Agriculture sector occupies the centre stage of India’s social security and overall economic welfare. Since Independence, India has witnessed significant increase in foodgrain production (green revolution), oilseeds (yellow revolution), milk (white revolution), fish (blue revolution), and fruits and vegetables (golden revolution). All these became possible owing to the application of cutting edge of science coupled with the positive policy support, and hard work of Indian farmers. The Indian Council of Agricultural Research (ICAR), an apex organization for conducting and co-ordinating agricultural research, has been at the forefront to lead these agricultural revolutions in the country, making India not only self-sufficient in food but also with surplus. As a forward looking organization, fully realizing the emerging complex challenges, ICAR has set a vision to attain ‘Rainbow Revolution’ covering the entire spectrum of activities in agriculture which will make India a developed nation free of poverty, hunger, malnutrition, and environmental safety. Towards this goal, it is operating two prestigious and mega projects, viz. National Agricultural Technology Project with emphasis on production system research, organization and management reforms and innovations in technology dissemination and Agricultural Human Resource Development Project with emphasis on improving the quality of agricultural education.

The ICAR began as the Imperial Council of Agricultural Research, an autonomous body (a registered society) in 1929. Presently the Union Minister of Agriculture is the President of the ICAR Society. The Director-General (DG) is the Principal Executive Officer and is also the Secretary to the Department of Agricultural Research and Education (DARE). DARE is the nodal department for all related scientific and development activities and bilateral scientific collaborations with other countries.

The Council has its Headquarters at New Delhi, and a vast network of institutes all over the country, consisting of 45 Institutes, four National Bureau, 30 National Research Centres, ten Project Directorates and...

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All India Coordinated Research Projects. The functions of ICAR are similar to those of University Grants Commission (UGC) in respect of agricultural education. The technical functions of the Headquarters are grouped into eight subject-matter divisions, each headed by an eminent scientist as Deputy Director-General.

Under the aegis of the ICAR there are 28 state agricultural universities, four deemed-to-be-universities and one central agricultural university, 261 Krishi Vigyan Kendras (KVKs: farm clinics) in the rural districts of the country for transfer of technology, and eight trainers training centres. For staff training and addressing research management issues, it has established an institute for human resource development called the National Academy of Agricultural Research Management (NAARM).

ICAR is one of the leading agricultural research and development systems in the world, having 30,000 personnel, with more than 7000 engaged in active research and management.

THE MANDATE

The mandate of ICAR is:

- To plan, undertake, aid, promote and coordinate education, research and its application in agriculture, agroforestry, animal husbandry, fisheries, home science and allied sciences.
- To act as clearing house of research and general information through publications and information system, and instituting and promoting transfer of technology programmes.
- To provide, undertake and promote consultancy services in the fields of education, research, training and dissemination of information.
- To look into problems relating to broader areas of rural development concerning agriculture, including post-harvest technology, by developing cooperative programmes with other organizations such as the Indian Council of Social Sciences Research, Council of Scientific and Industrial Research, Bhabha Atomic Research Centre and universities.
- To do other things considered necessary to attain the objectives of ICAR.

CROP SCIENCE DIVISION

The Crop Science Division has played a key role in ushering in the era of Green and Yellow Revolutions in the country. It is the largest Division of the Council with focus on the development of improved crop cultivars and appropriate crop production-protection technologies, and basic and strategic researches in crop science. The Division has ten institutes, one bureau, five project directorates, seven national research centres and 30 all India coordinated research projects. In addition, a large number of ad-hoc research projects and revolving schemes are also in operation.

ACHIEVEMENTS

- Over 2,300 high-yielding varieties and hybrids of field crops have been developed, released and notified for their commercial cultivation.
First in the world to develop hybrid cultivars of cotton, grain pearl millet, pigeonpea, castor and safflower, and second to develop hybrid cultivars of rice and sorghum. Hybrid cotton is a landmark achievement in hybrid research.

The varieties of foodgrains, particularly that of wheat and rice, have been instrumental in ushering in the area of Green Revolution in mid-60s and sustaining the momentum of productivity enhancement in post-green revolution period.

The improved varieties played a catalytic role in the adoption of other components of improved technology package, such as fertilizers, pesticides, irrigation water and transforming the mindset of farmers from conservative to technology-responsive ones.

Incorporation of resistance to diseases and tolerance to abiotic stresses in high yielding background have enabled insulation of crop plants against these stresses and thus provided stability in food production and food security.

Development of short duration varieties of rice, sorghum, cotton, pigeonpea, chickpea, greengram, blackgram etc. has opened up awareness for multiple cropping systems and helped in enhancing cropping intensity.

Developed / deployed the concept of new plant type in various crop plants particularly wheat, rice, maize, sorghum etc. to upgrade genetic ceiling of yield potential.

Spectacular success has been achieved in introduction and improvement of new crops, such as soybean and sunflower. India is now the fifth largest producer of soybean in the world.

Improved varieties of sugarcane, wheat, rice, maize, sorghum, groundnut, mustard etc. developed in India have been used for commercial cultivation in many other countries.

Developed new breeding methods, mating designs and analyses, and germplasm screening techniques for evaluation of resistance/tolerance to biotic and abiotic stresses.

Developed experimental transgenics in cotton and rice by incorporating genes for insect resistance. Also developed protocols for micropropagation.

The etiology, epidemiology and the management of major diseases/insects pests have been worked out, facilitating the forecasting system and in developing location-specific integrated pest management (IPM) modules for sustainable crop production. Protocols have been developed for mass multiplication and release of biocontrol agents.

Adoption of IMP modules has helped in lowering the quantum of pesticide requirements and promoting non-chemical eco-friendly approaches.

Established the National Gene Bank at the National Bureau of Plant Genetic Resources, New Delhi, one of the World’s leading gene banks, for long-term storage of seed and other planting materials. About 0.20 million accessions have been conserved.

Steady increase in breeder seed production resulting in enhanced supply of quality seeds to the farmers. About 26,000 q. of breeder seed is being produced annually and supplied for production of foundation seed and in turn certified seed.

Seed production technologies for various crops refined, particularly with reference to hybrid seed production.

Developed a unique concept of multi-disciplinary, multi-locational approach in crop improvement in the form of All India Coordinated Research projects which led to synergistic cooperation for the development of widely adapted/location-specific cultivars and production technologies.

Between 1950-51 and 1998-99, the production of foodgrains increased from 50.8 to 202.5 mt, oilseeds from 5.2 to 25.7 mt, cotton from 3.0 to 12.8 mt and sugarcane from 5.2 to 290.7 mt. The productivity of wheat increased four times and that of rice, maize and cotton three times.
Development and adoption of new varieties of oilseeds and complementary technologies doubled oilseeds production in a decade (12.6 mt during 1987-88 to 24.4 mt during 1996-97), generally known as the Yellow Revolution.

Increased food production has transformed the ship to mouth nation of early 1960s into a food secure one with exportable surplus of certain commodities.

India has become the second largest producer of wheat and rice and is also amongst the top exporters of rice.

**Horticulture Division**

The Horticulture Division has nine research institutes, 11 national research centres and 15 coordinated research projects.

**Achievements**

- India has emerged as the second largest producer of fresh fruits and vegetables in the world.
- India is presently the largest exporter of spices and cashew.
- A total of 460 high-yielding varieties and hybrids of horticultural crops have been developed. As a result, productivity of banana and potato has gone up three-times each, and cassava two-times.
- Regular bearing mango hybrid, export quality grapes, multi-disease resistant vegetable hybrids, high value spices and tuber crops of industrial use have been developed.
- Substantial increase in production of banana plantlets through tissue culture, use of drip irrigation, chemical regulation of mango flowering and high-density orcharding in fruit crops have been obtained.
- True potato seed (TPS) technology is standardized.
- Low cost environment-friendly cool chambers for on-farm storage of fruits and vegetables have been developed.

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*Top: Breeding work in mustard is receiving top priority
Bottom: India is the second largest producer of fresh vegetables in the world. Vegetables are an important source of vitamins, minerals, fibre and anti-oxidants in human diet*
NATIONAL BUREAU OF PLANT GENETIC RESOURCES

National Bureau of Plant Genetic Resources (NBPRG) was established in 1976 by ICAR, at Pusa Campus, New Delhi. The institute has been vested with the responsibility to plan, undertake and coordinate activities and services related to plant genetic resources including collection, exchange, quarantine, evaluation, documentation, conservation and utilization of crops plants and horticultural plants, their land races and wild relatives. Besides its Headquarters at the Pusa Campus and Experimental Farm at the Issapur village near Delhi, the institute has 12 regional stations/exploration base centers/quarantine stations/satellite stations located in diverse agro-climatic zones of the country. NBPRG is the nodal organization for developing, operating and coordinating the Indian Plant Genetic Resource System. The system comprises base collections of germplasm of different crops kept under long term storage at NBPRG headquarters and a network of over 30 National Active Germplasm Sites located throughout the country. These sites are responsible for evaluation, multiplication and storage of germplasm. NBPRG has been able to build up 2,02,228 accessions from 183 species in its base collections in the National Gene bank (at -20° C) as of June 2001.

ANIMAL SCIENCES DIVISION

The Division has seven research institutes, one bureau, two project directorates, six national research centres, and 11 coordinated research projects.

ACHIEVEMENTS

- A number of new genotypes in cattle – Karan Swiss, Karan-Fries and Frieswal developed for increased milk production. Murrah, Nili, Ravi and Surti buffaloes improved for milk production.
- Three new high producing strains of sheep for fine wool, carpet wool and mutton evolved; and a strain of Mohair goat developed.
- Two hybrids of fast-growing poultry broilers and four high producing layer strains developed and released.
- Various immuno-biologicals, vaccines, immuno-diagnostics, indigenous drugs and medicines against various infectious and non-infectious diseases of livestock and poultry, developed.
- Monoclonals have been developed for the diagnosis of various diseases and reproductive disorders.
- ELISA-based diagnostic tests for various livestock and poultry diseases developed for precise and rapid diagnosis. Effective disease monitoring and surveillance have resulted in reduced morbidity and mortality.
- Process, techniques and equipment for the manufacture of quality milk and dairy products with reliable quality testing methods developed.
- Methods of preparation of different recipes and preservation of meat and eggs developed, and quality testing protocols for egg, meat and meat products standardized.
- Blending of camel hair and Angora rabbit wool with other fibres and converting those into yarn suitable for making finished goods achieved.
- Nutrient requirements of various categories of livestock for different production functions studied and standards set up.
- Technologies for utilization of cereal straws, agro-byproducts, conventional and non-conventional feeds developed area-wise and region-wise.
- Artificial insemination and embryo transfer technology used for improvement of native germplasm, and production and multiplication of elite germplasm.
FISHERIES DIVISION

This Division has six institutes, one bureau and one research centre. In addition a good number of ad-hoc research projects and revolving fund schemes are also in operation.

ACHIEVEMENTS

- Blue Revolution has been attained by enhancing fish production from 0.75 million mt in 1951 to 5.4 million mt in 1997.
- India has emerged as the second largest producing country in the world in freshwater aquaculture.
- Phenomenal growth of marine products export.
- Indigenous design of fishing craft and gears.
- Developed national standards for fish inspection and quality control.
- Nutritional evaluation of major fish species and fishery products.
- Created national collection centre for characterization and storage of important marine microorganisms.
- Developed value-added fishery products for export market.
- Technology development of Retortable Pouch Process as a substitute for canning fish.
- Commercial production of chitin and chitosan from shrimp head and shell.
- Hatchery technology for shrimp.
- Semi-intensive shrimp farming.
- Fattening of lobsters and crabs.
- Artificial feed for shrimp farming.
- Technology package for broodstock management, production of fingerlings and grow-out systems for major finfish, shellfish and molluscs.
- Culture and utilization of sea weeds.
- Technology package for mass culture of 11 species of micro-algae.
- Production of ornamental fish under hatchery conditions.
- Breeding of seabass under controlled conditions.
- Commercial production of cultured pearls from pearl oysters.

Goats and sheep grazing in a field in Andhra Pradesh

Photo: H.Y. Mohan Ram
- Induced breeding of major carps, catfishes and other finfishes.
- Production of freshwater pearls.
- Development of vaccines and formulation of drugs for fish diseases.
- Genetically improved, rohu, CIFA IR-I.
- Commercialization of fish feeds for inland aquaculture.
- Production of mahseer and snow-trout in hatcheries.
- Conservation of endangered species.
- Cryopreservation of milts of consumable important fish species.
- Enhanced fish productivity of reservoirs.

**Agricultural Engineering Division**

The Division provides engineering inputs for mechanization of conventional and protected agriculture, conservation of produce and by-products from quantitative and qualitative losses, and value addition and agro-processing enterprises for additional income and employment, energy management in agriculture and rural living for increasing production and productivity, and reducing drudgery.

**ACHIEVEMENTS**

- Manual, animal and power-operated seeds drills, and planters, weeders; animal drawn multi-purpose tool frame; zero-till/strip-till-drills, till-planters; puddlers; manual and self-propelled rice transplanters; tall tree, orchard, and high clearance sprayers; self-propelled, walking/riding and tractor/ power tiller mounted vertical conveyor reaper; and multi-crop threshers.
- 126 types of agricultural machines developed, of which more than 60 have been commercialized and 23 released for front-line demonstrations.
- Hand-operated groundnut-cum-castor decorticator, low-cost grains, pulse, oilseed mills; power operated straw baler, vegetable dehydrator; manually and power operated dough mixer; rice puffing machine; crop residue fired and solar drier; cleaners, sifters and graders; low cost improved storage structures for foodgrains, evaporative cooled structures for fruits and vegetables.
- Machinery for soybean processing and solid, granular and liquid jaggery developed.
- Technologies for cotton and jute products developed.
- Process for the preparation of shellac, lac dye and wax from lac factory effluents; insulating varnishes, melfolac, primer and paint compositions, shellac bond powder, aleuritic and jalaric acids, perfumery compounds developed.
- Energy efficient equipment and packages; enhanced system efficiency in use of animate power; tractors and power tillers; low cost biogas plants; pyrolysed briquetted fuels; low cost solar cookers and water heaters, solar tracking device; high efficiency cooking stoves; gasifiers for process heat and mechanical power; charcoal briquetting machine; portable charring kiln developed.
- System improvement and safety in centrifugal pumps; solution to corrosion and incrustation in tube-wells; construction of wells in hard rock areas; surface, sub-surface and vertical drainage.
- Establishment of Agricultural Research Information System (ARIS), a WAN connecting 28 State agricultural universities and their 120 zonal agricultural stations, 49 ICAR institutes, 10 project directorates, 25 NRCs and its headquarters in *Krishi Bhavan*.

**Natural Resources Management Division**

The Division has nine research institutes, one bureau, two project directorates and two national research institutes.

**ACHIEVEMENTS**

- Soil map of the country on 1:7 million scale, state map on 1:250,000 scale and district soil maps on
1:50,000 scale have been prepared. Soil degradation map of the country on 1:4.4 million scale has also been prepared.

- Twenty agro-ecological zones and sixty agro-ecological sub-regions of the country based on physiography, soils, climate, length of growing period and available soil moisture are mapped on 1:4.4 million scale.
- Modification of land configuration on Alfisols, Vertisols and Inceptisols for on-farm rainwater management in rainfed areas.
- An integrated strategy of managing rainfed areas through watershed development projects in several parts of the country.
- Soil and water conservation treatments in mountainous watersheds to runoff and soil loss.
- Off-season tillage to improve moisture conservation and weed control on Alfisols.
- Techniques of sand dune stabilization and shelter belt plantation were developed for arresting the movement of sand dunes in the arid zone.
- Cropping sequences and intercrop combinations developed for irrigated and rainfed areas.
- Water-use efficient irrigation schedules for major crops were evolved resulting in saving of irrigation water.
- Water-use efficient, micro-irrigation methods and technologies for utilization of available water in scarce areas were developed for irrigation, resulting in considerable saving of water and significant increase in crop yields.
- Technology for reclamation of alkali soils has been adopted in 1.0 M ha in Haryana, Punjab and Uttar Pradesh.
- Sub-surface drainage technology developed for waterlogged saline soils in Punjab, Haryana, Rajasthan, Gujarat, Karnataka, and Andhra Pradesh.
- Critical growth stages of various crops and cropping systems with respect to water stress and water requirement have been identified.
- Methodology of artificial groundwater recharge developed for excess groundwater utilization by the use of cavity wells, irrigation-cum-recharge well and by percolation tank in hard rock areas.
- Relay, parallel, multiple and multi-storey cropping systems resulted in improved cropping intensity and productivity.
- Agri-siliculture, agri-silvi-horticulture, agro-horticulture, silvi-pasture systems have been developed and evaluated for different agro-ecological regions.
- Agriculture production strategies developed based on weather forecast.

**Agricultural Education Division**

The Education Division provides administrative support to the Central Agricultural University (CAU) and the National Academy of Agricultural Research Management and development grants to State Agricultural Universities, CAU, and Deemed-to-be Universities in ICAR.

**Achievements**

- Establishment of Accreditation Board for quality assurance to clientele.
- Grants of over Rs.760 millions sanctioned to SAUs, Central University and DUs to strengthen and update infrastructure and faculty improvement during VIII Plan.
- Revision and updating of course curricula of all 11 undergraduate (UG) courses completed and adopted by all SAUs.
- Qualifying National Eligibility Test (NET) made compulsory for recruitment at Assistant Professor/Lecturer level.
- To reduce inbreeding and promote cultural exchange, 300 National Talent Scholarships in UG, 437 Junior Research Fellowships (JRF) and 200 Senior Research Fellowships (SRF) are awarded to meritorious students in every academic session.
- 200 foreign students from Iran, Ethiopia, Nepal, Bhutan, Bangladesh, Eritrea, Mauritius, Uganda and Yemen were admitted in UG and PG courses.
in 1998-99 academic session.

- Organized summer/winter schools in different disciplines to train scientists and faculty members.
- Arranged training programmes under Centres of Advance Studies to train scientists/teachers in current advancement in several areas.
- A workshop was held for writing university level books and 35 titles were finalized.
- National Information System on Agricultural Education (NISAGE) developed.
- Nine National Professors and 25 National Fellows are in position.

**Agricultural Extension Division**

This is the backbone of the ICAR System for technology assessment, refinement and transfer to the farmers.

**Achievements**

- 25,000 farmers and farm women are trained every year in agriculture and allied fields such as crop production, plant protection, livestock production and management, soil and water management, farm machinery and tools, and home science.
- Vocational training is imparted to 46,000 rural youth in poultry, dairying, piggery, beekeeping, fisheries, fruit and vegetable preservation, maintenance and repairing of farm machinery and tools, and hybrid seed production.
- In-service training programme to upgrade the knowledge and skills in transfer of technologies in agriculture and allied areas for 2,200 extension functionaries in KVKs and Trainers’ Training Centres (TTCs).
- Front-line Demonstration (FLD) on oilseed and pulse crops benefitting 11,000 farmers.
- Training of trainers in frontier areas such as dryland agriculture, animal production, horticulture, freshwater, aquaculture, marine fisheries, hill agriculture, agricultural engineering and women in agriculture in TTCs.
- Multi-locational advance varietal trials of 17 selected crops in 60 centres under irrigated and rainfed conditions under separate cropping sequences in a joint collaborative Technology Evaluation and Impact Assessment Project with Crop Science Division.
- Identification, assessment and development of gender-specific technologies at the National Research Centre for Women in Agriculture, Bhubaneshwar (Orissa). Training of farm women in farm implements and tools at the sub-centre of NRCWA at the Central Institute of Agricultural Engineering, Bhopal (Madhya Pradesh).
- Establishment of 40 Agricultural Technology Information Centres in ICAR Institutes and SAUs. These centres will provide a ‘Single Window’ delivery system for technology products, services and information available in the institutions to the farmers.