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सत्यमेव जयते

Department of Agricultural Research
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Indian Council of Agricultural Research
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GOLDEN JUBILEE YEAR OF INDIA'S INDEPENDENCE

Indian Council of Agricultural Research

President	Dr Jagannath Mishra Minister of Agriculture	(from 8.2.1996 to 16.5.1996)
	Shri Suraj Bhan Minister of Agriculture	(from 16.5.1996 to 1.6.1996)
	Shri Chaturanan Mishra Minister of Agriculture	(from 28.6.1996 to date)
Director-General	Dr R S Paroda Secretary Department of Agricultural Research and Education	
Secretary	Shri G S Sahni Joint Secretary Department of Agricultural Research and Education	
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Foreword

Development of agricultural sector cannot be achieved in absence of a strong research backing. As an apex body of the National Agricultural Research System (NARS), the Indian Council of Agricultural Research (ICAR) is entrusted with national agricultural research agenda and it has satisfactorily carried out its mandate of providing guidance and leadership in agricultural research, education and extension. Our agricultural scientists have always risen to the occasion and have provided valuable and viable solutions as per the need of the hour. Only a total commitment and dedication to the cause could have permanently shed the begging-bowl status of our country, for which the agricultural scientists deserve all appreciation.

Following the success of Green Revolution in the rich-resource endowment areas, the Council has directed its research efforts towards amelioration of small and marginal farmers in 70% of the area that could not get benefits of the Green Revolution for obvious reasons. A second Green Revolution is needed for making grey areas green. The existing bottlenecks withholding technological, socio-economic and infrastructural advances in unfavourably placed rainfed areas, especially in eastern India, will have to be removed to clear the way to an evergreen revolution. I am glad to see that there is a visible impact of agricultural research in these areas during the last few years.

As we are marching into the 21st Century, I visualise that in addition to improving food and nutritional security, agriculture would be guided by concerns for environmental protection, sustainability of production and supply as well as profitability of farm enterprises. Following the General Agreement on Tariffs and Trade (GATT), liberalization process and globalization of markets would call for competitiveness and efficiency in agricultual production, and the agriculture sector will have to face a challenging situation on the ecological, climatic, economic, equity, social justice, energy and employment fronts.

The success of modern agriculture in a free and competitive national or international market would be resultant of the complex gamut of inetracting activities such as continuous identification of

problems under changing environment, and development and marketing of appropriate technology, which is consistent with sustainable agriculture and effective technology transfer activity through various ways and means.

Today we are emerging as major exporters of agricultural products, but we have still to exploit our competitive advantages fully. The centre of the global economic activity is shifting towards South and South-East Asia, wherein India has to become a major player in the changing scenario. We must capitalise on the situation to become a substantial gainer in the enviornment of economic liberalisation and free world trade. In this context, I feel that the work culture needs a total transformation. I appreciate the various steps taken by the ICAR like initiating a process of modernisation and renewal, formulation of perspective plans, National Agricultural Technology Project (NATP) to bridge the critical gaps in the research and the technology generation, assessment, refinement and transfer, administrative and financial reforms, introduction of partnership, training, consultancy, contract research/contract service for additional resource generation, invigorating incentive and reward systems, establishment of agricultural research information system, strengthening of the publications and information programmes, agricultural human-resource development and social audit of the various projects and programmes. I hope that these programmes as also the recommendations of various committees will be implemented in true letter and spirit to realise the national goals. The National Agricultural Research Project (NARP) funded by the World Bank, concluded recently, will help in creating infrastructural facilities even in remote tribal areas. I am looking forward now to realise the vast potential of the National Agricultural Technology Project, whose success will be judged mainly by the quick and effective transfer of income-generating technologies from laboratories to land. It must improve the functional literacy skills of the poorest section of the farm population through a massive national effort of tiding over the adverse and challenging constraints. The ensuing Ninth Five-Year Plan envisages to optimise the use of resources through planning, laying priorities and co-ordination to foster sustainable agricultural development for ensuring food and nutrition security of the present and future generations of our vast country. I have no doubt that our scientists have all the skill, knowledge and talent needed to provide food for all.

Chaturanan Mishra

(Chaturanan Mishra)
President, ICAR Society and
Minister for Agriculture

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The Mandate of the Indian Council of Agricultural Research

(*i*) To plan, undertake, aid, promote and co-ordinate education, research and its application in agriculture, agroforestry, animal husbandry, fisheries, home science and allied sciences.

(*ii*) To act as a clearing house of research and general information relating to agriculture, animal husbandry, home science and allied sciences and fisheries through its publications and information system, and instituting and promoting transfer of technology programmes.

(*iii*) To provide, undertake and promote consultancy services in the fields of education, research, training and dissemination of information in agriculture, agroforestry, animal husbandry, fisheries, home science and allied sciences.

(*iv*) To look into the problems relating to broader areas of rural development concerning agriculture, including post-harvest technology, by developing co-operative programmes with other organizations such as the Indian Council of Social Science Research, Council of Scientific and Industrial Research, Bhabha Atomic Research Centre and the universities.

(*v*) To do other things considered necessary to attain the objectives of the Society.

1. Introduction

DARE

The Department of Agricultural Research and Education (DARE) was established in the Ministry of Agriculture in December 1973. The subjects allotted to the DARE as per the Government of India (Allocation of Business) Rules are specified in Appendix 1.

The Indian Council of Agricultural Research (ICAR) is an autonomous body under the Department of Agricultural Research and Education. The Secretary to the Government of India in the DARE functions as the Director-General of the ICAR. The Financial Adviser of the DARE is the Financial Adviser of the ICAR. Generally single-file system is followed between the DARE and the ICAR.

The DARE has 10 Group A, 14 Group B, 15 Group C and five Group D employees. The recruitment to the posts in Groups A, B and C is being made centrally, either through the Department of Personnel and Training or through the Department of Agriculture and Cooperation, depending on the level of the post. The DARE makes direct recruitment only to Group D posts. Such recruitments are being made in accordance with the orders of the Government of India regarding reservations for scheduled castes, scheduled tribes and other backward classes. Presently the DARE has seven scheduled caste employees and one scheduled tribe employee.

A detailed break-up of the posts and names of the important functionaries is given in Appendix 2 and that of financial requirements in Appendix 3.

ICAR

The Indian Council of Agricultural Research is the apex organization at the national level for the promotion of Science and Technology Programmes in the areas of agricultural research and education.

The ICAR was set up on 16 July 1929 as a Registered Society under the Societies Registration Act, 1860, on the recommendations of the Royal Commission on Agriculture (Appendix 1). It was reorganized twice—in 1965 and 1973. The headquarters of the ICAR is located at Krishi Bhavan, New Delhi.

The Minister of Agriculture is the President of the ICAR. Its principal executive officer is the Director-General. He is also the Secretary to the Government of India in the Department of Agricultural Research and Education.

The General Body is the supreme authority of the ICAR. It is headed by the Minister for Agriculture, Government of India. Its members are the Ministers for Agriculture, Animal Husbandry and Fisheries, and senior officers of various state governments, representatives of the Parliament, industry, educational institutes, scientific organizations and farmers (Appendix 1).

The Governing Body (Appendix 2) is the chief executive and decision-making authority of the ICAR. It is headed by the Director-General. It consists of eminent agricultural scientists, educators, legislators and representatives of farmers. Its present strength is 23 members. It is assisted by the Standing Finance Committee (Appendix 3), Accreditation Board (Appendix 4), Regional Committees (Appendix 5), Policy and Planning Committee, several Scientific Panels and a Publications Committee.

The Director-General of the IACR functions as the Principal Adviser to the Government of India in all matters concerning research and

education in agriculture, animal husbandry and fisheries.

In scientific matters, the Director-General is assisted by eight Deputy Directors-General—each in charge of (*i*) Crop Sciences, (*ii*) Horticulture, (*iii*) Soils, Agronomy and Agroforestry, (*iv*) Agricultural Engineering, (*v*) Animal Sciences, (*vi*) Fisheries, (*vii*) Agricultural Education, and (*viii*) Agricultural Extension. The DDGs are responsible for the institutes and projects in their respective fields. The senior officers posted at the headquarters are listed in Appendix 6.

The ICAR receives funds from the Government of India and from the proceeds of the Agricultural Produce Cess.

It is the endeavour of the ICAR to develop technologies and to disseminate knowledge to the farming community not only for increasing yield levels of crops but also for alleviating its economic status. The ICAR has established 9 National Research Centres during the Eighth Five-Year Plan, upgraded the Directorate on Pulses to an Institute, and the All-India Co-ordinated Research Project (AICRP) on Biological Control as well as that on Maize to a Project Directorate, initiated the National Institute of Animal Nutrition and Physiology, National Research Centre on DNA Finger-printing, Network on Animal Genetic Resources, Crop-based Animal Production System and Embryo Transfer. The National Research Centre for Women in Agriculture for developing and testing women-specific technologies attuning to the New Economic Policy was also approved. The Publications and Information Division of the ICAR was upgraded to the level of directorate, the Directorate of Publications and Information on Agriculture.

The research set-up includes 45 Central Institutes (Appendix 7), four National Bureaux (Appendix 8), 10 Project Directorates (Appendix 9), 30 National Research Centres (Appendix 10), and 86 All-India Co-ordinated Research Projects (Appendix 11). Apart from financing research schemes through the United States-India Fund, 13 externally aided projects are in operation (Appendix 12).

The ICAR also sanctions research projects to national professors, national fellows and emeritus scientists, whose existing strength is given in Appendix 13. Research programmes are given the required thrust by holding workshops, seminars, summer institutes etc. The details of the summer institutes or short courses are given in Appendix 14.

For higher education in agriculture and allied fields, the ICAR has four deemed universities, viz. Indian Agricultural Research Institute, Indian Veterinary Research Institute, National Dairy Research Institute and Central Institute of Fisheries Education, which undertake specialized training mainly at the post-graduate level. The National Academy of Agricultural Research Management (NAARM) of the ICAR imparts training to new entrants in the Agricultural Research Service (ARS) and orientation to scientists and administrators.

The ICAR also promotes research, education and extension education through 28 state agricultural universities along with a Central Agricultural University for North-Eastern Hills Region, by providing financial assistance in different forms (Appendix 15).

For effective communication of research findings among the farmers, the ICAR maintains an effective network of 261 Krishi Vigyan Kendras and 8 Trainers' Training Centres (Appendix 16) along with 8 Zonal Co-ordinating Units (Appendix 17).

The total sanctioned as well as existing strength of employees of the ICAR system including that of scheduled castes and scheduled tribes is given in Appendix 18.

The ICAR also has 9 incentive schemes in different categories to award its meritorious scientists (Appendix 19).

Thus with an extensive network of research infrastructure, backed by excellent teams of scientists and other employees, the ICAR is making rapid strides in the field of agricultural research—poised and determined in this Golden Jubilee year of Indian Independence to lead India ahead in the Twenty-first Century.

Overview

In the golden jubilee year of Independence, the country can be proud of achievements in the field of agriculture. Mahatma Gandhi mentioned as far back as 1930 that Indian Agriculture will continue to stagnate unless brains and brawns are married in the countryside. This could be achieved only after Independence when India's first Prime Minister Pt Jawaharlal Nehru said in 1948, "Everything else can wait but not agriculture". He initiated a process of institution building, introduction of science and technology in various facets of production, and promoted practices of improved management. The introduction of improved varieties that respond well to good irrigation and soil fertility management led to the realization of enhanced productivity and production. The foodgrain production increased from about 50 million tonnes in 1950-51 to approximately 190 million tonnes in 1996-97. The yield of wheat and potato increased nearly 9 times since 1951, maize 6 times, and rice, sugarcane, cotton and sorghum 3.5 times. A record in agricultural export was achieved during the year 1996-97 by earning about Rs 77.77 billion worth of foreign exchange in addition to more than $ 1 billion earned through export of fish and sea-foods.

The Second International Crop Science Congress (ICSC-II) was held from 17 to 24 November 1996 at New Delhi. Jointly organized by the ICAR and the National Academy of Agricultural Sciences, the Congress was attended by about 1,500 delegates from more than 70 countries, including the eminent stalwarts such as Nobel Laureate Dr Norman E. Borlaug, Dr M. S. Swaminathan, Dr Edouard Saouma, Dr Ismail Serageldin, Dr G. S. Khush, Dr Maria Jose de O'Zimmermann and Dr W. J. Peacock. The Congress was inaugurated by the Hon'ble President of India, Dr Shankar Dayal Sharma. The inaugural function and other related events were given wide coverage by media. A daily newspaper *Sasya Shyamala* brought out during the Congress and a book *50 Years of Crop Science Research in India* received wide appreciation. The ICSC-II reviewed the current status of the food security, agricultural sustainability and environmental health, and analysed the role of science in ensuring food and nutritional security for the mankind. The various presentations and discussions revealed that the world's natural resources, if managed suitably, should be able to meet the food demand towards the year 2020 A.D. and beyond. Judicious harnessing of new and emerging technologies hold great promise for alleviating hunger from the face of the earth.

One of the important achievements of the year was commissioning of world's largest genebank at NBPGR, New Delhi with the capacity of 1 million samples. It was inaugurated by the Hon'ble Vice-President of India, Shri K R Narayanan.

On the basis of the trends in the consumption level and pattern, the estimated total requirement of foodgrains for India is at 220.5 and 243.2 million tonnes for 2001-2 and 2006-7 A.D. respectively. Its break-up would be 94 and 103.5 million tonnes rice, 75.7 and 84.3 million tonnes wheat, 32.6 and 34.4 million tonnes coarse cereals, and 18.4 and 21.5 million tonnes pulses for the two periods respectively. Future increases in the production of food and non-food agricultural commodities have to be achieved essentially through increase in per unit pro-

ductivity. Therefore our primary focus of agricultural research has to be on technologies that can increase the productivity per unit area based on the concept of integrated resource management at farmer's level.

Evaluation of plant and animal genetic resources and their conservation becomes the main thrust of the research mandate. Collection, characterization, evaluation, documentation and conservation of plant genetic resources is a very important activity for maintaining biodiversity and broadening the genetic base of the improved modern varieties to increase unit productivity. During 1996-97 more than 657 accessions of various agri-horticultural crops were collected from different parts of the country including North-Eastern Hills. Under the programme of the exchange of germplasm, 28,122 samples of different agri-horticultural crops were received from 18 countries, including IRRI and CIMMYT.

National Genebank received 5,121 germplasm accessions of various agrihorticultural crops for long-term conservation. As a support to this activity, the National Research Centre for DNA Finger-printing was established during the year and it has started characterization of a number of crop plants and animals. This facility has been linked to three bureaux of the Council, i.e. NBPGR, NBAGR and NBFGR.

Varietal Improvement

In **rice** eight new varieties ('Nidhi', 'Pusa 677', 'ASD 19', 'ADT 42', 'PMK 2', 'TPS 3', 'Shyamla' and 'Purnima') and two new hybrids ('CORH 1' and 'PHB 71') were released. Under **wheat**-improvement programme, 'Ganga' was released for irrigated late-sown conditions of North-Eastern Plains Zone and 'DDK 1001' for irrigated timely-sown conditions of Peninsular Zone. 'DDK 1001' is the first semi-dwarf variety ever released anywhere in the world. Wheat Workers' Workshop identified three *Triticum aestivum* varieties and one *T. durum* variety for release in favourable environment and five *T. aestivum* varieties for suppressive environment. A catalogue of wheat varieties was released with characterization of 153 varieties so far released by the Central Variety Release Committee.

In **barley** three varieties ('RD 2503', 'RD 2508' and 'BCU 73') were released. Two **maize** hybrids ('KH 5981' and 'KH 5901') were released for cultivation, whereas five hybrids were notified provisionally. They have built-in tolerance to major diseases and pests. In **sorghum** grain hybrid 'CSH 15R' was released for *rabi* season in addition to grain variety 'Sel 3' (for *rabi*), and 'DSV 3' and 'JJ 938' (for *kharif*). The *chapati*-making qualities of 'CSV 15', 'SPV 1025' and 'CSH 9' were found to be superior in taste, whiter in colour and better in puffing. A multicut fodder hybrid 'PCH 106' with 70 tonnes green forage/ha in 3 to 4 cuts was identified for release.

In **pearl millet** two new hybrids ('RHB 58' and 'Pusa 444') were released for general cultivation for all pearl millet-growing areas of the country. Two varieties of **finger millet**, and one each of **little millet**, **foxtail millet** and **kodo millet** were released.

Underutilized Crops Programme developed improved technologies for crops with future promise such as pseudocereals, job's tears, minor pulses and legumes, minor oilseed plants/trees. Over 1,800 accessions of underutilized crops were evaluated. In **ricebean** 'RBL 6' and in **fababean** 'Vikrant' varieties were released.

Among forage crops, three varieties of **sorghum**, one variety each of **fodder cowpea**, **fenugreek**, **lucerne**, **guinea grass**, **ricebean**, **shaftal**, **oat**, **teosinte** and **maize** were released in addition to two each for **gobhi sarson** and **fodder guar**.

In **pulses**, **chickpea** variety 'DCP 92-3' was released with a yield potential of 20-25 q/ha for North-Western Plains Zone. Genotypes for low temperature tolerance were identified. In **pigeonpea** a new hybrid 'RAUPH 9406' recorded 44.3% more yield over the best check 'Pusa 9'. Two varieties each for **mungbean** and **urdbean** were identified for pre-release seed multiplication. A bold-seeded rust-resistant lentil variety 'DPL 62' was identified for release in North-Western Plains Zone.

Among **oilseeds** the protocol for efficient and novel methods of inducing multiple shoots

from somatic embryos rather than one-to-one direct conversion of somatic embryos to seedlings was developed in **groundnut**. High yielding advanced cultures were identified for rainfed areas. Two new **sunflower** varieties ('AKSF 9' and 'PKVSH 27') were released; 44 new accessions of ***toria*** and 16 of **yellow sarson** were collected from Himachal Pradesh and Punjab; and two new varieties of **mustard** were identified for release. Sustained efforts for improvement of quality traits have opened new opportunities to improve the status of oil of rapeseed-mustard.

Four improved varieties of **soybean** ('Ahilya 1', 'Ahilya 2', 'Ahilya 3' and 'PK 1042') were released.

A number of varietal trials were conducted in **niger** for improving yield in tribal areas. In **safflower**, variety 'AKSF 68' with 5-7 days earliness in maturity gave better yield among spiny varieties. The newly developed non-spiny male-sterile line showed high combining performance.

In **cotton** 23 high-yielding hybrids/varieties were released for cultivation in different zones. Complete plants were obtained from the multiple shoots by repeated subculturing and incorporation of changes in the media. The protocol for *Agrobacterium*-mediated transformation utilizing **Bt** gene into cotton explants is being standardized.

Four new strains of **sugarcane** were found promising in different zones. The variety 'Co 86032' was found suitable for Tamil Nadu and Karnataka states. Four new FCV varieties of **tobacco** were identified for release in Andhra Pradesh and Karnataka. One *Corchorus olitorius* variety and two new *C. capsularis* varieties were released.

Seed Production and Seed Technology

A total of 2,624.6 tonnes of breeder seed was produced during the year, covering different crop varieties. The overall availability of quality/certified seed for the farmers, after eventual follow-up of seed- production chain in the country, now stands at about 0.7 million tonnes. Planting ratios for the optimization of hybrid seed production were standardized in pearl millet and sunflower hybrids.

Biological Control

Compoletis chlorideae and *Diadegma argenteopilosa* were reared successfully in the laboratory host, *Corcyra cephalonica*. An artificial diet with cabbage leaf powder as phagostimulant proved good for rearing *Spodoptera litura*. Some fungal antagonists were isolated from sunflower and rice ecosystems. Seventy-six shipments of parasitoids and 12 shipments of host cultures were sent to co-ordinating centres and other research organizations for field trials and experimentation. Agronomic practices were perfected to use bio-control measures for checking pests in sugarcane, cotton, pigeonpea, chickpea, fruit crops, vegetable crops and for controlling weeds.

Honeybee Research

Research on honybee has shown that there was resource partitioning in different *Apis* species. Flora with longer corolla tubes are availed by *Apis mellifera* in comparison with small-flowered plants liked by *Apis indica*. Apple orchards need eight colonies per hectare for pollination to achieve average fruit set of 48%, whereas in Kiwi-fruit the fruit-set was increased to 67-97% by placing bee colonies for pollination. Intensive bee pollination has also shown to increase seed-set in hybrid sunflower.

Pest Control and Pesticide Residues

No detectable residues of chlorpyriphos were present in tobacco leaves, indicating that it can be safely recommended for control of pests on tobacco. Repeated and excessive spraying of insecticides should be avoided in grapes and no spray is to be given 1 month before harvest of mango fruits. Most of the 2,500 samples of fruits and vegetables analysed had pesticides within the permissible limits. Sorghum as screen around maize fields was found effective in reducing parakeet damage to ripening maize in Punjab. Seven entomogenous nematode species belonging to two genera, *Heterorhabditis* and *Steinernema*, were found to be effective against other soil insect pests like cutworms and wireworms, giving up to 80% mortality. Two deep ploughings after harvest of summer fodder

crop in August exposed the whitegrubs to predatory birds and reduced the grub population by 70%.

Horticulture

In mango several hybrids were developed with export potential, regular bearing and late harvesting. In banana two improved cultivars ('Karpuravalli' and 'Monthan') were selected for low input conditions. A hybrid banana 'H 9' developed at Kanara was found highly promising. In grape 'Flame Seedling', an introduction from California, was identified for 10-day late ripening and better fruit quality than 'Perlette' for cultivation in Punjab. Thirteen hybrids were selected for their fruit quality, table purpose, juice and wine-making. Rough lemon 'Australia' was found highly tolerant to salt. A high-yielding, disease-tolerant acid lime selection, 'Sai Sharbati', was supplied to the growers. In orchards drip irrigation was found superior to sprinkler irrigation. Fungicides have shown complete inhibitory effect on apple scab. A high-yielding selection of guava, 'CISH-G 1', has deep red fruits with attractive shape for export. An early-bearing ber, 'CHES 1', was identified for release. In *Annona* an improved hybrid 'Arka Sahan' was developed. 'H 7' is a promising hybrid of pineapple. In papaya a hybrid 'CP 81' was identified for high yield and quality. 'PKM 3' sapota was released.

Modified atmosphere packaging (MAP) technology was found to increase the keeping quality up to 1 month in mango, banana and citrus fruits. On-farm storage technology for fruits and vegetables using evaporative cold chambers was standardized at different agroclimatic locations. Technology for low-cost preservation and processing of fruits and vegetables was developed. Several innovative products were also developed and standardized.

In vegetable crops one hybrid and five varieties of brinjal were identified for release. In tomato one hybrid and three varieties were identified. 'Pusa Hybrid 1' was identified in pumpkin. Two varieties of chilli, and one each of bittergourd and okra were also identified for release.

In potato a new technique for germplasm distribution has been evolved by nutrient incapsulating *in-vitro* nodal cuttings in sodium alginate to avoid spoilage during transit. The encapsulated propagule can be regenerated on incubation under light. Fourteen potato hybrids were developed possessing different characteristics. Several potato-based cropping systems were identified, giving income of Rs 30,000 to Rs 47,000 per hectare. Eco-friendly biocontrol schedules could save potato crops from diseases and pests.

Five improved varieties of cassava were identified for short duration and higher tuber yields. A motor-driven chipping machine has been fabricated as an improvement over the pedal-operated chipping machine. Three high-yielding hybrids have been identified in yams. In *taro* seven hybrids recorded fairly good yield.

A new edible fungus *Neopaxillus echinospermum* growing on the upper hills of Assam was recorded for the first time in India. Two high-yielding strains of *Agaricus bitorquis*, 'NCB 6' and 'NCB 13', showed superiority in fruit-body quality and size of mushroom. Coir pith has proved as a promising viable casing medium for button mushroom cultivation. Thirty species of oyster mushroom have been tried for year-round cultivation. A large number of agro/agro-industrial wastes were tested as a substrate for oyster mushroom cultivation.

Floriculture

Three promising rose hybrids have been identified for release. Four hybrids of gladiolus were found promising. A new variety of chrysanthemum ('White Charm') was released at Lucknow. In China variety of aster, 'Kamini' and 'Purnima', proved promising at Bangalore. Four varieties of gerbera, viz. 'Tropical Panama', 'Pendora', 'Carona' and 'Ludukimari', were found promising for commercial cultivation.

Plantation Crops

'Philippines Ordinary' was found superior and was recommended for commercial cultivation in the West Coast, including Konkan region, and East Coast (Andhra Pradesh and West Bengal). Cultivating coconut with organic manures gave higher nut yield. A nitrogen-fixing

bacterium, *Beijerinckia indica*, was grown in coir pith in combination with farmyard manure and soil to produce a biofertilizer for coconut. ELISA test was developed to detect root-wilt in coconut. In oilpalms plantlet development from leaf calli was achieved through both somatic embryogenesis and direct organogenesis. Tenera hybrids recorded highest yield in farmers' fields in Andhra Pradesh. Twenty four new cultivars of cashew were clonally multiplied and added to the National Genebank. A hybrid cashew has been identified for higher yield. Two high-yielding varieties of arecanut, 'Cal 17' and 'SAS 9', were released for Andaman islands and hilly area of Sirsi respectively.

New high-yielding varieties of spices belonging to ginger ('IISR Varada'), turmeric ('IISR Prabha' and 'IISR Pratibha') and cinnamon ('IISR Navashree') were released by the IISR, Calicut. Micropropagation protocol clones of cinnamon, camphor and several herbal spices were developed.

Protoplast isolation and regeneration of callus was achieved in *Piper colubrinum*. Nine cardamom collections with high volatile oil were identified. Three high-yielding cultivars were identified in black pepper. A new coriander variety 'RCr 20' was recommended for south-eastern Rajasthan.

Soils

The soil-resource maps of 8 states were digitalized and thematic maps on important soil parameters such as soil depth, texture, pH, erosion and drainage were prepared. Mulching through intercropping of sunnhemp as a green-manure crop in maize proved highly efficient in reducing run-off and soil loss on slopy lands and in improving crop yields. Optimal farm plans with improved technologies were developed for small and medium farm groups in outer Himalayas to maximize farm income and minimize soil loss. Vegetative barriers were assessed for soil and water conservation on slopy lands.

A technology of integrated plant-nutrient supply and management system for sustainable productivity of soybean-wheat cropping system covering 4 million ha area of the black soils of the country, was developed. Sulphur status of Indian soils showed deficiency from 11 to 64% in different soils. Red and laterite soils of Chhotanagpur in Bihar showed 58% deficiency. Widespread deficiency of zinc has also been indicated. Integrating organic manure (FYM) with recommended NPK fertilizer doses sustained higher level of productivity while maintaining soil fertility in most of the cropping systems. Phospho compost was produced using different organic wastes, supplemented with small amount of cattle dung, soil, manure, compost and slurry of Mussoorie rock phosphate.

The system of broad furrow and ridge was developed for shallow Vertisols to conserve moisture. It helped in excellent growth of pigeonpea in rainfed areas.

Highly promising cropping systems were developed and recommended for different ecosystems. Sunflower is gaining ground in Indo-Gangetic plains of Haryana, Punjab and parts of western Uttar Pradesh. At Ranchi, agroclimatic conditions revealed that it is not useful to sow rice beyond second fortnight of July, as the late-sown crop will experience a moisture-stress during reproductive stage and was prone to higher disease intensity. In Brahmaputra *diara*, intercropping rajmah in sweet potato increased the yield by 38.5% over sole crop of sweet potato and 36.6% over sole crop of rajmah, whereas in Ganga *diara* three hand-weedings and hoeing behaved alike in wheat; the chemical methods were superior. In soybean highest grain yield was recorded with the use of herbicides. Neem-cake + *Trichoderma viride* could inhibit the germination and seedling vigour of *Phalaris*. Marigold grown in association with *Parthenium* reduced the latter's height and root length.

Water Management

Artificial recharge of ground water is one of the promising options to augment the depleting groundwater in over-exploited regions. At Ludhiana it was possible to recharge aquifer by 1,144 m of run-off water in one season through one cavity well. A collaborative ICAR-MNES Network Project on performance, evaluation and optimal utilization of water of solar photovoltaic pumping system is under operation at 10 centres.

The Project Directorate (Water Management) has been shifted from Rahuri to Patna.

For the efficient use of sodic or alkaline waters, passing water through gypsum-beds is essential. Yield improvement of 3 to 16 times was observed in pearl millet with gypsum application. Gypsum beds improved yields of paddy and sorghum by 20 to 30%. The technique of abstraction of freshwater floating over the saline ground waters in the coastal sandy soils was successfully adopted by farmers.

Rice variety 'CSR 13', with long slender grain and better cooking quality, has been recommended for salt-affected soils throughout the country. Considerable saving of irrigation water as well as increase in economic returns were obtained by introducing water-efficient crops such as oilseeds, pulses and vegetables in traditional cropping systems.

Farm Implements and Machinery

To sustain productivity in rice-wheat systems a strip-till-drill was developed at the PAU, Ludhiana, and no-till-drill at the GBPUAT, Pantnagar. Both the drills are operated by 35 hp tractor and can sow wheat directly in fields where paddy has been grown earlier. The Punjab government is subsidizing this drill. A six-row manually operated paddy transplanter is being manufactured and is getting popular. CRIDA has developed an animal-drawn drill plough with various attachments, costing around Rs 1,000. The Government of Andhra Pradesh is subsidizing the cost by 50%. A high-capacity multicrop thresher developed at the CIAE, Bhopal, is able to thresh soybean, sunflower, Bengal gram and wheat. A six-row manual mat-type paddy transplanter and self-propelled reaper have also been developed at the CIAE. The institute supplied 1,200 prototypes of improved implements to farmers, private parties and government institutions. The IISR, Lucknow, has developed a sugarcane sett-cutter planter.

A high-capacity groundnut decorticator has been developed and tested at Bhopal. At Udaipur a hand- and power-operated garlic bulb-breaker was developed, tested and released for manufacture. A mini *dal*-mill suitable for pigeonpea and greengram was developed at the PKV, Akola, and released for manufacturing. Soy-whey has been used as fermentation medium and a *poha* recipe with 8.75% protein has been developed using puffed rice. A pilot plant was fabricated at the PKV, Akola, to process kaghzi lime waste for production of citric acid granules. A laboratory-scale rice polisher was developed at the IARI, New Delhi. Several designs of low-cost greenhouses have been tested. Energy use patterns for major crop rotations, fruits, dairy and poultry products have been studied for saving energy. Low-cost diesel engine safety device and energy-efficient reflex valve have been developed at the PAU, Ludhiana.

A solar-energy based onion-flake dehydration plant of 100 kg per batch capacity was developed in SPRERI, Vallabh Vidyanagar, Gujarat, and was used for 'Nasik' variety. SPRERI has also developed a 20 kW capacity rice husk-based gasifier system for power generation. Air-dried mango leaves, chopped rice straw and soybean straw were successfully utilized as slurry absorbent for composting.

A procedure has been developed to estimate run-off from daily rainfall data. A network of subsurface clay tile drainage system was developed for tea plantations in north-eastern India. It eliminated the problem of maintenance and increased the tea yield by 30%. A package of practice for Kusumi broodlac as well as sticklac production on *kusum* host has been developed, providing multifold increase in profitability compared with traditional practices. A continuous lac scraping machine has been developed at the CIPHET, Ludhiana.

The CIRCOT, Mumbai, conducted trials on pure Indian cotton varieties for the production of combed yarns. A shell fish by-product, chitosan, was used for pretreatment of cotton to make it receptive to lac dye.

Animal Sciences

The project to evolve a national milch breed, 'Frieswal', capable of producing 4,000 kg milk in a mature lactation of 305 days, is yielding good dividend. So far 119,010 doses from 35 bulls (Frieswal 32 and Sahiwal 3) were frozen and 67,755 doses distributed to various military farms for breeding this genotype. Under the

Indigenous Breeds Project, the Germplasm Unit distributed 2,050 doses of Ongole bull semen to various herds. In buffaloes, 34,983 doses of semen were frozen from elite young bulls. Different breeds of sheep are being improved through selection and *inter-se* mating for wool and mutton production.

Emphasis is being given for improvement of goat through farmers' participation. Superior bucks were provided in adopted villages for breed-improvement programme. The farmers' participation in the adopted villages has been highly satisfacatory. To improve production under Indian condition, seven genotypes were generated through AICRP on Pigs, which are under test. On the basis of a wide survey of population in North-Eastern Hill states, mithun was classified into two breeds, namely 'Arunachalees' and 'Nagamees'. In poultry, many pure indigenous stocks excelled their crosses in respect to fertility and hatchability.

A data bank on animal genetic resources was developed on livestock breeds recording their stock management practices, physical characteristics, performance traits and breeding farms. Observations on socio-economic status of yak farmers, their husbandry practices, types of yak etc. were recorded under a pilot survey on yak of Arunachal Pradesh. Molecular genetic and immuno-genetic characterization of farm animals was also undertaken. The blood group system of mithun closely resembled that of cattle. A major network project for strengthening the NBAGR has become operational during the current year.

It has been decided to locate animal component of National Research Centre on DNA finger-printing at the National Bureau of Animal Genetic Resources (NBAGR). The component on *ex-situ* conservation of breeds of livestock has been strengthened in the Bureau in association with species institutes.

A large-scale national survey conducted among cattle and buffaloes in 22 states indicated prevalence of brucellosis in 1.7 and 2.3% animals respectively. A general-purpose computer-based disease-forecasting system was developed. The viral agent responsible for a new emerging viral disease, infectious body hepatitis (IBM), commonly known as 'Leechi disease', occurring in broiler farms in Uttar Pradesh, Andhra Pradesh and Haryana was isolated and successfully grown in cell culture. Brucellosis ELISA kit is now available for testing more than 0.15 million animals and will be released through the national network. This indigenously developed ELISA kit has a good commercial potential. A vaccine against *Babesia bigemina* was produced by MASP culture technique. Cost effective techniques were developed for the treatment of ailments of musculo-skeletal system, nerves and bone fractures. A major success was achieved in tendon reconstruction. Different grafts and implants were successfully used; however, carbon fibres proved superior to all.

The high-security animal-disease laboratory (P-5 facility) at Bhopal is nearing completion at a cost of Rs 300 million.

A National Institute on Animal Nutrition has been established at Bangalore with the major mandate to initiate basic research in biotechnological approach : (i) to release energy from crop residues (plant cell-wall) by microbial intervention to break lignocelluloses into carbohydrates; and (ii) to separate incriminating factors from oilcakes, oilmeals and tree leaves in order to make available bound protein for livestock feed.

A balanced concentrate ration was formulated using mustard-cake, rice *churi*, rice grit and pulse *churi*, which are by-products of main crops. To spare cereal grains for human consumption, low-grain and grainless diets were developed for livestock consumption. In poultry, neem kernel-meal, a protein-rich by-product of neem oil extraction industry, was successfully utilized in the diet of layer hens without any adverse effect.

A new large dairy plant run on commercial lines jointly by NDDB and NDRI was commissioned during the year in order to provide hands on training to dairy managers and technologists for upgrading their working skill in management of new technologies.

Microwave technology was successfully used for manufacture of ghee from high-fat cream/ butter. Microwave treatment causes the least damage to water-soluble vitamins in milk.

The NRC on Equines has developed a field-

oriented immunostick ELISA kit for the detection of EHV-1 and EHV-4 antibodies for better management of latent infection in thoroughbred horses.

The NRC on Camel has generated scientific data on Indian camels, especially genetic resources, calf mortality, camel genetics and breeding, draughtability, nutrition, reproduction, physiology, milk and hair, and behaviour.

The NRC on Yak has been undertaking genetic resource survey programme for yaks. In the NRC on Mithun, necessary infrastructure is being developed for undertaking basic and applied research on mithun.

Fisheries

Artificial insemination of tiger prawn has been achieved and thus the country is many steps ahead in solving the problem of spawning of unfertilized eggs due to non-mating and non-deposition of spermatophores.

A comprehensive survey of impact assessment due to shrimp farming has been launched in Nellore district in Andhra Pradesh and several positive socio-economic indicators were noticed, e.g. higher level of employment for the village people, increase in income and increase in the consumption-pattern index. As a result of the Supreme Court judgment, this project has been strengthened.

Pen culture of giant freshwater prawn was undertaken successfully in tidal wetland, i.e. *bheri*. This method has become very popular among the local *bheri* owners and has the potential of mass-scale adoption in the coastal West Bengal. A viable hatchery technology of the giant freshwater prawn was developed and standardized. A biological treatment complex for treatment and utilization of domestic sewage comprising duckweed and fish culture system was established. A feed comprising groundnut cake, roasted soybean meal, rice bran, fish meal, vitamin-mineral premix and an attractant was formulated for grow-out carp culture. Feeds for shrimps were also developed using indigenously available raw materials.

The Central Institute of Fisheries Education was strengthened to modernize the infrastructure of research, teaching and training. For extension of new technologies, various training programmes and technology-transfer programmes were conducted for fishermen, farmers and entrepreneurs. Consultancy services are also being provided to various commercial companies and organizations in addition to private entrepreneurs. By the end of the IX plan, it is planned that CIFE will be largest University on Fisheries.

To exploit coldwater fishery resources, technologies for intensive production of fry of Himalayan mahseer have been standardized and the rearing of fry and fingerlings of snow-trout on artificial feed is being done under cemented pond environment.

To strengthen the databank on fish germplasm resources of India, a compendium entitled *Fish Biodiversity of India* has been finalized. Work on genetic improvement of carps through gene manipulation is also progressing well.

In an attempt to improve harvesting technology, resource-specific gears for squid, quality fishes and prawns were identified for in-shore and offshore waters. A collagen-chitin membrane prepared was found to perform satisfactorily as 'artificial skin' for covering burns and wounds.

Agricultural Statistics and Economics

The National Research Centre for Agricultural Economics and Policy Research was further strengthened for evolving policy guidelines to job-led growth of Indian agriculture through pro-poor, pro-women and pro-environment technologies.

A study of 16 districts in nine states of the country revealed that the main constraints in adoption of new crop technologies were inadequate water, lack of funds and ignorance of plant-protection methods. Keeping goats, sheep and rabbits provide additional source of income. The benefits of co-operative agricultural credit are not reaching the small and marginal farmers. Preharvest forecasting of inland fish can be made 3 months before harvest. Studies made on public expenditure by centre as well as states on research and education concluded that larger share of national resources are needed for Bihar,

Madhya Pradesh, Orissa, Uttar Pradesh and West Bengal. Another study on policy analysis for sustainable resource use in rice-wheat cropping system showed that the conflict between social objective of maximizing water-use efficiency and the farmers' objective of maximizing stable income can be resolved through a systems approach. Analysis of diversification of agriculture in Punjab suggested that gradual shift to the extent of 15% of the area under foodgrains by the year 2000 A.D. and 28% by the year 2020 A.D. would not jeopardise the country's food security as long as the rest of the states continue to grow their output at the rate experienced during the last decade.

Agricultural Education

An all-India competitive examination for admission to the under-graduate and post-graduate level was conducted to reduce in-breeding and promote national integration. First All-India Entrance Examination for committing 15% seats of the under-graduate (UG) course in SAU was conducted, in which 1,300 candidates qualified. Similarly, for the post-graduate (PG) courses, 800 students were selected for admission in 25% seats in SAUs.

The Second All-India Examination for admission in UG courses has been announced. The examination is scheduled on 25 May 1997.

Computerisation and networking has been taken up in a big way, so that the students and scientists could be able to have access to latest information. The West Bengal University of Animal and Fishery Sciences has been accorded recognition. Laboratory facilities were strengthened in 14 states. Many sophisticated equipment have been funded by the ICAR to facilitate better research quality. Full 100% grants were given to SAUs for construction of girls' hostels. Fourteen SAUs were helped in establishing Computer Centres for use by students and faculty members. Modernization and computerization of P.G. school libraries and renovation of hostels and libraries were supported in all four deemed universities, namely IARI, IVRI, NDRI and CIFE. The government of Sikkim has agreed to transfer land near Majithar and Rangpoh for the College of Engineering and Post-Harvest Technology, to be established as a part of central agricultural universities system. Support was also provided to 35 Centres of Advanced Studies in the different SAUs. A total of 850 scientists were trained and provided latest information in their areas of specialization. Training programmes on hybrid technology for rice, millets, pulses, oilseeds, cotton and forage crops were conducted.

The National Dairy Research Institute, Karnal, a deemed university, offers academic programmes both at under-graduate (B. Tech. in Dairy Technology) and post-graduate (Masters and Ph.D. programmes in Dairying) levels in the field of Dairy Science and Technology.

The Agricultural Human Resource Development Project launched with the assistance of the World Bank is being implemented in three states, viz. Andhra Pradesh, Haryana and Tamil Nadu, and their respective state agricultural universities (APAU, Hyderabad; CCS HAU, Hisar; TNAU, Coimbatore, and TNVASU, Chennai).

Accreditation Board was constituted by the Council in place of Norms and Accreditation Committee, to advise the Council (*i*) in evaluating standards for accreditation of colleges and institutions, and (*ii*) in evaluating academic programmes and periodically assessing the course curriculum to maintain standard of agricultural education in the country.

The agreement for overseas training has been signed with FAO and about 80 faculty members/scientists would be sent abroad for training in different areas during this financial year.

The Third Deans' Committee Report has been submitted and the recommendations have been sent to all the Vice-Chancellors. Apart from increasing the practical training to 50% of the course work, a Rural Agricultural Work Experience (RAWE) has been proposed for a period of 6 months as an integral part of the graduate degree. This is in operation in a few universities but will be implemented in all the SAUs in IX Five-Year Plan. The Council will bear 50% of the fund requirement of this activity. An attempt has been made to have a uniform course curriculum to facilitate movement of teachers and students among SAUs. This will

improve academic standards and reduce inbreeding.

The Best Teacher Award has been instituted by the Council with the objectives to provide incentive and encouragement for good teaching, to recognise outstanding teacher and also to promote the art of teaching, leading to academic excellence and improvement of Department/ Faculty/Institution and other seats of higher learning and teaching. All the teachers/scientists/extension specialists working under universities shall be eligible to apply. The Council has awarded Best Teacher Award to the teachers in IARI, New Delhi, TNVASU, Chennai, and OUAT, Bhubaneshwar, this year.

Nutritional evaluation of various unconventional/lesser-known foods revealed that all the foods were good source of dietary fibres. To cater to the needs of infants and pre-school children of subsistence farm families, a system of Community Child Care Centre was introduced on the basis of community participation. Blends of red palm oil and sunflower oil were separately used to prepare 40 different food items. These can be used as a good supplement of vitamin A under rural community nutrition programme.

Transfer of Technology

At present there are 261 Krishi Vigyan Kendras and 8 Trainers' Training Centres. The Pilot Project on Technology Assessment and refinement through Institution-Village-Linkage Programme (IVLP) has been implemented at 34 centres. In this project the methodology of agro-ecosystem analysis using PRA tools has been used instead of conventional questionnaire scheduled survey approach. About 22,000 farm families were selected under the IVLP. More than 10,000 training courses were organized for the benefit of about 0.25 million farmers to impart improved technologies. The impact studies revealed 23 to 100% adoption of different skills/ technologies among the trained people. About 47,000 rural youths were trained in more than 2,000 long-term vocational courses. In addition, 1,000 training courses were conducted for more than 21,000 grass-root level extension and develoment personnel from government and non-government organizations. Potential of improved technologies was demonstrated in about 3,400 ha, involving 7,000 farmers and field-days, farmers' fairs, Kisan goshthies, farm women fairs, agricultural exhibitions, clinical camps, video and film shows, and radio as well as TV programmes were organized throughout the year.

National Research Centre for Women in Agriculture (NRCWA) started functioning at Bhubaneshwar from April 1996.

Research for Tribal and Hill Regions

The ICAR Research Complex in North-Eastern Hills Region has developed promising cropping systems to raise the income of the people of this region. Intercropping of maize with groundnut was found most remunerative. Several varieties of paddy were identified to be promising for natural farming under wetland conditions. Application of FYM and zinc sulphate was recommended to increase the production of groundnut. Neem formulations sprayed at silking stage and 15 days after silking resulted in 85% decrease in larval populations of cob-borer of maize. Timely baiting with zinc phosphide resulted in reducing rodent damage, which is very high in rice-growing areas of Meghalaya. Various agroforestry systems, paddy-cum- sericulture and paddy-cum-fish culture were developed for valley lands. Pineapple in paired rows with guava and turmeric resulted in more income. Piggery, poultry and rabbit farming were recommended for mixed farming.

Various intercropping systems were developed for growing fruits and vegetables in Andaman and Nicobar islands. Poly-culture of air-breathing fishes and mullet culture practices were improved by developing and popularizing new technologies. The problem of infertility in crossbred cows is being tackled. A disease-resistant bird has been identified to check the outbreak of IBD in layer chicks. Forty bacterial isolates from mangroves are being analysed to find bioactive compounds. For northern hills an awnless high-yielding variety of wheat 'VL Gehun 738' was identified in addition to garden pea 'VL 6'. Mulching with pine-needles was found to be

as effective as one irrigation for vegetable pea in Uttar Pradesh hills.

International Co-operation

A new era of international co-operation in emerging new technologies and frontier areas was opened up with signing of agreements and memoranda of understanding with many countries. These include the USA, Russia, Australia, Japan, Tunisia, Israel, Trinidad and Tobago, Uzbekistan, Nepal and Mongolia. The collaborative research with CGIAR system was further strengthened with signing of MoUs with the International Centre for Living Aquatic Resource Management (ICLARM), International Plant Genetic Resources Institute (IPGRI), International Livestock Research Institute (ILRI), International Irrigation Management Institute (IIMI) and International Centre for Genetic Engineering (ICGE). A work plan was signed for cooperation among SAARC countries. India contributed towards development funds of CGIAR, CABI, APAARI, NACA, CGPRT, ISTA and CHF. These incentives will help in the real globalisation of agricultural research and development. A demonstration farm is being established at New Delhi with the help of Israeli experts.

Publications and Information

In view of the great importance of communication of research findings among scientists and farmers, the Publications and Information Division was upgraded to the level of directorate. The Directorate of Publications and Information on Agriculture started functioning with modern computerized facilities, from August 1996.

During this period, besides 9 regular periodicals, 21 titles in English and 10 in Hindi were published. At the time of ICSC-II, a series of new publications were brought out. The main ones in English are : (*i*) *50 Years of Crop Science Research in India;* (*ii*) special issue of *Indian Farming*, depicting the achievements of research in crop science; and (*iii*) a new vision of ICAR, entitled *ICAR : Now and Ahead ...* , giving the history, growth and development of Indian Agriculture through ICAR and what we propose to do in future. Similarly, in Hindi we published *Badalte Parivesh me Krishi Anusandhan evam Vikas ke Naye Aayam, Sabji Vigyan* and *Phal Vriksh Pravardhan.* Special issues of popular periodicals were brought out on other occasions too, like World Food Day, XX International Congress on Poultry Science, when a special issue of *Indian Farming* was brought out depicting the achievements of Indian poultry science. The ICAR participated in 12 exhibitions during the year. The Directorate is now functionally autonomous and has added new dimension to agricultural communication. It has added a media unit, strengthened ARIC as a national informatics bureau and abstracting centre for FAO, UNDP and SAARC. The editorial units have been strenthened and computerized.

Perspective Plan, Administrative Reforms and New Initiatives

Eighty-four perspective plan documents were finalized for the respective research institutes and centres of ICAR, giving details of research priorities according to the population growth and food demand of 2020 A.D. Forty-six documents have been approved for printing. The objectives, roles, activities and accountabilities of each of the constituents of the National Agricultural Research System (NARS) have been set to put them in motion with an accelerated velocity. This will take care of agricultural challenges of the first quarter of next century.

The draft proposal of National Agricultural Technology Project (NATP) is under active consideration of the World Bank. It will bring about Rs 8 billion worth of grant to finance the technology refinement and intervention programmes for minimizing regional imbalances.

A committee was constituted under the chairmanship of Dr H. K. Jain to review the All-India Co-ordinated Research Projects; it has submitted a draft report to revamp the whole system of AICRPs.

Social Audit of Research and Development Programmes

To assess the impact of developments in agricultural research and technologies on socio-economic conditions of farmers of the country, especially small and marginal farmers, and to remove the impediments on extending the investment made in agricultural sectors to the

intended beneficiaries, the Council has decided to conduct social audit of technologies developed and adopted by farmers in various parts of the country. The social audit is being undertaken in 11 research and development programmes

Agricultural Research Information System

This project aims to bring the information management culture to every agricultural scientist, so that the person can carry out research more effectively, using modern tools. Every campus including SAUs and their ZRSs as well as ICAR institutes have been provided with a LAN server and a number of PC workstations with associated software packages. All KVKs and AICRPs have been included in the list of sites to be connected with WAN for e-mail and other services. Training on day-to-day use of computers has been imparted to a large number of officers/staff from ICAR headquarters, ICAR Institutes and SAUs. LANs have been created at the ICAR headquarters (Krishi Bhavan and Krishi Anusandhan Bhavan). The IARI has access to World Wide Web, and e-mail connectivity has been established at 69 ICAR institutes.

Diversification, value addition and concerns for sustainable agriculture, environmental protection and globalization of agriculture would require necessary adjustments in our research prioritization and planning. Time is ripe to move fast to re-orient our efforts to meet future challenges successfully. This eventually would ensure a bright future for our younger generation. This is by no means a small task, and we must move, and rather move fast. The key to the future success would largely depend on the 'Renewal of our National Agricultural Research System (NARS) — a goal towards which we all must aim as 'partners' in order to effect the much-needed change; obviously a change for the better.

(R S Paroda)