

Annual Report ***(2010-11)***



National Academy of Agricultural Sciences
NASC, DPS Marg, New Delhi - 110 012, India

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1. Introduction

1.1 Background

The National Academy of Agricultural Sciences (NAAS), established in 1990, is among the youngest of the Science Academies in India. It owes its origin to the vision of the late Dr. B. P. Pal, FRS. The Academy focuses on the broad field of agricultural sciences including crop husbandry, animal husbandry, fisheries, agro-forestry, and interface between agriculture and agro-industry. The Academy's role is to provide a forum to Agricultural Scientists to deliberate on important issues of agricultural research, education and extension, and present views of the scientific community as policy inputs to planners, decision/opinion makers at the various levels. To achieve this, the Academy organizes and supports national and international congresses, conferences, seminars, symposia, workshops and brainstorming sessions on the critical issues in the field of agricultural sciences.

The Academy has emerged as a vibrant national level body devoted to agricultural sciences. The Fellows of Academy, recognized for their contributions to science, include distinguished personalities in the field of agriculture and allied sciences, both from India and abroad.

1.2 Objectives

The major objectives of the Academy, *inter-alia*, are to:

- promote ecologically sustainable agriculture,
- recognize and promote excellence of individual scientists in the field of agriculture,
- promote interaction among research workers of different institutions and organizations within the country, and with the world scientific community,
- organize inter-disciplinary analysis of issues of importance for farmers and farming, and prepare further policies designed to advance agricultural research, education and development
- carry out such activities as are relevant to the accomplishment of the above goals.

2. Management

2.1 General Body

The General Body: The General Body of the Academy constituted by its Fellows, met on 5 June 2010 and adopted the Annual Report and Audited Statement of Accounts for the year 2009-10.

2.2 Executive Council

Composition: The Executive Council was re-constituted on 1.1.2011 with changes in the incumbency of offices of the President, Secretary, Editor, and four Members of the Council. The composition of the Executive Council for 2010 and 2011 is as under:-

	2010	2011	Tenure
President	Dr Mangala Rai	Prof R.B. Singh	Dec 2013
Immediate Past-President	Prof M. S. Swaminathan	Dr Mangala Rai	Dec 2013
Vice-President	Dr H.K. Jain	Dr H.K. Jain	Dec 2011
Vice-President	Dr S. Ayyappan	Dr S. Ayyappan	Dec 2012
Secretary	Dr P.K. Aggarwal	Dr A.K. Srivastava	Dec 2011
Secretary	Dr A.K. Srivastava	Dr. Anwar Alam	Dec 2013
Foreign Secretary	Prof R.B. Singh	Dr S.M. Virmani	Dec 2012
Editor	Dr Rajendra Prasad	Dr P.S. Pathak	Dec 2011
Editor	Dr P.S. Pathak	Dr C. Devakumar	Dec 2013
Treasurer	Dr Suresh Pal	Dr Himanshu Pathak	Dec 2012
Member	Dr S.A.H. Abidi	Dr S.A.H. Abidi	Dec 2011
Member	Dr (Ms.) Rintu Banerjee	Dr (Ms.) Rintu Banerjee	Dec 2011
Member	Dr C.L. Acharya	Dr S.K. Datta	Dec 2013
Member	Dr (Ms.) P. Geervani	Dr (Ms.) P. Geervani	Dec 2011
Member	Dr H.S. Gupta	Dr H.S. Gupta	Dec 2012
Member	Dr Lalji Singh	Dr Raj K. Gupta	Dec 2013
Member	Dr (Ms.) Shailaja Hittalmani	Dr (Ms.) Shailaja Hittalmani	Dec 2011
Member	Dr G. Kalloo	Dr G. Kalloo	Dec 2012

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	2010	2011	Tenure
Member	Dr A.N. Mukhopadhyay	Dr A.N. Mukhopadhyay	Dec 2012
Member	Dr N.S.L. Srivastava	Dr B.S. Pathak	Dec 2013
Member	Dr R.P. Singh	Dr R.P. Singh	Dec 2012
Member	Dr M.P. Yadav	Dr M.P. Yadav	Dec 2013
Member	Sh Rajiv Mehrishi, Secretary, ICAR	Sh Rajiv Mehrishi, Secretary, ICAR	(ICAR nominee)

During 2010-11, four meetings of the Executive Council were held on: (i) 4 June 2010, (ii) 17 September 2010, (iii) 29 November 2010 and (iv) 9 February 2011. The meeting of the Annual General Body was held on 5 June 2010.

Some of the important items considered were as under:

- Review of implementation of Academy's programmes and formulation of proposed activities of the Academy for the year 2010-11.
- 10th and 11th Agriculture Science Congress.
- Academy's initiative to start a journal in agricultural sciences.
- Review of entire process of election of Fellows including the criteria and weightage assigned to different items.
- Adoption of (a) Annual Report and (b) Audited Statement of Accounts of the Academy for the year 2009-10.
- Appointment of Auditors for the year 2010-11 and fixation of their remuneration.
- Recommendations of Sectional Committees and the Conveners' Group for finalization of Academy's Fellows/Associateship for the year 2011.
- Election of the (a) Office Bearers and Members of the Executive Council for the year 2011 and (b) Fellows 2011.
- Review and rating of scientific journals.
- Calendar of activities of the Academy in the year 2011.
- Instituting a Memorial Lecture in the name of Late Dr. A.B. Joshi.
- Review of Bye-Laws and Personnel Policy of Secretariat staff.
- Guidelines for organizing the Brainstorming Session.

3. Fellowship

3.1 Sectional Committees

A total of 9 **Sectional Committees** were constituted, which met in September 2010, and short-listed candidates for electing Fellows and selecting Associates for 2011. They presented their recommendations to Executive Council for approval and election by ballot.

3.2 Election of Fellows

During 2011, twenty-four Fellows were elected. As on 31.03.2011 the total number of Fellows (in the live register) is 511, which includes 47 Foreign Fellows and one Corporate Fellow. Brief details of the new Fellows elected in 2011 are as follows:

Section I : Crop Science	
Dr. H.S. Balyan	<i>Professor, Department of Genetics & Plant Breeding, Ch. Charan Singh University, Meerut, U.P.</i>
Dr. L.M.S. Palni	<i>Director, G.B. Pant Instt. of Himalayan Environment and Development, Kosi-Katarmal, Almora, Uttarakhand</i>
Dr. A.K. Singh	<i>Sr. Scientist & Program Leader (Rice), Division of Genetics, Indian Agricultural Research Institute, New Delhi</i>
Dr. S.P. Tiwari	<i>Former Vice Chancellor, Swami Keshwanand Rajasthan Agricultural University, Bikaner, Rajasthan</i>
Dr. O.P. Yadav	<i>Project Coordinator (Pearl Millet), All India Coordinated Pearl Millet Improvement Project (ICAR), Mandor, Jodhpur, Rajasthan</i>
Section II : Horticulture Science	
Dr. Pious Thomas	<i>Principal Scientist, Division of Biotechnology, Indian Institute of Horticultural Research, Hessarghatta Lake, Bangalore, Karnataka</i>
Section III : Animal Sciences	
Dr. G.R. Patil	<i>Joint Director (Academic), National Dairy Research Institute, Karnal, Haryana</i>
Dr. R.C. Sobti	<i>Vice Chancellor, Panjab University, Chandigarh</i>
Section IV : Fisheries Sciences	
Dr. (Mrs) I. Karunasagar	<i>Professor & Head, Dept. of Microbiology, Director, UNESCO MIRCEN for Marine Biotech, Karnataka Veterinary, Animal & Fisheries Sciences University, College of Fisheries, Mangalore, Karnataka</i>

Section V : Natural Resource Management

Prof. Madhoolika Agrawal	<i>Professor, Department of Botany, Banaras Hindu University, Varanasi, U.P.</i>
Dr. B.S. Dwivedi	<i>Principal Scientist, Division of Soil Science & Agril. Chemistry, Indian Agricultural Research Institute, New Delhi</i>
Dr. P.K. Ghosh	<i>Head, Crop Production Division, Indian Institute of Pulses Research, Kalyanpur, Kanpur, U.P.</i>
Dr. R.C. Srivastava	<i>Director, Central Agricultural Research Institute, Port Blair, Andaman & Nicobar</i>
Dr. K.P.R. Vittal	<i>Director, National Institute of Abiotic Stress Management, Malegaon, Pune District, Maharashtra</i>

Section VI : Plant Protection

Dr. Madhuban Gopal	<i>National Fellow & Principal Scientist, Division of Agricultural Chemicals, Indian Agricultural Research Institute, New Delhi</i>
Dr. H.S. Prakash	<i>Professor, Department of Studies in Biotechnology, University of Mysore, Manasagangotri, Mysore, Karnataka</i>
Dr. A.K. Saxena	<i>Head, Division of Microbiology, Indian Agricultural Research Institute, New Delhi</i>

Section VII : Agricultural Engineering and Technology

Dr. R.T. Patil	<i>Director, Central Institute of Post Harvest, Engineering & Technology, Ludhiana, Punjab</i>
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Section VIII : Social Sciences

Dr. V.K. Bhatia	<i>Director, Indian Agricultural Statistics Research Institute, New Delhi</i>
Dr. Rajender Parsad	<i>Head, Division of Design Experiments, Indian Agricultural Statistics Research Institute, New Delhi</i>

Section IX : Frontier Sciences

Prof. Arun Goyal	<i>Professor and Head, Department of Biotechnology, Indian Institute of Technology, Guwahati, Assam</i>
Prof. B. Jha	<i>Head & Coordinator, Discipline of Marine Biotechnology & Ecology, Central Salt & Marine Chemicals Research Institute, Bhavnagar, Gujarat</i>

Foreign Fellows

Dr. D.S. Jayas	<i>Vice-President (Research) and, Distinguished Professor, Univ of Manitoba, Winnipeg, Canada</i>
Dr. Narendra Tuteja	<i>Senior Scientist, Plant Molecular Biology Group, ICGEB, New Delhi</i>

3.3. Fellows deceased

The Academy condoled the demise of its following Fellows during 2010-11:

1. **Dr. J.S.P. Yadav**, expired in Apr, 2010
2. **Prof. N.B. Nair**, expired in Apr, 2010
3. **Dr. A.B. Joshi**, expired in Jul, 2010
4. **Dr. Shyam Prakash**, expired in Aug, 2010
5. **Dr. K.S. Bhargava**, expired in Sept, 2010
6. **Prof. V.S. Rama Das**, expired in Dec, 2010
7. **Dr. S.R. Padwal Desai**, expired in Dec, 2010
8. **Dr. R.P. Purkayastha**, expired in Jan, 2011

3.4 NAAS-Associateship

The following were selected as NAAS Associates during 2011, thereby making the total number of Associates to 34.

Sl. No.	Name & Affiliation	Specialization
1.	Dr. Ranjan Bhattacharyya , <i>Scientist, Vivekananda Parvatiya Krishi Anusandhan Sansthan (VPKAS), Almora, Uttarakhand</i>	Soil Science/Soil Physics/ Soil & Water Conservation
2.	Dr. Debashis Chakraborty , <i>Scientist, Division of Agricultural Physics, Indian Agricultural Research Institute, NRL Building, New Delhi</i>	Soil and Water Management
3.	Dr. Arindam Dhali , <i>Senior Scientist (Biotechnology-AS), National Institute of Animal Nutrition and Physiology, Adugodi, Bangalore, Karnataka</i>	Animal Production, Animal Biotechnology
4.	Dr. V.K. Dubey , <i>Associate Professor, Department of Biotechnology, Indian Institute of Technology, Guwahati, Assam</i>	Plant Protease/Natural Products
5.	Dr. Mukesh Jain , <i>Staff Scientist, National Institute of Plant Genome Research, New Delhi</i>	Plant Genomics, Bioinformatics and Biotechnology
6.	Dr. Rajesh Kumar , <i>Senior Scientist, Division of Agricultural Chemicals, Indian Agricultural Research Institute, New Delhi</i>	Development of Agrochemicals
7.	Dr. B.K. Sarma , <i>Assistant Professor, Department of Mycology & Plant Pathology, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, U.P.</i>	Plant Pathology

4. Foundation Day

About 172 Fellows attended the Foundation Day celebrations and 17th Annual General Body Meeting, scientific sessions, foundation day lecture and business session on 5th June 2010. The 72th meeting of the Executive Council was held in the forenoon of 4th June 2010.



4.1. Scientific Sessions (Presentations by the Newly Elected Fellows)

Two scientific sessions were organized, where the newly elected Fellows of the Academy presented their scientific contributions. The first scientific session was held in the afternoon of 4th June, 2010, jointly chaired by Dr. H.K. Jain, Vice-President and Prof. R.B. Singh, Foreign Secretary of the Academy and the second in the forenoon of 5th June 2010, chaired by Dr. S. Ayyappan, Vice-President, NAAS. The following presentations were made.

Name of the Fellow	Topic of the Presentation
Dr. Amaresh Chandra	Biochemical and molecular studies on forage crop improvement
Dr. Malavika Dadlani	Quality seeds for increasing agricultural productivity
Dr. P.B. Kavi Kishor	Cloning, characterization and genetic manipulation of lignin biosynthetic pathway genes
Dr. Sanjay Kumar	Bioprospecting genes, enzymes and processes from Himalayan flora for plant adaptation and metabolic engineering

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Name of the Fellow	Topic of the Presentation
Dr. Rajeev K. Varshney	Developing and applying genomic resources for SAT legume improvement
Dr. S.D. Shikhamany	Technologies for producing table grapes for export
Dr. C. Devakumar	Bio-active compound mining through chemo- and bioprospecting
Dr. Alok Kalra	Improving plant productivity and health in medicinal and aromatic plants - Microbial way
Dr. A.K. Rai	Living with cyanobacteria
Dr. S.K. Chaudhari	Towards sustainable soil physical environment
Dr. D.K. Pal	Recent developments in soil science
Dr. Ashok K. Patra	Nitrogen cycling: ecology and biodiversity in agro-ecosystems
Dr. B. Venkateswarlu	Rhizosphere micro-organisms alleviate abiotic stresses in plants
Dr. R.B. Rai	Livestock production in island ecosystem and disaster mitigation
Dr. A.K. Verma	Urinary purine derivatives as an index for the estimation of rumen microbial protein production
Dr. Surendra Singh	Most significant contributions in research & development
Dr. T.K. Srinivasa Gopal	Development of convenience food from fish and shellfish
Dr. Pratap Singh Birthal	Source of growth in Indian agriculture: implications for research and policy
Dr. K.M. Paknikar	Bioinspired nanotechnology and its uses in medicine and agriculture

4.2. Presidential Address

The Presidential Address “*Towards Developing An Innovative Model for Transformation of Agriculture in India*” was delivered by Dr. Mangala Rai, President NAAS. Brief highlights of his address are as follows:

General Agriculture

- In the modern materialistic world, the real inclusive growth process is seldom given importance. If this situation is allowed to continue, it would not only speak on the health of food, nutrition and environmental securities but also on the very basic fabric of our country. It is therefore, imperative that real agricultural situation is appreciated, and concrete measures initiated to help producers and consumers alike.



- With the onset of Green Revolution, the first World Food Summit in 1974, promised to “*eradicate world hunger within a decade*”. Since then in the passage of 45 years the three more World Food Summits were held in 1996, 2000 and 2002, but resolved to reduce world hunger only to half by 2015. Unfortunately, with the on-going efforts even this target is not likely to be met as continents after continents, decades after decades, investments in R&D in agriculture have been reduced in the real comparative terms.
- Soon after Independence in 1947, realising the importance of agriculture, Pandit Nehru declared “*Everything else can wait but not agriculture*”. However, in the last four decades, area under cultivation continues to be the same but the population has doubled. With the acceleration of economy, enhancement of purchasing power and improved access to food, it is a difficult task to meet growing demands of India, the second-most populous nation of the world.
- Agriculture is becoming more and more knowledge-intensive and market-driven, far more innovative research and development efforts, efficient policies and effective delivery of services, supplies and markets are imperative. There is a vast gap between the agricultural technology generated and adopted, and very little effort has been put on the value-chain. Agriculture predominantly even at present continues to be subsistent with scattered efforts on commercialization and technology-led inclusive growth.
- The imbalanced nutrient management has led to multi-nutrient deficiencies in the Indian soils. Geo-referenced, soil-fertility maps including macro, secondary and micro nutrients need to be prepared on priority at the district and block levels to serve as guide for proper fertilizer allocation, distribution and application.
- Exploration and exploitation of marine resources await our attention for various products, starting from drinking water to high-value compounds apart from fish wealth. Development of entrepreneurship for freshwater aquaculture in wetlands and ornamental fish culture and trade merits added efforts and support to capitalize on the vast potential available in the country.
- For proper management of water resources, Geographical Information System, simulation tools and also remote sensing are required to be integrated with scientific management of irrigation networks, water distribution, crop planning, watershed activities and related operational activities.
- Mahatma Gandhi National Rural Employment Guarantee Scheme provides opportunities to integrate social capital of unemployed with natural resource

management. This manpower can be unleashed for conserving rainwater, arresting land degradation and erosion, agroforestry, developing horticulture, producing grasses, fodder, acquiring numerous other assets of livestock and enterprises to generate enhanced opportunity for self-employment.

- The farmers suffer thrice: first, when they do not get the kind of quality input they need, second when they do not get the worth of their produce because of man-made and natural calamities, and finally when they have to buy consumables from the market at an enhanced rates. Quality assurance through regulation is crucial for seeds, insecticides and fertilizers.

Energy

- Energy-efficient agricultural practices and equipments can conserve commercial energy. Use of biogas, biofuel, solar-cooking, solar-water heating, solar-crop drying, photovoltaic gadgets, wind and hydro electric power, can help meet energy needs partly. Refinements in cropping and crop-rotations can be energy-saving.
- Only one-third of the biomass produced in the country is utilized as food, feed and fiber. It is estimated that about 150 million tonnes of surplus biomass is still available for conversion into fuel. Briquetting, solid-state fermentation, gasification and pyrolysis are a host of technologies that are available today to efficiently convert available surplus biomass into solid, liquid and gaseous fuels. This biomass can generate about 15000 MW of quality power for meeting demands in the production catchments.

Seed and breed improvement

- Intensified efforts on genome-wide genome analyses, effective use of transgenes in potential backgrounds, development of cultural/rearing practices commensurate with potential and dimensions of the problem and linking innovative technological developments and their translation into actual production systems, are vital for meeting existing and emerging challenges.
- To meet ever-increasing needs, hybrid culture in agriculture, irrespective of crops and livestock would prevail. If parents are carefully developed, cross-combinations effectively made and evaluated, exploitation of allelic and non-allelic interactions in the form of heterosis would be providing for greater resilience and enhanced sustained productivity and production over the varietal threshold in the fragile and harsh environments, be it biotic or abiotic.

- Transgenic culture in agriculture would be the order of the day as we go along. In fact, that would be the saviour in the fast climate change scenario for which little has been done so far.
- Production of seed, planting material, and germplasm in case of field and horticultural crops, semen and fingerlings in case of animals and fish has to be enhanced both in terms of quantity and quality. Seed industry is also an employment provider besides ensuring food and nutritional security.

Extension

- To address challenges, a multi-pronged strategic intervention should focus primarily to: (i) enhance investment for need-based agricultural infrastructure; (ii) develop human resources and effective knowledge management system; (iii) enhance productivity and competitiveness of farm produce; (iv) create and promote farmer-consumer linkages by improving marketing efficiencies; and (v) provide an enabling policy environment so that farmers could access input and output markets, reduce cost, and receive remunerative prices.
- Rapid developments in the areas of intellectual property rights, benefit-sharing, increasing role of private sector in agricultural research and development and for sharing gains from commercialization, require a system for Intellectual Property Portfolio Management and Commercialization of Technologies to be evolved rather quickly.
- Livestock extension education can play an important role in making livestock products quality specific and cost-effective by training farmers and entrepreneurs on export quality standards and phytosanitary requirements. Market intelligence through information technology-cyber extension; sensitization training to middle-level extension functionaries to improve their technical and professional knowledge and skills; conducting livestock extension education programmes on Good Agricultural Practices (GAP), Good Laboratory Practices (GLP), Good Manufacturing Practices (GMP); capacity building in the areas of understanding legal issues of WTO and SPS, food safety, risk analysis, diagnosis etc are the prime areas of importance for quality production and trade.

Market and Trade

- There is an immediate need to sensitize from farm gate-level to all, including markets, regarding the necessity for ensuring toxin-free quality food commodities to the consumers.
- For an efficient-and-spirited technology outflow, we need to capitalize on the

potential of PPP in the IPR regime for enhancing technology transfer and use in all fields of agricultural technology.

- Despite low level of processing, food processing industry is one of the largest industries in India, it ranks fifth in terms of production, consumption, export and expected growth.
- For bringing commerce in agriculture, the key is to ensure value-chain operation right from production to consumption.

Partnerships

- The research institutes under CGIAR and the NARS linkages have proved to be one of the most successful examples for research partnerships. But in the changed scenario, the seeds for instance, which contributed most in the IPR regime, are being seen as a perfect private good. Hence developing economies need to think seriously for setting their agenda commensurate with their growing needs.
- To promote entrepreneurship, it is necessary that our public sector institutes and universities apart from technological backstopping should extend guidance/ counseling to potential entrepreneurs on how to develop an economically viable proposal, organize resources, understand basic economic principles of supply and demand factors which influence price, common risks and problems likely to be encountered in agri-business marketing strategies.
- Thus the key of likely success would be new innovative partnerships in agriculture.

The President concluded that the agricultural research, education and extension should aim at;

- Resource carrying capacity based enhancing farm productivity, profitability, sustainability, employability, and inclusive growth.
- Developing forward and backward linkages, forging efficient, effective and relevant partnerships with an end to end approach involving stakeholders, players and partners.
- Ensuring technology generation, extension, adoption, production, processing and marketing in continuum.
- Enhancing skill, capacity and knowledge empowerment for technology-led growth.
- Advocacy for integrated, intensified, diversified, harmonized, need- oriented, demand-driven and forward-looking production-to-supply system.

- Striving for quality input supply system for quality output, outcomes and impact.

At the end the President thanked the Fellowship for their cooperation, support and participation in the Academy activities.

4.3. Foundation Day Lecture

Foundation Day Lecture on '*Space-An Innovative Tool for Agriculture*' was delivered by Dr. K. Kasturirangan, Member, Planning Commission, Government of India in the afternoon of 5th June 2010. Dr. Kasturirangan observed that there have been distinct transitions in Indian agriculture, which changed from traditional farming in early 1900's to mechanized farming in 1960's and the Green Revolution and accompanied intensive agriculture in 1970's. The 21st Century is the century of biotechnology and this is likely to change the face of Indian agriculture and it is going to be highly intensive involving higher use of agricultural inputs such as water, fertilizer and other agricultural chemicals. Increased agricultural inputs have already started creating problems of deeper and deeper water table, deficiency of secondary and micronutrients etc. in the rice-wheat belt of the north-western India. Water is going to be in short supply and a severe problem in future.



In this changing scenario of Indian agriculture, space technology would play an important role. Indian Imaging Capability has considerably increased and it is now possible to accurately monitor natural resources and environment (soil, water, forests). Thus soil, groundwater and drainage maps can be and are being made to develop land resource development plans for drylands. Maps showing the areas under different crops in different seasons are being prepared through imaging.

Remote sensing application in agriculture would permit expanding cultivable lands, enhancing irrigation and water use, enabling intensification/ diversification, addressing second generation issues in irrigation commands, participatory watershed management, agrometeorological services, risk reduction through drought management, informatics for agriculture / agricultural statistics, enabling crop insurance and precision agriculture

Remote sensing would help in: (i) preparing watershed inventory and increase water use efficiency, (ii) restoration of land capability, (iii) spatial decision support for

fertilizer distribution, (iv) drought assessment and monitoring, (v) developing precision agriculture and (vi) predicting potential fishing zones.

Dr. Kasturirangan observed that there is an urgent need for space and agricultural scientists to work together for a better future for Indian Agriculture.

5. Brainstorming Sessions

The following eight sessions were held in the year under report.

5.1. Protected Agriculture in North-West Himalaya

Sher-e-Kashmir University of Agricultural Sciences & Technology of Kashmir (SKUAST-K) organized a Brainstorming Session on “*Protected Agriculture in North-West Himalayas*” on June 12, 2010 at main campus, Shalimar under the aegis of National Academy of Agricultural Sciences, New Delhi. The Brainstorming Session, held under the Convenership of Prof. Anwar Alam, Vice-Chancellor, was attended by experts from various national institutions as well as scientists of SKUAST-K. The brainstorming session recognised the fact that sustainability of modern agriculture in north-west Himalayan States of Jammu and Kashmir, Himachal Pradesh and Uttarakhand is influenced by various mountain specificities like physiography, ecosystem diversity, fragility, marginability, biodiversity, cultural heterogeneity and extremely cold and protected winter shortening growing seasons. More than two-third population in these States draws its sustenance from agriculture and allied activities.

It was further recognised that there is little room for horizontal expansion and only option available is vertical expansion with high cropping intensity for getting over the constraints of production and productivity particularly with respect to inputs and the environment. Besides, without access to economically superior cropping systems that use improved technology and high pay-off inputs, the social and economic conditions of mountain population and dependence on subsistence farming are generating greater problems of environment and natural resource management. In the context of climatic change, being experienced in the region, use of modern technologies like application of precision farming techniques becomes all the more important. Experts were of the view that modifying the environmental conditions of the plants to realise higher production through protected farming could avoid the harmful effects of climatic factors as the plants in the open experience a number of biotic and abiotic stresses resulting in poor performance in terms of yield and quality. Once the protected farming is largely promoted, on time and scale, in the western Himalayan region, benefits would include crop production under unfavourable climatic

conditions, quantum increase in crop yields, superior quality of produce, high input efficiency, enhanced horticultural export and as a consequence, increased income per unit area to the farmers in the region. Vast untapped potential exists in the hills to derive the benefits on a large scale and therefore, the experts in the brainstorming session advocated for application and promotion of protected cultivation technologies. This would, however, require actions at research, development and policy level for a sustainable growth.

Deliberations led to the following recommendations:

A. Research

1. Development of appropriate, efficient and affordable protected agricultural structures for crops and animals with appropriate, durable, efficient and economical cladding materials.
2. Identify and develop suitable varieties of crops for protected cultivation both for high value vegetables and cut-flowers.
3. Develop affordable agro-practices specific to protected cultivation particularly with respect to IPM, INM including water soluble fertilizers, IWM (integrated water management), Best Management Practices (BMP), and package of practice for organic farming.
4. Standardize crop nursery practices under protected environment to make maximum use of available space and opportunity.
5. Develop post-harvest practices for handling, grading, packaging, transport and short term storage of produce from protected cultivation.
6. Develop tools, implements and machines for facilitating crop operations under protected cultivation e.g. laying of mulches, polytunnels etc.
7. Design of location and crop specific structures for energy efficient micro-climate control for maximum crop productivity. This includes development of intelligent control systems for micro-climate maintenance.
8. Multi-tier protected farming techniques need to be developed to maximize productivity per unit of ground area to cope up with growing demands of vegetables, fruits, flowers, medicinal and aromatic plants in declining land holding scenario.

B. Development

1. Human resource development through training of trainers, field extension workers, NGOs, village leaders and farmers. Rural artisans and craftsmen

need to be trained in construction and maintenance of plasticulture equipment and structure.

2. Large scale demonstration of proven protected cultivation practices in potential areas. Launching of schemes at state and central level with built-in incentives for the designs recommended by research institutions.
3. Create post-harvest handling, transport, storage and marketing infrastructure for protected cultivation produce ensuring better returns to farmers.
4. Networking of farmers/Self Help Groups (SHGs) for production, handling and marketing of produce from protected agriculture for domestic as well as export markets.

C. Policy

1. Create awareness and enabling environment for economic prosperity of stakeholders of protected agriculture.
2. Assured availability of cladding materials, other essential inputs (seeds, water soluble fertilizers, pesticides etc.) at the divisional level.
3. Precision Farm Development Centres (PFDCs) should be well equipped and should create a role for themselves in protected agriculture.
4. State Agricultural Universities and KVKs in the region need to lay emphasis on teaching, research and extension of protected cultivation as a major and important step towards strengthening livelihood base of small landholders.
5. Link the identified promotional schemes for protected agriculture with already existing State/National programmes. RKVY funds should be mobilized for promotion of protected farming in North-West Himalayan region.

5.2. Exploring Untapped Potential of Acid Soils of India

The Brainstorming session (BSS) on the “*Exploring Untapped Potential of Acid Soils of India*” was organized on 22-23 July 2010 in the premises of National Academy of Agricultural Sciences, New Delhi to identify policy issues. Dr. C.L. Acharya, former Director, Indian Institute of Soil Science, Bhopal, convened it. Dr. Mangala Rai, President NAAS and former Secretary DARE and DG, ICAR chaired the Brainstorming session. Dr. A.K. Singh, Deputy Director General (NRM) at the introductory session highlighted major issues and problems of acid soil regions. A total of 35 participants comprising subject matter specialists from the disciplines of Soil Science, Agronomy, Soil-Water Engineering, Microbiology, Plant Physiology and Plant Breeding from different acid soil regions of the country, nominees of NAAS executive, special invitees and

representatives of the industry took part in the deliberations. The convener presented a concept note highlighting the multiplicity of problems in acid soils of the country. A total of 11 presentations on the different aspects of the theme were made.

The deliberations were held under three different sessions viz., Session I: Multiplicity of problems of Acid Soil Region (ASR) and Technological interventions to mitigate them, Session II: Macro and micro-nutrient deficiencies/toxicities and constraints in using bio-fertilizers in ASR and Session III: Physiological disorders and plant sensitivity differences amongst cultivars in acid soil conditions. During the deliberations, it was brought out that there is a need to revalidate methods for determination of lime requirement and undertake constraint analysis in adoption of the recommended technologies for acid soil amelioration by the farmers. It was also decided to lay emphasis in the breeding programme to modify root characteristics for mitigating the problem of aluminium toxicity and nutrient deficiencies in acid soils besides developing fertilizer recommendations for conservation tillage based on water-amendment-nutrient interactions. Since water and nutrients are the two precious inputs, it was resolved that conservation irrigation systems need to be promoted for enhancing water and nutrient use efficiencies and crop productivity in acid soil regions of the country.

Delineation of extent and severity of sub-soil acidity and developing suitable corrective measures were also stressed during the deliberations. Since limited information on microbial diversity is available for acid soils, its exploration and utilization should find a place in acid soil research. Role of crop diversification involving acid-loving crops/trees and adopting integrated farming systems for acid soil amelioration besides income enhancement and employment generation was also discussed.

It was brought out during the discussion that there is a need to harmonize district-wise database on the type and degree of soil acidity and acreage available with the National Agricultural Research System for use by the State governments for planning and amelioration strategies. It was also emphasized to bring out publications in regional languages on the Best Management Practices (BMP) for acid soils and distribute amongst the farmers.

The issue of quality and availability of the low-cost liming materials was deliberated at length by the specialists and it was felt that there is a need for strict enforcement of their quality regulations. It was further pointed out that the government and steel industry should develop an assured supply chain of liming materials for acid soils with the specifications such as minimum 30% CaO, less than 1% free iron and 80 mesh size of the material. Furthermore, policy needs to be framed for judicious utilization of large lime reserves available in north-east hill region for agricultural use. It was concluded that a supply chain mechanism needs to be developed for use of

phosphate rock in acid soil region. There should be a nodal agency to coordinate and to implement the various acid soil management programmes in the country. It was also suggested that for effective coordination of the acid soil research in the country, the earlier network programme should be revived. The plenary session was chaired by Professor, Prof. R.B. Singh, Foreign Secretary, NAAS and outcome of the BSS was summarized by the convener. The following are the major recommendations:

1. There is a need for strict enforcement of quality control measures in value chain of low cost liming materials (dolomite, calcite, basic slag, paper mills sludge).
2. The government and the steel industry should develop an assured supply chain of basic slag, a low-cost liming material for acid soils with the specifications such as minimum 30% CaO, less than 1% free iron and 80 mesh size of material.
3. A supply chain mechanism needs to be developed for use of rock phosphate in acid soil regions.
4. There is urgent need to develop crop varieties that are tolerant to aluminium toxicity which is prevalent in acid soil region (ASR).
5. There is a need for repealing existing land tenancy norms for accelerated growth of agriculture in acid soil region of eastern and north-eastern states.

5.3. Soil Micronutrients and Human Health

A Brainstorming Session on “*Soil Nutrient Depletion and Human Health*” was organized by the National Academy of Agricultural Sciences from 7-8 September, 2010 at the Indian Institute of Horticultural Research, Hessaraghatta, Bangalore. Dr. A.N. Ganeshamurthy, Head, Division of Soil Science and Agricultural Chemistry, IIHR was the Convener of this meeting. It was attended by participants from ICAR institutes, National Institute of Nutrition and SAUs representing Soil Science, Agronomy, Plant Breeding, Horticulture, Animal Nutrition and Human Nutrition including Dr. Sesikeran, Director, NIN, Hyderabad, Dr. A.K. Srivastava, Director, NDRI, Karnal and Secretary, NAAS, Dr. S.D. Shikhamany, Vice- chancellor (Chair), Andhra Pradesh Horticultural University.

It was brought out that there have been significant losses in mineral content of the food available in every category in India. There could be many reasons for this. These include trace mineral depletion of the soil itself, extremely low addition of organic matter, excessive removal of biomass from the soil, the excessive use/ imbalanced use of NPK fertilizers, changes in varieties of plants, the loss of micro flora/fauna within the soil, etc.

The sessions aimed primarily to exchange ideas on scientific and policy issues related to soil health and human and animal health and bring out recommendations for operationalization at central and institutional levels. The significant aspect of the meeting was bringing together people working in the areas of soil health and nutrient vis-à-vis human and animal nutrient and health.

The following recommendations were made:

1. Two development sectors “Agriculture and Health” should be brought together.
2. Concepts of ‘one health’ which links animal systems, human health, soil and the environment must be incorporated into practical programmes.
3. Estimates of food consumption and dietary health must be made on the basis of real measures of what people eat and how this affects their health rather than from extrapolating agricultural production statistics.
4. Develop GIS-based spatial maps of different agro-ecological zones to specify predominant soil nutrient problems as an aid to develop zone specific fortified fertilizers containing essential plant and human nutrient elements. Integrate Soil Test -Crop Response (STCR) based fertilizer recommendations with such maps and periodical monitoring at regular intervals.
5. Mapping of mineral deficiencies in ‘soil-plant-animal-human system’ at district level and superimposing this information on mineral deficiency diseases in human beings is essential for both supply of area-specific mineral mixtures for animals and region-specific fortified food for human beings.
6. Diverse mineral interactions in ‘soil-plant-animal-human systems’ especially with regard to bio-availability of I, Fe, Zn; the most abundant deficiencies in human beings and livestock needs a coordinated effort between soil scientists and nutrition specialists.
7. There is an imminent need to legislate and implement preservation of soil health and enhance societal awareness on this issue.
8. A national authority on “Soil health” similar to “Rainfed authority”, “Farmers’ rights authority” may be set up to safeguard the national soil health.
9. Adopt strategies for improving basic nutrition through supplementing diets of the poor, fortifying processed foods, biofortification through agronomic and breeding methods and encouraging greater agricultural and dietary diversity.

5.4. Livelihood Opportunities for Smallholders: Challenges and Opportunities

A two-day Brainstorming Session on '*Livelihood Opportunities for Smallholders: Challenges and Opportunities*' on 7-8 September 2010 was held at the National Academy of Agricultural Research Management, Hyderabad. The International Food Policy Research Institute was also actively associated with this Brainstorming Session. The Brainstorming Session was attended by about 40 delegates; representing eminent policy researchers, policy advisors, professionals, corporate leaders, representatives of cooperatives and farmers' organizations, financial and insurance experts from different parts of the country.

The Brainstorming Session was organized to explore the livelihood opportunities for smallholders in changing scenario of emerging opportunities. The specific objectives of the Brainstorming Session were: (i) to explore emerging income-augmenting and employment generating opportunities for smallholders in different agro-eco-regions; (ii) to document promising institutional arrangements and policy options for enhancing livelihood opportunities for smallholders; (iii) to envision smallholder-friendly agri-research priorities for augmenting their income and livelihood opportunities; and (iv) to develop a roadmap to up-scale the successful models for involving smallholders in emerging income generating opportunities.

Dr Vijay S. Vyas, Member, Economic Advisory Council of the Prime Minister inaugurated the Brainstorming Session. He underlined four possible approaches to raise the income and livelihood opportunities of smallholders. These include: (a) increase productivity of different agricultural commodities; (b) introduce high-value commodities; (c) change enterprise-mix by promoting supplementary sources of income; and (d) generate non-farm employment opportunities, more so in the unorganized sector. He stressed that market opportunities and risk mitigation need to be explored for smallholder agriculture. He called for strengthening the existing delivery institutions (such as technology, credit, inputs, markets) to reduce transactions costs, manage production and market risks, and enhance absorption capacity of smallholders of changes.

Dr Ashok Gulati, Director in Asia, International Food Policy Research Institute (IFPRI) (currently, Chairman, CACP, Govt. of India) argued that the present growth trajectory is leading to rural-urban divide. He emphasized that the consumption basket of Indian consumer is changing in favor of high-value commodities. These have great potential for augmenting income, generating employment and conserving natural resources. He stressed that the reform processes need to promote high-value agriculture without compromising food security. Dr P.K. Joshi, the then Director,

National Academy of Agricultural Research Management (NAARM) emphasized the need for technological and policy support through smallholder-friendly institutions for improving their livelihood opportunities.

The Brainstorming Session was structured into four technical sessions to develop a roadmap for improving livelihood opportunities. These include:

(i) public sector income augmenting opportunities, especially technologies; (ii) role of cooperatives and non-governmental organizations in improving livelihood opportunities of smallholders; (iii) smallholders and the corporate sector, especially introducing technologies and institutions; and (iv) market opportunities through institutional innovations. A number of successful models were demonstrated from public sector, cooperatives, corporate sector, and non-governmental organizations. During the deliberations, it was brought out that gradually the private sector and nongovernmental organizations are overtaking the public sector in reaching smallholders. The key to success for improving the income opportunities of smallholders is 'reaching to the smallholders' rather than they struggle to reach different agencies. The other factors that led to success were: (a) distribution of incentives, (b) promotion of need-based interventions; (c) demonstration of transparency in governance; (d) access to capital; (e) involvement of women farmers; and (f) improvement of skills of human resource. Among other factors, the most important was providing effective leadership in reaching smallholders, understanding their problems and evolving appropriate solutions for raising their incomes. It was emphasized that reform process must start by correcting the delivery institutions to the farm sector, and make them more smallholder-friendly which presently suit the large farmers. These institutions must be inclusive, competitive and sustainable.

5.5. Prioritization and Value Addition of Nutritionally Important Crops

A Brainstorming Session on “*Prioritization and Value Addition of Nutritionally Important Crops*” was held at NAAS premises, New Delhi on 18th September, 2010. It was convened by Dr. G.A. Ravishankar, Scientist G, CFTRI, Mysore.

Forty participants from academia, research institutions, industries, several Fellows of the Academy including Dr. H.P. Singh, DDG (Horticulture), ICAR, Dr. R.T. Patil, Director, CIPHET and Dr. Satinder Bajaj, former Director, Lady Irwin College, Delhi participated in the Brainstorming Session. Introductory session was chaired by Dr. Mangala Rai, the President of the Academy and co-chaired by the Convener, Dr. G.A. Ravishankar and Dr. Satinder Bajaj. Dr. Mangala Rai outlined a number of issues such as necessity for increasing the productivity of the food crops both in terms of quantity

and quality. He stressed the importance of breeding of crop plants for improving response to fertilizers, climate change, while keeping the quality traits especially of nutritional value at adequately high levels. He also mentioned that there should be no compromise on the quality from the point of view of processing characteristics. It is important to focus on micro-nutrient deficiencies in plant production systems and its consequence on the nutritional compositions of the food and feed. He emphasized the need for promoting minor millets, fruits and vegetables, balancing of essential amino acids, fatty acids and to adapt biotechnological process for nutritional improvement. Genetic modification of plants for agronomic traits, processing characteristics and development of nutritionally rich food crops may be taken up in a scientific manner. Fortification of micro-nutrients in foods, and also biofortification for enrichment of nutritional value and combining adaptable food processing technologies for nutrients such as β -carotene, folic acid, ascorbic acid, flavonoids and other phytochemicals for nutritional and health benefits.

The following are some of the major recommendations:

1. Bio-fortification through plant breeding and genetic engineering of plants with a special focus on use as anti-diabetic, anti-cancer and several degenerative disorders.
2. Breeding of crops for quality traits with special reference to nutrients and nutraceuticals.
3. Enhancing the supply of nutritionally important fruits and vegetables; use of medicinal plants for nutraceutical value; natural colours as nutraceuticals, development of cost effective methods of production of nutraceuticals.
4. Development of a robust food processing sector with backward integration of induced farming and linking to food supply chain to deliver value added products for national and international demands in an economical and sustainable manner.
5. To reduce post-harvest losses, development of cold chains and storage facilities.
6. Development of low calorie natural sweeteners such as *Stevia*.
7. Enhancement of pulse production through inter-cropping and on marginal lands and on-farm processing of pulses.
8. Encouragement and support to homestead gardens.
9. Need of personalized foods, designer foods; stepping of public awareness on the nutritional and nutraceutical needs and adaptation of proper processing methods to preserve the available nutritional components

5.6. Making IPM Effective in India

A brainstorming session on “*Making IPM Effective in India*” was held in the NAAS premises, NASC, September 29, 2010. It was convened by Dr. B.L. Jalali, former Director (Research), CCS Haryana Agricultural University, Hisar]. Alongwith the Convener Dr. N.T. Yaduraju, National Coordinator (NAIP), Dr. T.P. Rajendran, ADG (PP) and Dr. O.M. Bambawale, Director, National Centre for Integrated Pest Management (NCIPM), New Delhi were the members of the core organizing committee. Seventy nine delegates from across 20 States comprising researchers, teachers and extension specialists from ICAR, State Agriculture Universities (SAUs), State Department of Agriculture (SDA), Non Governmental Organisations (NGOs), press media and Private industries attended the Brainstorming Session. Panel discussions were held in four thematic areas viz., a) IPM Research, b) IPM Education, c) IPM Extension and d) IPM Network.

Dr. Jalali in his introductory remarks elaborated the need to redefine and reorient IPM approaches in the Indian context for their effective and efficient functioning at rural settings and the objectives of conducting the brainstorming session involving all stakeholders of plant protection. Dr. O.M. Bambawale made a presentation on “*Current Status of IPM in India*” covering the aspects of major IPM programmes, investments made, institutional setup, recent epidemics of pests, role of information and communication technologies (ICT) and new trends and opportunities of IPM involving multiple stakeholders assisted by matching financial outlay. Dr. N.T. Yaduraju stressed the importance of weeds as pests under the radar of IPM and need for preparedness towards approaches of IPM in the context of herbicide-resistant crops likely to be commercialised in the country. Dr. T.P. Rajendran appreciated the efforts made by the core committee towards eliciting responses for the brainstorming session based on a base paper, electronic group discussion and a questionnaire.

Session on “*Research in IPM: Status and Priorities*” was chaired by Dr. B.V. Patil. Discussion and consultations under the session covered wide range of researchable issues of IPM right from the assessment of losses caused by pests for prioritising research to revalidation of IPM technologies before dissemination to farmers. Anticipatory research for alien invasive pests, pest risk analysis and IPM research for emerging problems on transgenic crops, organic farming and protected cultivation were stressed. Focus on nanotechnology, development of weather based degree models and strengthening research on restorative ecology towards fabricating IPM solutions were put forth.

Dr. C.D. Mayee, Chairman, ASRB while chairing the session on “*Education in IPM: Focus and Opportunities*” emphasised the importance of education over

research and the need for interdisciplinary courses in IPM at SAUs to strengthen the knowledge base of the students. Dr. R.K. Mittal, ADG (EQR), Education Division, ICAR explained the existing course curricula in SAUs and the importance given to the experiential learning and improvements in the lecture delivery mechanisms. Dr. O. Kaul highlighted the prevention, avoidance, monitoring and suppression (PAMS) approach to IPM and the need for self-education at all times. Creation of strong faculty in IPM through trainings and IPM experimentation and methodologies taught through instructional farms were suggested for improving IPM education.

Panel discussion on “*Extension of IPM Technologies*” was led by Dr. K.D. Kokate, DDG (Agricultural Extension), ICAR. Need for (i) integrating methodologies and approaches of IPM into farming systems with the goal of increasing production and productivity across commodities and regions; (ii) coordination of extension at district level with massive mission mode approach involving multiple stakeholders; (iii) capacity building for IPM and (iv) aggressive and wider publicity of IPM was deliberated and advocated for action. Review of IPM through a national level committee under ADG (PP), content development for pest advisories for use by extension agents, upscaling the bioagent/bio pesticide production *vis a vis* micro financing niche entrepreneurs, evolving a workable model for quality biopesticide production units facilitating rural youth empowerment and establishment of agro alert system were the salient action points that emerged out of the deliberations on IPM extension.

Possibility of networking IPM involving different stakeholders/sectors of IPM systems was deliberated in the session on “*Networking IPM*” moderated by Dr. S.N. Puri. Need for a nodal agency for networking of IPM, besides development of model networks for few selected pests across selected locations were suggested for implementation.

5.7. Carrying Capacity of Indian Agriculture

A brainstorming session on “*Carrying Capacity of Indian Agriculture*” was organized at NAAS premises, NASC on October 28, 2010. It was convened by Dr. C.R. Bhatia, former Secretary, Department of Biotechnology, Government of India.

Participants included experts in soils, water, energy resources, fertilizers, primary productivity, animal production, climate change and rain-fed crop production. Specialists in major crops - wheat, rice, pulses, oilseeds and high value horticultural crops contributed towards the future outlook considering the likely demand for food in the year 2050.

Ecologists define the carrying capacity of the ecosystems as the population of humans and animals that can be sustained, based on the primary productivity of plants, with the available resources and services without damaging the resource

base of soil, water and environment. Others identify it as the maximum number of individuals of a given species that can be supported on a sustainable basis. A more detailed definition is the maximum rate of resource consumption and waste discharge that can be sustained indefinitely in a defined region without progressively impairing the productivity and ecological integrity. Carrying capacity is not a static number; land productivity can be enhanced with inputs of water, energy, plant nutrients, crop genotypes and using advanced technologies / products. Global food productivity has increased several folds with the inputs of chemical fertilizers, that provided crop nutrients, and inputs of energy derived from fossil fuels. Estimations of human carrying capacity are not easy due to a large number of variables involved including variation in the consumption of food and differential use of resources by societies. However, in considering the carrying capacity of Indian agriculture, the question of sustainable food production or sustainable carrying capacity based on food production was the main objective.

Following the successful Green, White and Blue Revolutions, the efforts of the agricultural scientists, and the farmers, the food security has considerably improved. However, a large section, particularly preschool children and women, suffer from protein calorie malnutrition and/or micronutrient deficiencies - the hidden hunger. Projections indicate that the country's population would be 1.7 billion by 2050; it is expected to stabilize only around 2070.

It is widely realized now that the input intensive agriculture technology that contributed to self sufficiency in food production for a growing population has also caused adverse environmental effects. Improper use of inputs has contributed to degradation of the resource base – soil, water, and environment. The fertilizer response has also declined due to limitations in soil organic matter and micro-nutrient deficiencies. Therefore, there is an urgent need for developing sustainable farming systems that not only conserve but also ameliorate the resource base, and at the same time, meet the nutritional needs of the population. It was recognized that estimating the population level that can be adequately fed without hunger or hidden hunger is a complex problem involving many different disciplines. Nevertheless, it is essential for estimating the population that can be supported through sustainable agriculture that does not adversely impact the resource base – soil, water and environment.

The main recommendations emerging from the brain storming session were:

1. Robust, science-based estimates for sustainable carrying capacity are urgently needed. These should include possible scenarios for the unknown and unpredictable changes. The group was fully aware that such estimates may not be perfect, but certainly far better than having no estimates of the number of people that can be supported from the available resources. This recommendation

is addressed to the planning and policy makers, scientific community, social and political scientists. The information on ecologically sustainable carrying capacity is necessary for making the road-map for sustainable agriculture.

2. Creating awareness in the media and public on the concept of carrying capacity, so that the people understand the need for a balance between the population and the natural resources.
3. Agricultural scientists should plan long term experiments on sustainability of the farming systems. Though sustainable agriculture has been a topic of interest for a long time, demonstration of the sustainability of the systems, yield levels harvested, and the effect on resource base needs to be collected. The agricultural research and development should aim at increasing productivity along with improving the resource base.

5.8. Drought Preparedness and Mitigation

A Brainstorming Session on “*Drought Preparedness and Mitigation*” was organized on 26 November 2010 at the Academy, New Delhi. Drs. K.D. Sharma and A.K. Sikka, were the Convener and Co-Convener, respectively.

In his opening remarks, Shri P.K. Basu, Secretary, Department of Agriculture & Cooperation, Ministry of Agriculture, Government of India emphasized that although institutions to manage the drought are in place, their coordination is required for proper monitoring and switching over from reactive to proactive mode of drought mitigation. More emphasis is required in the areas of water conservation, using water efficiently and a contingency plan for fodder supply during the distress. A policy and protocol for working on ground for drought preparedness and mitigation is required to be developed.

Two Technical Sessions were held followed by discussions among the fellowship of the Academy. Coordination among different stakeholders emerged as the key issue for drought mitigation. Short and long-term measures such as fodder production, alternative cropping systems, water management, biotechnological tools for plant adaptation, horticulture in drought-prone districts, forest management through JFM, etc. were highlighted. Risk assessment emerged as a primary tool for drought mitigation. Monitoring to identify the emerging rainfall deficiencies and probabilistic forecasting of rainfall under anticipated climate scenarios will provide a critical input for drought preparedness and mitigation.

Prof. Abhijit Sen, Member (Agriculture), Planning Commission, Government of India emphasized the use and strengthening of existing protocol and framework for drought management. It was felt that drought is considered as a ‘hot political

issue' in the country whereas it is a scientific problem to be tackled through long-term measures. Focus to shift from isolated water resources management to basin level planning, both for the surface water and groundwater is essential in drought management. Appropriate cropping pattern is to be devised in the moisture-stress area and legislation on cropping pattern should be brought up as an agenda for governance. Policy to restore and rejuvenate the traditional water harvesting and water reservoir systems will also go a long way in drought mitigation. It was agreed to incentivize the resources conservation technologies in terms of insurance premium for drought-prone areas in the country.

6. Special Publications

6.1. Degraded and Wastelands of India – Status and Spatial Distribution,” a joint publication by ICAR and NAAS authored by Drs A.K. Majhi, G.P. Obi Reddy and Dipak Sairkar with Dr. S.M. Virmani as the Co-ordinating Editor was released by Dr. K. Kasturirangan, Member, Planning Commission, Govt. of India on 5th June 2010.

6.2. Conservation Agriculture: Innovation for Improving Efficiency, Equity and Environment (selected papers of the 4th World Congress on Conservation Agriculture)

Dr. H.K. Jain, Vice President, NAAS released the publication edited by Dr. P.K. Joshi, Dr. S.M. Virmani and Dr. Jagannadham Challa on 29th November 2010. On this occasion Dr. Mangala Rai, the then President, NAAS stated that 4th WCCA was a success and hoped that this publication would be very useful for planning future agricultural strategies in India.



Dr. K. Kasturirangan, Member, Planning Commission, releasing the publication “Degraded and Wastelands of India – Status and Spatial Distribution”



Dr. H.K. Jain, Vice-President releasing the publication of the Academy

6.3. State of Indian Agriculture - The Indo Gangetic Plain

On December 31, 2010, the then President of the Academy, Dr. Mangala Rai, released second issue of “*State of Indian Agriculture – The Indo-Gangetic Plain*”. The President informed the Fellowship and the guest audience that the first issue of “*State of Indian Agriculture*” has been widely appreciated and very well received. The second issue has been designed to provide a comparison of the western region of the Indo-Gangetic Plains, where the agricultural productivity has peaked and started experiencing second generation problems, to the eastern part of the Indo-Gangetic Plains, where much remains to be achieved in agricultural production. This publication brings out incisive picture at natural resources of the region, agricultural performance, socio-economic scenario and a set of recommendations relating to technology generation, its disseminations, policy support and large scale investments required. It is hoped that this publication will help in making policy decisions and initiate appropriate action to develop the eastern part of Indo-Gangetic Plain, which can greatly help in meeting the country’s food demands. He congratulated and thanked all the contributors to the second issue of the State of Indian Agriculture, the Editors, Dr. Anjani Kumar and S.M. Virmani and the secretariat of the Academy for doing an excellent work within the time frame.



Release ceremony of Academy's publication State of Indian Agriculture - The Indo Gangetic Plain

Dr. Rai also informed the Fellowship and the guest audience that the third issue of the State of Indian Agriculture has been planned on ‘Water’ the most precious natural resource, the per capita availability of which is declining under great pace and an

all-out effort has to be made on war-footing to save and use it most efficiently. The next issue in the series could be on Energy, which is vital, scarce and costly input for agriculture, agro-processing and rural living besides other sectors of economy. Considering the fast speed with which the country's economy is moving forward, it may be desirable to review the situation and bring out the second edition of State of Indian Agriculture. The President once again thanked all those associated with the Academy's publications and the entire Fellowship for their kind co-operation throughout his entire tenure, which he considered as a great privilege and the memories of which he shall always cherish.

The President Prof. R.B. Singh appreciated the excellent achievements made under the leadership of Dr. Rai and his team and assured him and the Fellowship to try his best to maintain high standards set by Dr. Mangala Rai. Dr. H.K. Jain, Vice-President also appreciated and praised the publication just released and complimented the authors and the Editors for the compact and incisive publication. At the end Dr. A.K. Srivastava, Secretary, NAAS proposed a very hearty vote of thanks to Dr. Mangala Rai, Prof. R.B. Singh, Dr. H.K. Jain, the Fellowship and distinguished guests present on the occasion.

7. New Year Get-Together



Dignitaries at the dias

A large number of Fellows of the Academy from NCR and a few from other cities, who happened to be in Delhi attended the New Year-2011 get-together. Dr. A.K. Srivastava welcomed the Past Presidents Dr. R.S. Paroda and Dr. Mangala Rai, the newly elected President Prof. R.B. Singh,

Vice-President Dr. H.K. Jain, newly elected Secretary Dr. Anwar Alam and all the Fellows and Associates and wished them all a Very Happy and Prosperous New Year-2011.

Dr. Mangala Rai, the outgoing President also wished one and all a Very Happy New Year. He observed that since one of the goals of the Academy is to guide the planners and the Government in the future agricultural planning of the country, he initiated a series of publication entitled "*State of Indian Agriculture*". The first issue

of the series, describing the present State of Indian Agriculture was released in 2009, and the second issue, which provides a comparison between the Western and Eastern States in Indo-Gangetic Plains was released on 31 December 2010.

He requested the President Prof. R.B. Singh to pursue the third issue in the series, which is on “Water” in the year 2011. He also informed the Fellowship that during his period seven policy papers were brought out. He thanked the entire secretariat and editors for doing a commendable job. Dr. Jain touched upon the new advances in biotechnology and observed that genome mapping of a species which used to take a few billion US dollars earlier can now be done in just about fifty US dollars. He urged the Fellowship to continue to enhance their inputs in the advancement of agricultural technology in the country. Dr. Paroda wished that with Prof. R.B. Singh as the President, the Academy should create international linkages with the developing countries in Asia, Africa and South America. Prof. R.B. Singh thanked Dr. Mangala Rai, Dr. R.S. Paroda and Dr. H.K. Jain for their words of advice and observed that the outgoing President has set very high standards which he would try his best to maintain to that level. He assured Dr. Paroda, that he would certainly explore the possibilities of creating linkages with other developing countries. He wished the Fellowship a Very Happy New Year 2011. The get-together ended with a vote of thanks proposed by Dr. Anwar Alam.

8. 10th Agricultural Science Congress

8.1. Inaugural Session

The 10th Agricultural Science Congress (XASC) under the aegis of National Academy of Agricultural Sciences, New Delhi was organized at the National Bureau of Fish Genetic Resources, Lucknow from 10 - 12 February, 2011 jointly by the National Bureau of Fish Genetic Resources, Lucknow in collaboration with the Indian Institute of Sugarcane Research and the Central Institute for Subtropical Horticulture, Lucknow. The theme of the Congress was “*Soil, Plant and Animal Health for Enhanced and Sustained Agricultural Productivity*”. Over 700 delegates including researchers, academicians, extension personnel, policy makers, personnel from financial institutions, entrepreneurs, farmers and students involved in agricultural research and development all across the country participated in the Congress.

The Congress was inaugurated on 10th February, 2011 by His Excellency Shri B. L. Joshi, Governor of Uttar Pradesh and Shri Harish Rawat, Hon’ble Minister of State for Agriculture & Food Processing Industries, Government of India presided the Inaugural Function. The other dignitaries present on the dais during the Inaugural



Dignitaries at the dais (L to R) Dr. J.K. Jena, Co-Convener, 10th ASC; Dr. W.S. Lakra, Convener, 10th ASC; Dr. R.S. Paroda, Former President, NAAS; Shri Harish Rawat, MOSA; H.E. Shri B.L. Joshi, the Governor of Uttar Pradesh; Prof. R.B. Singh, President, NAAS; Dr. Mangala Rai, Immediate Past President, NAAS and Prof. Anwar Alam, Secretary, NAAS

Function were Prof. R. B. Singh, President, NAAS, New Delhi; Dr. R. S. Paroda, Chairman, Trust for Advancement of Agricultural Sciences, New Delhi as Guest of Honour; Dr. Mangala Rai, Immediate Past President, NAAS, New Delhi as Guest of Honour; Dr. Anwar Alam, Secretary, NAAS; Dr. W.S. Lakra, Director, CIFE, Mumbai and Convener, XASC and

Dr. J.K. Jena, Director, NBFGR, Lucknow and Co-convener, XASC.

The Souvenir of 10th Agricultural Science Congress on “Soil, Plant and Animal Health for Enhanced and Sustained Agricultural Productivity” was released by His Excellency the Governor while the Book of Abstracts was released by Hon’ble Shri Harish Rawat.

Dr. W.S. Lakra, Convener of the Congress welcomed the dignitaries and delegates and noted that such an important Congress of the Academy is being organized for the first time in the region. In his welcome address Dr. Lakra also read out the message received from Dr. S. Ayyappan, Secretary, DARE and DG, ICAR.

Prof. R.B. Singh in his Presidential Address emphasized that agriculture is the livelihood base of about 600 million people, comprising over 120 million farming families - over 50% of country’s population. Thus, agriculture is central to the nation’s equitable growth. He reminded that while the overall GDP growth rate of the country since mid nineties has been 7-9%, the agricultural growth rate has been hovering around 2.5-3.0%. He expressed his concern on the decelerated agricultural growth rate causing further marginalization of rural population, widened urban-rural



Prof. R.B. Singh, President, NAAS addressing the delegates

and inter-states divides creating hotspots of acute distress, indebtedness, deprivation and even farmers' suicides.

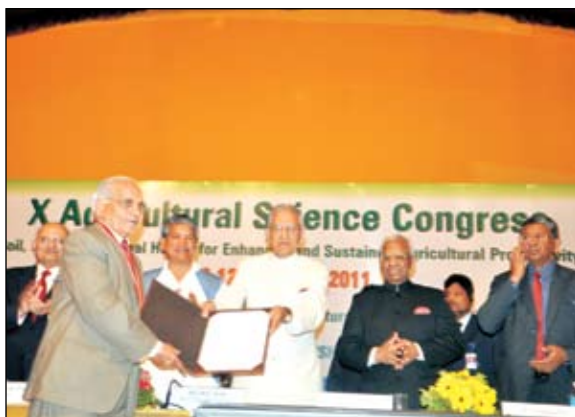
Prof. Singh underlined that despite the Green Revolution, the agrarian crisis continues. Technology fatigue, glaring technology transfer gaps, extension failures, huge post harvest losses, declining net agricultural trade intensity and food self-sufficiency, worsening cost-risk-return structure of farming and rising farmers' indebtedness, increasing vulnerability to climate change and worsening volatility of markets dot the agrarian landscape. He called for business unusual to overcome the problems and to harness new opportunities.

Dr. R. S. Paroda in his brief address as Guest of Honour emphasized the need for greater policy support and economic awareness for meeting the challenges of nutritional security.

Dr. Mangala Rai, Immediate Past President of NAAS, called for the judicious use of water in agriculture as the per capita availability is fast approaching critical limit.

Dr. Anwar Alam, Secretary NAAS coordinated the award presentation of NAAS given away by the Chief Guest and President. The awardees were: Drs. P.N. Bahl, K.V.B.R. Tilak, P.K. Joshi, T.K. Adhya, Gaya Prasad, P.S. Naik, K.C. Bansal, Himanshu Pathak, A.B. Mandal, Rintu Banerjee, V.K. Dubey and Anirban Roy.

Hon'ble Shri Harish Rawat in his address as President of the Inaugural Function congratulated and complimented agricultural scientists, policy makers and farmers of the country for food self-sufficiency and developing, refining and widely adopting modern technologies not only in crops, but also in horticulture, livestock and fisheries. He expressed concern about inflation in food prices. He echoed the call for evergreen revolution, where the issues such as judicious conservation of soil, water and biodiversity



H.E. Shri B.L. Joshi, the Governor of Uttar Pradesh conferring Academy's Awards to the Awardees



Shri Harish Rawat, Minister of State for Agriculture & Food Processing Industry

resources, upgradation of genetic resources and optimal utilization of natural resources through improvement in management practices etc. must receive due attention. He urged the scientific community to enhance the existing transfer of technology process and create new models of management for diversified entrepreneurship. He emphasised the key role of food processing industry in agricultural growth and in making India a leader in agro-based industries.

Shri Rawat complimented the National Academy of Agricultural Sciences and the organizers of the Congress on the appropriate theme to focus on soil, plant and animal health. He urged the need for new innovations and creativity in disease and pest management and reducing dependence on synthetic chemicals and pesticides.

He stressed the need for development and modernization of infrastructure for handling, processing, transport and storage. He also highlighted the need for establishment of affordable, cost effective cold chains for different high value perishable commodities. He hoped that the Congress would identify new prospects, opportunities, workable strategies and action plans to improve and stabilise health of soils, plants, and animals, thus minimizing losses, increasing production, productivity and farmers' income, and improving product quality that are globally competitive.

In his Inaugural Address, His Excellency Shri B.L. Joshi acknowledged that the Congress has assembled the best brains of the country in agriculture. He reminded the contribution of Green Revolution of late 1960s in achieving quantum jump in production and productivity in food grains followed by White Revolution in milk, Blue Revolution in fisheries, and Yellow Revolution in horticulture. However, he expressed his concern on deceleration in production and productivity growth rates during the last 10 to 15 years threatening the food and nutritional self-reliance of the country. He was also concerned about the high levels of hunger and poverty and soaring commodity prices. In this context, he lauded the appropriateness of the theme chosen for the Agricultural Science Congress by the National Academy of Agricultural Sciences for enhancing and sustaining agricultural productivity.



*H.E. Shri B.L. Joshi, the Governor of Uttar Pradesh
Inaugurating the Congress*

Alluding to the vital significance of the state of agriculture in Uttar Pradesh and the entire Indo-Gangetic Plain for food and livelihood security of the country, His

Excellency referred to the bountiful natural resources of fertile soil, abundant water, varied climate and rich cultural and historical heritage of the region. He also reminded that the Indo-Gangetic Plain is very densely populated, both by humans and livestock, nearly 90 percent of its farmers are small and marginal and the pressure on land and water is ever intensifying. Further, water erosion and increasing micronutrient deficiencies, salinity, soil acidity and biological degradation have aggravated water and soil health problems. Emphasising that the Indo-Gangetic Plain accounts for almost 50 percent of the country's utilizable annual surface water, he cautioned that if this is unduly stressed, the country's food security can be seriously jeopardized. The Chief Guest urged the National Academy of Agricultural Sciences to prepare a comprehensive national plan for keeping this greatest national treasure robust, healthy and biosecure.

His Excellency called for additional research and policy efforts on improving input-output efficiency, off-farm employment and improved employment security, farmers' income, post-harvest management and value addition, skill development and vocationalization of secondary education and ecotechnological solutions to veritable problems hindering agriculture-led alleviation of hunger and poverty. In this context, the Chief Guest recalled the words of Pandit Nehru that "everything else can wait, but not agriculture" and asserted that this message is as profound today as 63 years ago.

Dr. Anwar Alam, Secretary, NAAS proposed the Vote of Thanks.

8.2. Agrivision-2011

His Excellency Shri B.L. Joshi and Hon'ble Shri Harish Rawat also inaugurated the Exhibition "AGRIVISION-2011". ICAR institutes, publishers, industries and firms dealing with agriculture had showcased the recent advances in agricultural research and technology development in the exhibitions in as many as 46 stalls erected for the purpose.

8.3. The Plenary Session

Dr. Mangala Rai in his keynote address on "*Efficiency mediated Sustainable Enhancement Measures*" asked to strive for enhanced factor productivity and stable production and profitability equipped with climate change adaptation and capability of capitalization and ecosystem function leading to reduced green house gas emissions and carbon footprint in agriculture. The principles of ecosystem technologies like application of ecosystem approach throughout entire food chain, developing diverse farming systems to have optimal impacts on profits and sustainability must be adhered

to. One must also recognize the equitable right of use and access to resources especially land, water, credit and knowledge. The ecosystem-based production must be aligned with programmes and policies enabling environment for adaption of regionally differentiated strategies with backstopping for technology dissemination and extension in continuum. In the natural ecosystem, agro-ecosystems are to be so evolved that land capacities can meet the continuously changing societal needs. The course of evolution needs to increase agricultural production but with greater environmental protection. We need to appreciate that land is basic to agriculture, and it is finite and fragile. Water is life but is limited and is getting polluted. Also, the crucial congenial climate for agriculture is changing and changing fast, in fact, outpacing the technology development. At the same time, our needs are growing, and hence, there is an urgent need to produce more and more with less and less resources. Obviously, efficiency-mediated sustainable productivity enhancement measures would be imperative. The cornerstone should clearly be to capitalize on the complementarities and to harness the coherent synergies of various components of agricultural production systems in an agro-ecosystem. Hence, the key-word is to always ensure positive interaction and its effective harnessing on a changing time-scale. It is difficult but is certainly not impossible. As softer options are far and few, we will have to think out of box, he asserted.

Dr. Thomas A. Lumpkin, Director General, CIMMYT, Mexico delivered the keynote address on '*Global Food Security: Challenges and Opportunities for Agro-eco Technologies for South Asia*'. He expressed his concern on climate change which is impacting agriculture. He informed that every one degree rise in temperature increases irrigation requirement by about 2% to produce same amount of food. The depletion of groundwater is unsustainable. Heat shocks impact grain filling in wheat, thus decreasing productivity by around 20%. Climate change is giving rise to new diseases and pests. The melting and retreating glaciers which is a major source of water for wheat production is a matter of concern. All these issues are increasing the food prices of major crops and time may come when countries like India and China may no longer export their crops no matter what prices offered. We need to be extremely bold in where we are going, we need to meet food demand in future and allocate 50% land for carbon sink under biodiversity. Dr. Lumpkin



finally appraised about the new Borlaug Institute for South Asia (BISA) which will develop a strong synergistic partnership between NARS institutions, private research institutions, NGOs, and commercial agro and ICT industries.

Dr. Robert Zeigler, Director General, IRRI, Philippines delivered his keynote address on '*Global Food Security and Climate Change*'. He underpinned the strong IRRI India partnership in ensuring reliable rice supplies for future generation. Global rice production needs intensive measures to meet demand of the year 2035. The world is dependent on India to produce sufficient rice. The climate change has hard hit rice production in India. Food shortage is rampant across the world. New demand of food grains for biofuel production is adding to the challenge. Lack of political will and vision in many countries is a major constraint. Recently, food prices have increased in India by 40 to 50% and it hurts the domestic economy. In the coming years, the cost of fertilisers is also likely to increase. Dr. Zeigler observed that there is a definite relationship between poverty and lack of availability of rice across nations. The future world relies on rice varieties that will tolerate high temperature, survive prolong flooding, tolerate drought and soil salinity. India needs production practices that require less water and labour. The wild relatives of rice should be explored for disease and pest resistance through genomic approach. The entire Integrated Pest Management and research and extension across Asia need to be reinvigorated. India would then play a key role in global rice agenda by partnering in frontier research areas. Rice crop is sensitive to heat-stress. It has been observed that higher the night temperature, lower has been the yield of rice. Alternate wetting and drying is a water-saving technology that low land rice farmers can apply to reduce their water use in irrigated fields. Rise in sea levels could possibly wipe off some rice producing regions. IRRI has recently demonstrated the success of a rice variety which could withstand water submergence of 1 metre. He thanked the efforts of IRRI scientists which enables farmers cultivate rice using flood tolerant rice in 12 million hectares of north-east India. A long term experiment on rice-maize crop rotation revealed depletion of organic carbon by 25%. Dr. Zeigler alluded to the urgent need for capacity building for next generation of rice scientists in India. IRRI is also promoting with internship integrated postgraduate and Ph.D programs leading to attraction of young and bright students. Dr. B. Hanumaiah, Vice Chancellor, BBAU, Lucknow in his brief speech advocated the need to reorient sustainable development



by equitable and judicious utilization of resources, as the numbers of hungry people in the world are increasing by 4 million every year. Innovative schemes are needed for technology upgradation enabling small and marginal farmers to ensure sustainable agricultural system. He emphasized that the expertise available in conventional universities can be combined for strengthening basic research in agricultural universities and cooperation between these university systems for enhancing productivity and resource conservation would be necessary.

The chairman of the session, Prof. R.B. Singh, thanked the speakers for their informative presentation and hoped for greater collaboration among national and international organizations, such as the CGIAR institutes, to sustainably enhance the food security situation.

8.4. Special Lectures

In the evening on first two days of the Congress, two special lectures were delivered as under which received wider attention by the delegates and guests.

In his special lecture, Dr. R.S. Paroda addressed the concerns of food security, soil health and climate change. Heralding the unique success of Green Revolution, he said that during the past 60 years agricultural production increased four folds with more real income to farmers. It also contributed in doubling the life expectancy. He, however, expressed his anguish that over one billion people in the world are suffering from malnutrition and hunger. He was concerned about the steady decline in the growth rate of food production in the last four decades. Compounded with the diversion of food grains for bio-fuel, the buffer stocks of food grains have declined globally. He was equally concerned about the increasing population. He added that one Kazakhstan is being added every year in India's population. He underlined the agriculture- related Millennium Development Goals (MDG), namely, MDG-1: related to eradication of extreme poverty and hunger, MDG-7: ensuring environment sustainability and MDG-8: developing a global partnership. He called for concerted efforts in realizing these MDGs. The real challenge in agriculture is to increase productivity with higher income to farmers in a sustainable manner by overcoming biotic and abiotic stresses and climate change.



He advocated a twin-pillar strategy of germplasm improvement through biotechnology and integrated natural resource management.

Dr. Paroda urged for narrowing the time gap in exploiting research leads into technologies and cited the case of hybrid rice in China where research started in 1964 and farmers adopted hybrid rice in 1976. Today, 53% of rice grown in China is hybrid rice giving an additional production of 15 million tonnes. He, however, lauded the success of hybrid maize in India. He wondered as to why we are still debating about the benefits of transgenics at a time when the transgenics of soybean, maize, cotton and canola are being grown in about 134 m ha globally. He was happy that Bt cotton introduced in 2001 is being cultivated in 8.4 m ha resulting in doubling of the production with insecticide use being reduced by 40 per cent. It is benefitting 5 million farmers.

The importance of soil quality and health in sustainable development was elaborately highlighted. About the depletion of soil organic carbon, he quoted Dr. Rattan Lal, an eminent NAAS Fellow and soil scientist, *“If soils are not restored, crops will fail even if rains do not; hunger will perpetuate even with emphasis on biotechnology and genetically modified crops”*. We must reclaim our soils so that they become engines of economic development. The capacity for properly managed soils to sequester atmospheric carbon is enormous. India has the potential of carbon sequestration of 40-50 Tg C / year (1 teragram = 1 million tonnes). The carbon credit may reach around \$ 1 trillion by 2020. Burning of agricultural biomass contributes 3.7 Pg C/year as emission in the tropics (1 pentagram = 1 billion tonnes). If farmers were rewarded in carbon credit for regenerative practices that aggregate rather than aggravate soil structure, it would solve green house gas emission problem and at the same time improve factor productivity.

Resource conservation agriculture is an innovative practice expanding rapidly in USA and Brazil. About 3.2 million hectares are under conservation agriculture in India. Laser land-levelling is another measure that can save 10-20% water. Alternate furrow irrigation so common in Central Asia saves 30% of irrigation water. Zero-till drill transplanted rice, direct-seeded rice, aerobic rice, small farm mechanization etc. need to be popularized in a big way. Zero-till drill is used in over 2 million hectares in rice-wheat cropping system in the Indo-gangetic plains.

Without adequate adaption and mitigation to climate change, food insecurity and loss of livelihood are likely scenario in Asia. For coping global climate change, we must adapt in terms of time of sowing, varieties and new cropping systems. He cited some practical examples for mitigating adverse effects of climate change in agriculture. Advancing the sowing of wheat by 10-15 days combined with conservation practices

can reduce the adverse effect of terminal heat. Aeration in rice culture can reduce methane emissions significantly.

The subsidy to Indian agriculture is around 6.5% of agricultural GDP while the figures for Japan and USA are 65 and 24%, respectively. Even though India and China have doubled their investment in agricultural R&D, it is still far too low when compared with that of developed nations like USA and Japan. He advocated strong synergy in public-private partnership. Private sector must also invest more in agricultural R & D.

Dr. Paroda concluded his lecture with a beacon of hope that agriculture has the potential to liberate India from hunger, malnutrition and poverty with equitable access.

Dr. K. L. Chadha delivered a special lecture on “*Horticulture-led Transformation of Agrarian Economy with Special Reference to the Eastern Indo- Gangetic Plains (IGP)*”.



He observed that horticulture sector is the best option for diversification and maximizing system productivity under the diverse agro-ecological settings in the country. Horticultural crops have shown their efficiency in improved productivity and profitability compared to field crops and provide nutritional adequacy in rural and remote areas besides being environmentally safe.

These also provide higher employment generation opportunities. Horticulture sector has ample opportunities to accommodate increasing role of private sector in R&D, seed production, micro-irrigation, farm mechanization, post harvest management, nutritional adequacy, cold chain, exports and transfer of technology. He further observed that Indian horticulture is at an advantageous position as the fast developing multinational chains in food sector and retail chain and modernization of airports, roads and highways have boosted the marketing of the horticultural produce.

Dr. Chadha highlighted that India is now the second largest producer of fruits (11.8%) & vegetables (13.3%) in the world and has second largest area under floriculture after China. It is also the largest producer of banana, mango, sapota, papaya, acid lime, cauliflower, peas, okra, cucurbits etc. It is considered to be the treasure house of Medicinal and aromatic plants. It is a major player in coconut production in the world (1.90 million ha) with an annual production of nearly 13,000

million nuts (22.34% share) and is the largest producer, consumer and exporter of spices and spice products (4.02 million tonnes from an area of about 2.47 million ha). India is the leading producer of arecanut and accounts for 56% and 58% of the total area and production in the world. India is the largest producer (6.95 lakh MT), processor, consumer and exporter of cashew. The total horticultural area and production has been estimated at 20.88 million ha and 223.09 million tonnes while its exports are valued at Rs 67692 millions. The demand for horti-produce is on the increase and is expected to accelerate with increase in population, urbanization and per capita income besides health concerns. The sector has registered a satisfactory annual growth rate of about 4 to 5 percent in recent years and the pace is required to further increase to meet the target. There is growing demand for high quality, high value produce throughout the country as well as the world.

Among the several challenges faced by Eastern IGP in intensifying horticultural economy, the following need focused attention:

- i. High intensity and frequency of natural disasters (flood and drought and water logging).
- ii. Slow diversification of high value crops.
- iii. High post-harvest losses and unorganized market systems.

The following strategies for mitigating these challenges were highlighted:

- Capture non-conventional opportunities like mushroom cultivation, bee-keeping, protected vegetable production
- Exploit waste land for horticultural crops
- Undertake well planned cultivation of vegetables in home gardens
- Cultivate makhana and lotus in water logged areas
- Japanese mint and vegetables in flood affected areas
- Promote fast growing horti-crops like papaya, banana and vegetables and organic production of fruits and vegetables
- Strengthen production and availability of quality planting material
- Encourage high density planting
- Promote integrated approach that must involve conservation, horticulture and organic farming
- Improve orchard efficiency through systematic rejuvenation/replanting programmes
- Encourage protected cultivation and precision horticulture technologies for

improving productivity and quality and round year availability of vegetables and flowers

- Popularise use of plastics for nursery and crop production
- Promote of mulching, micro-irrigation, fertigation, slow release fertilizers and beneficial microbes to improve water and nutrient use efficiency
- Promote mechanization in horticulture
- Follow cluster approach to provide infrastructure facilities in a pooled manner for farmers
- Follow harvesting of produce at optimum maturity
- Establish pesticide residue laboratory to ensure quality produce
- Establish ripening chambers of banana and low cost eco-friendly cool chambers in potato
- Develop post harvest infrastructure, namely, cold storage, pre-cooling, cool chain, primary processing and packaging centres, food parks etc.
- Introduce suitable and innovative extension mechanism for ensuring technology transfer and adoption in horticultural crops
- Encourage public-private-partnership in technology transfer and adoption
- Enhance capacity building and skill development of small farmers and field functionaries in various activities of horticulture

Dr. Chadha concluded that horticulture has emerged as an engine for economic growth. A strengthened horticulture sector in Eastern IGP can have a positive impact on removing poverty and improving income of farmers. However, future development must be technology-based and knowledge driven as recommended by the National Commission on Farmers.

8.5. Technical Sessions

There were seven technical sessions on the following themes:

- i. Status of Farm Health and Assessment of Losses
- ii. Biosecurity with Special Reference to Emerging Exotic Diseases and Pests
- iii. Diagnostics and Health Management
- iv. Risk Assessment and Management
- v. Climate Change and its Impact on Farm Health
- vi. Unleashing the Agricultural Potential of Eastern India

vii. Interactive Session with Farmers, Bankers, Industry and Others

At least three invited lectures followed by brief panel discussions were organized in each session.

8.6. Poster Sessions

Out of 426 abstracts received for the Congress, 167 posters were presented. Ten of them received Best Poster Presentation Awards with Certificate of Merit and Mementoes presented by Prof. R.B. Singh, President NAAS.

8.7. Elocution Contest

An Elocution Contest on the theme of Congress was conducted by Academy in six Zones covering all the State Agricultural Universities in that zone. 10 students who were the Winner and Runner-up at the zonal level further participated at the National Elocution Contest held during 10th Agricultural Science Congress at NBFGR, Lucknow. The following students bagged the first three prizes which were given out by Prof. R.B. Singh.

First Prize - Mr. Ashutosh Bhakani GBPUAT, Pantnagar

Second Prize - Mr. Muzadin Khan Pathan, CIFE, Mumbai

Third Prize - Ms. Fatima Bano, Sher-e-Kashmir University of Agricultural Sciences & Technology, Kashmir

8.8. Valedictory Function

Prof. R. B. Singh, President NAAS, presided over the Valedictory Function of the Congress. The conveners of the Plenary and different Technical Sessions presented the following recommendations:

Plenary Session: Ecotechnologies for Livelihood Security (Convener: Dr. P. S. Pathak)

- The major problems flagged were the issues related to land use, land cover, and land degradation. Emphasis was made on the need for precision agriculture, protected cultivation, indigenous livestock breed development and fodder banks
- Global warming has increased the need of more irrigation water for ensuring same productivity. It was emphasized to encompass agro-forestry, range land development and biodiversity as a part of resource conservation strategies
- In rice, need of the hour is to develop varieties resistant to high temperature and other abiotic stresses.

- Educational policies must help in strengthening cooperation between agricultural and conventional universities by networking to promote basic research for enhanced productivity and resource conservation
- Technical Session 1: Status of Farm Health and Assessment of Losses (Convener: Dr. A. N. Mukhopadhyay)
- Paradigm shift is needed in animal health management, and focus on welfare by adopting short, long and medium term plans
- National animal disease outbreak alert is needed for early warning system for effective disease prevention
- Regulation of genetically modified crops after addressing their biosafety issues

Technical Session–II: Biosecurity with Special Reference to Emerging Exotic Diseases and Pests (Convener: Dr. M. P. Yadav)

- Establishment of National Biosecurity Authority through enactment of National Biosecurity Act
- Establishment of transboundary animal disease diagnostic network in SAARC countries with India as the lead centre
- Establishment of an institution on veterinary epidemiology, ecology and informatics and information sharing among SAARC and other Asian countries on plant, animal and fish diseases.

Technical Session – III: Diagnostics and Health Management (Convener: Dr. S.A.H. Abidi)

- Development of low-cost, robust, fast diagnostic kits for different diseases of plants and animals at field level with greater collaboration of plant and veterinary virologists and pathologists
- Development of thermostable vaccines against important animal diseases
- Need for suitable seed treatments to control pathogens, and need for better immunodiagnostics
- Technical Session – IV: Risk Assessment and Management (Convener: Dr. A. Subba Rao)
- Risk assessment and management expertise and skills in climate change management should be leveraged by using new tools like GIS mapping
- Risk management by implementing effective insurance products and schemes, assuring timely payment to affected people

Technical Session – V: Climate Change and its Impact on Farm Health (Convener: Dr. Anand Swaroop)

- Land degradation is a major concern because of non-judicious use of agricultural inputs and overexploitation of natural resources
- Enhanced carbon sequestration is important for climate change management and food security
- Monsoon based forecasting with timely advisory to stakeholders needed to minimize biophysical and socio economic impact
- Emphasis should be made to develop biomarkers for and mapping of micro-nutrient deficiencies
- Policy interventions needed for suitable micronutrient based animal feeding and management
- Area based mineral mixture is needed to increase milk production in the country

Technical Session – VI: Unleashing the Agricultural Potential of Eastern India (Convener: Dr. P. K. Joshi)

- Sustainably enhance investment in rainfed Eastern India to promote investment in water management approaches
- Harness potential of existing and improved technologies for important varieties and hybrids
- Strengthen existing institutions and evolve new ones, and connect production centres with remunerative domestic and global markets
- Strength role of cooperative farmers and contract farming
- Promote diversification through high value commodities such as fruits, milk, meat and fish
- Increase employment opportunities in the region
- Effectively utilize rice fallow lands especially for increasing pulse production
- Explore short duration rice varieties
- Strengthen conservation and judicious use of water, land and biodiversity; diesel cards to be issued to farmers and focus on cooperative tube wells and community-based resource management
- Establish national commission on soil resource health

Technical Session – VII: Interactive Session with Farmers, Bankers, Industry and Others (Convener: Dr. R. L. Yadav)

- Promote policy for export of high value as well as organically produced commodities
- Encourage Indigenous low cost micro irrigation systems
- Incentivise farmers for grain storage
- Promote mechanization in view of the labour scarcity
- Form a national sugarcane mission to look into the problems of sugarcane farmers and sugar industry
- Involve farmers in the formulation of policy and research agendas

Prof. R.B. Singh, President NAAS addressed the gathering and congratulated the organizers. He was happy at the presentations, deliberations and details that came out from the Congress. He focused on unleashing the potential of Indo-Gangetic Plains. He reasserted that the syndrome of hunger, poverty and inequality needs to be broken and continued violence of hunger must be avoided. Prof. Singh emphasised that the small and marginal farmers of India, although themselves under-fed, are the ones who are subsidizing food for the rich. They hold the key to food security in the nation and can no longer be ignored. He urged the farmers and scientists to work together for *Sampurna Swaraj*. He also said that innovation of farmers, students and researchers need to be exploited to save the farmers, the land, the biodiversity and the farming itself. We must respect our scientists and scientist farmers and students and innovators who bring incentive in farming. Prof. Singh appreciated the Ganga Gallery Project of the National Academy of Sciences, India (NASI) and said that health of Ganges is an indicator of wellness of our people. Citing “peanuts produce peanuts”, he called for enhanced investment in agricultural research, education and extension. Farmer-centric approach is critical for development which should explore unusual paths of success with an effective auditing and clear focus. With 40% of the world’s malnourished children being our own children, food and nutrition and livelihood security is vital for building strong India, said Prof. Singh. Prof. R B Singh, President NAAS, felicitated the Convener, Dr. W. S. Lakra, Director, CIFE, Mumbai and the Coconvener, Dr. J. K. Jena, Director, NBFGR, Lucknow for successful organization of the Congress. Dr. Jena proposed the vote of thanks.

9. Academy Awards

The Academy has instituted the following category of awards to recognize scientists for excellence in research in agricultural and allied sciences.

- (i) Memorial Awards
- (ii) Recognition Awards
- (iii) Young Scientists' Awards
- (iv) Endowment Awards (Sh. L.C. Sikka Endowment Award)

These awards are presented at the Agricultural Science Congress, organized by the Academy once in two years. Nominations for Academy's Awards for the biennium 2009-2010 were invited in January 2010. The Award Judging Committees, constituted by the Executive Council of the Academy, considered all valid nominations in September 2010 and recommended following scientists for different awards, which were approved by the Executive Council of the Academy. These awards were presented at the Inaugural Function of the X Agricultural Science Congress on 10th February 2011 by H.E. Shri B.L. Joshi, The Governor of Uttar Pradesh at NBFGR, Lucknow.

Recipients of Academy Awards for the biennium 2009-2010 are follows.

(i) Memorial Awards

Award name	Field	Awardee
Dr K. Ramiah Award	for contributions in Agricultural Research in Plant Improvement	Dr P.N. Bahl
Dr K. C. Mehta Award	for contributions in Plant Protection	Dr K.V.B.R. Tilak
Dr M. S. Randhawa Award	for contributions in Agricultural Administration, Transfer of Technology and Social Sciences	Dr P.K. Joshi
Dr N. S. Randhawa Award	for contributions in Soil Water and Environmental Sciences and Natural Resources Management	Dr T.K. Adhya
Dr P. Bhattacharya Award	for contributions in Animal Sciences	Dr Gaya Prasad

(ii) Recognition Awards

Crop Sciences	Dr K.C. Bansal
Soil, Water and Environmental Sciences	Dr Himanshu Pathak
Animal Sciences	Dr A.B. Mandal
Agricultural Engineering and Technology	Dr Rintu Banerjee

(iii) Young Scientist's Awards

Crop Sciences	Dr V.K. Dubey
Plant Protection	Dr Anirban Roy

(iv) Endowment Award

Shri L. C. Sikka Award	Dr P.S. Naik
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10. Regional Chapters

The Academy has five Regional Chapters as follows. The Regional Chapters make suggestions with regard to policies and problems concerning their areas of operation.

The Conveners of these Chapters are:

Southern Chapter (<i>Hyderabad</i>)	Dr. N.H. Rao
Northern Chapter (<i>Lucknow</i>)	Dr. P.S. Pathak
Eastern Chapter (<i>Bhubaneshwar</i>)	Dr. T.K. Adhya
Western Chapter (<i>Mumbai</i>)	Dr. S.S. Kadam
North Eastern Chapter (<i>Imphal</i>)	Dr. S.N. Puri

Activities of the Regional Chapters

- The Eastern Chapter organized the following Lectures at CRRI, Cuttack in October 2010.
 1. 'ECOSEE – Simulating Greenhouse Gas Emissions across Different Temporal and Spatial Scale' by Prof. Joanne U. Smith, University of Aberdeen, Scotland, UK
 2. 'Global Greenhouse Gas Mitigation Potential in Agriculture' by Prof. Pete Smith, Royal Society – Wolfson Professor of Soils and Global Change, Institute of Biological and Global Change, Institute of Biological and Environmental Sciences, University of Aberdeen, Scotland, UK.
- The North Eastern Chapter organized a Brainstorming session on *Scope and Strategies for Mechanization of Hill Agriculture in NEH Region* on 19-20 November 2010 at College of Agricultural Engineering and Post-Harvest Technology, Ranipool, Sikkim.

11. Publications

List of publications brought out during 2010-11 is as follows.

- i. Presidential Address on “*Towards Developing an Innovative Model for Transformation of Agriculture in India*” delivered by Dr. Mangala Rai at Foundation Day
- ii. *Degraded and Wastelands of India – Status and Spatial Distribution*, a joint publication by NAAS and ICAR
- iii. *Conservation Agriculture – Innovations for Improving Efficiency, Equity and Environment – Selected Papers of 4th World Congress on Conservation Agriculture*
- iv. *State of Indian Agriculture – the Indo-Gangetic Plain*
- v. Policy Paper 43 : *Antibiotics in Manure and Soil – A Grave Threat to Human and Animal Health*
- vi. Policy Paper 44 : *Plant Quarantine including Internal Quarantine Strategies in View of Onslaught of Diseases and Insect Pests*
- vii. Policy Paper 45 : *Agrochemicals Management: Issues and Strategies*
- viii. Policy Paper 46 : *Veterinary Vaccines and Diagnostics*
- ix. Policy Paper 47 : *Protected Agriculture in North-West Himalaya*
- x. Policy Paper 48 : *Exploring Untapped Potential of Acid Soils of India*
- xi. Policy Paper 49 : *Agricultural Waste management*
- xii. NAAS-News (four issues)
- xiii. Agricultural News (six issues)

12. Programmes Planned for 2011

- Integration of Millets in Fortified Foods - Convener: Dr. A.K. Srivastava
- Bio-safety Assurance for GM Food in India - Convener: Dr. Manju Sharma
- Value-added Fertilizers for SSNM - Convener: Dr. Rajendra Prasad
- Sustaining Agricultural Productivity through Integrated Soil Management - Convener: Dr. A. Subba Rao
- Fish Stock Certification and Ecolabelling - Convener: Dr. T.K. Srinivasa Gopal
- Fighting Child Malnutrition - Convener: Dr. V. Prakash

- Strategies for Human Resource Development for Agriculture - Convener: Dr. M.S. Swaminathan
- Saving the Harvest - Convener: Dr. Anupam Varma
- Livestock Infertility and Its Management - Convener: Dr. B.S. Prakash
- Biopesticides Quality Assurance - Convener: Dr. A.N. Mukhopadhyay

13. Finance, Budget and Audit

The main source of funds for the Academy is the grant received from the Indian Council of Agricultural Research (ICAR). During the year 2010-11, ICAR released Rs. 100 lakhs.

The accounts of the Academy are audited by Chartered Accountants appointed with the approval of the General Body. Utilization Certificates up to the year 2010-11 have been submitted to the ICAR.

A brief Audited Statement of Accounts and Auditor's Report for 2010-11 is annexed with the report.

Acknowledgment

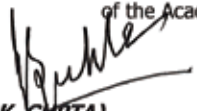
The Academy is grateful for the co-operation and support received from various organizations in implementing its activities. The Academy would, in particular, like to acknowledge with grateful thanks the support received from the Indian Council of Agricultural Research for its liberal and continuing support for Academy's programmes, and for extending generous financial support since its inception. This has greatly helped the Academy to (a) organize a number of meetings, workshops, seminars etc on major policy issues and (b) award medals to distinguished scientists and young scientists in recognition of their contributions and (c) maintain office of the Academy with necessary infrastructural facilities.

The Members,
National Academy of Agricultural Sciences,
NASC Complex, DPS Marg, Pusa,
New Delhi.

We have audited the attached Balance Sheet of **NATIONAL ACADEMY OF AGRICULTURAL SCIENCES, NEW DELHI** as at March 31, 2011 and the annexed Income and Expenditure Account for the period ended on that date. These financial statements are the responsibility of the management. Our responsibility is to express an opinion on these financial statements based on our audit.

We conducted our audit in accordance with auditing standards generally accepted in India. These standards require that we plan and perform the audit to obtain reasonable assurance, whether the financial statements are free of any material misstatement. Our audit included examining, on a test basis, evidence supporting the financial transactions and disclosures in the financial statements. Our audit also included assessing the accounting principles used by the management, as well as evaluating the overall financial statements presentation. We believe that our audit provides a reasonable basis for our opinion.

1. We have to report that:
 - (a) We have obtained all the information, which to the best of our knowledge and belief were necessary for the purpose of our audit.
 - (b) In our opinion, proper books of accounts as required by law have been kept by the Academy, so far as appear from our examination of the books.
 - (c) The Balance Sheet and the Income and Expenditure Account dealt with by this report are in agreement with books of account of the Academy.
 - (d) In our opinion, the Balance Sheet and the Income and Expenditure Account comply with the accounting standards as applicable.
2. In our opinion and to the best of our information and according to explanations given to us, the said Statements of Accounts read together with notes thereon and document annexed thereto give a true and fair view:
 - (i) In case of the Balance Sheet, state of affairs of the Society as at March 31, 2011 and,
 - (ii) In case of the Income and Expenditure Account, the excess of Income over Expenditure of the Academy for the period ended on that date.


(K.K. GUPTA)
For and on behalf of
KRISHAN K. GUPTA & CO.
Chartered Accountants



Place : New Delhi
Dated : May 06, 2011

EXPENDITURE	AMOUNT (Rs.)	INCOME	AMOUNT (Rs.)
To Expenditure/contribution on Project Programmes	97,52,274.37	By Grant in Aid from ICAR	1,00,00,000.00
To Expenditure on 4 th WCCA	6,69,010.00	By Contribution and other receipts of 4 th WCCA	2,66,692.52
To Depreciation	15,90,705.68	By Contribution from Publications, Subscriptions and other receipts	27,53,334.00
To Excess of Income over Expenditure transferred	68,55,410.45	By Interest Received	58,47,373.98
Total:	1,88,67,400.50	Total:	1,88,67,400.50

As per our report of even date attached

Sd/-
K. K. Gupta
 Krishan K. Gupta & Co.
 Chartered Accountants

Sd/-
Treasurer
 National Academy of Agricultural Science

Sd/-
Secretary
 National Academy of Agricultural Sciences

Place: New Delhi
 Dated: May 6, 2011

BALANCE SHEET AS ON 31.03.2011

LIABILITIES	AMOUNT (Rs.)	ASSETS	AMOUNT (Rs.)
CAPITAL FUND		FIXED ASSETS	
Opening Balance	10,37,93,245.29	Opening Balance	3,84,22,242.40
Add: Transferred from Accumulated Fund	80,96,577.35	Addition during the year	2,47,724.00
Add: Excess of Income over Expenditure during the Year	68,55,410.45	Less: Depreciation	(-)15,90,705.68
Less: Funds transferred to Specific Reserve	1,18,74,153.80		3,70,79,260.72
SPECIFIC RESERVE FUND		Deposits in approved Securities	11,27,74,398.04
Opening Balance	4,47,60,931.07		
Add: Addition during the year	1,18,74,153.80	CURRENT ASSETS	
Less: Utilized during the year	80,96,577.35	Bank Balance	33,53,405.41
Sir Dorabji TATA Trust (NAAS-TATA Young Scientist Award Project)		Cash Balances	1,597.00
Sir Dorabji TATA Trust (NAAS-TATA Bihar Project)		ADVANCES	
		Tax Deducted at source	25,48,625.64
Total:	15,57,57,286.81	Total:	15,57,57,286.81

As per our report of even date attached

Sd/-

K. K. GuptaKrishan K. Gupta & Co.
Chartered Accountants

Sd/-

Treasurer

National Academy of Agricultural Science

Sd/-

Secretary

National Academy of Agricultural Sciences

Place: New Delhi

Dated: May 6, 2011