1. Overview

The Indian Council of Agricultural Research provided the critical technological inputs for various processes of agriculture that led to the highest ever food production of all components of cereals, pulses, fruits and vegetables, meat, milk, fish and eggs during the year. It was also marked by the gracious presence of the Hon'ble Prime Minister of India at the Indian Council of Agricultural Research on the occasion of its 83rd Foundation Day on 16 July 2011. This was a memorable occasion for the National Agricultural Research System (NARS) when he addressed the august gathering, and said *"The ICAR has served our country with great distinction for over eight decades now. It has done pioneering work in many areas of agricultural research, leading to very significant breakthroughs in several areas. The contribution of ICAR scientists in the achievement of national self-sufficiency in foodgrains and diversity in food production is truly enormous."* He further added, *"You have a record to be proud of, although the future challenges are truly enormous, I am sure our agricultural research system will succeed in delivering the national good, whatever be the odds. With these words, I wish the ICAR family, all success in its efforts. May God bless your path."*

The ICAR records its gratitude to the Hon'ble Prime Minister and presents some of the salient achievements below.

Soil and water productivity: Soil fertility maps were prepared for 62 major districts of the country. At the individual farms in rainfed production systems, biochar (fine-grained carbonized materials), developed from the crop residues, has shown the potential to sequester carbon and increase crop productivity and sustainability of the soil systems. In Indo-Gangetic plains, econometric analysis of groundwater markets indicated the need of special monitoring for further development of groundwater in Trans-Gangetic and north-west and south-west sub-regions of Upper-Gangetic plains and for faster development of groundwater in Middle and Lower-Gangetic plains.

Farming system: For wheat cultivation, zero, strip and rotary till drills and bed planter technologies are cost-effective (24-27%), energy-efficient (34-37%) and resulted in higher yields (15-22%) with greater net returns (26-31%). These conservation technologies also reduced the incidence of the weed, *Phalaris minor* compared to conventional sowing.

In irrigated medium land of Jharkhand, intensive cropping system of rice-potato + wheat-greengram enhanced production nearly four times and employment generation by 174% over the conventional rice-fallow system. On the extremely degraded ravinous lands, located along Mahi, Chambal and Yamuna rivers, bamboo plantations with supportive staggered trenches utilized 80% of the rainfall and the higher plant survival and growth could generate ₹ 27,000 to 36,000/ha/year. Under rice-cropping system during dry season in Odisha, groundnut cultivation in paired rows saved 40% irrigation water and enhanced pod yield over flat method of planting.

Climate change: The National Initiative on Climate Resilient Agriculture (NICRA), launched as a network project, is spreading its wings across the country with development of crop varieties for climate change and ground-level interventions in the villages.

Performance of rainfed maize (C_4 plant) variety, PB 8 was predicted using HadCM3: A2a scenario and effects of increased CO_2 on maize yields were assessed by the Decision Support System for Agrotechnology Transfer (DSSAT) crop simulation model. Simulations made for representative locations in Andhra Pradesh and Maharashtra indicated increased yields by 23, 18%; and 27, 21%; at enhanced level of CO_2 (450 ppm) for 2020 and 2050 respectively.

Eight cold-tolerant bacterial strains were identified for developing bacterial consortia to alleviate cold stress effects on wheat crop.

Genetic resources: Thirty-six explorations of crop plants were undertaken and 2,713 accessions, including 570 of wild species, were collected. Under exchange programme, 42,947 germplasm accessions were imported from 42 countries including 12,488 international trial material and 536 transgenics. Of the 97,700 imported samples processed for quarantine clearance, 5,038 samples were found infested/infected with different pests and 5,024 samples were salvaged.

Eighteen isolates of actinomycetes of 465 collected from Chilika lagoon, Odisha, were found moderately alkali-halophilic.

In temperate fruits, 1,994 exotic and indigenous germplasm were collected, conserved and evaluated. Thirty-five accessions of mango and 14 of guava were collected from Uttar Pradesh, Bihar and Goa. Five walnut genotypes, CITH-Walnut 6, CITH-Walnut 7, CITH-Walnut 8, CITH-Walnut 9 and CITH-Walnut 10, were identified for release. Guava Purple and Lalit were found potential donors for pink pulp and HAPSI 35 and HAPSI 46 pink pulp guavas have shown promise for nectar preparation.

In tuber crops, 4,738 accessions are being maintained in the active field gene bank, and spice germplasm repository includes 2,695 of black pepper, 550 of cardamom, 1,026 of turmeric and 590 of ginger. Mushroom genera recorded for the first time are *Humidicutis, Leucoagaricus, Leucopaxillus,*

Micromphalea, Otidea, Schizostoma, Tulostoma and *Vascellum*.

Decoding of pigeonpea genome, a first time accomplishment by an entirely Indian group of scientists has received appreciation and wide acclaim from peer group world around. A total of 47,004 protein-coding genes were identified in the genome, of which 1,213 are for disease resistance and 152 are for tolerance to drought, heat and salinity.

Cattle breeds, *Binjharpuri, Ghumsuri, Khariar* and *Motu* and buffalo breeds, *Banni* and *Chilika* were registered. *BMP4* mRNA abundance in the ovaries of high-fecundity ewes indicated its role in regulation of ovulation rate. Molecular genotyping of buffaloes from Nagaland placed this group in a distinct cluster and buffaloes of the upper Asom between riverine and true swamp types. In chicken, genetic diversity analysis showed relatively low genetic distance within broiler and layer lines and native populations were found more close to broilers than layers.

Whole genome sequencing of a female Murrah buffalo (NDRI 5620) was undertaken and buffalo genome assembly integrated into a publicly available genome browser (http://210.212.93.84/cgi-bin/gb2/gbrowse/bovine/). The National Gene Bank at the NBAGR now stores 84,200 frozen semen doses, belonging to 26 breeds of cattle, buffalo, goat, sheep, camel, horse and yak.

Phylogenetic relationships among different Indian carps, *Catla catla*, *Cirrhinus mrigala*, *Labeo rohita*, *L. calbasu*, *L. fimbriatus* and *L. bata* were elucidated using partial sequence of *Cytochrome C Oxidase I (COI)* gene. This will be useful for accurate identification of seeds of carp species using DNA barcoding. In Indian white shrimp, 81 polymorphic microsatellites to be used for commercial shrimp breeding and selection programmes were developed. Transcriptome sequencing of *rohu* (*Labeo rohita*) provided better understanding of polymorphisms and immune-related genes responsible for resistance to *Aeromonas hydrophila* infection. Partial cDNA of glycerol-3-phosphate dehydrogenase (GPDH) was characterized in Indian snow trout, *Schizothorax richardsoni* and the *GPDH* gene showed its possible role in cold acclimation.

Crop improvement: Forty-eight varieties/hybrids of crops including major food crops of rice, wheat, maize and pulses were released for different agroclimatic regions of the country. A long-duration rice hybrid, CR Dhan 701 was developed for the irrigated and shallow lowlands. Synthetic wheat hexaploids identified having higher phytase levels would enable enhancement of enzyme levels in bread and durum wheats, resulting in better micronutrient bioavailability in the human system.

Four high-yielding pulses, Ujjawala of *kabuli* chickpea for the central zone, IPM 02-3 of mungbean for spring in the north-western plains zone and IPM 02-14 for summer in the south zone, and IPF 4-9 of fieldpea for Uttar Pradesh, were released. Eighteen early-duration pigeonpea hybrids were developed, utilizing seven early-maturing cytoplasmic male-sterile lines. Enhanced productivity levels of pulses through 6,000 demonstrations across the country contributed to a record all time high in pulse production.

Cotton CSHG 1862, a GMS-based *hirsutum* hybrid, recording an overall mean seed-cotton yield of 2.1 tonnes/ha, was released for the irrigated north zone. A unique dark-brown lint multispecies derivative MSH 53 of cotton with open canopy and leaves with long pedicels allowing direct penetration of sunlight, thus minimizing attack of cotton bollworm, was developed. F_1 seeds of interspecific hybrid between *Hibiscus cannabinus* and its wild progenitor *H. surattensis* were harvested, and hybrid plants could be grown successfully.

In fruit crops, Early Red, Mcintosh, Criterian and Scarlet Spur in apple; Dixi Red, Early Red June and Red Globe in peach; CITH-Cherry 5 and CITH-Cherry 7 in cherry; Coratina and Leccino in olive; cluster type elite walnut collections such as CITH-W 426 and CITH-W 427 are some of the promising lines for yield and quality characteristics. Coconut hybrid, IND 058S × IND 042S, with a yield of 140 nuts/palm/year and copra yield of 4.66 tonnes/ha was identified for release.

Cowpea variety Kashi Unnati was recommended for Rajasthan and Gujarat. In yams, the accession Da 11 recorded highest true protein content of 13.3 and 4.0% on dry and fresh weight basis respectively. *Amorphophallus* hybrids, Am H 1, Am H 1(b), Am H 5 and Am H 102, with excellent cooking quality could be harvested in seven months.

In gladiolus, four new varieties, Punjab Flame, Punjab Elegance, Punjab Lemon Delight and Punjab Glance, and in chrysanthemum two varieties, Kaul and Khoshoo, were developed.

Livestock improvement: In Frieswal cows, the average of 300 days milk yield was 2,859 kg in the first lactation that reached 3,542 kg in the fourth lactation. Supplementation of protected fat to high-yielding dairy cows improved milk yield, reproductive efficiency and proved cost-effective to farmers. In buffalo ration, 10% *mahua* seed-cake and 2% *harad* resulted in over 17% reduction in *in vivo* methane production. Incorporation of sheanut (*Butyrospermum parkii*) cake in the feed of ruminants as a source of energy and protein suppressed methanogenesis. In a flock of prolific sheep breed in Kendrapada, Odisha, the fecundity enhancement gene *FecB* was detected in 84% population. The Muzaffarnagari sheep usually produces a single lamb, but the twinning rate was improved to around 14% through selective breeding and this breed produced triplets with higher litter weight than that of a single lamb. Technological interventions in the Jakhrana breed of goat resulted in further improvement of milk yield with a peak of over two litres a day. Three crossbred lines of pig with 50% exotic inheritance of Hampshire with Ghungroo showed promise for average litter size at birth and weaning. New heavy crosses, HC-3 and HC-4 were found

promising for backyard poultry with a weight range of over 1 kg at seven weeks and 2 kg at 12 weeks.

Breeding and larval production of silver *pompano*, a high-value marine tropical finfish, was accomplished successfully. Improved strains of Hungarian scale carp, Ropsa scaly and Felsosomogy mirror carp were bred for improving economics of carp culture in the mid-hill region. Early breeding of grass carp achieved in April would ensure off-season seed availability.

Crop management: During terminal heat-stress situation, rice genotypes IET 20924, IET 20935, IET 20734, IET 20893, IET 20907 and IET 20905 showed better resistance to physiological changes related to membrane injury, photosynthesis, water, spikelet and pollen fertility. In rainfed upland ecosystem, the intercropping of rice + sunhemp with the nutrient application of 60:40:40:500 or 60:60:40:500 of N:P:K:lime kg/ha and foliar spray of 0.5.% zinc sulphate was found promising for improving grain yield and soil health.

In soybean-safflower cropping system, application of P was successfully substituted by seed treatment with phosphate-solubilizing bacteria and five tonnes of farmyard manure (FYM)/ha without adversely effecting safflower productivity in western Maharashtra. On rainfed Vertisols, the cotton genotype PKV 081 proved ideal for high density planting system (166,006 plants/ha) on the basis of yield, morphological features, earliness, tolerance to sucking pests and boll weight. In a new method for management of weeds in irrigated cotton, the weed-seed bank was exhausted before sowing under stale-seed bed technique in which ridges and furrows could be prepared and irrigated two weeks before cotton sowing.

The yellow mosaic in wild species/sub-species of *Vigna* was confirmed to be caused by mungbean yellow mosaic India virus (MYMIV). This is the first report of nucleic acid-based identification of the MYMIV in *V. hainiana, V. trilobata* and *V. radiata* var. *radiata.*

In litchi, application of ethrel at 150 ppm, 100 ppm, naphthalene acetic acid at 40 ppm and maleic hydrazide at 15 ppm showed early shoot maturation and flower initiation during the month of October. Integrated nutrient management (combined application of 75% of RDF + 7.5 tonnes of FYM + 3.75 tonnes of poultry manure/ha) resulted in significantly higher yields of onion. A PCR-based protocol for detection of latent infection of *Phytophthora infestans* in seed-potato tubers was validated, which could detect infection up to a distance of 20 mm from the lesion. An aeroponic system for mass multiplication of potato mini-tubers was developed using locally available materials.

As a management measure in banana cultivar Poovan infected with streak virus and bract mosaic virus, the application of 20 kg FYM + 0.9 kg neem cake + 2.0 kg vermicompost + 0.9 kg groundnut cake yielded the highest bunch weight of 19 kg with 12 hands and 192 fingers/bunch. Three new bactericides, Piperaciline (500 ppm), Dichloropene (500 ppm) and Triclosan (0.5%) were found effective for the management of bacterial blight in pomegranate field. Black pepper variety Thevam recorded significantly higher dry berry yield (1.71 kg/vine) when it was grown as a mixed crop in the coconut garden.

Livestock management: The Veterinary Type Culture Collection at Hisar maintains 358 accessions of veterinary microbes including 255 bacterial and 103 viral cultures along with 169 recombinant clones. The National FMD Virus Repository at Mukteswar holds 1,712 isolates (O-1102, A-276, C-15 and Asia 1-319). A logistic regression analysis for 15 economically important livestock diseases was carried out using the National Animal Disease Referral Expert System model. Forecast maps and spreadsheet modules for economic impact analyses of different diseases were prepared to estimate the 'direct costs'.

An indigenously developed *r3AB 3 DIVA Kit*, designed as per the WHO guidelines, was found suitable for differentiation of FMD virus infected from vaccinated animals. In buffalo, parthenogenetic embryonic stem cells were generated and propagated up to seventh passage.

In vitro fermentation study of local camel feeds and fodder indicated maximum gas production in *bajra* grains and it was low in complete feed blocks containing local feeds in different proportions. The effect of the area-specific mineral mixture supplementation was beneficial over grazing alone on the reproductive performance of female camels.

In Vanaraja breeder chicks, calcium and non-phytin phosphorus contents in the diet could be reduced by supplementing vitamin D_3 during 0-6 weeks of age. Krishibro chicks responded better to high levels of digestible amino acids at the market age. During peak summer in north India, performance of colour broiler chickens (assessed through HL ratio, immune-competence and oxidative profile) improved with the addition of *sarpagandha* or *ashwagandha* root powder or *geloi* (*Tenospora cordifolia*) stem powder or *aonla* fruit powder. In Odisha, CARI model of backyard poultry farming proved beneficial in providing household nutritional security and supplementary income.

The *heat shock protein-70* gene expression was highest in the duodenum under stressors like heat and feed withdrawal in broiler and layer chickens. Feed withdrawal was most effective in inducing high expression of the gene in various gastrointestinal segments, but the trend was reversed by administration of a protein synthesis inhibitor, cycloheximide in broilers. Analysis of nucleotide sequences of two swine flu (H1N1) isolates indicated their close relationship with pandemic H1N1 2009 human isolates from India, Canada, Argentina, Taiwan and China.

Nutrient profiling of clam, crab and prawn indicated that crab has a superior nutritive fat profile. Fish species distribution maps of rivers Ganga, Yamuna, Chambal, Betwa, East Banas, Son, Ken, Rupnarayan, Ajay, Subarnarekha, Kangsabati, Tapti, Narmada, Godawari, Krishna, Kaveri, Tava, Tungabhadra, Hemawati,

Mahanadi and Pennar were delineated. The marine fish landing statistics of the Central Marine Fisheries Research Institute, Kochi was recognized as official statistics of the Government of India. *Kali sarson* and lemon grass effectively inhibited growth of *Saprolegnia*, which affects coldwater fishes, mahseer and trout**.** Farm-pond emerged as the most profitable land-shaping model with highest benefit:cost ratio of 2.33, followed by paddy-cum-fish, deep furrow and high ridge, shallow furrow and ridge and paddy-cum-brackishwater fish. An immunoperoxidase test was standardized to detect *Macrobrachium rosenbergii* nodavirus (*Mr*NV) in virus-infected larval stages of prawn. Pen rearing of fish seed provided an efficient *in-situ* model for stocking at Dimbhe reservoir in Maharashtra in draw-down lands of farmers.

Mechanization and energy management: Tractor-drawn farmyard manure spreader was modified as bullock-drawn to meet the requirement of small and marginal farmers that reduced cost of manure spreading by 26%. A power-operated jute-ribboning machine was developed that yielded 100-125 kg of jute-ribbons/hr. A twin-row engine-operated weeder for rice intensification performed well under all soil conditions and its commercial model is now available under the brand name '*Garuda*'. Use of hydraulic power block in purse seine operations was standardized.

Post-harvest management and value-addition: Power-operated gel extractor was developed for *Aloe vera* and the machine-peeled gel contained only 1.0% aloin within the safe limits, as compared to 1.99% by hand-peeling.

CIRCOT Minicard, a novel sliver making machine having a production capacity of 1-2 kg/hr was developed for production of cotton yarn showing optimum strength for the given count. High quality cellulose nano-fibrils were produced from short staple cotton fibres through a refining process after pre-treatment with zinc chloride and cellulose enzyme. A jute-glass hybrid fabric was developed to mould products such as fittings for automobiles. Development of a fibre segregator has opened up a new avenue for utilization of finer coconut fibres for value-added products.

A technology was developed for production of cholesterol-free soy butter similar to peanut butter in taste and texture, but significantly low in total and saturated fat. Packaging of soy paneer in retortable pouches and autoclaving extended the shelf life by 18 days at room temperature and 45 days under refrigeration.

Digital radiography, CT and MRI imaging techniques were developed to detect presence of seed weevils in mango. Semi-ripe (40-50%) Totapuri mango fruits with an acidity of 0.8-1.0% were found ideal for preservation by hurdle process. In papaya and pineapple, osmotic dehydration to the moisture levels of 13-15% prevented browning and enhanced the shelf life. Dehydration of blanched chillies at 50°C retained maximum green colour and ascorbic acid content as compared to 60-70°C. Rehydration of dried green chilli flakes at 100°C for 45 seconds resulted in good retention of texture, vitamin C (26.47 mg/100 g), capsaicin (0.36%) and green colour.

Packaging of fish cut-up parts, fingers, chunks and nuggets of freshwater fishes rohu and catla in round polypropylene rigid containers with lid of 500 micron thickness, maintained hygiene and keeping quality for seven days and three months under chilled and frozen conditions respectively. Shelf life of tapioca and fish curry could be extended to three months at the ambient storage when packed and processed as twin packs in high impact polypropylene (HIPP) thermoformed containers. The products remained in good quality for nine months when freshwater catfish, *Wallago attu* was smoked and canned in oil in tin-free steel cans.

Human Resource Development: To provide experience-based and skill-oriented hands-on training to students, 19 Experimental Learning Units were added in 51 universities to the existing 264 units. Operational guidelines for the National Professorial Chairs and National Fellowships were revised for more functional autonomy and efficient execution, and 16 new ICAR National Fellows were appointed. Three universites, Sri Venkateswara Veterinary University, Tirupati; Sher-e-Kashmir University of Agriculture and Technology, Jammu; and Navsari Agricultural University, Navsari were accreditated. Niche Areas of Excellence were supported to achieve global competence in agricultural research, teaching and consultancy in the specific fields. In order to reduce inbreeding, 1,763 students in the Under-graduate level and 2,076 students in the Post-graduate level were admitted through centralized admission by the ICAR. Besides, the ICAR International Fellowships, the India-Africa Fellowship and India-Afghanistan Fellowship programmes were continued for higher studies in the Indian Agricultural Universities.

Agricultural economics, marketing and statistics: Studies indicated that self sufficiency status in wheat has improved by 15% and rice by 7%. A field survey covering 225 farmers in Punjab, Bihar and Uttar Pradesh showed that greater sensitization, awareness generation and capacity upgradation of milk farmers resulted in improved compliance with food safety measures at the farm level.

A centralized Statistical and Computational Genomics Lab (SCGL) Facility was created. 'e-Learn Agriculture' was designed, developed and implemented to fulfil the increasing demands of online interactive post-graduate courses in agriculture sciences. *AgriDaksh*, a Knowledge Management tool for building online expert system for crops was developed comprising knowledge model creation, knowledge acquisition, problem identification, knowledge retrieval, ask questions-to-experts and administration. The National Agricultural Bioinformatics Grid in the ICAR will be a national facility to provide computational framework to support biotechnological research in the country.

Information, communication and publicity services: Realizing the need for knowledge sharing and management for sustainable agricultural growth, the ICAR renamed its Information and Publications arm as the Directorate of Knowledge Management in Agriculture (DKMA), with Agricultural Knowledge Management Centres (erstwhile ARIS Cells) across the ICAR system.

The website of ICAR with value-added features was visited by 2.23 million stakeholders from 200 countries; number of registered users of online versions of the ICAR research journals was over 13,000 from 180 countries; and e-publications posted on the website recorded 32,000 visitors. The Knowledge Information Repository in Agriculture for North-East (KIRAN) and Rice Knowledge Management Portal were launched. The new initiative to utilize mass media resources for enhancing visibility and brand image of the ICAR resulted in 2,500 news clippings and 500 video clippings in national and regional media in 18 Indian languages. The ICAR technologies were showcased in 21 national conferences and fairs across the country and in a first of its kind, participated in the overseas trade fair at Muscat, Oman. Open access to all researches was further enhanced towards globalization of activities

Technology assessment, refinement and transfer: In crops and animals, under different thematic areas in 283 locations, 208 technological interventions were refined. Nearly 95,000 frontline demonstrations on cereals, millets, oilseeds, pulses, cotton and other important crops; 6,984 on improved tools and farm implements; 8,007 on livestock species; 795 on related enterprises; and 4,009 on gender-specific technologies were conducted during the year. Approximately 56,000 training programmes were organized for 15.96 lakh farmers, farm women, rural youth and in-service extension personnel. Technology demonstrations for harnessing productivity of pulses were undertaken in 137 districts of 11 states and over 6,000 demonstrations were laid out on pigeonpea, chickpea, urdbean, mungbean and lentil covering 2,236 ha area.

About 1.10 lakh short text messages (SMSs) were delivered to 13.40 lakh farmers for timely actions through Kisan Mobile Advisory functional at 310 KVKs. At present, 42 Directorates of Extension Education are vested with the responsibility of technological backstopping of the KVKs across the country. Technological information was provided to about 10.74 lakh farmers through print and electronic media and 2.68 lakh farmers were given quality technological products, viz. 30,713 q seed, 5.61 lakh saplings, 5.24 lakh livestock species and fingerlings, 1,805 poultry birds and 5,627 q bio-products through the Agricultural Technology Information Centres (ATICs).

Research for tribal and hill regions: Eight hybrids/varieties, Maize Hybrid 39, Vivek Maize Hybrid 43, VL Matar 47, VL Masoor 514, VL Masoor 133, Vivek Matar 11, VL Tamatar 4 and VL Shimla Mirch 2, developed at Almora were released. Two cold tolerant phosphate solubilizing bacteria *Pseudomonas poae* RT5RP2 and RT6RP were isolated from rhizoplane of wild grass at Uttarakhand.

At Umiam, Meghalaya, two upland varieties, Bhalum 3 and Bhalum 4 and two lowland varieties Megha SA 1 and Megha SA 2 of rice were developed. A high yielding advance breeding line of turmeric (RCMT 7), highly rich in curcumin, was developed for cultivation in Manipur.

CARI-Pretty Green Bay was identified as a potential terrestrial orchid for export owing to its good keeping quality and long attractive spikes with many green florets.

IP portfolio management: Forty-three patent applications were filed and one international and three national patents were granted during the year. Over 200 extant varieties were registered and granted protection and 436 applications were brought out in the *Plant Variety Journal*. Six Copyrights were registered by the ICAR institutes to protect developed softwares. 'Weather Cock' software package, capable of agro-meteorological analysis to understand possible impacts of climate change on crop performance, was developed and registered. Trademark 'IISR' was granted to the Indian Institute for Spices Research, Kozhikode. The ICAR now has a corporate platform, 'AgrInnovateIndia' for technology commercialization and consultancy at home and abroad.

Awards and incentives: Two prestigious awards, viz. *ICAR Norman Borlaug Award* and the *ICAR Challenge Award* were instituted to honour scientists, who provide a breakthrough in agricultural research and find solutions for long-standing problems impeding agricultural development. Under the 17 different categories, 85 awards were conferred to 13 institutions, 59 scientists, 10 farmers and three journalists. Of the 59 scientists and three farmers, nine were women scientists and one woman farmer.

Partnership and linkages: The ICAR collaborated with CIMMYT, Mexico in the initiative for establishment of Borlaug Institute for South Asia. Collaborative projects, viz. Twinning of Laboratories between Freidrich-Loeffler Institute (FLI), Institute of Bacterial Infections and Zoonoses, Jena, Germany (the parent laboratory) and NRC on Equines, Hisar (the candidate laboratory); Animal Health Institute, United Kingdom (the parent laboratory) and National Research Centre on Equines, Hisar (the candidate laboratory); and Novel vaccine against Haemorrhagic Septicaemia in cattle and buffalo by the Indian Veterinary Research Institute, Izatnagar (Uttar Pradesh) with Moredun Research Institute, United Kingdom University of Glasgow, Inocul 8 and GAL V were initiated.

National Agricultural Innovation Project: In order to foster an ecosystem for technology innovation and successful commercialization of technologies, the project is supporting a number of policy and institutional changes and financing investments in 185 sub-projects under the four components. Three sub-projects under the Component-3 are being funded by additional

financing grant from the Global Environment Facility (GEF) Trust Fund of the World Bank.

Under the component of 'ICAR as the catalyzing agent for management of change in the Indian NARS', metadata and abstracts of 7,332 and full texts of 5,759 Ph.D. theses, 2,740 international journals and group catalog "AgriCat" of 12 major libraries are available for online access by researchers and students. Twenty websites of the ICAR institutes were redesigned and recorded increased number of visitors. A total of 150 e-courses were developed for six degree programmes. By subscribing to the general purpose advanced statistical software package, the NAIP has enabled NARS scientists to analyze voluminous research data on their desktops and publish research in high impact international journals. Ten Business Planning and Development Units have commercialized about 30 technologies.

Technology for extraction of Omega-3 fatty acid from linseed and its cake was developed and commercialized through 'Linseed Bio-village' concept. A biochip capable of detecting mastitis causing pathogens and *E.coli* was developed. An artificial neural network model to forewarn first appearance and crop age at peak appearance of yellow stem-borer in rice was standardized.

National Fund for Basic, Strategic and Frontier Application Research in Agriculture: Two new projects of national importance, viz. 'Phenomics of moisture deficit and low temperature stress tolerance in rice' and 'Development of pod borer resistant transgenic pigeonpea and chickpea' were initiated. Salient achievements under the project include identification, cloning and validations of the genes which trigger the defence system of mustard plants to aphids; a positive marker vaccine for FMD virus by incorporating GFP epitope and testing in 12 crossbred female calves; and novel FMD virus Asia 1 (Indian Vaccine strain) replicon based viral vector for R&D in vaccine.

Finance: The plan and non-plan allocations (RE) to DARE/ICAR for 2010-11 were ₹ 2,300 crore and ₹ 2,865 crore respectively. An internal resource of ₹ 113.93 crore (including Interest on Loans and Advances, Income from revolving fund schemes and Interest on Short-term deposits) was generated. The plan and non-plan allocations (BE) for 2011-12 are ₹ 2,800 crore and ₹ 2,157.60 respectively.

In a unique initiative, the Hon'ble Union Minister of Agriculture and Food Processing Industries and President of ICAR Society interacted with a cross section of agricultural scientists on one-to-one basis to discuss the research programmes, that greatly motivated the scientists. The Indian Council of Agricultural Research, apart from developing Vision 2030 documents for all its constituent institutions, also undertook a series of consultations with stakeholders to prioritize the programmes in the XII Plan. The emphasis would be on R&D for enhancing both productivity and profitability of farming in all its dimensions, including climate resilient agriculture and secondary agriculture and also quality human resource development, through greater synergy and partnerships.

I wish to place on record our gratitude to the Hon'ble Union Minister of Agriculture and Food Processing Industries and President of the ICAR Society and Hon'ble Union Ministers of State for Agriculture and Food Processing Industries, for their valuable guidance, support and encouragement in all endeavours of the DARE/ICAR. I wish to convey our thanks to various Ministries and Departments of the Government of India, State Agricultural Universities, National and International Organizations and other stakeholders, for their association in formulation and implementation of different programmes of the ICAR. I am confident that the efforts of the Council would enable farming and empower farmers to achieve higher levels of efficiency and prosperity.

(S Ayyappan)
Secretary
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and
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