12. Agricultural Human Resource Development

Quality human resource development is crucial for addressing the challenges in sustaining agricultural productivity in diversified agro-ecological regions. To address the challenges of agricultural growth and enhancing the benchmark quality standards of higher agricultural education across the State Agricultural Universities (55 SAUs), Deemed-to-be Universities (5 DUs), Central Universities (4 CUs with agricultural faculties), and Central Agricultural University (1) the Education Division of ICAR is playing a pivotal role by providing logistics and catalytic financial support for infrastructure development including domains of governance, development of uniform course curricula and capacity building. This has been possible through the XI Plan scheme of "Development and Strengthening of Higher Agricultural Education in India" through various sub-schemes and programmes.

During this year, three new agricultural universities namely Kamadhenu Veterinary University, Raipur, (Chhattisgarh), Tamil Nadu Fisheries University, Nagappatinam (TN), and University of Agricultural and Horticultural Sciences, Shimoga have been established by respective State Governments.

Infrastructural Development

The development grant through financial support helped in strengthening the infrastructure which included students' hostels, laboratories, smart class rooms, computer and internet facilities, instructional farms, state of art equipments and instruments, educational museums, educational technology cells, sports and recreational facilities etc.in the agricultural universities. In the XI Plan the construction of 89 girls' hostels, 46 boys' hostels, 35 international hostels, 37 educational museums and 45 examinations halls in 52 agricultural universities was supported. Most of these facilities have been completed and made functional enhancing the overall infrastructure in the campuses. Financial assistance of ₹ 545.43 crores was provided in the financial year 2011–12 for infrastructural development and strengthening of Agricultural Universities including civil works, student amenities for counselling and placement, faculty amenities, Best Teacher Awards, catalytic support for faculty exchange, Guest and Adjunct faculty, personality development, tutorials for SC/ST students and support to Deans for meeting expenditure under education technology and examination cells in addition to HRD, experiential learning and niche area of excellence.

Special and Institutional Grants

Special grant was provided to Mahatma Phule Krishi Vidyapeeth (MPKV), Rahuri, Maharashtra, Sher-e-Kashmir University of Agricultural Sciences and Technology (SKUAST), Srinagar (₹ 100 crore), Kerala Veterinary and Animal Sciences University (KVASU), Kerala (₹ 100 crore) and Sher-e-Kashmir University of Agricultural Sciences and Technology (SKUAST), Jammu, during the financial year 2011–12. The union budget 2012–13 also had the provision of institutional grants of ₹ 100 crore each for ANG Ranga Agricultural University, Hyderabad and Kerala Agricultural University, Thrissur and ₹ 50 crore each for CCS Haryana Agricultural University, Hisar, Orissa University of Agriculture and Technology , Bhubaneshwar and University of Agricultural Sciences, Dharwad.

Library Strengthening: Financial support of ₹ 57.16 crore was also extended for strengthening and modernization of libraries including networking for online access to literature, which ensured equity and availability of quality learning resources both in the main campuses and off-campus colleges. This has benefitted students and teachers for planning the research and preparation of teaching material by consulting the relevant learning resources and reference books.

- Demand-based additional new journals not covered under CeRA were procured, book bank for the benefit of the SC, ST and BC students were developed, special text-book collections built up at each campus, similarly separate competitive examination cells were established with the latest

A view of the new amenities created out of ICAR grant at Junagadh Agricultural University, Junagadh

collections for the aspirants of ICAR, ASRB, ARS, ICAR-JRF/NET, UPSC, APPSC, GMAT, TOEFL and bank examinations etc.

- **Digital Library**: The digital library infrastructure facilities viz. computers with latest configuration, Touch Screens for providing OPAC, internet facility, UPS etc. were strengthened in existing libraries and new ones were established to utilize the electronic information like CeRA, CAB Abstracts, *Krishiprabha*, EBSCO, Indiastat etc for the improvement of academic and research programmes. The e-Library infrastructure facility was also updated and strengthened with the latest versions of computer systems, online UPS, servers for utilization of electronic information resources and internet facility. Some libraries have also added e-Books (for example CRCnetBase e-Books on Agriculture and allied subjects) which can be accessed through I.P. and User ID password and act as virtual library for the teachers, scientists and students to browse important agricultural content. A separate e-Resource Training Centre to organize user awareness cum training programmes on e-Resource in Agriculture regularly and for offering Library and Information Science Course has been established at ANGRAU, Hyderabad.

Organization of AGRI-SPORTS

The XIII ICAR Sports Meet was hosted during 16–19 February 2012 at Dr PDKV, Akola (Maharashtra), in which, 41 agricultural universities participated in seven different sport categories and 1673 participants comprising 1,169 male and 361 female students and 143 team officials took part. The university also brought out daily bulletins and a colourful souvenir. PAU Ludhiana won the overall championship in athletics both in men and women categories. The University of Bangalore was declared as the overall champion.

Niche Area of Excellence (NAE): With an objective of achieving educational excellence in teaching, research, consultancy and other services, support to 51 Niche Area of Excellence have been provided, out of which 28 centres accomplished the task as on March 31, 2012. A grant of ₹ 26.66 crore provided during the financial year 2011–12, enabled creation of excellence in the chosen niche areas. Some of the significant achievements are:

- Development of the diagnostic kits and assays for quick and sensitive detection of the viral pathogens, and augmentation of immune response to vaccines by using new approaches. Efforts have also been made for augmentation of immune response through use of calcium phosphate and Poly L glycolide (PLG) nanoparticles based vaccine delivery. Capacity building of stake holders was done by organizing training programmes in emerging areas like molecular techniques for disease diagnosis and to address the problem confronting poultry sector. A repository of poultry viruses has been established and also in terms of development of an array of avian diagnostic assays for the benefit of farmers. A patent has been filed for chicken infectious anaemia virus antibody detection kit.
- Work was done on Isolation, characterization, production and dissemination of bio-agents at SVBPUAT, Meerut. A number of entomopathogenic fungi such as *Beauveria bassiana*, metarhizium, *Nomuraea* and *Verticillium* were successfully screened against legume pod borer. Rearing of the test insects on artificial diet was done successfully. A new species of entomopathogenic nematode *Steinernema asiaticum* has been identified. In addition, a number of predatory coccinellid beetles, pentatomid bugs and predatory syrphid flies have been recorded. Around 17 species of white grubs were collected from soils of different locations of the State.

The virulent strains of *B. bassiana* and NPV have been transferred to 7 agribusiness companies for their mass multiplication and dissemination in the field.

- Work at IVRI centre resulted in development of 15 processes and technologies for immune prophylactics and 11 types of innovations on immune-diagnostics against different infectious diseases of livestock and poultry in addition to submission of 143 gene accessions in GenBank. Identification, documentation and utilization of indigenous technological knowledge for diseases control, study of the mechanisms and amelioration of drug resistance developed in infectious agents and the host resistance to various diseases as well as a success story on PPR diagnostics and vaccine technologies are some of the major achievements.
- Implementation of newly designed P.G. Programmes, establishment of national and International linkages and training to about 160 researchers was done by Water Technology Centre at ANGRAU. This Centre popularised drip irrigation and fertigation for crops and evolved alternative cropping strategies for improving water productivity.
- SKRAU, Bikaner made efforts to demonstrate and highlight positive benefits of micro-irrigation and fertigation in realizing higher yields from high value crops in arid regions of Rajasthan, besides substantial savings in water and fertilizer use. Similarly, use of specific bio-regulators has led to high yield and savings in use of irrigation water. Also, the student community and other stake holders were benefitted through their involvement.
- Support by the niche area on Hi-tech horticulture including aromatic and medicinal plants, helped in organising trainings for youths/farmers at MPUAT, Udaipur. This centre also extended the facilities for experiential learning programme-

one on Hi-tech Horticulture and another on post harvest handling of horticultural crops. An innovative method of providing employment to unemployed agriculture graduates through nursery raising was designed and found very successful. The students raised more than 8 lakh saplings of different fruit crops, which were sold by the centre to the fruit growers of the region leading to resource generation.

- Work was done on key areas of plant microbe interactions and microbial molecular biology. About 20 postgraduate students from various life sciences degrees/B. Tech. (Biotech) have been trained in various molecular biology tools and worked with various aspects of the programme. Linkages were established at the intra-institutional and inter-institutional levels.

(A) Infected and ToLCV symptoms on non transgenic tomato Pusa Ruby; (B) White flies on T3 transgenic Pusa Ruby

- Niche area of excellence in medicinal and aromatic plants at JNKVV, Jabalpur contributed significantly in higher education (PG programme), research and extension activities for promoting medicinal and aromatic plants cultivation in the state of Madhya Pradesh, as a result, a large number of cultivators generated interest and started cultivation of medicinal plants.

Entrepreneurship Development

Experiential Learning is aimed at promoting entrepreneurship, knowledge and marketing skills through meaningful hands on experience and working in project mode, through end-to-end approach in product development. Some of the achievements are:

- Ten experiential learning centres for entrepreneurship among the students were established at MAU Parbhani. The students' expertise as master trainers emerged out for commercial exploration suitable for small scale and cluster mode of operation.
- Entrepreneurial skills were developed among students in Sabour by organizing different training programmes on processing and preservation of fruits and vegetables, preparation of value added products etc. Trainings were organized that benefitted the farmers and students. Ten students prepared entrepreneurship projects and submitted for funding to financial institutions.
- Experiential learning units at NAU, Navsari were established in post harvest technology (mango, tomato, and banana), onion dehydration plant, tissue culture lab, protected cultivation unit (vegetable and floriculture), bio fertilizer and biopesticide, bio-control unit and food quality testing unit. Among them, the bio-fertilizer production unit is a huge success in the region, leading to substantial resource generation.

Rural Agricultural Work Experience (RAWE)

RAWE programmes in the undergraduate curricula provide real life experience to students. This includes precisely prescribed programmes of work in farms as well as KVK's instructional plants, State farmers communication centres, industrial attachments etc. for a period of one semester with provision for adequate supervision, reporting and examination at the end. The scheme is supported jointly by ICAR and State Governments in sharing the stipend in the ratio of 75 : 25. In the XI Plan period about 27,600 students benefitted from RAWE.

At the national workshop on RAWE held on 19–20 May, 2012 at UAS, Bangalore, the new concept of student READY (Rural Entrepreneurship and Awareness Development Yojana) combining both RAWE and Experiential Learning courses together during the final year (VII and VIII semesters) was accepted. It would provide hands on experience and rural awareness to the students to become effective professionals and entrepreneurs.

National Information System on Agricultural Education Network in India (NISAGENET)

The web portal http://www.iasri.res.in/Nisagenet/ is being maintained at the central server of IASRI, New Delhi as a regular ongoing activity of the Agricultural Education Division of the ICAR. With the active participation of SAUs, DUs and other organizations engaged in agricultural education, the NISAGENET has become a single Window Information Delivery System. Its operational architecture has been modified to three tier web architecture and has enabling direct entry/ updation of data from the respective university/college(s) using the authenticated user Id and password. The database contains information on academic data of the universities, infrastructural facilities, budget provision, manpower employed, faculty and R&D activities. Moreover, it has an exhaustive Query/Reports system to provide information at country, state, university and college levels as well. To meet the requirements of the users, recently, the module on dynamic and selective reporting has been strengthened and scope widened.

The HRD data with regard to students admitted/passed and faculty/administrative manpower has been uploaded and validated for the year 2009–10 and 2010–11 by the respective AUs/colleges. For validation of the existing data in NISAGENET, Appraisal-cum-Data Validation Workshop for the Nodal Officers was organized at SKUAST Jammu, Jammu, (J&K) during 12–13 September, 2012.

Manpower Development

All-India Entrance Examination for Admission to UG and PG: The 17th Undergraduate Examination for degree programmes for admission to 15% seats in agriculture and allied subjects other than veterinary sciences including the award of National Talent Scholarships (NTS) was conducted on 14 April 2012. The examination attracted 57,627 applicants out of which 51,939 candidates appeared and a record number of 1,875 candidates were finally recommended for admission in 54 AUs through counseling. All the candidates who joined a university outside their State of domicile were awarded NTS of ₹ 1,000 per month. The examination for PG was conducted on 15 April 2012 for admission to 25% seats in PG programmes at 62 Universities, including award of ICAR Junior Research Fellowships (JRF). A total of 18,693 candidates appeared in the examination out of 20,896 applicants, and 2,404 candidates were recommended for admissions. In all, 472 students were awarded JRF in 20 major subject groups.

All-India Competitive Examination for ICAR Senior Research Fellowship for Ph.D: A total of 189 Senior Research Fellowships were awarded and 592 candidates were declared qualified for Ph.D. admission without fellowship in 13 major subject groups and 56 sub-subjects.

Globalization of agricultural education: About 250 candidates from 34 countries like Afghanistan, Bangladesh, Bhutan, Cambodia, Congo, Egypt, Eritrea, Ethiopia, Fiji, Guyana, Ghana, Indonesia, Iraq, Iran, Kenya, Mauritius, Maldives, Mozambique, Mongolia, Morocco, Myanmar, Namibia, Nepal, Niger, Nigeria, Rwanda, South Africa, Sudan, Sri Lanka, Syria, Turkmenistan, Vietnam, Uganada and Zimbabwe, exercised their preference to join various agricultural universities under various fellowships or as self-financed candidates.

Capacity Building of Faculty

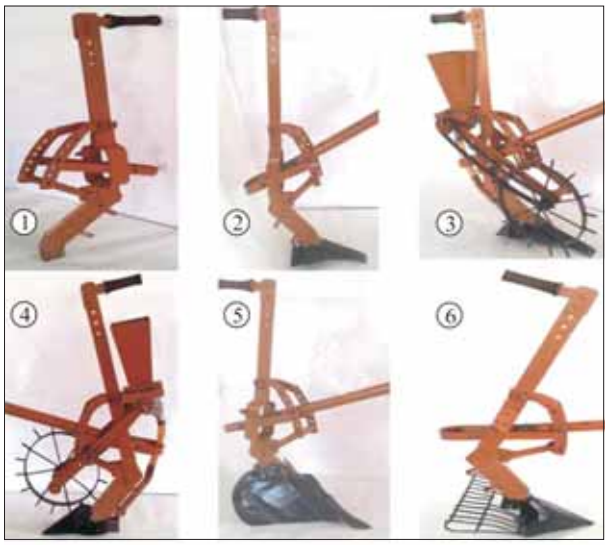
Summer/Winter Schools and Short Courses: Summer and Winter Schools and Short Courses of 10 to 21 days duration (40 SWS of 21days and 23 Short Courses for 10 days) were conducted at ICAR Institutes and State Agricultural Universities in key areas of agriculture and allied sciences like Application of remote sensing and GIS, Advances in Micro-irrigation and Fertigation, Farmers Empowerment and Entrepreneurship Development, Functional Genomics, Molecular Biology, Integrated Disease Management, Climate Change, Bio-fuels, Agri-business and Market Intelligence, Education Technology, etc.

Centers of Advanced Faculty Training: The 31 Centers of Advanced Faculty Training provided training to 966 scientists/faculty members from the National Agricultural Research System through 36 training programs in cutting edge areas of agricultural and allied sciences.

Promotion of Excellence and HRD

ICAR National Professor Scheme: For promoting excellence and creating a culture of basic research at national level, ten positions of National Professors have been created. Major achievements of ongoing ICAR National Professorial scheme comprised:

- *Designs for single factor and multi-factor experiments and their applications in Agricultural Systems Research:* A research level book entitled "Combinatorics in Sample Surveys vis-à-vis Controlled Selection" has been published. The book demonstrated the use of combinatorial properties of experimental designs in exercising control over sample selection from a finite population, besides the calibration approach based estimators when there is a negative correlation between the study and the auxiliary variable. The theoretical expressions for bias, variance and variance estimator of the proposed estimator are also developed. A web resource entitled "Sample Survey Resources Server" has been initiated and made available at www.iasri.res.in/ssrs/. Design resources server has been further strengthened by adding A- and D-efficient row-column designs in a given parametric range with two rows for 2-colour micro array experiments.
- *Development of technologies for subsoil structure modification, deep placement of fertilizers (P & K) and micro-nutrients and controlled field traffic for different cropping systems of Indo-Gangetic Plains:* An innovative gadget named Pant-ICAR Animal Drawn Six-in-One Tillage Outfit / Assembly was designed and developed, is being patented for soil cultivation especially in hilly regions. The outfit is embodied with different components alternately for performing six different farm operations such as ploughing without soil inversion, deep placement of fertilizers at 15 cm depth, sowing of cereals and pulses, furrow and ridge formation, interculture operation and potato digging. The outfit is light in weight and could be operated with medium size draft animals. The cost of the complete set



Pant-ICAR Animal Drawn Six-in-One Tillage Outfit / Assembly

is about ₹ 6,000/-. The KVKs of GBPUA&T, Pantnagar are being provided with at least one unit of outfit for field evaluation.

- *Plant-Need Based Nitrogen Management in Rice and Wheat:* Three different techniques, the Leaf Colour Chart (LCC), the chlorophyll meter (SPAD meter) and optical sensors (patented units) have been tested for their effectiveness in a series of field trials. Both the LCC and the SPAD meter have been found to be very useful in identifying the critical stages when the leaves start exhibiting the 'needs syndrome' and the fertilization at that stage ensures proper grain yields. The former (LCC) is inexpensive and easy to use and even semi-literate farmers can easily learn to use them.
- *Assessment, prediction and enhancement of biotic carbon sequestration in agricultural soils:* Impact of long-term application of organic amendments and fertilizer nitrogen (N) on carbon sequestration and its distribution among various physical pools of soil organic matter was studied post11-years of rice–wheat cropping. The studies showed that the application of farmyard manure and rice straw increased soil organic carbon pool by 34% over sole application of fertilizer N. Organic amendments had also a major influence on distribution of organic carbon among different soil organic matter pools.
- *Broadening the genetic base of Indian mustard* (*Brassica juncea*) *through alien introgressions and germplasm enhancement:* Developed and validated the concept of resynthesizing digenomic *B. juncea* from related digenomics. Morphological and molecular assessment of a large number of such derived juncea genotypes helped in establishing their potential as a new and distinct germplasm resource of tremendous breeding value for germplasm enhancement in mustard. Demonstrated the heterotic potential of derived *juncea* genotypes in crosses with natural *B. juncea*. Developed determinate mustard (Samar) for the first time in the world. It is expected to set in motion crop architectural transformation in mustard and enhance productivity through improved harvest index and better resource mobilization to developing sinks.

Determinate mustard genotype(Samar)

- *Allele mining for agronomically important genes in wild rice germplasm and stress tolerant landraces of rice growing in the hot spots:* 160 accessions of wild rice and 23 landraces of rice were collected from different districts of Eastern Uttar Pradesh and Southern Bihar from the Ganga and Son river plains along with full passport data. These accessions were grown in IARI fields during *kharif* season of 2011 and 2012 and basic morphological data were recorded. Phylogenetic analysis of these wild rice accessions was done using SSR DNA markers that clustered them into three main groups.
- *Design, construction and validation of DNA chips for virus identification and differentiation:* DNA chip for detecting animal viruses specific to Indian livestock now contains probes for 175 viruses and 146 virus genera. The chip, besides, identifying many common virus infections from clinical samples also identified a mix infection of BHV 1 and BVD 2 in cattle, which was subsequently confirmed by RT-PCR. A DNA chip for screening animal, fish and bird viruses in 8X60K has been developed and is under clinical testing. This chip contains unique probes for 826 viruses and 149 virus genera.
- *Changing consumption pattern in India: Opportunities for diversification towards high value commodities through production and marketing linkages:* Analyzed the pace and pattern of diversification of agriculture across states considering data for 30 years. There has been a consistent and significant growth (4% per annum) of high value commodities (HVCs) such as horticulture, livestock and fisheries resulting in improved income for farmers. Punjab, Haryana and UP were identified as low diversifying states while the North-Eastern states, Kerala and Gujarat were among the high diversifying states. Adequate policy support for marketing and value addition through both public and private investments holds key to sustain the shift towards HVCs. The introduction of e-tender system in the regulated markets of Karnataka was found to improve efficiency of marketing through reduced manipulations in price bidding and increased competition.

ICAR National Fellow Scheme: With an objective to provide support and develop strong centers of research and education around outstanding scientists, 25 ICAR National Fellow positions have been provided in National Agriculture Research System. Highlights of the ongoing projects are:

- *Improvement of strain of Chaetomium globosum, a potential antagonist of fungal plant pathogens for enhanced bioefficacy and developing molecular markers for its identification:* A Hsp22 gene of 630 bp from *C. globosum* (Cg 1) was

cloned and sequenced that showed 603bp open reading frame encoding 200 amino-acids. BlastX analysis revealed that the gene codes for a protein homologous to the previously characterized Hsp22.4 gene from *C. globosum* (AAR36902.1, XP 001229241.1) and shared 95% identity in amino acid sequence This gene was further cloned into pET28a(+) expression vector and transformed *E. coli* BL21 cells were induced by IPTG, and the expressed protein of 39 kDa was analyzed by SDS-PAGE. The IPTG induced transformants displayed significantly greater resistance to NaCl and Na_2CO_3 stresses. In addition, another gene responsible for the production of xylanase (1000 bp) has been cloned and sequenced from *C. globosum* (Cg2).

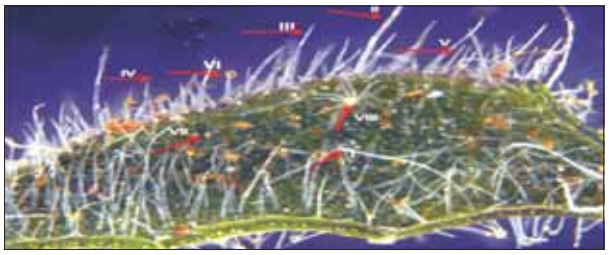
- *Decontamination of pesticide residues from edible commodities:* Use of saponin could decontaminate imidacloprid from okra up to 99% when used as a combination of 3 reagents. A transition metal catalyst along with hydrogen peroxide degraded organophosphorus (OP) pesticides to the extent of 92–100%. Degradation was however restricted to 60–70% for organochlorine (OC) and a new pesticide pyridalyl.
- *Assessment of sustainability of treated/developed watersheds in rainfed agro-eco-sub-regions of Peninsular India using GIS and remote sensing:* Based on an intensive study of eight watersheds, monitoring indicators that could help Project Implementing Agencies to monitor their project for sustainable development include—status of fodder availability (3.5%), total crop production trend (7.8%), gross agricultural income (7.8%), state of S& WC structures (17.9%), adoption of soil moisture conservation measures (17.9%) and practicing farm OM recycling (13.4%). Critical evaluation indicators that help in assessing sustainability of a given watershed project were—soil organic carbon content (13.4%), availability of credit facility for farmers (15.9%), presence of other gainful employment options for farm hands (13.4%), adequate availability of fodder (12.2%), state of soil fertility (12.4%) and Crop Diversity Index (13.6%). Both sets of indicators essentially signify aspects that are critical for sustainability of rainfed agriculture.
- *Development of ELISA based immunodiagnostics for Classical Swine Fever:* RT-PCR using primers specific to the E2 gene segment of classical swine fever virus (CSFV) was carried out to compare the results of the double antibody sandwich ELISA for detection of CSFV. All the forty-nine CSFV antigen positive samples in the ELISA were confirmed by the RT-PCR. Cloning of the E2 gene segment of the RT-PCR positive CSFV isolates has been completed and twenty cloned DNA products were sequenced. IgG level in the colostrum of sows after CSF vaccination was higher in the sows that were vaccinated within second month of pregnancy. A significant increase of CSFV specific antibody level was observed in the serum samples of piglets given zinc sulphate @ 150 ppm for 60 days from one month of age and CSF vaccine at 56 days of age.
- *Assessing soil quality key indicators for development of soil quality index using latest approaches under predominant management practices in rainfed agroecology:* The key soil quality indicators that emerged for Alfisol soils at Bengaluru Dryland Centre were: pH, available N, available P, available K, available S, Organic C, Mean Weight Diameter (MWD) and labile Carbon. Highest carbon stock was recorded in minimum tillage + 100% organic N (9.01 Mg/ha) followed by reduced tillage + 100% organic N (8.24 Mg/ha). Reduced and minimum tillage recorded 23.5 % and 27.2% higher carbon stock, respectively compared to conventional tillage. In groundnut–finger-millet rotation, Maize Residue (MR) @ 5 t/ha + 50% N, P_2O_5, K_2O recorded highest carbon stock (9.28 Mg/ha) followed by MR @ 5 t/ha + 100% N, P_2O_5, K_2O (8.90 Mg/ha), the increase over control being 36.6% and 31.1% respectively. FYM @ 10 t/ha + 100% N, P_2O_5, K_2O was found superior in finger-millet mono-cropping system.
- *Evolution of textile articles through processing of wool with silk waste and cotton to create entrepreneurial skills in rural women:* Rambouillet wool, eri and muga silk and regenerated cellulosic lyocell fibers were made into hand and ring spun eco-friendly pure and blended yarns (30 : 70, 50 : 50, 70 : 30 and 100 : 00). Yarn count, twist per inch, strength and elongation and yarn evenness of hand and ring spun pure and blended yarns were tested to estimate the yarn quality. Best selected blended yarns were chosen on the basis of physical properties. The pure yarns as well as best selected blended yarns dyed with acid, and reactive, direct and natural dyes. Fair to excellent colorfastness properties were observed in case of perspiration, rubbing, washing and light fastness tests with wide range of colours from natural dyes. Forward linkages have been made with the support of government agencies for income generation from textile entrepreneurial activities.
- *Identification and quantification of phosphatase hydrolysable organic P sources for plant nutrition and refinement of a non-destructive technique for phosphatase estimation:* Three organisms viz. *Aspergillus flavus* TFR1 (JN194185), *Aspergillus terreus* TFR2 (JN194186) and *Aspergillus oryzae* TFR9 (JQ 675296) were developed that can successfully synthesize nano-phosphorus from calcium phosphate with a particle size between 8 and 40 nm. The synthesized nano particle was encapsulated by oleic acid to form nano-phosphorus fertilizer. The developed nano-P

fertilizer was tested as foliar spray @ 16 litre/ha with a concentration of 40 ppm on 2 weeks old plants of arid crops like pearl millet and clusterbean under field condition. The nano-P fertilizer improved P use efficiency by 43% in pearl millet and 57% in cluster-bean. Additional 24% and 57% improvement of grain yield was noticed in pearl millet and cluster-bean, respectively.

- *Nanotechnology in aquaculture: An alternative approach for fish health management and water remediation:* Synthesized Silver nanoparticles showed strong antibacterial activity against a wide range of Gram positive and Gram negative bacterial pathogens of fish. Iron oxide nanoparticles as feed additives increased growth, haematological parameters and innate immune responses with no toxic side effects. Iron oxide nanoparticles exhibited potential for reducing ammonia and nitrate level of hatchery waters. Surface modified Poly-å-caprolactone microspheres and inorganic calcium phosphate nanoparticles acted as immunoadjuvants through parenteral immunization in fish with no toxic side effects (unlike oil adjuvants) using different protein antigens.
- *Development of soy and multigrain based nutritionally balanced functional foods for children:* To assess the nutritional status, 150 children of Bhopal district were surveyed for data on 24 h dietary recall, food frequency, socio-economic parameters, and anthropometry. As per the survey the children received only 50-55% of the recommended amounts of energy, protein and fat and 68% of iron. Height and weight of the children showed that they suffered from mild to moderate malnutrition as per the Gomez and Waterloo classification showing the urgent need for supplementation in the diets. Sixteen combinations consisting of corn, wheat, malted *ragi*, sprouted green gram, roasted peanuts, soy protein isolate, and papaya etc were chosen from 1450 feasible combinations using construction of composite index based on Principal Component Analysis (PCA). The protein content of the mixes was around 17.5 g/100 g, fat content around 5/100 g. Phenolics content was 100–125 mg/100 g equivalent of Gallic acid and antioxidant capacity was 5.6 to 9% radical scavenging activity. These mixes are now further being incorporated into products like porridges, biscuits, etc. as supplementary foods for children.
- *Precision nutrient management using GIS-based spatial variability mapping under Upper and Middle Gangetic Plain Zones of India:* The work on assessment of spatial variability in soil fertility status in the Western Plain Zone (WPZ) was taken up. Farmers participatory survey indicated that fertilizer use was skewed towards N (68–71%), whereas nutrients like K, S and micronutrients were generally neglected indicating highly imbalanced fertilizer management practices of the region that may not sustain high productivity of the crops in the long run. Highest K recycling through irrigation water under cropping systems was noticed under sugarcane–ratoon–wheat (112 kg K/ha), followed by rice–wheat system (79 kg K/ha). Marked variability in macro- and micro-nutrients status of soils across the districts and cropping systems was revealed. Different fertility parameters were classified into low, medium and high categories using the user defined ranges to develop homogenous fertility zones for the precision fertilizer recommendations for use by the farmers and policy makers.
- *Development and evaluation of neuraminidase DIVA marker vaccines against highly pathogenic H5N1 avian influenza viruses in chickens:* Antigenic and genetic analysis of highly pathogenic H5N1 viruses from Indian outbreaks from 2006 to 2010 was carried out for selection of hemagglutinin (HA) gene donor vaccine candidate. On the basis of 3-D antigenic cartography, A/chicken/West Bengal/80995/2008 H5N1 virus was found to be the best fit as the HA gene donor virus. For development of reverse genetics based non-pathogenic H5 vaccine strain, the basic amino acid cleavage site RRRKKR*GLF (major genetic character responsible for highly pathogenic nature of H5N1 viruses) in the HA gene of the selected H5N1 strain was modified to IETR*GLF by site directed mutagenesis. Using the mutated HA gene in the reverse genetics system, a recombinant H5N2 virus was generated from cloned gene segments of influenza virus as a non-pathogenic vaccine candidate for developing DIVA marker vaccine against H5N1 in poultry.
- *Development of commercially viable process technologies for weaning food based on underutilized crops of Uttarakhand:* A Popper/Puffing device costing ₹1,200 with a capacity of 1 kg/h for popping the grains of undervalued crops has been developed. Developed process technology for finger-millet, black soybean, horse-gram based multipurpose composite flour using optimized parameters of pretreatment methods like soaking, germination, blanching and malting. These optimized pretreatments could reduce anti-nutrients and thus improve the bioavailability of nutrients. A nutri-enriched bread has been prepared using optimized flour blend that contains 1.9% fat, 13.4% protein, 1.5% fibre and 301.5 Kcal energy, besides better sensory scores.
- *Functional Genomics, Epigenetics and Gene Silencing Technology for improving productivity in poultry:* Day old broiler birds showed higher expression of calmodulin, calreticulin, collagen, troponin C, troponin slow type protein, sarcolipin, myoglobin, cardiac related protein and myelin

genes than those of corresponding layer birds while myostatin, IGF-1 and GHR had higher expression in layer than broiler birds. At 6 weeks age, all thirteen genes had higher expression in layer birds than broilers. The ORF of chicken myostatin gene was characterized and its expression was found to be lowest during sixth week followed by fourth, seventh and second week, and day old. A total of nine haplotypes in promoter and six haplotypes in coding region of myostatin were observed in control broiler line where h1 haplotype was the most predominant one. Haplotype combinations showed significant effect ($P<0.05$) on body weights at 2 and 7 weeks of age. At 2 weeks age, h1h3 haplogroup recorded highest body weight (150.9g), whereas at 7 weeks, h1h6 haplogroup exhibited 28.16% higher body weight than h1h2.

- *Studies on phyto-semiochemicals involved in Insect-Plant interactions of major horticulture pests: Deciphering chemical cues*- Glandular and non-glandular trichomes (Type I–VIII) were observed in wild and cultivated Solanum species. Stellar trichomes (Type VIII) were found to be abundant in *S. melongena, S. indicum* and *S. gilo*. Types I–VII trichomes were also present in *S. mammosum* and *S. viarum*). The bioassays revealed the neonate larval mortality due to entrapment, repellency and feeding indicating the potential trichome based antixenosis and antibiosis. Host cues isolated from mango, viz. γ-Octalactone, 1-Octen-3-ol and ethyl tiglate were identified as potential ovipositional attractants. Ethyl tiglate was found to be most attractive with ovipositional index (OI) of 0.7 on natural substrate, while, γ-Octalactone was the most preferred ovipositional cue for *B. dorsalis* on artificial substrate with OI of 0.92.



S. viarum leaf covered with multiple trichome types, including the type I-VIII, the types VI & VII are glandular trichomes

- *Development of transgenic goat using Sperm-Mediated Gene transfer (SMGT) method and its use as a bioreactor for producing novel proteins of therapeutic importance:* Promoter region (app 2 kb upstream) of uroplakin gene has been cloned and characterized for making a vector cassette to drive the expression of the transgene in the target organ (urinary bladder). Cloning of a bigger upstream region app 8–10 kb is in progress. Electroporation parameters for transfection of testes/sperm has been optimized and being validated using *in vitro* fertilization. Isolation and *in vitro* culturing of urothelilal cells has been optimized.
- *Whole genome wide SNPs based assessment of genetic relationship of Indian native cattle adapted to different agroclimatic condition:* To discover the genome wide SNPs and unravel whole genome based population structure of Indian cattle, a total of 23 individuals representing 7 native cattle breeds viz. Amritmahal, Gir, Ongole, Red Kandhari, Sahiwal, Tharparkar and Leh adapted to different agroclimatic regions and two exotic Holstein and Jersey cattle breeds were genotyped using 770 K high density bovine SNP chip. The population structure analysis through multidimensional scaling plot revealed grouping of Indian cattle breeds in one cluster and widely separated from Bos taurine cattle. The native cattle from Leh and Laddakh region were genetically distinct from rest of the Indian cattle. This study represents a first approach to assess population structure of Indian native cattle breeds using the high density SNP chip and re-establishes the genetic distinctness of Indian cattle from Bos taurine cattle.
- *Comprehensive screening of target, non-target and unknown emerging organic contaminants in fruits and vegetables by GC-MS and LC-MS:* An integrated method of analysis was developed for the residue analysis of pesticides and plant growth regulators in fresh fruits and vegetables with special emphasis on semi-polar to polar compounds based on a generic method of sample preparation using methanol as extraction solvent. A GC-MS/MS method was also established for simultaneous analysis of 375 pesticides. More than 500 samples of 5 different vegetable commodities from different districts of Karnataka, Maharashtra, Tamil Nadu and Gujarat were screened for pesticide residues using GC-ToF and LC-MS/MS. The results with respect to different agro-climatic and horticultural practices were compared. Furthermore, precise, accurate and sensitive methods based on LC-MS/MS and UPLC with fluorescence detection have also been developed for multi-mycotoxins and aflatoxin analysis, respectively in plant matrices. The above analytical methods support holistic risk assessments related to food contamination at 10 ppb and lower residue levels.
- *Development of sensitive and specific diagnostic assays for detection of Trypanosoma evansi infection in animals using modern molecular tools:* Bloodstream forms of *Trypanosoma evansi* have been cultivated in axenic system using Iscove's modified DMEM-based HMI-9 medium supplemented with bathocuproine disulphonic acid, 1-cysteine, hypoxanthine, 2-mercaptoethanol, pyruvate, thymidine and heat

inactivated horse serum. The HMI-9 medium yielded best results in terms of adaptation, survivability and multiplication of trypanosomes. Phylogenetic analysis of the invariant surface glycoprotein gene sequences showed heterogeneity among four *Trypanosma evansi* Indian isolates of different geographical area.

- *Development of novel immunopotentiator molecules from fish host and pathogens for broad spectrum disease control in freshwater aquaculture:* The anti-microbial peptide genes (apolipoprotein M, apolipoprotein A1, hepcidin, mitochondrial anti-viral signaling peptide) partial sequence information were generated in rohu, *Labeo rohita*.. The expression level of the genes in various tissues and different developmental stages of rohu were studied. Further, the expression pattern of these genes was also measured after experimental infection of rohu with *Aeromonas hydrophila* and the potential role played by these molecules in bacterial pathogenesis determined.
- *Environmentally sustainable termite control: integrative and inclusive approach of frontier and indigenous technologies:* Effect of agronomic practices like tillage and crop residues in control of termite infestation was investigated with integration of termiticides, seed-treatments, and other biological options like botanicals (garlic-based products), entomo-pathogenic-fungi (*Beauveria bassiana* and *Metarhizium anisopliae*). A termite species *Heterotermes indicola* (Wasmann) identified from Delhi region. The seed-treatment with double dose of Chlorpyriphos 20% EC, and Fipronil 5% SC (@ 9 & 6 ml/kg seeds) was found to be detrimental to the wheat seedlings.

Emeritus Scientist Scheme

The ICAR continued to operate Emeritus Scientist Scheme as a structural method of utilizing Skill Bank of the outstanding superannuated professionals of NARS. Some of the major findings of the projects under this scheme are:

- Installation of light traps for mass trapping of adult insects with two deep ploughings before planting followed by soil application of talc based formulations of *Bacillus cereus* or *Metarhizium anisoplae* pellets (half at planting and half at earthing up time) + 2–3 foliar sprays of Jatropha and mycojaal (cattle urine extracts) were found viable alternative to chemical control against potato insect pest complex in Shimla hills.
- Microbilogically bioscoured cotton yarn in hank form dyed with natural indigo and fabrics made in handloom sector were converted to readymade jean pants of different sizes. The process adopted is least polluting and suitable for handloom sector.
- Release of exotic parasitoid *Acerophagus papayae* reduced the mealybug damage from grade 5 (>80% damage) to 1 (less than 5% damage) in Gulbarga and from 4 (>50% damage) to 1 in Bengaluru within four months.
- Atmosphere modified with cow dung cake smoke controls storage pests (insects and microbes) effectively.
- Out of 388 working germplasm of cotton in CICR Nagpur, 100 working germplasm has been characterized individuality using 28 STMS markers.
- A major shift towards the culture of the American Whiteleg shrimp (*Litopenaeus vannamei*) in the states of Andhra Pradesh, Tamil Nadu, Gujarat and Odisha was observed in over production of cultured shrimp and decline in prices. Most of the *Penaeus monodon* hatcheries and farms were converted into *L. vannamei* hatcheries and farms in these states.
- *Helicoverpa armigera* can be effectively controlled by mass trapping of male moths (male annihilation technique-MAT) through installation of pheromone traps @ 40 and 50 traps per hectare in tomato and pigeon pea, respectively. MAT was demonstrated and implemented on wide-area in guava, cucurbits and mango for the management of fruit flies; chickpea for management of *H. armigera*; and brinjal for the management of fruit and shoot borer (*Leucinodes orbonalis*).
- A high level of genetic diversity was observed among *Corchorus olitorius,* which could be used for the jute improvement programme.
- Adjuvants identified *in vitro* that enhance the immune system in birds.
- A line, having better Zn availability, was found in the pearl millet hybrid samples tested compared to check, while 32 lines were having better Fe content.
- Cowpea can be incorporated in rice–wheat cropping system in Tarai area of Uttar Pradesh and Hills of Uttarakhand.
- Using available data from known sources, current available catch and gap in present and required catch of tuna has been done.

Quality assurance and reforms

Accreditation: Quality assurance in higher agricultural education was pursued through accreditation of agricultural universities, their constituent colleges and programmes. Five universities, viz. Animal and Fisheries Sciences University, Bidar; Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana, University of Agricultural Sciences, Raichur, Uttar Banga Krishi Viswavidyalaya and CSK Himachal Pradesh Krishi Viswavidyalaya, Palampur were visited by the concerned Peer Review Teams for validation of Self Study Report (SSR). The SSRs of 7 SAUs seeking accreditation have been received.

India-Africa Fellowships: India is offering 75 fellowships each year for a period of four years to the

nationals of African continent for pursuing Master's and Ph.D. programmes in Agriculture in Indian AUs to support the Agricultural human resource development in Africa through formal education of African scientists/ faculty and students. During the current year, a total of 132 (88 Master's and 44 Ph.D.) candidates, against the available slots, from 16 African countries, viz. Benin, Botswana, Egypt, Ethiopia, Ghana, Kenya, Lesotho, Malawi, Mozambique, Nigeria, Rwanda, Somalia, South Sudan, Sudan, Tanzania, and Uganda, have been recommended to 24 Indian AUs. During 2010–11 and 2011–12, a total of 91 candidates including 60 for Master's and 31 for Ph.D programmes were admitted in different subjects.

India-Afghanistan Fellowships: To strengthen and expedite the process of human resource development in Afghanistan, India is offering 115 fellowships every year for pursuing Master's and Ph.D programmes in Indian AUs, to faculty members and students. In the current year, a total of 193 candidates have been recommended for admission in 35 Indian AUs for pursuing Bachelor's, Master's and Ph.D. programmes.

ICAR International Fellowships: With an objective to develop competent human resource and showcasing the strengths of Indian ICAR-AUs system, ICAR International Fellowships were introduced in 2009–10, for pursuing Ph.D. programme at the Indian agricultural universities (AUs) and overseas universities for overseas and Indian candidates, respectively.

A total of 15 candidates were selected during 2011–12, of which 13 candidates have joined their programmes in various overseas universities.

For the year 2012–13, 14 candidates have been selected for pursuing their Ph.D programme.

ASEAN-India Working Group: The second meeting of the ASEAN-India Working Group on Agriculture and Forestry (AIWGAF) was held on 6–8 March, 2012 in Plembang, South Sumatra, Indonesia. During the meeting, it was agreed to hold a conference of Heads of Educational and Research Institutions in India, Workshop on Climate Change adaptation and mitigation in agriculture was organized during 22–25 August, 2012 in New Delhi.

ASEAN-India meeting of Agriculture Minister and Senior Officers: The meeting was held at NASC Complex, New Delhi on 17–19 October, 2012. An Agri-Expo was also organized on this occasion. Shri Sharad Pawar, Hon'ble Minister of Agriculture, Government of India, inaugurated the meeting. The first issue of newsletter entitled "ASEAN India Newsletter" was also launched on 17 October 2012.

Policy for Higher Agricultural Education and guidelines for establishing new CAU: The Committee constituted to develop 'Policy for Higher Agricultural Education and Guidelines for Establishing the New Central Agricultural University' in the country held consultations with various stakeholders, during the year and the contents finalized.

Liaisoning with other departments and academic institutions: Liaisoning with MHRD, AICTE, UGC, NCERT, CBSE, IAUA etc. was maintained to improve the quality of higher education in the country, in general and of agricultural education in particular through synergies and exchange of information.

National Academy of Agricultural Research Management

National Academy of Agricultural Research Management (NAARM) continued to focus its activities in areas of capacity building, research, policy support and post graduate education.

Capacity building: The Academy organized 45 programmes, which included 3 foundation courses for Agricultural Research Service (FOCARS) and 42 other senior-level training programme in the areas like information and knowledge management, personal effectiveness, discipline competencies, business orientation and building linkages.

The Academy developed a scheme to institutionalize an integrated competency framework for capacity building for research excellence and leadership succession across NARS to address future challenges. It includes a new model of Foundation Course for ARS probationers (FOCARS), Executive Development programme for newly-recruited Directors and Management Development Programme in Leadership for aspiring research managers (a Pre-RMP programme),

Second ASEAN-India Ministerial Meeting on Agriculture & Forestry and Agri Expo was organized at NASC Complex, New Delhi

besides the refresher course for lateral entrants to the ARS.

Research: The research projects of the Academy are operative in five thematic areas viz. Agricultural science and technology policy, accelerating agricultural innovations through ICTs and institutional change, Organization and management for strengthening agricultural research, Agri-marketing and value chain management, and Governance and institutional arrangements attracting funding by NAIP, DST and other agencies. The research by faculty of NAARM led to nearly 100 publications in peer reviewed national and international journals, book chapters and other publications and presentations.

Policy Support: Eleven workshops, conferences and seminars conducted at the Academy provided a platform for dialogue on several issues of concern for national and international policy in agriculture that included workshops on Leadership Effectiveness and Performance Enhancement in NARS, Public Private Partnership in Agriculture, Policy and Prioritization, Monitoring and Evaluation (PME) Support to Consortia-based Research Projects in Agriculture, Annual Conference of Indian Society of Agricultural Marketing, Policy Workshop on Training Transfer at NARS, etc. These workshops provided platform for 400 professionals from public and private institutions of NARS to deliberate and recommend pragmatic policy strategies.

Education: All students (20) of the outgoing batch of Post Graduate Diploma in Management (Agriculture) got placements in mid-level management positions in private sector companies relating to retail, input, commodity exchange, services (logistics and collateral management) and finance. The selection process of students for PGDMA included an all India test conducted jointly with MANAGE, Hyderabad and NIAM, Jaipur (Joint Entrance Test for Agribusiness Management or JETABM) followed by group discussions and personal interviews.

NAARM successfully organized a one-year Post Graduate Diploma in Technology Management in Agriculture (PGDTMA) in Open Distance Learning (ODL) mode in collaboration with University of Hyderabad.

Other activities

Agribusiness Knowledge Centre (AKC): The AKC is a Public Private Partnership (PPP) initiative between NAARM and Gyantech Information Systems Private Limited (GISPL), Hyderabad to primarily 'Value Chain' farmers, academia, research and industry through exchange of knowledge among them. AKC has established space for private sector to function at NAARM. AKC successfully conducted National Mega Meet on Technology Commercialization with participation from ICAR institutes, private companies and grass root innovators wherein it identified five technologies for further commercialization. AKC has entered MoU with 'efreshindia' (www.efreshindia.com) for providing content for crop management and good agricultural practices in four identified regions of Andhra Pradesh.

Linkages: The Academy continued its linkages with its traditional partners – institutes of ICAR, SAUs and the CGIAR institutions. In addition, new linkages have been developed with a wide range of international institutions including universities, agribusiness, industry and NGOs in areas related to technology management, post graduate education and capacity building.

NAARM Collaborates with APTDC: Andhra Pradesh Technology Development and Promotion Centre (APTDC) and Confederation of Indian Industry (CII) in association with International Crop Research Institute for Semi-Arid Tropics (ICRISAT) organized AP-TEC 2012, a conference and exposition focusing on Technologies for Modern Agriculture with NAARM as knowledge partner.

National Stakeholders' Consultation Meet was organized by NAARM to plan and prioritize the XII Plan programme.

Reorganization of NAARM: NAARM has been restructured into six functional divisions, i.e. Human Resources Management; Information and Communication Management; Research Systems Management; Agribusiness Management; Education Systems Management; and Extension Systems Management in tune with its new vision and mandate. Accordingly, its cadre strength has also been increased to 62 from the present strength of 43. Efforts are underway to fill the vacant positions by recruitment and transfer.

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Vice-chancellors Conference

The annual conference of vice-chancellors of the Agricultural Universities and interactive meet between ICAR senior officers and Directors was organized during 15–17 February, 2012 in New Delhi. A dialogue between CGIAR and AU system was also organized on 15 February, 2012 for understanding the areas of cooperation and exchange. The first prize was given to KAU, Thrissur and second prize to CAU, Imphal in recognition of output in ICAR JRF examination. The GBPUA&T, Pantnagar and Dr PDKV, Akola jointly bagged the third prize.

Annual conference of vice-chancellors of the Agricultural Universities and interactive meet between ICAR senior officers and Directors was inaugurated by Shri Sharad Pawar, Union Minister of Agriculture and Food Processing Industries