

CHAPTER 11

SCIENCE AND TECHNOLOGY

Science and Technology continues to play an important role in the economic and social development of the country. Sustained efforts have been made to implement the well defined, time bound programmes in various disciplines of science and technology such as atomic energy, space sciences, biotechnology, ocean sciences, industrial research etc. and to use them as important inputs in the developmental processes. Research and development activities are being undertaken by optimally utilising the existing resources and infrastructure, both in the basic and applied fields to promote science and technology and to achieve self reliance in the fields of technology development and utilisation for solving the problems relating to fulfillment of essential needs of the common man. Some of the major achievements of the Science and Technology (S&T) Departments/Agencies during 1999-2000 and the programmes proposed for the year 2000-01 are briefly outlined below:

DEPARTMENT OF SPACE

Major Achievements In 1999-2000

2. The INSAT-3B, carrying 12 extended C-band transponders, 3 Ku-band transponders and S-band mobile satellite services payload and the first in the third generation INSAT satellites (INSAT-3 series), was successfully launched in March, 2000 to provide business communication, developmental and mobile communication. PSLV-C2 was successfully launched in May, 1999 from Sriharikota carrying IRS-P4 (Oceansat) into orbit, in addition to, two auxiliary foreign satellites TUBSAT (of Germany) and KITSAT (of Republic of Korea), and demonstrated the multiple satellite launch capability of PSLV. The successful launch of IRS-P4 (Oceansat) has enhanced the applications of IRS satellites for Oceanographic Studies. The Oceansat carried an ocean colour monitor and a Multi-frequency Microwave Radiometer for generating ocean biological parameters and estimating a number of geo-physical parameters such as atmospheric water vapor, cloud liquid water, sea surface winds and sea surface temperatures.

3. The INSAT-2E was successfully launched on April, 1999, and carried, in addition to communication and VHRR payloads, a charge coupled device (CCD) based camera for meteorological applications. Eleven transponders onboard INSAT-2E were leased to International Telecommunications Organisation (INTELSAT).

4. The GSLV project has successfully completed all the development phases and entered the flight hardware realisation phase. The indigenous Cryogenic Upper Stage Project (CUSP) has achieved an important milestone by realisation of critical test facilities and initiation of engine hot tests.

Major Programmes For The Year 2000-01

5. The important programmes include: launching of first developmental flight of GSLV (GSLV-D1); assembly, integration, testing and launching of GSAT 1 satellite by GSLV-D1 from Sriharikota carrying experimental payloads for digital audio and data

broadcast services; completion of spacecraft fabrication assembly and testing of Technology Experiment Satellite (TES), an experimental test satellite to develop and test a number of new innovative technologies required for the IRS follow on high resolution systems for launch onboard, the indigenous launch vehicle PSLV-C3; completion of spacecraft fabrication, assembly, testing and preparations for launch of INSAT-3C.

6. Activities on the other ongoing projects like IRS-P5, IRS-P6, Second Launch Pad, CUSP, INSAT-3 and applications projects would be continued. Under the INSAT-3 Programme, the emphasis would be towards completing the payload and satellite fabrication and testing work related to INSAT-3C and achieve substantial progress in flight hardware realisation and advanced meteorological payload development for INSAT-3A. Most of the subsystem fabrication activities for IRS-P5 (Cartosat) and IRS-P6 (Resourcesat) would be completed. Efforts would be continued towards realisation of addition engines, continuation of hot tests and realisation of proto-stage under the CUSP project. The activities relating to structural fabrication and erection of subsystems like umbilical tower, launch pedestal tower, etc. for the Second Launch PAD would be continued.

7. In the area of space applications, the Jhabua Development Communication Project (IDCP) would be expanded to the neighbouring districts of Dhar and Barwani. Efforts will be made to evolve a suitable institutional framework to replicate the programme in other districts/states in a phased manner. Training and Development Communication Channel (TDCC) network with more uplinks and new technologies for distance education and training would be expanded. The activities under various application missions such as National Drinking Water Mission, expansion of National Resource Information System (Phase II), Land Slide Zonation Studies, Biodiversity Characterisation, Crop Production and Acreage Estimation, Waste Land mapping and Drought/flood monitoring would be continued.

DEPARTMENT OF ATOMIC ENERGY (R&D)

Major Achievements In 1999-2000

8. Significant progress was made in the areas of reactor development. The important activities undertaken include: designing and development of an Advanced Heavy Water Reactor (AHWR); refurbishing and engineering of various systems of APSARA reactor; refurbishing, DG set servicing, heat exchanger replacement, radiation shielding windows, ventilation system of the CIRUS reactor; designing and engineering of the Advanced Reactor Experimental Facility. All the three accelerators namely 20 MeV microtron, 450 MeV booster synchrotron and 450 MeV storage ring were indigenously designed and developed. Setting up of beamlines for the utilisation of Indus-I was completed. Folded Tandem Ion Accelerator has become operational. The construction of a super conducting cyclotron was at advanced stage.

9. The engineering development activities in support of Prototype Fast Breeder Reactor (PFBR) were pursued and the major activities included: experimental studies on Large Component Test Rig (LCTR), component hydraulics, sodium pump and reactor instrumentation. The first phase of head transfer experiments on the LCTR, a major sodium facility for heat transfer studies related to PFBR roof slab, was completed. The construction of the Boron Enrichment Facility and Steam Generator Test Facility were taken up. The isotope separation plant for the production of enriched Boron-10 was in an advanced stage of

construction. Various equipments for the Fast Reactor Fuel Reprocessing Plant (FRFRP) such as the chillers, condensers etc. were received.

10. As part of up-gradation of isotope hydrology, the activities relating to the procurement of liquid scintillation counter, mass spectrometer, preparation systems for mass spectrometry and up-gradation of existing mass spectrometer were in progress. Serve-controlled mechanical systems and nucleonic gauge for radio tracer and sealed source development were procured. The development of hardware and software for Aerial Gamma monitoring has reached the completion stage. Design of Dynamic Autoclave and development work related to code for activity transport for PHWRs was taken up. The activities relating to design of biological shield, radiation source, source rack, source loading & unloading system, under water lighting and source geometry for the Poton and super structure for main plant building were completed and biological shield was near completion. Significant progress was achieved in fabrication and cold modelling of cavities, wave guide and power feed.

Major Programmes For The Year 2000-01

11. The major activities to be completed in the current year are related to: physics and thermal hydraulics design of AHWR; flow sheet preparation; specifications for major equipments; piping layout of integral test facility; spacer design optimisation for fuel assembly development; designing and engineering of the Advanced Reactor Experimental Facility; designing and drawings preparation of various systems viz., EB welder, EB evaporator, plasma melter, plasma RF reactor, plasma microwave system, laser RF CO₂, laser photochemistry of carbon, laser scan probe, tunable femto second dye laser, ultra short pulsed solid state laser; mechanical designing and drawings of on-axis and off-axis Linac, cooling channel of Linac.

12. Setting up of beamlines for the utilisation of Indus-I cyclotron would be continued and some of the beamlines would be commissioned. Efforts would be made to commission Indus-II cyclotron. The development of hardware and software for Aerial Gamma monitoring would be continued. Designing of dynamic autoclave and development work related to code for activity transport for Pressurised Heavy Water Reactors (PHWRs) would be undertaken. Development and installation of MACE, BEST and MYSTIQUE telescope facilities would be continued Giant Meter Wave Radio Telescope set up at Narayangaon near Pune will be commissioned shortly.

DEPARTMENT OF SCIENCE AND TECHNOLOGY

Major Achievements In 1999-2000

13. Science and Engineering Research Council (SERC) continued to support R&D programmes in challenging areas. The Swarnajayanti Fellowships Scheme supported six young scientists with proven capability of outstanding research works to explore new frontiers in their field of specialisation. 41 young scientists were selected for Better Opportunities For Young Scientists in Chosen Areas of Science And Technology (BOYSCAST) fellowships. IRHPA programme has resulted in the strengthening of the infrastructure and research capabilities in selected areas of Science and Engineering in the country and the major supported programme include: NMR Facilities at IISc, Bangalore;

National X-Ray Diffractometer facility at IIT-Mumbai; Integration of Computational Facilities for Scientific Research (ICOSER); 300MHz NMR Facilities at IIT-Kanpur and IISc, Bangalore; Facility for Laser Scanning Confocal Microscope at CCMB, Hyderabad.; Facility for Technical Acoustics at IISc, Bangalore; Augmentation of the existing facility at the National Centre for Experimental Mineralogy and Petrology at University of Allahabad; Initiation of the Indian Solar Terrestrial Energy Programme with Department of Space, etc.

14. The important activities initiated were related to: Kishore Vigyanik Protsahan Yojana and the programme on Fund for Improvement of S&T Infrastructure in Universities and related Institutions (FIST). Regional Sophisticated Instrumentation Centres (RSICs) and Sophisticated Instrumentation Facilities (SIFs) provided the services of sophisticated instruments to scientists for analysis of samples for research, quality control work etc. Thirteen autonomous research institutions supported by DST, continued to achieve excellence in their areas of specialisation. Technology Information Forecasting and Assessment Council (TIFAC) has initiated follow-up action on the Technology Vision 2020 and supported many projects in the Home-grown Technology programme, which are likely to result in the development of indigenous technologies. The National Accreditation Board for Testing and Calibration Laboratories (NABL) provided accreditation to testing and calibration laboratories within the country. National Science & Technology Management Information System (NSTMIS) generated and made available, information on both the manpower and financial resources devoted to S&T activities in the country.

15. Science and Technology Advisory Committee (STACs) set up in 24 socio-economic Ministries continued to provide S&T inputs to the concerned sectors. Scientific services in the areas of meteorology, survey and mapping were provided to the user agencies through the India Meteorological Department, Survey of India (SOI), National Atlas and Thematic Mapping Organisation (NATMO) and National Centre for Medium Range Weather Forecasting (NCMRWF). Agromet Advisory Services were issued regularly and the network was strengthened from 28 to 48 units. District Planning Maps were produced for 125 districts.

Major Programmes For The Year 2000-01

16. SERC programme would support more infrastructure in the university sector to tap the expertise available in the universities. The scheme, Opportunities for Young Scientists would continue to support R&D projects, BOYSCAST fellowships, Contact Programmes, Fellowship through State S&T Councils/Departments to young scientists. New facilities and groups/centres would be set up under the scheme Intensive Research in High Priority Areas (IRHPA). Jai Vigyan Mission Projects will be initiated in the areas of Natural Disaster Mitigation in Himalayas, Area Development Mission for A&N Islands through S&T and Remote Medical Diagnostic Care to Rural Population through Telemedicine.

17. Under the Kishore Vigyan Protsahan Yojana (KVPY) programme, 190 new students will be selected and the 100 students selected during 1999-2000 would also continue to be supported. The research projects for the drug development in the areas of diseases would be supported. National Survey for Collecting data on the Resources devoted to R&D activities would be launched. Under the FIST programme, 15 identified departments will be selected for support to improve quality of teaching and research through modernisation of laboratories and by augmentation of library facilities. The TIFAC will formulate and

implement new mission mode projects based on the document S&T Vision 2020. Under the Science and Society scheme, specific programmes for socio-economic upliftment of weaker sections of the population in farm and non-farm sectors would be developed with focus on optimum utilisation of local resources and skills.

DEPARTMENT OF BIOTECHNOLOGY

Major Achievements In 1999-2000

18. Human resource development programme was expanded by additional five post-graduate programmes in biotechnology, 31 post-doctoral/post-graduate and post MD/MS courses, 26 overseas associateships and 14 national associateships. Bioscience career development award and special awards for women were announced. Pest and disease resistance new hybrids and transgenic plants were identified. Multi-institutional and multi-disciplinary research programmes on nutrient management, bioprospecting for biological wealth, anti-cancer compounds from plant sources, abiotic stress in plants, molecular taxonomy, food biotechnology, vaccines and diagnostics, functional genomics, neurosciences and plant genome research have resulted in R&D leads/breakthroughs, technologies, patents and publications.

19. Four Jai Vigyan National S&T Missions on developing new generation vaccines, biotechnology for herbal product development, establishment of mirror sites for genome research and biotechnology for coffee improvement were initiated. Bilateral projects under International collaboration with Switzerland, Israel, ASEAN, France, Tunisia, Poland, Sri Lanka, Myanmar were launched. A number of projects was supported in the area of heavy metal removal, treatment of effluent from paper and pulp mills, dye industry, automobile industry etc. under environment biotechnology. The phase I clinical trials of both rota viral strains were completed in the United States. Significant progress was made in development of edible vaccine for cholera in tomato and tobacco. A bioinformatic software namely, "Gene Scan" for use in gene sequence search and genomics developed at JNU centre was released. About 300 women benefited in various projects on fish farming, food technology, and floriculture and sericulture under biotechnology based programmes for women.

20. The National Bio-resource Development Board was set up for sustainable development and utilisation of precious of biological resources of the country employing biotechnology tools and techniques. Two technologies of mycorrhiza and rhizobium biofertilisers have been transferred to 3 entrepreneurs for commercial production. BIBCOP formulated 125 million doses of OPV for supply of National Immunisation Programme.

Major Programmes For The Year 2000-01

21. The ongoing activities would be continued and the major initiatives proposed would include establishment of: International Depository Authority, National Facility for testing tissue culture-raised horticulture plants from viral diseases, a network of toxicological testing facilities, bio-villages for specific requirements for rural areas, hills, deserts and coastal regions. New bilateral projects under international cooperation with Switzerland, Australia, South Korea, Myanmar, Japan, Russia and SAARC and ASEAN countries would be taken up. Five more sub-bioinformatic centres will be established and molecular graphic facilities would be augmented.

22. The other important initiatives would include: projects for technological and economic empowerment of women, a network programme on genome diversity in different geographical regions and supporting initiatives in human genetics and strengthening molecular biology research in fisheries and scaling-up R&D leads related to feed and vaccines and an integrated wheat genomic programme with objectives of physical mapping and functional genomics; participation in International Rice Genome Sequencing Programme in collaboration with ICAR along with a network of national project on abiotic stress resistance in rice; genome mapping and analysis on plasmodium vivax; national programme on different aspects of oral cancer, designing of new vaccines for viral diseases (Hepatitis E and research on diagnostics for safe blood supply)

DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH INCLUDING COUNCIL OF SCIENTIFIC RESEARCH

Major Achievements In 1999-2000

23. Substantial progress was made by CSIR under the projects related to design and development of Light Transport Aircraft (LTA) and development of Light Combat Aircraft (LCA). Certification of the two-seater trainer aircraft – HANSA-3 was obtained and commercial production of the aircraft has been commenced by a private sector party. R&D programmes in the areas of agro-biotechnology, industrial biotechnology, molecular genetics, control of gene expression, genetic manipulation of microbes, recombinant DNA products etc. were continued. A major coordinated programme on development and commercialisation of bioactive molecules was initiated for new drug design, molecular modeling, computer graphics, analytical chemistry and combinatorial chemistry; and facilities for synthesis of antisense, nucleotides, peptide and small peptidomimetic molecule.

24. The other important achievements were related to the development of: two fast curing non-toxic bacterio-static and non-allergenic bio-adhesives for controlling and stopping acute bleeding from ruptured veins during endoscopic surgery; pollution control device for brick kiln in about 220 brick kilns in different parts of Haryana and few parts of Uttar Pradesh; high quality synthesis system useful for the visually handicapped persons as a 'reading' machine; device for receiving and transmitting standard time in a master/slave configuration in a telephone network; commercially viable technology to produce energy efficient & environment friendly soft coke; improved technology for fresh ginger processing for value added products; Modified Atmospheric Packaging (MAP) wherein the atmosphere surrounding the commodity is rendered different from normal in suitable polymeric film packages of desired permeability; low cost online water purification system that quickly makes water free from bacteria as well as removes toxic metals like iron, chromium, lead, zinc and nickel to safe levels; candleless teracotta water filter "Terafil" made from pottery red clay, sand and saw dust mixture which brings down the turbidity of water from 100 Nephelometric Turbidity Units (NTU) to 0.5 to 2.0 NTU. A centralised unit for R&D on information products was established at Pune to convert the dispersed and non-digital databases of CSIR especially on traditional knowledge to merchandisable information products.

25. Under DSIR the major achievements included: organisation of 13th National Conference on In-House R&D in Industry; recognition of 50 new in-house R&D units and 35 new Scientific & Industrial Research Organisations under the RDI scheme; support to around

20 new and around 65 on-going technology absorption, development and demonstration projects under the PATSER scheme; support to about 30 projects aimed at development of innovative technologies/processes under the Technopreneur Promotion Programme (TePP); support to S&T information centres and Value Added Patent Information System (VAPIS); services at R&D and academic institutions under the National Information System for Science and Technology (NISSAT) scheme; licensing of technologies like bio-degradable plastics, powder hair dye formulation; signing of agreement with the Government of Egypt for setting up Science and Technology Entrepreneurship Parks in Egypt; development of electroless plating process to enhance Ultra High Efficiency (UHE) solar cells production, etc.

Major Programmes For The Year 2000-2001

26. CSIR would continue to carry out R&D activities in the identified areas and would provide value aided services not only to industry but also to almost all sectors of the economy. The emphasis would be on for first developmental flight test of prototype of a multi-role Light Transport Aircraft. The augmentation of National Trisonic & Aerodynamic Facility at National Aerospace Laboratory (NAL) would be initiated for enhancement of its productivity and data quality. R&D activities would further be pursued for DNA transcription; bio-chemical processing; neurotoxicity of pyrethroid; quinalphos and lindane; immunogenetics and molecular medicines; introduction, characterisation, improvement and commercialisation of ornamental crops; improvement in productivity of quality of hill area tea; chemicals from plant gums; development of engineering intensive chemical processes; enviro-catalysis and processes; development biodegradable polymers derived from lactic acid; commercialisation of bio-active molecules programme; assessment and management of ground water resources; methane and gas hydrates along the continental margins of India and earthquake hazard assessment.; green house and monitoring of new parameters like viruses in air; development of polymer additives for crude oil production and transportation; development of value added products from oil seeds and spices; development of alternate building materials and utilisation of industrial wastes; utilisation of waste/marginal materials in road construction; wind tunnel studies of bridges, towers, chimneys etc.

27. The other important activities would be related to life cycle assessment for steel sector; sustainable management of environmental resources and human habitat upgradation in North-East region; marine bio-diversity of selected ecosystems along the Central West Coast of India. A new millennium Indian technology leadership initiative has been launched by CSIR from the Annual Plan 2000-2001 to focus on few areas which would fulfill the national objectives of achieving a global leadership in technology.

28. Under DSIR the major activities would include: organisation of 14th National Conference on in-house R&D in industry; support to about 30 new and 70 on-going technology absorption, development and demonstration projects under the Programmes Aimed at Technology Self Reliance (PATSER) scheme; support to about 30 projects aimed at development of innovative technologies / processes under the Technopreneur Promotion Programme (TePP); development of Indian S&T web server (Vigyan); establishment of internet school and development sector specific web sites under the NISSAT scheme; support to scientists-entrepreneurs willing to set up industrial units based on laboratory technology; participation in 10 international exhibitions; promotion of joint venture companies abroad and opening a technology internet café; development of thin films technology for SPV;

design and development of dielectric resonator oscillator, automation of ferrite cores manufacturing, etc

DEPARTMENT OF OCEAN DEVELOPMENT

Major Achievements In 1999-2000

29. The 19th Indian Scientific expedition to Antarctica was launched from Cape Town, South Africa in December, 1999 and new studies were taken up. They were related to earth-air current systems, crack propagation of the ice-shelf, processes of Iceberg generation etc. Assessment for demersal fishery resources of the Indian continental slope was made by acoustic survey and trawling operations. Six marine organisms showing potent anti-diabetic/anti-diarrheal; antihyperlipidaemic, anti-anxiety, anti-cholesterol cum antioxidant; anti-bacterial cum anti-fungal and larvicidal activities were taken up for product development. A underwater crawler was developed for sand mining operation at 500 m water depth and the system was successfully launched up to 410 meter depth off Tuticorin coast in March, 2000. A design report for 6000 meter deep sea nodule mining system with a collector and crusher was prepared.

30. Monitoring of pollution continued by 11 institutions at 82 locations in the 0-25 km transects from the coast to the sea. The two vessels Sagar Purvi and Sagar Paschimi completed 43 cruises. Two shallow water buoys were deployed one each at Pipavav and New Mangalore port for collection of met-ocean parameters required for developmental activities of these ports. 10 modern tide gauges stations were established at Mumbai, Porbunder, Goa, Kochi, Chennai, Visakhapatnam, Paradip, Kavaratti, Machlipatnam and Tuticorin for systematic and accurate monitoring the tidal level to derive long term variations in the mean sea levels.

31. A dedicated Indian National Ocean Information Services (INCOIS) was set up at Hyderabad in February 1999 as an autonomous body of the Department for generation and dissemination of user oriented data products on operational basis. Generation and dissemination of SST and PFZ maps to 170 fish landing stations was continued. Four Ocean Science & Technology Cells (OSTCs) were set up at Tamil University, Tanjore ; Annamalai University, Parangipettai; Cochin University of S & T, Kochi; IIT, Kharagpur. National Institute of Ocean Technology (NIOT) continued its mission programme in the areas of Ocean Thermal Energy Conversion (OTEC), Deep Sea Technology and Ocean Mining, Coastal and Environmental Engineering, and Marine Instrumentation.

Major Programmes For The Year 2000-01.

32. The XX Indian Scientific Expedition to Antarctica would be coordinated and executed by the National Centre for Antarctic Ocean Research (NCAOR) as the nodal agency. The scientific and logistics co-operation developed between India and South Africa with the launching of the XIX expedition from Cape Town would lead to the initiation of state-of-the-art research programmes in Polar Sciences in the disciplines of polar remote sensing, southern ocean oceanography & paleoclimatology, antarctic global change. The activities relating: establishment of techniques for estimation of fish, zooplankton; large marine ecosystem studies of the Arabian Sea; assessment of mesopelagic resources of the high seas; identification and bio-evaluation of the marine flora and fauna from the Indian

Chapter 11: Science and Technology

coastal waters; pharmacology and toxicology of the anti-diabetic and anti-diarrheal drug; patenting of anti-cholesterol molecule; spot sampling of nodules using grab sampler with spot photography at 5 km. grid; relinquishment of additional 20% of the Pioneer area to ISBA would be continued.

33. Development of an integrated mining complex module of 25,000 tons/yr. capacity for 6000 m. depth would be carried out. A pilot plant of 500 kg./day capacity nodules would be demonstrated and commissioned. Monitoring of marine pollution at 82 locations for 25 parameters would be undertaken and GIS based information system for monitoring pollution in the coastal waters would be adopted. Coastal Research Vessel (CRV) 'Sagar Purvi' & 'Sagar Paschimi' would complete 48 cruises each for pollution monitoring both in the east and west coast.

34. Indigenisation of Data buoy technology and operation and maintenance of 12 data buoy system would be taken up. The 22 ongoing OSTCs research projects would continue to be implemented and two more OSTCs would be set up. Baseline, bathymetry and seismics data would be collected under the scheme Delineation of Continental Shelf. The NIOT would continue its mission programmes.

35. The details of the plan outlays/expenditure for the S&T sector are given in Annexure 11.1 and 11.2.