Jha Dr. R.K. Batta	Production, Processing. Marketing and Export of Litchi for Economic Prosperity	NRC. Litchi. Muzaffarpur (Bihar)	June 8-11, 2008
All Scientists of the Institute	Meeting with Dr. A.K. Upadhyaya, Secretary ICAR	ICAR-RCER, Patna	June 09, 2008
	Meeting with J. Prabhu of Hindu daily under the chairmanship of Shri Ramadhar, Chairman, Kisan Ayog, Govt. of Bihar	Kisan Ayog, Patna	June 12, 2008
	Institute Research Council of ICAR-RCER	ICAR-RCER, Patna	June 16 - 19, 2008
All Scientists of the Institute	Inauguration of Institute World Web Site	ICAR-RCER, Patna	June 19, 2008
Dr. A.K. Jain	Brain storming session on role of ICAR and SAUs as a catalyzing agent for Patna management of the changes in the Indian NARS (National Agricultural Research System)	ICAR RCER,	June 25, 2008.
Dr. Mohd. Idris	Enhancing Productivity, National Security and Export Potential through Arid Legume	CAZRI, Jodhpur (Raj)	June 28-30, 2008
Dr. M.A. Khan	Summer School Course on 'Sustainable Water Resources Development and Management' at National Institute of Technology (NIT)	Patna	June, 29 2008
Dr. Bikash Das	18 Group Worker's Meeting on Subtropical Fruits	C.I.S.H. Rehman khera, Lucknow	June 29 - July 2, 2008
Dr. R. K. Batta	CPWF Networks Coordination Meeting International Water Forum Meeting	New Delhi	July 7-8, 2008
Dr. M.A. Khan	ICAR Foundation Day/Director's Conference	New Delhi	July 15-18, 2008
Dr. M.A. Khan	National Seminar on Amorphophallus: Innovative Technologies".	Bihar Veterinary College Campus, Patna	July 19, 2008
Dr. Janardan Jee	National Conference on Geographical Indicators	CII & BIA, Patna	July 26-272008
Dr. M.A. Khan	Divisional Committee Meeting for	KAB-II, ICAR,	Aug. 01,

Dr. A.R. Khan	Monitoring & Reviewing the progress of Foreign Aided Projects	New Delhi	2008
Dr. M.A. Khan	Workshop on Farmers' Club Programme Constitution of Farmers' Technology Transfer Fund (FTTF) by NABARD Operational Guidelines	NABARD, Patna	Aug. 08, 2008
Dr. M.A. Khan	Training Programme on 'Horticulture Extension Management for District/Sub District Level Officers of Bihar State' relevance to National Horticulture Mission	SAMETI, Bihar D.N.S. Regional Institute of Cooperatives, Patna	Aug. 25-29, 2008
Dr. J.P. Sharma	Mushroom Mela	NRC for Mushroom, Solan	Sept. 13, 2008
Dr. M.A. Khan	ICAR and ACIAR interaction Workshop and Retreat of ACIAR Project on 'Water Harvesting and Better Cropping System for Benefit of Small Farmers in Watershed of the Eastern Indian Plateau'	ICAR-RCER Ranchi Centre, Ranchi	Oct. 13-14, 2008
Dr. S.S. Singh Dr. Janardan Jee	Chief Minister's Fast Seed Multiplication Programme by Agriculture Department, Bihar Govt.	Gandhi Maidan, Patna	Oct. 16, 2008
Flood study team members	Flood Review Committee with Dr. T. P. Trivedi of ICAR , New Delhi	ICAR-RCER, Patna	Oct. 20, 2008
All Scientists of the Institute	Visit & Meeting with D. G. & Secretary, ICAR	ICAR-RCER, Patna	Oct. 30, 2008
Dr. A.K. Singh Dr. R.S. Pan Dr. Bikash Das Dr. B.K. Jha	3rd Indian Horticulture Congress-2008 on "New R & D Initiatives in Horticulture for Accelerated Growth and Prosperity".	O.U.A.T., Bhubaneswar	Nov. 6- 9, 2008
Dr. P.K. Ray	Silver Jubilee Annual conference of Indian Association of Veterinary Pathologists and International Symposium on "Quality Assurance in Pathology and Disease Diagnosis" & Satellite Seminar on "Descriptive Gross and Microscopic Veterinary Pathology in Necropsy, Biopsy and Certification Examination (CL Davis foundation, California, USA)	IVRI, Izatnagar.	Nov. 10-12, 2008
Dr. R.D. Singh	Flood affected area of Koshi region	Saharsa & Supaul	Nov. 11 17, 2008
Dr. R. Elanchezian	Challenges and emerging strategies for improving plant productivity	IARI, New Delhi	Nov. 12-14, 2008
Dr. A.K. Singh	National Symposium on " New Paradigm in agronomic research"	Navsari , Gujrat	Nov. 19-21, 2008
Dr. M.A. Khan	XIX Meeting of ICAR Regional Committee No. IV	IIVR, Varanasi	Nov. 21-22, 2008

Dr. Janardan Jee	International Consortium of Contemporary Biologists, ICTBR-2008	Ranchi, Jharkhand	Nov. 20-22, 2008
Dr. B.K. Jha	8th Indian Fisheries Forum on "Fish for Health & Livelihood"	Eastern Zonal Cultural Centre, Salt Lake City, Kolkata, (W.B),	Nov. 22-26, 2008
Dr. R.C. Bharati	Participated in 62nd Annual Conference of Indian Society of Agricultural Statistics.	Acharya N.G. Ranga Agricultural University, Tirupati	Nov, 24-26, 2008
Dr. R. D. Singh	Farm Mechanization and Extension	BAMETI, Patna & MANAGE, Hyderabad	Nov., 27, 2008
Dr. K. Rajan	National seminar on "Development in Soil Science 2008"	GKVK, UAS Bangalore	Nov. 27-30, 2008
Dr. M.A. Khan Dr. A.R. Khan Dr. Janardan Jee Dr. Sanjeev Kumar Dr. N. Chandra Dr. Ujjwal Kumar Dr. B.P.S.Yadav, Dr. S.K. Das Dr. A. Dey	Launching Workshop of NAIP Project "Sustainable Livelihood Improvement through Need based Integrated Farming System Models in Disadvantaged Districts of Bihar"	ICAR-RCER, Patna	Nov. 28, 2008
Dr. S.K. Singh	Zonal workshop of KVKs Zone-II	KVK, Nimperth, WB	Nov. 28-30, 2008
Dr. R. Elanchezian	System of Rice Intensification in India	TNAU, Coimbatore	Dec. 1-3, 2008
Dr. M.A. Khan	End of Project Meeting and Synthesis Workshop of CPWF Project 7 organized by the CGIAR-CPWF	Manila, Philippines	Dec. 02-04, 2008
Mr. B.R. Jana	2nd International Symposium on Papaya	TNAU, Madurai	Dec. 9-12, 2008
Dr. Janardan Jee	Global Potato Conference 2008 Opportunities and Challenges in The New Millennium	New Delhi	Dec. 9-12, 2008
Dr. R. D. Singh	Challenges and Opportunities for Agricultural Development in Bihar	State Farmers Commission, Bihar	Dec. 10-11, 2008
Dr. R.S. Pan	International soyabean processing and utilization conference-V	CIAE, Bhopal	Dec. 10-14, 2008
Dr. A.R. Khan Dr. Janardan Jee Dr. B.P.S. Yadav	Launching Workshop - Roji Roti Promoting Sustainable Livelihood (DFID)	ICAR-RCER, Patna	Dec. 16, 2008

Dr. R. D. Singh Dr. Sanjeev Kumar Dr. Shivani Dr. N. Chandra Dr. Ujjwal Kumar Dr. S.K. Das Dr. A.K. Jain			
Dr. Sanjeev Kumar	Meeting for Development and initiation of Integrated Farming System Project Work in different districts of Bihar	Director, Agriculture, GOB., Vikas Bhawan, Patna	Dec. 18, 2008
Dr. R. D. Singh	State level meeting on Watershed management	Soil Conservation Department, Govt. of Bihar	Dec. 23, 2008
Dr. S.K. Singh Dr. Janardan Jee	State level workshop Organised by Women Development Corporation, Bihar	Hotel Patliputra Patna-1	Dec. 29, 2008
Dr. S.K. Singh	3rd National Conference of KVKs	GBPUA & T, Pant Nagar	Dec. 27-29 2008
2009-10			
Dr. S.S. Singh Dr. Sanjeev Kumar	Workshop for the application of the questionnaire Survey (NAIP), organized by IWMI, India.	ICAR-RCER, Patna	Jan.19-20, 2009
Dr. R.C. Bharti	International symposium on e-Infrastructures for Distance learning.	India Habitat Centre, New Delhi	Jan.28-29 2009
Dr. Ranvir Singh Dr. J. P. Sharma Dr. A.K. Singh Dr. R.S. Pan	XXVII Group Meeting of AICRP of Vegetable crops.	Tamil Nadu Agricultural University, Combatore	Feb.12-15 2009
Dr. A. Upadhyaya Er. A.K. Singh	Participated in XLIII ISAE Annual Convention & Symposium.	BAU, Ranchi	Feb.15-17 2009
Dr. S.S. Singh Dr.AR Khan	Planning workshop of CSISA by IRRI, Manila.	NASC, New Delhi	April26-30 2009
Dr. S.K. Singh Miss. Punam Tiwari	KVK Zonal workshop, Zone II, ICAR.	BAU, Ranchi	May 23 - 25, 2009
Dr. M. A. Khan Dr. A. Dey	Annual Progress Meeting of the Challenge Programme on Water and Food Project No. 68.	ICRISAT, Hyderabad	May 25 - 26, 2009
Dr. Ujjwal Kumar	CSISA delivery and adaptive research planning meeting	CSSRI, Karnal	May 28 - 29, 2009
Dr. Sudhir Kumar Singh Dr. R.K. Roy	National conference on technology led development of horticulture for rural development.	Mahmada Village, Pusa, Samastipur	May 28-31, 2009
Dr. P.K. Thakur	National Review Workshop of NAIP (Comp-3).	CIAE, Bhopal	June 1-2 2009

Dr. K. M. Singh	Workshop on Tracking Changes in Rural Poverty in Household and Village Economies in South Asia.	ICRISAT, Hyderabad	June 30 - July 2, 2009
Dr. R.C. Bharti	Workshop of National Knowledge Network.	National Informatics Centre, New Delhi	July 3, 2009.
Dr. A. Haris Dr. Adlul Islam	Annual Workshop of the ICAR Network Project on Climate Change "Impact, Adaptation and Vulnerability of Indian Agriculture to Climate Change".	CRIDA, Hyderabad	July 3 - 4, 2009
Dr. S.S. Singh Dr.AR Khan Md. Idris	Joint Review Meeting of Experimental Research Platform (CSISA).	ICAR-RCER, Patna	July 28, 2009
Dr. Janardan Jee	Bihar Maize and Poultry Task Force workshop.	BIA, Patna	July 30, 2009
Ms. Punam Tiwari	Mainstreaming gender concerns in agriculture.	DNS-RICM, Shastrinagar, Patna	Aug.17 - 1, 2009
Dr. S.S. Singh Dr.AR Khan Dr. Mohd. Idris	CSISA Experimental Platform Meeting	ICAR-RCER, Patna	Aug.27, 2009
Dr. A. Upadhyaya	International workshop on "Water quality research to evaluate the effects of Agricultural Conservation Practices utilized in the United States and India.	Allahabad Agricultural Institute, Allahabad	Sept. 7 - 8, 2009
Dr. J. P. Sharma	National Mushroom Mela.	Dir. of Mushroom Solan, Himachal Pradesh	Sept.10, 2009
Dr. R.D. Singh	Workshop on "Alternate implementation models for efficient public delivery system"organized by World Bank in collaboration with the Rural Development Deptt., Govt. of Bihar.	Patliputra Ashok Hotel, Patna	Sept.15,2009
Dr. R.D. Singh Dr. Shivani Dr. Sanjeev Kumar	Workshop onAdvantages of Resource Conservation Technology in minimizing the cost of production & obtaining higher yieldorganized by ICAR-RCER and sponsored by BAMETI Govt. of Bihar.	ICAR-RC ER, Patna	Sept. 17-19, 2009
Dr. A. Upadhyaya Dr Biplab Saha	Conference on Food and Environment Security through Resource Conservation in Central India: Challenges and Opportunities.	CSWCRTI, Research Centre, Chhaleser, Agra	Sept 16 - 18, 2009
Dr. K. M Singh	Workshop on Strengthening	ICRISAT,	Sept. 22 -

	Partnerships and Networks in Agricultural Research and Development.	Hyderabad,	24, 2009.
Dr. Nitu Kumari	First Indian Agricultural Scientists and Farmers Congress on Technological Innovation for Enhancing Agriculture education.	CCSU., Meerut	Oct.3-4, 2009
Dr. N. Subash	Indo-Russian workshop on Regional Climate Change.	NERC - India, Cochin	Oct. 8 - 9, 2009
Dr. K. M Singh	Stakeholders Workshop on Fodder	ICAR-RCER, Patna	Oct. 27-2009
Dr. Ujjwal Kumar Dr. N Chandra Dr. Abhay Kumar Dr. S. K. Singh Dr. A. Dey Dr. S.S. Singh Dr. Sanjeev Kumar Dr. A. R. Khan	Marketing in Bihar organized by ILRI, Asia Centre, India.		
Dr. S.K. Singh	National Conference on KVKs.	TNAU, Coimbatore	Nov.06 - 08, 2009
Dr. S. Kumar, Dr. J.P. Sharma	5th International Conferences on Plant Pathology in the Globalized Era.	Division of Mycology and Plant Pathology IARI New Delhi	Nov.10 - 13, 2009
Dr. Janardan Jee	Assocham agriculture Investment - Bihar 2009.	Hotel Patliputra, Patna	Nov.12.2009
Dr. Janardan Jee	Communal Harmony Campaign week.	ICAR –RCER, Patna.	Nov.19 - 25, 2009
Dr. Janardan Jee	Workshop on Creating a healthy society with focus on climate change, health and environment.	IEED, Patna	Nov.16 - 18, 2009
Dr. Janardan Jee Dr. A.K. Singh Dr. Bikash Das	2nd International Conference on Bio-Wealth Management for Sustainable Livelihood (ICBMSL).	Institute of Forest Productivity, Ranchi, Jharkhand	Nov.20 - 22, 2009
Md. Idris	Int. Conf. on Nurturing Arid Zones for the People and the Environment: Issues and Agenda for the 21st Century.	CAZRI, Jodhpur (India)	Nov.24 - 28, 2009
Dr. Abhay Kumar Dr. R. C. Bharati	63rd Annual Conference of Indian Society of Agricultural Statistics.	RAU, Pusa	Dec.3-5, 2009
Ms PunamTiwari	Post Harvest technology and value addition of grains for designer foods to address life style disorders and health challenges.	College of Rural Home Science, UAS, Dharwad	Dec.03 - 23, 2009

Md. Idris	State Pest Surveillance and Advisory Unit Meeting.	Director Agriculture, Patna	Dec.4, 2009
Dr. B.P.S. Yadav Dr. P.C. Chandran	National Seminar on Strategy for Veterinary Services – Vision 2010.	Bihar Veterinary College	Dec. 11 - 13, 2009
Dr. S. Kumar, Dr. Bikash Das	XIX Group Workers' Meeting of AICRP on Sub-tropical fruits.	B. Sawant Konkan Krishi Vidyapeeth, Dapoli	Dec14 to 17, 2009
Mr. B. R. Jana	National Symposium on Recent global developments in management of plant genetic resources.	NBPGR, New Delhi	Dec17 - 18, 2009
Dr. Ujjwal Kumar	Technical working group meeting of Cereal Systems Initiative for South Asia (CSISA) Central Bihar Hub.	ICAR-RCER, Patna	Dec.17.2009
Dr. A. R Khan	International Conference on Food Security and Environmental Sustainability.	I.I.T., Kharagpur	Dec.17 - 19, 2009
Dr. R. K. Roy	Training on Operationalization of ATMA & SREP.	DNS-RICM, Shastrinagar, Patna	Dec.21-23, 2009
Dr. K. Rajan	Platinum Jubilee Symposium on Soil science in meeting the challenges to food security and environmental quality conducted by Indian Society of Soil Science, New Delhi.	IARI, New Delhi	Dec. 22 - 25, 2009
Dr. M. S. Meena, Dr. K. M Singh	National Seminar on enhancing efficiency of extension for sustainable agriculture and livestock production.	IVRI, Izzatnagar (UP).	Dec. 29 - 30, 2009
Dr. Janardan Jee	20th All India Congress of Zoology and National Seminar on Bioresearches and its Management for Food, Livelihood and Environmental Security & National Helminthological Congress.	CIFE, Mumbai	Dec. 29 - 31, 2009
2010-11			
Dr Ujjwal Kumar	Annual Review Workshop of NAIP Comp-3	ICAR-RCER, Patna	January 22, 2010.
Dr. A. Upadhyaya	To present a paper and participate in XLIV ISAE Convention	ICAR, KAB-II, IARI, New Delhi	January 28-30, 2010
Dr. A.K. Singh	Meeting cum workshop	ICAR IINRG, Namkum, Ranchi	February 19-20, 2010
Dr. K. M. Singh	Seminar on Tracking Changes in Rural Poverty in Household and Village Economies in East India,	NCAP, New Delhi	February 20, 2010
Dr. A.K. Jain	seminar on Applications of biotechnology and development of Bihar	Central University of Bihar, Patna	March 22-24, 2010

Dr. A. Upadhyaya	1st Meeting of the reconstituted ICAR-CWC Joint Panel Meeting	Pusa, New Delhi	April 21, 2010.
Dr. R. Elanchezhian	National seminar on Impact of Climate Change on Water Resources	Irrigation Division, Govt. of Bihar, Patna	April 23, 2010.
Dr. A. R. Khan Dr. Ujjwal Kumar Dr. R.C. Bharati	Workshop on CSISA Delivery and Adaptive Research	Belia, Tarapith, Birbhum, West Bengal,	May 11-12, 2010.
Dr. R.D. Singh	Workshop onCommon Format for Preparation of District Level Contingency Plans for Northen Statesorganized by Project directorate for Farming Systems Research, Modipuram, Meerut (U.P.)	PDCSR, Modipuram, Meerut (U.P.)	June 3, 2010
Dr. Nitu Kumari	Seminar cum Training Programme on 'Canopy Management and Propagation of Quality Planting Material' organized by Department of Agriculture and Cooperation, Ministry of Agriculture, GOI, New Delhi in collaboration with Department of Horticulture, Govt. of Bihar	Taramandal, Patna	June 25, 2010.
Mrs. Punam Tiwari	Training programme on Online Reporting of KVKs, organized by ZPD, Zone II	RAU, Pusa, Samastipur	June 26, 2010.
Dr. K. M. Singh Dr. S. K. Barari	Launch Workshop of NAIP Consortium on 'Developing, Commissioning, Operating and Managing an Online System for NET/ ARS-PRELIM Examination in ASRB, ICAR'	NAAS Complex New Delhi	July 1, 2010
Dr. R.K. Roy	One day orientation workshop for KVKs at CRIDA, Hyderabad to discuss possible interventions in vulnerable districts on climate resilient technology	CRIDA, Hyderabad	July 1, 2010.
Dr. S.K. Singh	Seminar on Agriculture and Horticulture, organized by Director Agriculture, Bihar	Saran, Chhapra, Bihar	July 08, 2010.
Dr. Janardan Jee	IPR issues in Agriculture National Productivity Council	Patna	July 24, 2010.
Dr. A.K. Singh	ICAR-Industry Meet Organized by ICAR	NASCE Complex, New Delhi	July 28-29, 2010
Dr. S.K. Singh	State level Workshop on Organic Farming in Bihar- Business prospects and future direction organized by Organic Mission in collaboration with ECOCERT-India	B.I.A., Patna	August 04, 2010.

Dr. A.R. Khan	Attended Divisional Committee Meeting to review the foreign aided projects under NRM Division	KAB II, ICAR, Pusa, New Delhi	August 10, 2010.
Dr. R.K. Roy	Review meeting cum workshop of KVKs of Bihar	RAU, Pusa	August 12-13, 2010.
Dr. R. Elanchezhian	2nd CAC meeting of NAIP Project - Modeling the Performance of a Few Major Cropping Systems in Eastern India in the Light of Projected Climate Change	OUAT, Bhubaneshwar	August 27, 2010
Dr. A.K. Singh	Participated in First National Congress on Emerging Trend in Agricultural Research organized by Society for Recent Development in Agriculture	PDFSR, Modipuram, Meerut,	September 11-12, 2010
Dr. N. Chandra	Hindi Workshop	ICAR-RCER, Patna	September 14, 2010.
.Dr. Janardan Jee	Hindi Pakhwara	ICAR-RCER, Patna	September 14-30, 2010.
Dr. Deokaran	RCM of ICAR,	BAU, Ranchi	October 7 to 9, 2010.
Dr. Janardan Jee	National Food Day Seminar on Food Security in Period of Crisis.	Bihar Productivity Council, Patna	October 16, 2010.
Dr. A. K. Singh	Nature Fest' organized by NABARD – NRMC Kolkata,	Central Park Salt lake Kolkata	October 25 to November 3, 2010.
Dr. R.C. Bharati	Interactive Meet on Information and Communication Technology in ICAR	NASC Complex New Delhi.	November 3-4, 2010.
Dr. Janardan Jee	Processing and Marketing of Fruit	Bihar Industry Association (BIA), Patna	November 15, 2010.
Dr. A.K. Singh, Dr. R.S. Pan	4th Indian Horticultural Congress-2010,	Horticulture Society of India, New Delhi	November 18 to 21, 2010.
Dr. S.K. Singh	National Conference on Biodiversity of Medicinal and Aromatic Plants Collection, Characterization and Utilization, Organized by Medicinal and Aromatic Plants Association of India	Anand, Gujarat	November 24 to 25, 2010.
Dr. R. Elanchezhian	National conference of Plant Physiology "Physiological and Molecular Approaches for Crop Improvement under Changing Environment"	Banarus Hindu University, Varanasi	November 25 to 27, 2010.

Dr. R.D. Singh, Dr. S.S. Singh, Dr. Sanjeev Kumar Dr. Shivani Dr. A. Upadhyaya	Participated in XIX National Symposium on Resource Management Approaches Towards Livelihood Security	U.A.S. Bangalore	December 2 to 4, 2010
Dr. A.R. Khan	Experts Meet for Formulation of Syllabus of Post-Graduate Courses	Central University, Patna, Bihar	December 6 to 7, 2010.
Dr. Deokaran, Mr. Sarfaraj Ahmad	State Level Workshop of KVK, Zone-II,	BVC, Patna	December 10 to 12, 2010
All Scientists	Brain Storming Session on Second green revolution: Strategies for agricultural transformation in Eastern region,	ICAR-RCER, Patna	December 11 to 12, 2010.
Dr. Deokaran Mr. Sarfaraj Ahmad	Brainstorming session on Second Green revolution in Eastern India	ICAR-RCER, Patna	December 12, 2010.
Dr. (Mrs.) Bhavana P.	International Symposium on Recent Advances in Cross-disciplinary Microbiology: Avenues & Challenges' and 'International Workshop on rRNA Sequencing, Phylogeny and Next Generation Genome Sequencing'	Birla Institute of Technology, Mesra, Ranchi	December 14 to 17, 2010
Dr. Abhay Kumar	19th International Conference of FIM on 'Interdisciplinary Mathematical and Statistical Techniques' Department of Statistics,	Patna University, Patna	December 18 to 20, 2010.
Dr. Janardan Jee	IT & Rural Development,	Bihar, Times Conclave Patna,	December 19, 2010.
Dr .Deokaran	5th National conference on KVK	MPUAT, Udaipur	December 22-24, 2010
Dr. A. Upadhyaya	Global India Scientists and Technologists (GIST) 2010 Convention on Scientific and Technological Approaches for Sustainable Use of Water Resources	Pune,	December 26 to 27, 2010.
2011-12			
Abdul Haris A. Bharati R.C. Chandra, N. Dey A. Elanchezhian R. Kaushal D.K. Singh R.D. Singh S.S. Singh K.M.	Participated in the International Conference on Organic Bihar organized by ICAR-RCER and Govt. of Bihar	Patna	June 22-24th, 2011

Thakur, P.K. Kumar Sanjeev Kumar Santosh Shivani Kumar Ujjwal Meena M.S. Kumar Abhay Kumar, S. Singh A.K. Jha B.K. Das, Bikash Naik, Sushanta Kumar Mali Santosh and Choudhary, J. S.			
Abdul Haris A., Dey A. and Kaushal, D.K.	Participated in State Level Workshop on Bihar State Action Plan on Climate Change		November 11-12, 2011
Abdul Haris A.	Participated in International Conference on Climate Change, sustainable agriculture and public leadership organized by NCCSD, ICAR	NASC, New Delhi	February 7-9, 2012
Bharati, R.C.	Participated in meeting on CSISA Delivery and adaptive research	Begusarai	May 30, 2011
Chandra, N.	Participated in workshop on Sustainable agriculture: traditional indigenous knowledge systems and security	CIPM, Patna	May 3-5, 2011
Chaudhary, B. K., Kaushal, D.K. and Jha, B.K.	9th Indian Fisheries Forum IMAGE	Chennai	December 19-23, 2011
Choudhary, J.S. and Das Bikash	High Level Review Meeting of NICRA" organized by CRIDA	NASC Complex, New Delhi	December 12-13th, 2011
Das, Bikash	Workshop on mango horticulture-A livelihood opportunity for rural poor, organized by PRADAN	Ranchi	March 24 - 25, 2011
Dayal, Shanker	28th Annual Conference of Indian Poultry Science Association	Bihar Veterinary College, Patna	December 22-24, 2011
Dwivedi, V.	6th National Conference on Krishi Vigyan Kendra	JNKVV, Jabalpur	December 3-5, 2011
Elanchezhian, R.	Participated in Interaction Meet with scientist trained abroad in Frontier Areas of Agricultural Sciences	NASC, New Delhi	Nov. 29-30, 2011
Elanchezhian, R.	Participated in Interface meeting with Department of Agriculture of different states of eastern region of India viz.	Department of Agriculture, Govt. of Bihar,	April 29 - May 5, 2011

	Bihar, Chattisgarh and Odisha for identification of research gaps and issues of R&D	Chattisgarh and Odisha	
Elanchezhian, R.	Participated in Meeting on Prioritization of Plant Physiology and Biochemistry Research for 12th Five Year Plan Period	IARI, New Delhi	August 5-6, 2011
Islam, Adlul	Participated in the Workshop on Capacity Development for Farm Management Strategies to Improve Crop-Water Productivity using AquaCrop Model organized by ICAR and FAO under National Initiative on Climate Resilient Agriculture (NICRA)	CRIDA, Hyderabad	October 18-22, 2011
Islam, Adlul	Participated in International Training Workshop on Ecosystem Approach to Disaster Risk reduction organized by National Institute of Disaster Management, New Delhi in collaboration with Partnership on Environment and Disaster Risk Reduction (PEDRR), United Nations	New Delhi	December 12-15, 2011
Jee, Janardan	Participated in Ethic and Values in Organisation LBS National Academy of Administration	Missouri, UP	Feb 28.-March 4, 2011
Jee, Janardan	Participated in Brain Storming Session on Bios Pesticide Quality Assurance, organised by National Academy of Agricultural Sciences, New Delhi	NASS Complex, New Delhi	June 24 2011
Jee, Janardan	Delivered lecture on Conservating Energy in Agriculture in National Productivity Week Celebration	Patna Dairy Project, Patna	February 18, 2011
Jee, Janardan	Participated in National Seminar on "Farmers Journey from Farm to Industry organised by INDUCTUS at BSSTC," and chaired the session on Agro-Industry	Planetarium, Patna	September 22, 2011
Jee, Janardan	Participated in National Seminar on Development of Horticulture in Bihar: Issue and Strategies	Bihar Veterinary Collage, Patna	January 28-29, 2011
Jee, Janardan	Participated in National Seminar on Management of Wetland Resources for Sustainable Fisheries Development: Current Status and Future Challenges	B. D. Evening College, Patna	February, 25-26, 2011
Jee, Janardan	Organized one day Hindi Karyashala and Strategy for Agricultural Development	ICAR-RCER, Patna	February 15, 2011
Jee, Janardan	Participated in Round Table on Skill Development Initiative: Focus Bihar, Hotel Chanakya	Patna	June 16 2011

Kaushal, D.K.	Participated in workshop on Culture of Freshwater prawn along with Indian Major Carps	Sone Bhavan, Patna	September 26, 2011
Kaushal, D.K.	Participated in workshop on Road Map of Fisheries Development in Bihar	Hotel Maurya, Patna	June 21, 2011
Kaushal, D.K.	Participated in workshop on Carp Seed Production, College of Fisheries	Dholi	January 20, 2012
Khan A.R	attended Review-cum-Planning meet of CSISA Research Platforms	NASC Complex, New Delhi	December 05, 2011
Khan, A.R.	Attended a Workshop School of Biotechnology and Health Sciences, Karunya University	Coimbatore, Tamil Nadu	July 25, 2011
Khan, A.R.	Attended International Workshop on Sustainable Agriculture: Traditional Indigenous Knowledge systems and Food security Chandragupt Institute of Management (CIMP)	Patna	May 3-5, 2011
Khan, A.R.	Attended National Symposium on "Innovative and Modern Technologies for Agricultural Productivity, Food Security and Environmental Management at Society of Applied Biotechnology (India)	Mangalore, Karnataka	July 22-23, 2011
Khan, A.R.	Attended Stakeholders' Meeting for Preparation of Vision 2030 document	Regional Center, NBSS & LUP, Kolkata Regional Center, NBSS & LUP, Kolkata	May 21, 2011
Khan, A.R.	Attended Divisional Committee Meeting to review the foreign aided projects	NRM Division KAB II, ICAR, Pusa, New Delhi	August 01, 2011
Kumar, Abhay Kumar, Sanjeev	Participated in the Annual Review Workshop of NAIP Comp.3 Projects	NBFGR, Lucknow	March 01-02, 2011
Kumar, Abhay	Participated in the Consortium Advisory Committee (CAC) meeting of NAIP Component 3 subproject	ICAR RCER, Patna	May, 26, 2011
Kumar, Abhay	Participated in the Consortium Implementation Committee (CIC) and Consortium Monitoring Committee (CMC) meeting of NAIP Component 3 subproject	ICAR RCER, Patna	May. 24, 2011
Kumar, S. Das Bikash, and Choudhary, J. S.	Participated in the "National Stakeholder Consultation on Climate change Platform"	CRIDA, Hyderabad	September 19-20, 2011

Kumar, S. Das Bikash; Mali, Santosh and Choudhary. J. S.	Participated in the "Thematic workshop on pest and disease dynamics" of NICRA on Mango	CRIDA, Hyderabad	February 26 - 27, 2011
Kumar, S. Das Bikash; Mali, Santosh and Choudhary. J. S.	Participated in "Group workers orientation workshop of NICRA on mango	ICAR-RCER, RC Ranchi	June 29 - 30, 2011
Kumar, Sanjeev	Attended in 2-days Training Programme on " Mechanical Rice Transplanter" under Accelerating Resource Conservation Technologies to Improve Livelihood Security (IFAD) organized by CSISA Central Hub	Kushinagar, U.P.	July 6-7, 2011
Kumar, Sanjeev	Participated in the "IFAD Workshop" alongwith IFAD team organized by IFAD, IRRI and ICAR-RCER, Patna	ICAR-RCER, Patna	September 03, 2011
Kumar, Sanjeev	Participated in the Annual Workshop on IFS organized by PDFSR, Modipuram (U.P.).	CARI, Port Blair	December 27-29, 2011
Kumar, Sanjeev	Participated in the meeting on "Vision 2030" for Bihar with Agriculture production Commissioner, Bihar	New, Secretariat	July 25, 2011
Kumar, Sanjeev	Participated in the Brain Storming on Agriculture system Research and Development Opportunity in Bihar and Possible Regional linkages	ICAR-RCER, Patna	July 28, 2011
Kumar, Santosh	Participated in 46th Annual Rice Research Group Meeting	Directorate of Rice Research, Hyderabad	April 8-11, 2011
Kumar, Santosh	Participated in a "Review Meeting for Foreign Aided Projects	NRM Division, ICAR, Pusa, New Delhi	January 3, 2012
Kumar, Santosh	Participated in a Workshop on Policy Dialogue on Sustainable Rural Livelihood in Disadvantaged Areas of Bihar	ICAR-RCER, Patna	March 29, 2011
Kumar, Santosh	Participated in a Workshop on SRI Technique and Agriculture Extension	Sri Krishnan Memorial Hall, Patna	January 27, 2011
Kumar, Santosh	Participated in Inception Meeting and Planning Workshop for Phase 2 of the project' Stress-tolerant rice for Africa & South Asia (STRASA)	NASC Complex, New Delhi	April 5 -6, 2011
Kumar, Ujjwal	Participated in the IFAD-IRRI Workshop and field visits	Ludhiana, Karnal, Modipuram and Patna	August 29 - September 3, 2011

Kumar, Ujjwal	Participated in the Policy Dialogue Meeting on Sustainable Rural Livelihoods in Disadvantaged Areas of Bihar organized by ICAR, IRRI, IFPRI and IWMI	ICAR-RCER, Patna	March 28, 2011
Mukherjee, J.	Participated in National Seminar on "Agrometeorological Research and Services to Combat Climate Change Challenges"	BCKVV, Mohanpur, Kalyani, West Bengal	December 9-10, 2011
Naik, Sushanta Kumar	Participated in the "Proposed Capacity Building Programme of Partner NGOs in Organic Farming in Jharkhand"	NHM, Jharkhand	January 11-13, 2012
Rahman, A.	Conducted Training on Scaling Up of Water Productivity in Agriculture for Livelihood	KVK, Bhojpur	Feb 8-14, 2012
Rahman, A. Sundaram, P.K.	Attended Seminar on Promotion of Bio Fuel & Green Energy for Sustainable Growth & Its Impact on Climate Change organised by Institute of Applied Systems & Rural Development (IASRD), Rural Electrification Corporation Ltd. & Defence Research and Development Organization	Hotel Maurya, Patna, Bihar	November, 30th 2011
Singh, A.K.	Participated in the "ICAR-Industry Meet 2011, organized by ICAR	NASC, Complex New Delhi	May 23, 2011
Singh, A.K.	Attended Workshop on "Stakeholder Consultation to Identify Thrust Area of Research and Development in the Area of Food Processing' organized by MOFPI and FICCI	Hotel Taj, New Delhi	June 29, 2011
Singh, A.K.	Attended two days Meeting cum Workshop on Commercialization of ICAR, Technology organized by BPD unit Kolkota	BAU Kanke, Ranchi	April 01-02, 2011
Singh, A.K.	Participated in First International Conference on Issues for Climate Change, Land use Diversification and Biotechnological Tool for Livelihood Security	SVBP University, Meerut (UP)	October, 8-10, 2011
Singh, K. M.	Participated in Workshop of Heads of Divisions and Region Stations/ Centres	CIAE, Bhopal	June 14-15, 2011
Singh, K.M and Kumar, U.	Participated in International Conference on Innovative Approaches for Agricultural Knowledge Management organized by INSEE and ICAR	New Delhi	Nov., 9-12, 2011
Singh, K.M. and Kumar, Abhay	Participated in International Conference on Sustainable Development of Rural Economy and Agri Business	Varanasi	Jan 21-23, 2011

Singh, K.M. and Kumar, Abhay	Participated in Policy Dialogue on Sustainable Rural Livelihoods in Disadvantaged Areas of Bihar under IFAD Facility Grant organized jointly by ICAR-RCER, Patna, IRRI, IFPRI and IWMI	ICAR-RCER, Patna	March 29, 2011
Singh, K.M.	Participated in Workshop on Policy Options and Investment Priorities for Accelerating Agricultural Productivity and Development in India	New Delhi	Nov 10-11, 2011
Singh, S.K.	Attended 4th International Conference on "Life Science Research For Rural and Agricultural Development (ICLRAD-2011)"	Central Potato Research Station, Patna	December 27-29, 2011
Singh, S.K.	Participated in Training Programme on "Importance of Organic Farming and its Future Prospects." sponsored by NABARD	ICAR-RCER, Patna	September, 26-28, 2011
Singh, S.K.	Participated in Training Programme on "Scaling Up of Water Productivity in Agriculture for Livelihoods Through Teaching – cum – Demonstration"	ICAR-RCER, Patna	August 23-Sept. 5, 2011
Singh, S.K.	Participated in Training Programme on "Recent Advances in Oilseed and Pulses Production in Bihar"	DNS-RICM, Patna	September, 15-17, 2011
Sundaram, P.K.	Attended 45th Annual Convention of ISAE and International Symposium on Water for Agriculture	College of Agriculture, Dr. PDKV Campus, Maharajbag, Nagpur, Maharashtra	Jan 17-19, 2011
Sundaram, P.K.	Attended International Workshop under IFAD Project " Accelerating Resource Conservation Technology (RCT) Adoption to Improve Food Security and Rural Livelihoods while Reducing Adverse Environmental Impacts in The Indo –Gangetic Plains"	Ludhiana	August, 29 2011
Upadhyaya, A.; Jee, Janardan; Singh, S.K.; Rahman, A.; Singh, A.K.; Kumar, Ajay; Sundaram, P.K.; Shivani; Singh R. D.; Singh, K.M.; Singh, S.S.	Attended 4th International Conference on 'Life Science Research For Rural And Agricultural Development (ICLRAD-2011)'	Central Potato Research Station, Patna	December, 27-29, 2011

Abroad

Scientist	Name of Seminar /Conference /Workshops/Symposia/Meetings	Place	Date
2006-07			
Dr. A.K. Sikka	ICAR-IWMI Steering Committee Meeting	Colombo, Sri Lanka	23-27 Jan. 2006
Dr. A.K. Sikka	Asia Project Leaders' Meeting of CPWF	Vientiane, Laos	14-18 Feb. 2006
Dr. A R Reddy	GECAFS meeting on "Basin scale analysis of vulnerability of food systems to global environmental change".	Kathmandu, Nepal Organized by (GECAFS), UK	26-28 June, 2006
Dr. A.K. Sikka Dr. A. Haris	Impact Pathway workshop and Annual Stakeholder Workshop	Kathmandu, Nepal	30 June -04 July, 2006
Dr. A. K. Sikka	World Water Week Forum	Stockholm, Sweden	19-26 Aug. 2006
Dr. P. Dey	13th Agronomy Conference	Australian Soc Agronomy, Perth, Australia	11-14 Sept., 2006
Dr. S. Kumar Dr. P.R. Bhatnagar Dr. P. Dey	Monitoring and Evaluation Workshop	DPI, University of Queensland Campus, Toowoomba, Australia	20 - 25 Sept., 2006
Dr. A. Haris	CPWF Strategic Workshop	Montpellier, France	23-27 Oct., 2006
Dr. A. Haris Dr. A. Upadhyaya	CPWF International Forum on Water and Food	Vientiane, Lao PDR	11-17 Nov., 2006.
2007-08			
Dr. Janardan Jee	Exploration of Makhana plant and International Seminar on Gorgan Plant	Nikada, Japan	Aug. 25-27, 2007
2008-09			
Dr. R.K. Batta	Annual Stakeholders workshop of CPWF	Dhaka, Bangladesh	Feb. 27-28, 2008
Dr. S.S. Singh	Challenge Programme Working Group Meeting	Addis Ababa, Ethiopia	May 9-11, 2008
	ICAR-IWMI Steering Committee Meeting	Colombo, Sri Lanka	July 21-22, 2008
	Promoting Sustainable Livelihood Development Project Planning Meeting	Bangkok, Thailand	June 19-23, 2008
Dr. M.A. Khan	Attended International Forum on Water and Food-2 and as Benchmark Basin Coordinator of IGB organized IGB Session and Exhibition on Science and Culture in the Basin as Basin Coordinator, CPWF	Addis Ababa, Ethiopia	Nov.10-14, 2008
Dr. A. Haris A.	International Forum on Water and Food	Addis Ababa, Ethiopia	Nov.10-14, 2008
Dr. M.A. Khan	End-of-Project Meeting and Synthesis Workshop : Project on "Development of Technologies to Harness the Productivity Potential of Salt-Affected Areas of the Indo-Gangetic, Mekong and Nile River Basins"	IRRI, Philippines	Nov. 02-04, 2008

2009-10			
Dr. S.S. Singh Dr. A.R. Khan	Workshop Planning Meeting of CSISA Project of BMGF/USAID	IRRI, Manila, Philippines	March, 23-24, 2009
Dr. Ujjwal Kumar	Innovation Asia-Pacific Symposium.	Kathmandu, Nepal	May ,4-7 2009
Dr. A. Upadhyaya	Workshop on "Innovation Asia-Pacific Symposium" and presented a paper on "A decision Support tool to explore conjunctive use options in Canal Command.	Kathmandu, Nepal	May, 3-8, 2009

Annexure-V

EDUCATION AND TRAINING OF STAFF UNDERTAKEN IN INDIA/ABROAD

India

Name of Staff	Name of Training Programme	Organizer	Period
2006-07			
Dr. Sanjeev Kumar	National Level training programme on "Drainage for reclamation of Waterlogged and Saline Lands".	Water and Land Management Institute(WALMI), Phulwari sharif, Patna-801505	Jan. 24– 30, 2006 (7days)
Dr. A. Rahman	"Advances in Natural Resource Management for Sustainable Agricultural Production in Canal Commands".	ICAR-RCER, Patna	Feb. 7–13, 2006 (7days)
Dr. L. K. Prasad	Remote sensing applications in agriculture with special emphasis on linkage ofremote sensing with simulation models for agri - production estimates and land use planning sponsored by DOS, GOI at IARI, New Delhi	Agri. Physics Div, IARI and ISRO, at IARI, New Delhi	Mar. 22–15, 2006 (21 days)
Dr. A. Islam	"Groundwater Governance in Asia : Theory and Practices" as a Junior Professional Research Fellow under Challenge Program on Water & Food	International Water Management Institute, Sri Lanka	Oct. 09, 2006 – Mar. 30, 2007
Dr.Sanjeev Kumar Dr. Shivani	"Recent Advances in Horticulture for development of Watershed"	Horticulture and Agro- Forestry Research Programme, Plandu, Ranchi	Nov. 15–Dec. 05, 2006 (21 days)
श्री अभिषेक कुमार सिंह	त्रैमासिक अनुवाद प्रशिक्षण	भारत सरकार, केन्द्रीय अनुवाद व्यूरो, राजभाषा विभाग : गृह मंत्रालय, कोलकता	जुलाई-सितम्बर 2006
2007-08			
Dr. R. Elanchezhian Dr Sanjeev Kumar Dr. L.K. Prasad Mr. Manibhushan Dr. Ujjwal Kumar Dr. Shivani Dr. N. Chandra	Human Relations Management at Work	National Academy of Agricultural Research and Management, Hyderabad and ICAR-RCER, Patna, Bihar jointly	Feb.5-7, 2007
Dr. L.K. Prasad	Water Quality and its Management	NIH, Roorkee and CSMRS, New Delhi	July 16-20, 2007
2008-09			
Er. Mali, S.S.	Water management under limited water supplies efficient crop production in command area	ICAR RCER, Patna	March 10- 15, 2008
Dr. Naresh Chandra	WTO issue, codex standards and SPS measures: implication for agricultural produces & exporters	Bihar Kisan Ayog,	June 24-25, 2008

Dr. Bikash Das Dr. B.R. Jana	Recent advances in rainfed Horticulture based farming systems in plateau and hilly region	ICAR RCER, Research Centre, Ranchi	Nov. 11- Dec. 1, 2008
Dr. Manibhushan	Data Mining in Agriculture, IASRI, New Delhi	IASRI, New Delhi	Nov. 4-24, 2008
Dr. P.K. Ray	Advanced Molecular Biology tools used in Animal Disease Research and diagnosis	Division of Biotechnology, IVRI Izatnagar.	Dec. 10-30, 2008
2009-10			
Sh. Dhananajay Kumar and Sh. Pradip Kumar Singh T-4,	Production of disease free seedling and planting material	Advance centre of Plant virology, Division of, IARI, New Delhi	1 - 6 June 2009
Dr. Santosh Kumar Scientist, Plant breeding	87th Foundation Course for Agricultural Research Service (FOCARS)	NAARM, Hyderabad	23 June - 20 Oct. 2009.
Mr. Dilip Sah, Technical Officer and Mr. Suresh Kumar, T-4	Quality Seed Production in Vegetables Crops: An Enterepreneurial Perspective.	IARI, New Delhi	26 -31 October, 2009
Dr. R.D. Singh Pr. Sci. (Agon)	Special Training on Vigilance Administration for Vigilance Officers of ICAR Institutes	NAARM, Hyderabad	October 29-31, 2009
Sri Sunil Kumar, Subhash Kumar, Kalyan Kumar, Bipan Kumar, Manoj Kr. Singh, Frances Murmuh and All SS Gr. III.	Capacity building at Regional Station, ICAR-RCER, Ranchi.	ICAR-RCER, Patna	December 10-24, 2009
2010-11			
Er. Mali. SS.	Geospatial Knowledge management for sustainable livelihoods security	NAARM Rajendranagar, Hyderabad	Feb. 16 - 26, 2010.
Dr. R.C. Bharati	Strengthening Statistical Computing for NARS	DWM, Bhubaneswar	June 18 - 19, 2010
Dr. Ujjwal Kumar	Science & Technology for Rural Societies	Lal Bahadur Shashtri National Academy of Administration, Mussoorie	June 28 - July 9, 2010
Dr. Nitu Kumari	Summer school on 'Wild and Underutilized Fruits	Dr. Yashwant Singh Paramar University of Horticulture and Forestry, Nauni, Solan	July 22 - 11 August, 2010
Dr. Ramakrishna Roy	Winter school on 'Recent concepts in Veterinary Laboratory diagnostics'	Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana	Oct. 12 - Nov. 1, 2010
Dr. R.C.Bharati	Strengthening Statistical Computing for NARS	IASRI, New Delhi	Oct. 25-30, 2010
Dr. A. Upadhyaya	Training programme on "High Performing Teams: for Scientists & Technologists working in	MDI Campus, Gurgaon	Nov. 08-11, 2010

	Government Sector"		
2011-12			
Abhay Kumar Thakur	Certificate Programme on Agri-business Management	Indian Institute of Crop Processing Technology, Ministry of Food Processing Industries, GOI, Thanjavur, Tamil Nadu	April 18-20, 2011
J.S. Choudhary	Winter School on "Introduction to biosystematics of insects, mites, spiders and their biodiversity"	NBAII, Bangalore	November 14-23, 2011
M.S.Meena	Training programme on "Quantitative Methods for Agricultural Policy Research"	Division of Agricultural Economics, Indian Agricultural Research Institute, New Delhi	October 17-22, 2011
R. Elanchezhian	Training on **"**Climate change mitigation strategies- Planning for implementing the mitigation practices in India"	Engineering Staff College of India, Hyderabad	July 12-14, 2011
R.C.Bharati	Workshop-cum Installation Training Programme	Directorate of Water Management, Bhuvaneswar	Dec 8-9 2011
Santosh Kumar	Participated ten days training on "Bioinformatics in Agriculture"	IASRI, New Delhi	Aug. 29th - Sep.07th , 2011
Sarfaraj Ahmad	Participated in three days training on "Hands on training on Any Time KVK (ATK)"	Zonal Coordination Unit Zone-V, CRIDA Campus, Hyderabad	April 25-27th , 2011
Sushanta Kumar Naik	Training programme on "Climate change and carbon mitigation" organized by DST	ICFRE, Dehradun	November 14-18, 2011

Abroad

Name of staff	**Name of training programme with venue**	**Organizer**	**Period**
	2009-10		
Dr S.S. Singh, Pr. Sci. (Agon)	Visit-cum-training at US and UK.	US &UK	September 27 - October 2, 2009
2011-12			
Abdul Haris A.	Three months advanced training programme on Carbon equestration/carbon trading/climate change	Colorado State University, USA	February 1st - April 30th , 2011
Abhay Kumar Thakur	Training programme in Nutraceuticals (Agricultural Engineering)	Richardson Centre for Functional Foods and Nutraceuticals, University	June 02 - August 30, 2011

		of Manitoba, 196 Innovation Drive, Winnipeg, Manitoba, Canada	
Adlul Islam	Deputed to Colorado State University, Fort Collins, Colorado and Agricultural Systems Research Unit (ASRU), USDA-ARS, Fort Collins, Colorado for Professional Scientific Collaboration Research and Training through Norman E Borlaug International Agricultural Science and Technology Fellowship Program with support from US Department of Agriculture	Colorado State University, Fort Collins, Colorado and Agricultural Systems Research Unit (ASRU), USDA-ARS, Fort Collins, Colorado	April 1- July 25, 2011
K.M. Singh	Attended Master Class on "Communicating research to stakeholders"	Thailand	Nov 27 to Dec 3, 2011
R. Elanchezhian	Three month international training program in the area of *Marker assisted selection* sponsored by NAIP-ICAR	Clemson University, SC, USA	Jan 21 – Apr. 20, 2011
S.S. Singh	5th World Congress on Conservation Agriculture & 3rd Farming System Design Conference on Resilient Food System for a Changing World	Brisbane, Australia	September 26-29, 2011
Santosh Kumar	Participated sixteen days foreign training on "Phenotyping for abiotic stresses in rice"	IRRI, Los Banos, Philippines	Oct. 27th - November 11th , 2011

ACRONYMS

ADB Asian Development Bank
AEZ Agro-Ecological Zones
AICRP All India Coordinated Research Project
AICVIP All India Coordinated Vegetable Improvement Project
BAU Birsa Agricultural University
BCKV Bidhan Chandra Krishi Vishwavidyalaya
CADA Command Area Development Authority
CBIP Central Board of Irrigation and Power
CEAD Center for Environment and Agricultural Development
CG Consultative Group
CGIAR Consultative Group on International Agricultural Research
CHES Central Horticultural Experimental Station
CIFA Central Institute of Fisheries and Aquaculture
CIFRI Central Inland Fisheries Research Institute
CNRM Centre for Natural Resource Management
CPCRI Central Plantation Crop Research Institute
CPWF Challenge Program on Water and Food
CRIDA Central Research Institute for Dry land Agriculture
CRRI Central Rice Research Institute
CSWCRTI Central Soil & Water Conservation Research & Training Institute
CTRI Central Tobacco Research Institute
CTRS Central Tobacco Research Station
CV Coefficient of Variation
CWC Central Water Commission
DAS Days After Sowing
DCR Division of Crop Research
DFID Department for International Development
DLFM Division of Livestock and Fisheries Management
DLWM Division Land and Water Management
DMSI Dry Matter Stress Index
DSEE Division of Socio-Economics and Extension
DSI Drought Stress Index
DSP Deep Summer Ploughing
DST Department of Science and Technology
DWMR Directorate of Water Management Research
EFC Expenditure Finance Committee
FLD Front Line Demonstration
FYM Farm Yard Manure
GB General Bodies
GBPUA&T Govind Ballabh Pant University of Agricultural & Technology
GFCC Ganga Flood Control Commission
GIS Geographical Information System
GM Green Manure
HACCP Hazard Analysis and Critical Control Point
HARP Horticulture and Agro-forestry Research Program
HQ Headquarter
HRD Human Resource Development
IARI Indian Agricultural Research Institute
IASRI Indian Agricultural Statistics Research Institute
ICAR-RCER ICAR Research Complex for Eastern Region
ICRISAT International Crops Research Institute for the Semi-Arid Tropics
ICT Information Communication Technology
IDE International Development Enterprise
IFAD International Fund for Agricultural Development
IIHR Indian Institute of Horticultural Research
IIPR Indian Institute of Pulses Research

IINRG Indian Institute of Natural Resin and Gums
IIT Indian Institute of Technology
IIVR Indian Institute of Vegetable Research
IMC Institute Management Committee
IMD India Meteorological Department
INARIS Integrated National Agricultural Research Information System
INCID Indian National Committee on Irrigation and Drainage
IPGRI International Plant Genetic Resources Institute
IPM Integrated Pest Management
IPR Intellectual Property Right
IRC Institute Research Council
ISO International Standard Organization
IVLP Institute Village Linkage Program
IWMI International Water Management Institute
J&K Jammu & Kashmir
JRF Junior Research Fellow
KIIT Kalinga Institute of Industrial Technology
KVK Krishi Vigyan Kendra
LCC Leaf Colour Chart
MoWR Ministry of Water Resources
MPT Multi Purpose Trees
NAARM National Academy of Agricultural Research and Management
NAAS National Academy of Agricultural Sciences
NABARD National Bank for Agricultural and Rural Development
NATP National Agricultural Technology Project
NBPGR National Bureau of Plant Genetic Resources
NBSSLUP National Bureau of Soil Survey and Land Use Planning
NCAP National Centre for Agricultural Economics and Policy Research
NGO Non-Government Organization
NHB National Horticultural Board
NIH National Institute of Hydrology
NRM Natural Resource Management
NRSA National Remote Sensing Agency
NRSP Natural Resources Support Program
NTFP Non-Timber Forest Products
OPTALL Optimal Allocation of Canal Water
PDCSR Project Directorate for Cropping System Research
PRA Participatory Resource Appraisal
QRT Quinquennial Review Team
RA Research Associate
RAC Research Advisory Committee
RAU Rajendra Agricultural University
RC Research Centre
RCM Research Centre on *Makhana*
RCT Resources Conservation Technology
SAU State Agricultural University
SFC State Farm Corporation
SHG Self Help Group
SRF Senior Research Fellow
SWOT Strengths Weakness, Opportunity and Threat
TIFAC Technology Information Forecasting and Assessment Council
USAID United States Agency for International Development
WTO World Trade Organization
WUA Water Users' Association
YSR Yield Stability Ratio
ZT Zero Tillage
ZTDSR Zero Tillage for Direct Seeded Rice

Item No. 22

Subject: Recommendations of QRT in in respect of ICAR Research Complex for Eastern Region, Patna and its two Regional Station for the period 2006-12.

The Quinquennial Review Team to review the work done by the ICAR Research Complex for Eastern Region, Patna, its two Regional Station and one Krishi Vigyan Kendra was constituted under the Chairmanship of Dr. R.P. Singh, Ex-Vice Chancellor, MPUAT, Udaipur.

The recommendations given by the committee reveal that there are five policy issues of the Research Complex and rest five are of technical nature. Wherever required, necessary budgetary clearances and appropriate approvals shall be obtained. Time-frame for implementation of these recommendations has been fixed wherever possible and has been indicated under Council's comments. Some of the suggestions have been made for strengthening of the ongoing programmes.

The recommendations of the QRT along with time-frame and the Council's comments are submitted to the Governing Body for perusal and further directions, if any.

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Council's comments on the salient recommendations of QRT (2006-12) for ICAR Research Complex for Eastern Region, Patna.

1. **Recommendation:** Establishment of new Centre: QRT strongly recommends the establishment of a Centre on Wetland eco-system rehabilitation at Assam Agriculture University.

   Council's Comment: May be accepted. Should work in collaboration with the Lowland Research Station of CRRI, Cuttack.

2. **Recommendation:** Creation of Division of Livestock and Division of Fisheries and Aquaculture in ICAR-RCER, Patna.

   Council's Comment: Looking into the importance of fishery and livestock in eastern region, creation of separate division may be agreed upon.

3. **Recommendation:** Since ICAR-RCER has also mandate for agricultural development of eastern region spread over five different agro-climatic zones, for effective implementation of outreach programmes, some **new KVKs may be allotted to the ICAR-RCER in some of districts of the states under eastern region**.

   Council's Comment: May be agreed upon.

4. **Recommendation:** Renaming research centre, Ranchi as "**Farming System Research Centre for Hill and Plateau Region**".

   Council's Comment: May be agreed to.

5. **Recommendation:** Keeping in view the jurisdiction and geographical area of eastern states, QRT recommends for sanction of the position of **Joint Director** to the Complex so as to implement monitoring of various research and extension programmes effectively.

   Council's Comment: May not be agreed to. A proposal, however, may be moved by the Director separately to the Council for restructuring the existing cadre strength of scientists.

6. **Recommendation:** It is necessary to develop climate resilient agriculture including Conservation Agriculture practices and efficient natural resource management to ensure food security in the eastern region. Linkages should be developed with ACIAR, ICARDA and DFID for effective implementation.

   Council's Comment: May be agreed upon.

7. **Recommendation:** Restoration of degraded lands through agroforestry interventions and amelioration of acidic soils is essentially required so as to sustain the livestock population in the region.

   Council's Comment: May be agreed to. The Research Complex may partner with NRC on Agroforestry, Jhansi for this purpose.

8. **Recommendation:** Harnessing of solar power to enhance agricultural production.

   Council's Comment: May be agreed to.

9. **Recommendation:** There is urgent need to develop new and cheap farm machinery implements for performing agricultural operations economically due to shortage of labourers in this region. Improved composite mechanical harvesters, graders, packing machine and popping machine required to be developed in collaboration of CIAE, Bhopal and CIPHET, Ludhiana.

   Council's Comment: May be agreed to.

10. **Recommendation:** There is need to modernize nursery for mass propagation of quality/genuine plant materials of fruit meet out the requirements of the stakeholders.

    Council's Comment: May be accepted.