Annual Report
2012-2013

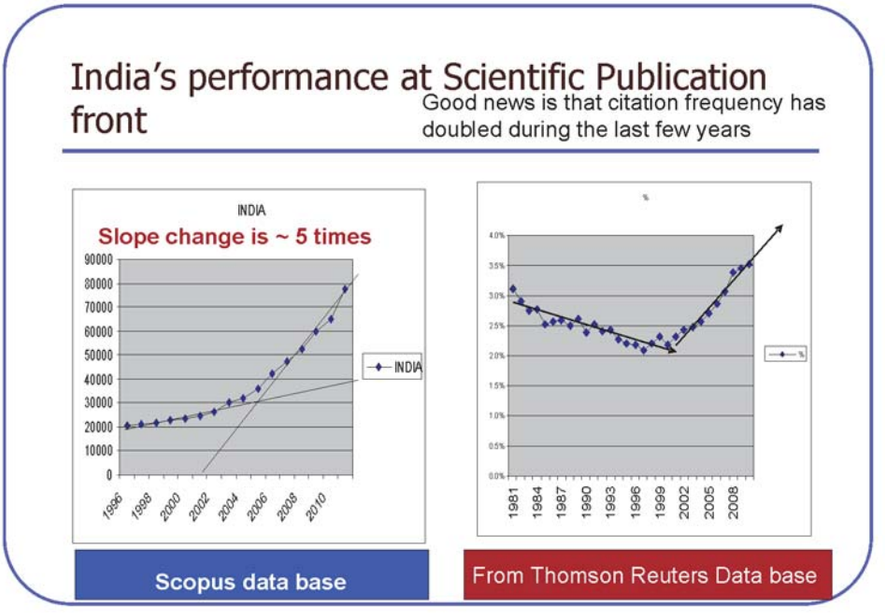
Government of India
Department of Science & Technology
Ministry of Science & Technology
New Delhi

CONTENTS

OVERVIEW

The trajectory of Indian science sector with respect to R&D outputs has maintained an impressive Composite Aggregated Growth Rate (CAGR) since 2010. During the year 2012-13, the high CAGR has been maintained at about 14%. Improvements in relative performance of the Indian R&D sector with respect to its own past performance have become evident. Trends with respect to scientific publications emanating from India during the period of 1981 to 2010 were analysed in 2012. Department of Science and Technology has been relying on evidence-based approaches in planning strategies and implementation of its programmes and schemes.

The Department commissioned two independent third party studies by Thomson Reuters and Elsevier for assessing S&T output indicators of India. They provide compelling evidence for significant improvements in the number of scientific publications emanating from India as presented in Figure 1 below.



There has been a 66% increase in the number of publications during 2006-10 compared to 2000-05 periods. Citation impacts in areas like engineering, materials science and physics are in the range of 0.80 to 0.95 of global averages. Some valuable leads have been obtained from the third party study for planned interventions in R&D funding in the country. The analysis and major recommendations for actions emanating from the study are hosted in the web site www.dst.gov.in

POLICY FORMULATION: New Science, Technology and Innovation policy has been formulated and enunciated in 2013 and was formally released at the 100th Session of Indian Science Congress at Kolkata on 3rd January 2013. Wide and National level consultation with major stakeholders was adopted for the formulation of STI policy 2013. Main features of the STI policy 2013 include a) expressed levels of aspiration, b) balancing between excellence and relevance, c) creating an enabling policy ambiance for attracting larger investments of private sector into Research and Development, d) promoting a science-led innovation ecosystem and e) establishing linkages between discovery processes of science and developmental priorities of the country in agriculture, manufacturing, services and infrastructure sector. The STI policy 2013 is hosted on the web site www.dst.gov.in

Department of Science and Technology undertook a lead role in the formulation of National Data Sharing and Access Policy 2012. The national policy has now been enunciated. The implementation of the policy has been undertaken by the Ministry of Information Technology. Main features of NDSAP are a) Non-sensitive or other data owned by the central government and not included in a negative list must become available for users from civil society, b) provisions for registered and regulated use of data are made, c) data owning department could develop its own pricing policy, d) Data need to be housed in its DATA PORTAL INDIA www.data.gov.in hosted by National Informatics Centre. Survey of India has already hosted some open series maps on the www.data.gov.in

NEW MODES OF R&D FUNDING: National Science and Engineering Research Board (SERB) started its full function during the financial year 2012-13. More than 5500 financial sanctions have been released so far during 2012-13. A notable development has been that the total number of research grants sanctioned for young scientists during the year has exceeded 1000, registering more than 100% increase in the number of sanctions under Fast Track Scheme compared to previous years. Total number of Extra Mural Research projects sanctioned though SERB during the financial year 2012-13 is far more than the proposals received by the Board relative corresponding periods in earlier years. Fuller utilization of funds allocated for general and capital support has been realised by the SERB already. Data reveal that there is a steady increase in the number of projects supported for research in engineering and materials science areas. Several new schemes have been developed and rationalization of heads of accounts for project grants has been made. PM's Doctoral Research Fellowship scheme has been launched in collaboration with Confederation of Indian Industries. The Board is in the process of designing a special scheme for promoting Empowerment and Equity in Excellence in research among researchers from the weaker segments of the society.

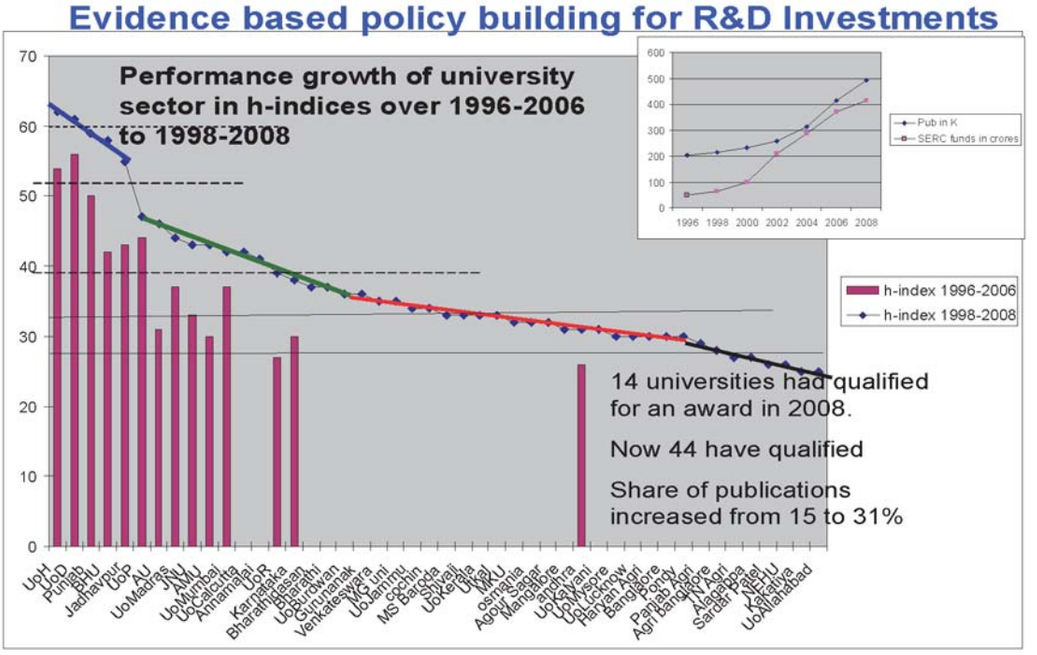
SERB has also established linkages with Ministry of Food Processing, Government of India and has accepted to service the Ministry in selecting projects for R&D support in the area of food processing. Similarly, linkages have been developed with Ministry of Telecommunications for commissioning research on the subject of "Assessing Risks from Telecommunication Towers and Mobile Communication" on campaign mode of study.

STRENGTHENING HUMAN CAPACITY FOR RESEARCH: Innovation in Science Pursuit for Inspired Research (INSPIRE) is a flagship scheme of the Government of India.

Under the scheme, more than 8 lakh awards for the age group of 10-15, ~ 1.5 lakh internships for age group of 16-17, 28,000 scholarships for undergraduate studies in sciences for youth in the age group of 17-22, about 2150 research fellowships for doctoral research and 270 faculty awards for post doctoral researchers under the age of 32 have been supported. For attracting and enrolment of youth for study of science courses at the Bachelor and integrated Master's level, partnerships with 29 school boards in the country have been designed. School boards have started to attach letters of eligibility for the INSPIRE scholarships along with mark certificates. Indicative of spread and reach of INSPIRE scholarship scheme. Almost all the targeted numbers of the INSPIRE scheme have been reached during 2012-13. E-Management systems and practices are being introduced for implementation of INSPIRE. E-Management practices are expected to ensure transparency, efficiency, speed and accuracy in the implementation of INSPIRE programme with wide reach and scale.

Department implements several fellowship schemes for nurturing human capacity for advanced research in the country. Fellowships named after JC Bose, Ramanujan, and Ramanna are being awarded to different categories of researchers. Currently, about 218 researchers are receiving JC Bose Fellowships. Their research outputs have been evaluated. On the average, Annual per-capita R&D output indicators of JC Bose Fellows are in the range of 6- 6.5 publications with impact factor aggregate of 20 plus. Ramanujan Fellowships have been able to attract more than 180 scientists of Indian origin to return to India for research. A conclave of Ramanujan Fellows was organized in Pune. Several new research initiatives in frontier areas of science by Ramanujan Fellows have become evident.

STRENGTHENING INSTITUTIONAL CAPACITY FOR RESEARCH: Research and Development Support Scheme of Department of Science and Technology includes initiatives such as Fund for Infrastructure Strengthening of S&T (FIST), and Promotion of University Research and Scientific Excellence (PURSE). Total of 44 universities have been supported under PURSE based on their R&D performance over 10 year periods. More than 1800 departments and institutions have been supported under FIST during the last three years. Special packages for NE Region 58 colleges and 12 universities, in J&K 34 colleges & 7 universities in Bihar 36 colleges and 8 universities have been supported. National Centre on Natural Resources (NCNR) has been supported in Ravi Shankar Shukla University in Raipur, Chhattisgarh. DST & RCUK research collaboration in the area of solar energy, fuel cells and next generation networks is being implemented in 20 institutions with over 250 researchers including doctoral students in frontier areas of science across the country. Intensification of Research in High Priority Areas (IRPHA) has been supported in five institutions in five High Priority Areas during 2012-13. Analysis of publication trends reveals also that average citation per paper from university sector in the country increases significantly through international cooperation. Special schemes are being developed by DST for promoting international S&T cooperation of Indian University sector. Analysis of publication data of the Indian university sector in 2012 reveals that the national share of publications has increased to 31% in 2010 and 23 universities figure among the top 50 institutions ranked on the basis of average citation per paper.



TECHNOLOGY DEVELOPMENT DEPLOYMENT AND MISSIONS: The Department of Science and Technology has been focussing on development of convergent technology solutions in addition to technology demonstrations. Focused areas for development and deployment of technology solutions are a) water, b) solar energy, c) affordable health care, d) potash based fertilizer, e) home-land security and f) bamboo-based construction materials. Several technology demonstration exercises by technology institutions were supported.

Convergent technology solutions for 23 kinds of water-related problems have been addressed under real-field conditions. As a result of necessary technology interventions, deployment of innovative solutions for addressing these water challenges benefited nearly 1.56 million people in 30 villages across various parts of the country. Sustainability of implementation of these solutions through development of suitable revenue models is currently being examined. Initiatives have been made to promote research on development of solar energy based technologies for both grid-based and decentralized generation and applications. Totally, 55 projects on solar energy research have been supported so far. One 256 kW decentralized power generation system for off-grid applications has been established in a village in Maharashtra. The plant is based on hybrid of technologies namely solar energy during the day and biomass during the night, thus opening a possibility for 24X7 applications."

Seven projects were supported and partnerships with 6 companies have been established during 2012-13 under the Drug and Pharmaceutical Research Programme (DPRP). A major outcome of the DPRP is in the commercial launch of anti-malarial drug on 25th April 2012 developed through indigenous research. The treatment using the new drug is expected to cost less than the currently adopted procedures by at least 30 % .The new drug apart from being more effective is also convenient to compliance as the dose is one tablet per day for 3 days.

The Department has supported the establishment of a test-bed for potash-based fertilizer and a multi purpose pilot plant at the Central Salt and Marine Chemicals Research Institute (CSMCRI). The test-bed is at an advanced stage of its establishment and it is expected to be commissioned before the end of 2013. Under National Mission on Bamboo Applications, 276 bamboo structures in Chhattisgarh and 54 structures in Maharashtra have been supported for the Sarva Shiksha Abhiyan.130 prefabricated shelters have been provided to paramilitary forces. 10 structures have been provided to the Sikkim Government for the rehabilitation of earthquake victims and 4 structures have been provided to J&K police during the year 2012-13. A range of technologies with potentials for adding economic value to bamboo based raw materials by 10- 30% has been developed and demonstrated so far.

Outputs from nano mission are 4476 papers in SCI journals, 1391 papers in conferences, 800 PhDs, 546 M Techs and 92 MSc level training. Nano mission has made contributions to India emerging as one of the top five or six nations in nano science and technology in terms of R&D output indicators.

SOCIAL CONTRACT OF SCIENCE AND TECHNOLOGY: The Department has been engaged in various activities which relate technologies to their socio-economic applications. Technology Business Incubators have emerged as one of the effective tools for linking science and technology to creation of employment. DST has been supporting 66 Technology Business Incubators for development of technology based entrepreneurship. The social outcomes of these TBIs were reviewed this year. As many as 28,000 jobs have been created as a result of the support of DST to TBIs. In F.Y. 2012-13, a total of 1415 training programmes have been supported to train 81,225 participants.

In partnership with Indian Institute of Management, Ahmedabad and Economic Times, DST has been implementing a project called “Power of Ideas” since 2010. During the year 2012-13, from among the 14,000 applications received for call for proposals for “Power of Ideas”, 504 were short-listed. Under this programme, 40 promising start-ups were chosen for awards of Rs.5 lakh each while 10 bright ideas were chosen for awards of Rs. 2 lakh each. Apart from these awards, 20 start-ups also received seed funding offer of Rs. 20 lakh each.

Department has been able to extend core support on long term basis to 21 science based voluntary organizations to promote and nurture them as “S&T Incubators”/”Active Field Laboratories” in rural and other disadvantaged areas to work and provide technological solutions and effective delivery of technologies for livelihood generation.

The Council of Science and Technology for Rural India is another pioneering initiative of the department for designing technology solutions for applications in rural India. Two centres one at IIT, Chennai and the other at NIEST, Johrat have started their activities in 2012-2013. An effort has been made to enrol local engineering colleges in scoping solutions for meeting location specific needs. To address the issue of equity, pilot scale multi-locational technological interventions programmes have been designed and implemented to involve and benefit and SC community. A pilot scale initiative focusing on improved livelihood and conservation around 12 protected areas through resource management in different geographical areas has benefited over 4000 households in 50 villages. This programme offers a viable and replicable model for integrating both conservation and livelihoods.

The department has taken the initiative to develop indigenous cost effective technologies for elderly and the disabled populations 10 technologies have been developed under this initiative and are now being pilot -tested with the user groups.

National Resource Data Management System (NRDMS) working closely with Survey of India (SoI) and National Spatial Data Infrastructure (NSDI) has developed a large number of thematic maps and their applications for National Resource mapping and management. In order to provide web-based access to seamless 1:50,000 topographic data of Survey of India, the Surveykshan portal has been operationalized. A regional Geo Portal prototype, North East Spatial Data Infrastructure (NESDI), has been demonstrated. Web-enabled Gender Atlas and Geo-visualisation Tools for landscape analysis and groundwater resource management have been developed. Results of studies covering various aspects of landslides and urban flood management have been useful in providing real time information for management of the geo-hazards by the authorities. Technical capacity has been built through a series of training and user awareness workshops amongst the scientific and the end user communities.

National Council for Science and Technology Communication (NCSTC) has been engaged in number of activities focused on popularization of science. Science Express is a flagship of NCSTC. During 2012-13, Science Express has been used for spreading the message of Biodiversity in collaboration with Ministry of Environment and Forests. So far more than 23 lakh people including 6 lakhs students and 32,000 teachers drawn from 7000 schools have visited the Science Express during 2012-13, NCSTC has been making special efforts to spread the cause of education in mathematics since the declaration of 22nd December as National Mathematics Day. Several interlinked initiatives to strengthen mathematics education in schools and colleges have been made. Celebration of Women Science Congress, Children Science Congress, Teachers Science Congress, Science communicator's congress and many other related activities has been supported. A pilot project for Building Educator's for Science Teaching (BEST) has been launched in collaboration with Kendriya Vidyalaya.

S&T PARTNERSHIPS AND ALLIANCES: The Department of Science and Technology has been extending support to total of 26 State S&T councils by way of core grants for meeting the needs of revenue budget. Demonstration of successful technologies developed by public funded institutions for applications in various parts of India is supported. During 2012-13, such technology demonstrations in the areas of water management, mangrove protection, waste management, environment management, micro-hydel, and live stock rearing were supported in multiple locations. Some knowledge service based activities like advisories based on mapping of genetic disorders among rural population have been supported. A regional consultation with state S&T councils in the North East part of India was made and specific recommendations and networking of the programme activities of the state councils have been obtained. State-Centre technology partnerships are being developed. Under this arrangement, development of state specific road maps for selection and deployment of technologies is being targeted. Special schemes for seeding deployment of technologies for public and social good in various states under state-centre technology plan are being designed for implementation during the 12th plan.

INTERNATIONAL S&T COOPERATION: India's multilateral and regional S&T cooperation with many coalitions was further strengthened during 2012-13. European Union-India strategic S&T partnerships, built on principle of reciprocity and parity, has been deepened. Co-investments into EU-India partnerships have exceeded $ 30 million from each side. "Brussels Communiqué-Shared Vision & Pathways" was issued. Outcomes from India-EU research projects in computational materials science and solar energy, initiated in the previous years are becoming evident. Technologies for waste water recycling–reuse and water purification formed an area of intense collaboration between EU and India in 2012-13. India's S&T cooperation under regional frameworks such as with ASEAN, BRICS and international S&T organizations such as NAM S&T Centre deepened. ASEAN-India Technology Missions in Functional Food R&D, Renewable Energy R&D; ASEAN-India Workshops on Surface Engineering, Marine Biotechnology; Visit of 33 ASEAN students for participation in 20th NCSC at Varanasi; and ASEAN-India Program on Quality Systems in Manufacturing-Laboratory Accreditation were amongst the significant collaborative activities. DST, on behalf of Government of India, doubled its annual membership subscription to NAM S&T Centre, thereby strengthening India's visibility, leadership and prestige in the region.

International Bilateral S&T cooperation with 40 countries from among the 83 agreements signed so far has become active. Joint research project based networking of researchers under active bilateral S&T programs of cooperation with substantive programs with 9 countries were reinforced during the year 2012-13. Major achievements include bilateral R&D projects involving industrial partners with Canada, France, Germany, Israel, Switzerland and United States; Co-investment of resources including funds for symmetric joint research projects and strategic joint initiatives with Australia, Germany, Hungary, Norway, South Korea, Switzerland, UK, and USA; Execution of New Africa S&T Initiative Program including fellowships, trainings and strengthening of R&D institutions through twinning; and continued support to bi-national S&T Centres under institutional framework: (Indo-French Centre for Promotion of Advanced Research, Indo-German S&T Centre, Indo-Russian S&T Centre and Indo-US S&T Forum).

SIGNIFICANT S&T OUTPUTS FROM AIDED INSTITUTIONS: The Department of Science and Technology has been nurturing 16 autonomous research institutions by way of annual Grant-in-Aid. The Department supports also 5 professional bodies and administers two statutory bodies and two sub departments. In the year 2011-12 these autonomous institutions have published more than 1500 papers in refereed journals and over 80 books/ chapters in books. More than 150 patents have been filed. In terms of S&T output indicators per scientist, the overall performance of the 16 R&D institutions nurtured by DST figure high in the national scene. A new institute for Nano Science and Technology has been established at Mohali. National Centre of Molecular Materials at Kerala and National Centre for Himalayan Glaciology at Uttarakhand are at advanced stages of establishment.

The Indian Science Congress observed 2012-13 as the centenary year under the General Presidency of the Hon'ble Prime Minister. Year long and nation-wide celebration was organized. Totally about 18,000 registered delegates participated at the 100th session at Kolkata and about 12,000 in the 24 state and 3 regional level congresses during the year 2012-13. The intensity and level of participation at the 100th session of Indian Science

Congress is unprecedented. The Department of Science and Technology serviced the General President in organizing the event during 2012-13.

NEW INITIATIVES ANDS SCHEMES PLANNED DURING THE 12TH PLAN: The Department of Science and Technology obtained an allocation of Rs 21596 crores for implementation of the programmes planned for the 12th plan periods. These include the programmes for "Building National Capacity and Capability for High Performance Computing" and "National Geospatial Information System", NGIS. These are large nationally coordinated projects with super-ordinate goals and expectations. In addition DST is in the process of revamping, revising and restructuring the on-going schemes of the Department related to women and would initiate new sub programmes (Mobility Scheme) to address the problems faced by women scientists with a holistic approach under "DISHA" programme. Start-up grant scheme for scientists of Indian origin returning to research careers in India and many other programmes focused on long term benefits.

SUMMARY: The Department of Science and Technology implemented several new programmes starting the Eleventh plan. Many of these programmes have attained their critical value and viability during 2012-13. On the whole, 2012-13 has been a productive year for DST as well as the Indian Science Sector which seems poised for planned development during the 12th plan period. Raised National aspirations have been expressed in the new Science, Technology and Innovation Policy. DST aims to serve the cause of India through its service to science sector in conformity with the STI policy 2013. Actions needed for achieving the policy goals and targets have been identified and DST would strive to play its past as best as possible.

CHAPTER 1

STRENGTHENING BASIC RESEARCH AND DEVELOPMENT

The Department of Science and Technology has been playing the role of major funding agency for research and development in the country for more than 35 years. The main goal of the Department in the function of strengthening basic research and development has been to enable the Indian S&T community to increase the scientific outputs in the form of scientific publications and patents by way of improved R&D funding systems. The efforts made by the Department to speed up the process of funding R&D grants has been realized through National Science and Engineering Research Board (SERB) being operative since the financial year 2012-13. The Board has released more than 5500 financial sanctions in the financial year. The number of research grants sanctioned to young scientists under Fast Track Scheme has shown more than 100% increase as compared to previous year. Several new initiatives have been taken up by the Department including a special scheme for promoting excellence in research among researchers from the weaker segments of the society and PM's Doctoral Research Fellowship scheme.

SCIENCE AND ENGINEERING RESEARCH BOARD (SERB)

The Science and Engineering Research Board has expanded its reach to researchers across the country through various programmes. The Board so far has met five times in the past including three in the current financial year and has taken significant decisions on R&D management in the country. Following are the significant decisions taken by the Board:

- *Absorbed all the Extra Mural Research related activities including competitive mode of funding schemes of the Department of Science and Technology being implemented through the SERC to the umbrella of Board*
- *Adopted the Programme Advisory Committee (PAC) based peer review mechanism for individual project based support as adopted previously by SERC*
- *Rationalization of budget heads to ensure more operational flexibility to Project Investigators*
- *Approved "Performance Linked Incentives" for project investigators*
- *National Initiative on Next Generation Technologies for environmentally benign solution for wireless and mobile communication*
- *Initiated Public Private Partnership in Doctoral Fellowship Scheme: Prime Minister Fellowship scheme for Doctoral Research*

Overall, the Board has supported research and related activities in programmes such as competitive grants for project proposals submitted by individual investigators; Intensification of Research in High Priority Areas (IRPHA); Young Scientist project; fellowships including JC Bose, Ramanujan; Seminar/ Symposia and S&T Professional Bodies; and International Travel Support. Board has issued a total of 2800 financial sanctions for new projects and programmes and 1600 financial sanctions for ongoing projects. A total of Rs. 331.07 crore has been released so far.

The Board constituted 19 PACs in various disciplines. The broad discipline wise details of the achievements are as follows:

Support to R&D projects in frontier areas of chemical sciences continued. Many young researchers who have taken up faculty positions in institutions of repute were supported with substantial grant to undertake research in challenging areas. The output profile of the funded projects also showed improvements both in quality and quantity, reflecting its domination in the publication share of India.

The research projects and programmes supported under Physical Sciences covered a wide range of emerging topics like Condensed Matter Physics and Materials Science, Plasma Physics, High Energy Physics, Nuclear Physics, Astronomy & Astrophysics, Nonlinear Dynamics, Lasers, Optics and Atomic and Molecular Physics etc. Manpower training was given through SERC Schools in emerging areas. It has been observed that the support has resulted 3.1 trained manpower and 6.2 papers in refereed journals per project.

About fifty new projects were launched under PAC on Animal Sciences to promote basic research in organismal biology. Capacity building activities such as SERB schools in chronobiology and neurosciences were organized to generate quality research manpower and to facilitate value addition to R&D proposals in the area. A programme for promotion of research on wild life biology & conservation was also launched. Two new R&D schemes launched under the programme include, (i) 'Intensification of basic research in bird biology'; and (ii) 'Strengthening of faunal research in North East India'. More than a dozen projects each were sanctioned under each of these schemes. Projects were initiated in other sub-disciplines of animal sciences also.

In the area of Plant Sciences several projects in cutting edge and frontier areas as well as traditional areas such as taxonomy and bio-diversity were supported. Research projects were sanctioned in the areas of diversity in processing quality amongst corn genotypes grown in Indian Himalaya, cluster projects on climate change etc. In the achievement part, live, pure and authenticated cultures of fungi are deposited in National Fungal Culture Collection of India (NFCCI). Identification of about 450 fungal samples, received from 78 different academic and research institutions, and 09 private centres across the country were done, and 29 authentic fungal strains were supplied to various academic and private centres through the Fungal Identification Service (FIS).

Under the PAC on Biochemistry, Biophysics, Molecular Biology and Microbiology several areas of research such as cell organelles, structure-function relationships of macromolecules of biological processes such cell structure (bacterial, viral and eukaryotic), cell cycle, 3-D structures of proteins and peptides and nucleic acids, DNA and RNA structure and metabolism, control of gene transcription during development, electron transport proteins and bioenergetics, biological catalysis, macromolecular structure, membrane proteins, and biotechnology and biomolecular engineering and signal transduction were supported. The PAC is planning to develop frontier area of research in single-molecular approaches.

Chemical Engineering Programme (CEP) continues to achieve the best of both productivity and excellence in exciting frontline areas, involving quality fundamental research. In addition to a good number of publications in quality Journals, many of the studies would eventually create a base or find direct application in terms of process development and commercial practices. SERC Schools and workshops were conducted during the period, primarily aimed to target people from Universities, NITs and other Institutions to take up challenging R&D activities. Facilitation and support of R&D work in laboratories and institutions have resulted in more than 200 publications of high quality in national and international peer reviewed journals and conferences.

Electrical, Electronics and Computer Engineering Programme has evolved into a front runner in terms of efficiency, productivity and responsiveness. Contemporary areas and sub-areas of national as well as global relevance were identified to guide potential researchers in the Electrical, Electronics and Computer Engineering community. Facilitation and support of R&D work in laboratories and institutions have resulted in more than 200 publications of high quality in national and international peer reviewed journals and conferences.

Support to both basic and applied research was continued under the PAC on Material, Mining & Mineral Engineering. 29 new research efforts have been initiated / identified for support and another 39 are under evaluation.

A new PAC on Himalayan Glaciology has opened up several opportunities to scientists working on glaciers. The program deals with the structure and properties of glaciers, their formation and distribution, the dynamics of ice flow, and the interactions of ice accumulations with prevailing local weather conditions and regional climate forcings. Long-term observations at nine (9) identified glaciers under different climatic settings are in progress.

Studies in atmospheric science programme encompass a wide range of disciplines; include the physical, chemical, biological and dynamical aspects of the atmosphere (lower, middle and upper atmosphere), the monsoons, coupled land-ocean-atmospheric system, geosphere-biosphere interactions and development of atmospheric technology. Significant results were obtained in areas of Atmospheric Dynamics and Modeling, Space Weather Physics and Dynamics, Aerosols and Air Quality and Agrometeorology.

Various multidisciplinary projects related to earth sciences have been supported to different universities and institutions. Around 100 research projects have been received under the scheme and about 40 projects have been supported. As part of manpower development several contact/training programs have been conducted in the areas of national / global interest. Several initiatives were taken to address some of the important issues like increasing gap between international frontiers and Indian R&D in Solid Earth Geosciences, lack of innovation and newer ideas, poor international citations etc.

The Mathematical Sciences Programme promotes research in the areas of Mathematics, Statistics, Operations Research and Theoretical Computer Science. Twenty two new research projects were supported in the areas including Number Theory, Algebra, Graph theory, Game Theory, Wavelet Analysis, Differential Equations, Mathematical Modeling, Statistics, Reliability, Stochastic Modeling, and Optimization etc. Support to about 85 ongoing research projects in various areas of Mathematical Sciences was continued. As an outcome of research activities under ongoing projects about 100 research papers have been published in the journals of national and international repute during the year. Programmes/activities related to manpower development and training involving research students and young faculty members from the universities/

colleges/research institutions were also supported in various areas. The support to National Mathematical Sciences Initiative was continued for next phase of five years at Indian Institute of Science, Bangalore to organize thematic programmes on different topics at the interface between mathematics and other disciplines including compact lectures/ workshops/seminar etc. at various institutes in the country.

The Board constituted five Expert Committees on Fast Track scheme for Young Scientist in the areas of Chemical Sciences, Physical & Mathematical Sciences, Life Sciences, Engineering Sciences and Earth & Atmospheric Sciences. There is a significant increase of proposals submitted by young researchers. Several potential projects numbering a total of 880 in various disciplines were sanctioned and a total of Rs. 96.0 crores was disbursed to Young Scientists across the country.

PROMOTION OF AYURVEDA BIOLOGY

Department of Science & Technology, promotes research in newly emerging and front line areas of science and engineering. It is being planned to promote basic research in establishing biological basis of Ayurvedic treatment systems which has great traditions as well as Vedic systems of health care of India practiced effectively for thousands of years by millions of people. The empirical knowledge of Ayurveda is well established but the terms, concepts and its applications to describe types and functioning of the human body, to classify levels of health, and to describe the onset of disease have not yet been effectively related to modern scientific biology and medicine. It calls for intense research to establish and promote this area of utmost importance at international level.

The investigative work in this programme will necessarily involve the full participation of scientists and Ayurvedic experts who would be from established institutions of Science, Medicine, and Ayurveda in India. Individual or group of scientists, physicians and Ayurvedic experts are encouraged to submit project proposals on any interesting aspect of Ayurvedic concepts, procedures, or products, which would lend themselves to investigation by modern scientific protocols. The proposed studies would have active participation by scientific and Ayurvedic institutions. During the year research project entitled "Can Amalaki Rasayana Attenuate Cardiac Dysfunction Associated with Cardiac Failure and Aging" was undertaken by Rajiv Gandhi Centre for Biotechnology, Thiruvananthapuram, Kerala.

CHAPTER 2

STRENGTHENING INSTITUTIONAL CAPACITIES IN RESEARCH AND DEVELOPMENT

The Department of Science and Technology has extended support for strengthening the infrastructural facilities for post-graduate education and research in emerging areas of science and technology to universities and related institutions. Fund for Infrastructure Strengthening of Science and Technology (FIST) has continued to be successful ongoing scheme of the Department for past one decade. The scheme has improved the facilities at the university and college departments and also provided better exposure to the students for preparing their base in research. Consolidation of University Research for Innovation and Excellence (CURIE) is a special initiative to improve the R & D infrastructure of 'Women Universities' and all the six women universities are being supported by the Department at present this surely ensures to address the issue of gender parity in the long run. The Department has supported 44 Universities under the incentive based grant system "Promotion of University Research and Scientific Excellence" (PURSE) based on the evidence of scientific publications. There have been special packages for North Eastern Regions benefiting 70 institutions, J&K benefiting 41 institutions and Bihar benefiting 44 institutions during the year 2012-13.

FUND FOR IMPROVEMENT OF S & T INFRASTRUCTURE IN UNIVERSITIES AND HIGHER EDUCATIONAL INSTITUTIONS (FIST)

"**Fund for Improvement of S& T infrastructures in Universities and Higher Educational institutions" (FIST)** program was initiated by the Government during FY 2000-2001 to facilitate support towards augmenting higher education and research largely at the University and related Academic sectors by augmenting basic infrastructural facilities for teaching as well as for conducting research in basic or applied science areas including engineering, medicine, agriculture etc. During the last one decade or so, the program has enabled many departments across the country to perform cutting edge research and establish modern teaching facilities.

Currently, the Program is operating in the competitive mode of support at three levels i.e. Level 0, Level I and Level II covering seven areas such as Life Sciences, Physical Sciences, Chemical Sciences, Engineering Sciences, Earth and Atmospheric Sciences, Mathematical Sciences and PG Colleges. While the support under Level 0 is considered to PG Science & Applied science departments at colleges under "College as a whole", the supports under Level I and Level II are normally meant for departments of science and applied science areas in universities and related academic institutions. The financial support is considered mainly provided for four basic purposes i.e. Equipment, Networking & Computational Facilities, Infrastructural Facilities and Maintenance. Depending upon the Level, the total financial support is also limited to Rs 1.0 Cr, Rs 3.0 Cr and Rs 10.0 Crore for Level 0, Level I and Level II respectively.

At the beginning of every year, fresh proposals are sought through advertisements from eligible S&T related Departments and PG Colleges for considering support under this program. In the current year about 400 new proposals in all levels (L0 -116, Level I - 187 and Level II – 77) were received and finally 152 proposals (L0 - 42, Level I - 96 and Level II -14) were identified with verifying quantum of financial

support (from Rs. 20 lakh to Rs. 800 Lakh) at a total budget of about Rs.190 crores for 5 years. Besides this, support to a large number of ongoing projects was also provided during this year.

During the last one decade or so, more than 1800 S&T departments and PG colleges (Level 0-136, Level I-1529 and Level II-162) have been supported with a total investment of about Rs1500 crores or so. Teaching and Research infrastructure has been enriched in many departments.State of the Art facilities for performing high end research have been established. Some of the major facilities installed/recommended for support are : Neurosurgery Skills Training Facility involving Dissection Stations, High Resolution Transmission Electron Microscopy, FEG Based Scanning Electron Microscope, Dual Beam Focused Ion Beam Facility with Accessories, Nano-indentor with AFM/STM, 400 MHz NMR, 600 MHz NMR, Thermo-Mechanical Stimulator, Confocal Microscope, RT-PCR, Powder X-Ray Facility, Servo-Hydraulic Tensile Testing System, X-Ray Diffraction facility with Temperature Variation Facility, Protein Sequencing Platform, Electron Probe Micro Analyzer, Vacuum Melting Furnace, Atomic Force Microscopy, Raman Spectroscopy, Thin Film Deposition Systems such as Thermal Evaporation Setup, Electron Beam Evaporation, DC, RF and Magnetron Sputtering Systems, Chemical Vapour Deposition Systems, Nano-Imprint Lithography, Single Crystal X-Ray Facilities with CCD attachment, Universal Testing Machines, etc.

High Power Computational Cluster Facility has also been supported in many Departments. The departments of small colleges and universities have also been benefited by acquiring useful Text Books for the Departmental Library. The Program has also provided Communication technology based infrastructures in many departments such as Grid Computing, Networks and Communications systems.

Fig. 2.1: SQUID Magnetometer with Helium mini-Liquefier at Department of Physics, IIT Madras.

Fig. 2.2: Electron Probe Micro-Analyzer at Department of Materials Engineering, IIT Madras.

Fig. 2.3: Thermo-Mechanical Stimulator at Department of Metallurgical and Materials Engineering, IIT Roorkee.

Fig. 2.4: High Power Computer Cluster (256 Cores) and Thin Client Server Network at School of Physical Sciences, Jawaharlal Nehru University, New Delhi.

The progress achieved in the program is reviewed in one of the three methods such as i) through Progress Report ii) through Department's Presentation and iii) through on- the-spot visit to the department by the Expert Team. Reviews of ongoing projects identified and supported during FIST 2009 except Life Science area have been completed.

SPECIAL S&T PACKAGES

With a view to spread R & D base, state and region specific special packages have been evolved. North-Eastern Region package (2008) and Jammu & Kashmir Package (2009) were instituted for augmentation of the teaching and research facilities at the S&T departments of the Colleges and Universities in these states. Some of the salient features of these packages are: Augmentation of S & T infrastructure to Undergraduate Colleges, Enrichment of research efforts through exchange fellowships, Special assistance to Universities for acquiring teaching facilities, one time support to Universities for improving the quality of Power in these states, support for establishing major facilities, Summer/Winter school for UG and PG Students etc. A Special package for Bihar State has been initiated in the year 2011-12 and its implementation is now in progress.

CONSOLIDATION OF UNIVERSITY RESEARCH FOR INNOVATION AND EXCELLENCE IN WOMEN UNIVERSITIES (CURIE)

Strengthening Basic Research & Expanding R&D Base – Institutional Capacity:

Since 2009, 6 Women Universities namely, i) Avinashilingam Women University, Coimbatore, ii) Banasthali University, Banasthali, iii) SNDT Women University, Mumbai, iv) Sri Padmavati Mahila Visvavidyalayam, Tirupati, v) Karnataka State Women's University, Bijapur , and vi) Mother Teresa Women's University, Kodaikanal have been supported for 3 years under CURIE (Consolidation of University Research for Innovation and Excellence in Women Universities) programme. A visible impact of CURIE has been noticed on development of research facilities and infrastructure, human resource development and on the quality of research output in these universities. This has paved the way for **2nd** Phase of CURIE Programme which has been started in 2012 from Banasthali University, Banasthali.

PROMOTION OF UNIVERSITY RESEARCH AND SCIENTIFIC EXCELLENCE (PURSE)

In the 11th plan period, pro-actively the Department of Science and Technology initiated an incentive based program titled "**Promotion of University Research and Scientific Excellence" (PURSE)** to boost research at the University Sector. Based on the Study Report titled "Status of India in Science and Technology" conducted by the National Institute of Science, Technology and Development Studies (NISTADS), New Delhi as reflected in its publication output in Scopus International Database for 10 years periods i.e. 1996-2006 and 1998-2008, 44 performing Universities whose h-index ranging from 56 to 26 were identified and considered for support ranging from Rs 30.0 Crores to Rs 6.0 Crores depending upon h-index for 3 years period. A total investment of Rs 465 Crores was planned to these 44 Universities for this purpose. DST–PURSE intends to provide support to universities essentially for research man-power cost, augmentation of equipment and computational facilities, establishing research infrastructure, acquiring research consumables, fund for travel, organizing workshops and conferences, contingencies and maintenance of the facilities. Greater flexibilities with respect to areas of expenditure including selection of equipments required for research have also been provided to these Universities during implementation of the PURSE Project.

Some of the salient features of the program are as follows:

- The support provided to each university has been classified under '**Flexible**' and '**Fixed**' Components.
- The expenditure heads in '**Flexible Components (80-85%)'** are totally flexible among the expenditure heads like support for acquiring Equipment, Consumables, Infrastructure Facilities and Networking & Computational Facilities.
- The support areas in **'Fixed Components (20-15%)'** covers expenditure heads like Manpower Cost (10-15%), Contingences (1%), Travel (1%), Seminar/Workshop to organize or to attend abroad (1%) and Maintenance (2 %).
- No budgetary quotations for any equipment and other items are required for releasing grants by DST under this program. University will only inform DST about the equipment and other items as identified by them before acquiring and University would be responsible for all procurements.
- 'Manpower' to be engaged under this program should be for research and technical support and engaged on contractual basis and should not be equated with permanent faculty position.
- No support was made available for the building and civil construction related activities under PURSE initiative.
- Decision of Utilization of grants across different Departments of the Universities to be taken solely by the University.
- No Overhead amount is allowable.

The list of Universities which were identified through SCOPUS and now under support in PURSE program during 2009 and 2010 is given at **Table 1**.

A Program Management Board (PMB) constituted by the DST is continuously reviewing and monitoring the progress achieved in the projects at various Universities and guiding them for better performance.

Fig. 2.5: Single Crystal X-Ray Diffractometer as a Central Facility at Karnataka University.

Fig. 2.6: Scanning Electron Microscope with EDS Facility and Transmission Electron Microscope at University Science Instrumentation Centre at University of Rajasthan, Jaipur

Table 1: List of Universities supported under PURSE Program

S. N.	University	h-Index	Category
In 2009			
1	University of Delhi	56	**Category A**
2	University of Hyderabad	54	
3	University of Punjab	50	
4	University of Pune	44	**Category B**
5	Jadavpur University	43	
6	Banaras Hindu University	42	
7	University of Madras	37	**Category C**
8	University of Bombay	37	
9	Jawaharlal Nehru University	33	
10	Anna University	31	
11	Karnataka university	30	
12	Aligarh University	30	
13	University of Rajasthan	27	**Category D**
14	Andhra University	26	
In 2010			
1	University of Calcutta, Kolkata	42	**Category B**
2	Annamalai University, Annamalainagar	41	

S. N.	University	h-Index	Category
3	Bharathidasan University, Trichi	37	**Category C**
4	Bharathiar University, Coimbatore	37	
5	University of Burdwan, Burdwan	36	
6	Guru Nanak Dev University, Amrisar	36	
7	Sri Venkateswara University, Tirupati	35	
8	Mahatma Gandhi University, Kottayam	35	
9	University of Jammu, Jammu	34	
10	Cochin University of Science & Technology, Cochin	34	
11	M S University of Baroda, Vadodara	33	
12	Shivaji University, Kolhapur	33	
13	Utkal University, Bhubaneswar	33	
14	Madurai Kamaraj University, Madurai	32	
15	University of Kerala, Trivandrum	32	
16	Osmania University, Hyderabad	32	
17	Dr Harisingh Gour University, Sagar	32	
18	Mangalore University, Mangalore	31	
19	University of Kalyani, Kalyani	31	
20	University of Mysore, Mysore	30	
21	University of Lucknow, Lucknow	30	
22	Pondicherry University, Pudducherry	30	
23	CCS Haryana Agricultural University, Hisar	30	
24	Bangalore University, Bangalore	30	
25	Punjab Agricultural University, Ludhiana	29	**Category D**
26	Tamil Nadu Agricultural University, Coimbatore	27	
27	University of Agricultural Sciences, Bangalore.	28	
28	Alagappa University, Karaikudi	27	
29	Sardar Patel University, Anand	26	
30	North Eastern Hill University, Shillong	26	

Category A: Rs 30 cr for 3 years (@ Rs 10 crores per year)
Category B: Rs 15 cr for 3 years (@ Rs 5 crores per year)
Category C: Rs 9 cr for 3 years (@ Rs 3 crores per year)
Category D: Rs 6 cr for 3 years (@ Rs 2 crores per year)

SOPHISTICATED ANALYTICAL INSTRUMENT FACILITIES (SAIF)

The Department of Science & Technology has set up Sophisticated Analytical Instrument Facilities (SAIFs) in different parts of the country to provide the facilities of sophisticated analytical instruments to the research workers in general and specially from the institutions which do not have such instruments through its Sophisticated Analytical Instrument Facilities (SAIF) programme to enable them to purse R&O activities requiring such facilities and keep pace with developments taking place globally. At present the Sophisticated Analytical Instrument Facilities (SAIFs) are being supported by OST at lIT, Chennai; lIT, Mumbai; CORI, Lucknow; Panjab University, Chandigarh; NEHU, Shillong; lISc, Bangalore; AIIMS, New Delhi; Gauhati University, Guwahati; IIT, Roorkee; CVM, Vallabh Vidyanagar and Sophisticated Test & Instrumentation Centre (STIC), Kochi.

Fig. 2.7 : 700 MHz FT-NMR Spectrometer at the SAIF, Lucknow

Fig. 2.8 : EPR Spectrometer (X & Q band) at the SAIF, Mumbai

ANALYTICAL INSTRUMENT FACILITIES AVAILABLE AT THE SAIFs

The SAIFs are equipped with instruments such as Scanning Electron Microscopes, Transmission Electron Microscopes, Electron Probe Microanalyzer, Secondary Ion Mass Spectrometer, ICP, NMR, EPR Spectrometers, Mass Spectrometers, X-ray Diffractometers and Thermal Analysis Systems etc. to meet the needs of research workers in various areas of science & technology. Instrument facilities were strengthened during the year in the areas of high field NMR Spectroscopy, Electron Paramagnetic Resonance Spectroscopy and Thermal Analysis to meet the current and emerging needs of research community. Some of the major instrument facilities installed at the SAIFs during the year are 700 MHz FT-NMR Spectrometer (Fig. 2.7) at the SAIF, Lucknow; EPR Spectrometer (Fig. 2.8) at the SAIF Mumbai, and Thermal Analysis System at the SAIF, Kochi. The following instrument facilities are further being added to the existing SAIFs to strengthen them: EPR Spectrometer and Thermal Analysis System at the SAIF, Chennai, HR LC-MS/MS at the SAIF, Mumbai, FEG-SEM at the SAIF Chandigarh and SICART Vallabh Vidyanagar, 400 MHz Solid State FT-NMR Spectrometer at the SAIF, Bangalore and Mercury Analyser at the SAIF, Kochi. The SAIFs over the years have acquired the capabilities of repair and maintenance of instruments and a substantial number of the instruments with them are being maintained in-house. The instrument facilities at the SAIFs are accessible to all the users irrespective of whether they belong to the host institutes or are from outside the host institutes.

ANALYSIS PROVIDED/OTHER ACTIVITIES UNDERTAKEN

Analysis Provided/Usage of the facilities

- A wide range of analytical instrument facilities/techniques are being provided by the SAIFs to the research workers from all parts of the country. The instrument facilities at the SAIFs are meeting the analytical needs of scientists for materials characterization including qualitative/quantitative elemental, molecular/ compound analysis/characterization, structure determination, microstructure analysis and surface topographic studies etc., and enabling them to pursue research in various frontline areas of S&T.

- Services like solution to analytical problems including development of analytical methods for specific needs, sampling problems, spectrum analysis and interpretation of results etc. are also being offered by the SAIFs. Facilities and assistance for sample preparation are also being provided to the users.

- The facilities at the SAIFs facilitated research in various areas of Science & Technology. Some of these include synthesis of a variety of organic compounds, drug intermediates, extraction/study of natural products/screening for their biological activities, drugs & pharmaceutical research, research in various areas of Chemical sciences, Study of biomolecules and their structure elucidation, Research in Condensed matter physics/material science, Nano- science & technology, studies related to crops/ seeds, insecticides, various diseases etc. About 1,300 research papers were published by the users of the SAIFs with the support from the facilities provided during the year.

- About 15,200 research workers from all over the country utilized the facilities provided by the SAIFs during the year. These included research workers from almost all the universities in the country. About 86% of the users are from academic sector.

- About 1,35,000 samples were analyzed at the facilities during the year.

Workshops/Training programmes organized

Workshops and training programmes were organized by the SAIFs during the year on use and application of various instruments and analytical techniques to create awareness among the research community about them and on maintenance/repair/operation of the instruments for technicians. Some of the workshops/training programme organised are as follows:

- A workshop on "Basic Principles of Scanning Electron Microscopy" by SAIF, Shillong.

- A workshop on "Basic Principles of Transmission Electron Microscopy and its applications in Material Science" by SAIF, Shillong.

- A workshop on "Scanning Electron Microscopy" by SAIF Kochi.

- A training programme on "Electron Microscopy for Scientific Investigators" by SAIF, New Delhi.

- A workshop on "Single Crystal X-ray Diffraction and Structure Analysis" by SAIF, Kochl.

- A workshop on "Vibrating Sample Magnetometry" by SAIF, Chennai.

- A workshop on "Advanced Analytical Techniques" by SAIF, Mumbai.
- A workshop on "Nuclear Magnetic Resonance Spectroscopy" by SAIF, Chennai.
- A symposium on "New Developments in NMR" by SAIF, Bangalore.
- A workshop on "Applications of NMR in Chemical and Biological Sciences" by SAIF, Shillong
- A workshop on "Mass Spectrometry" by SA IF, Lucknow.
- Workshops on "Chromatographic Techniques" and "LC-Mass Spectrometry" by SICART, Vallabh Vidyanagar. Apart from the above workshops/training programmes for. researchers the SAIFs at Lucknow and New Delhi also organized short term training on various instruments/techniques for graduate/post-graduate students.

Analytical techniques developed/significant analysis done/research work facilitated.

Some of the analytical techniques developed/significant analysis done/research work facilitated by the SAIFs during the year are as follows:

- A new weak alignment medium "xanthon" for enantiomeric discrimination by NMR has been discovered at the SAIF, Bangalore.
- Procedure for Matrix Assisted DOSY experiment was optimized and new media for differentiating isomeric species by NMR was discovered at the SAIF, Bangalore.
- A novel NMR pulse sequence for exciting overtone transitions has been demonstrated at the SAIF, Bangalore.
- Combined use of HSQC, HSQC- TOCSY and NOESY was optimized for studying designed B-hairpin peptides at the SAIF, Bangalore.
- In a research work facilitated by the SAIF, Bangalore, entangement in a 3-spin Heisenberg-XY chain was demonstrated with NMR
- In a research work conducted at Jamia Hamdard University and facilitated by the TEM facility at the SAIF, New Delhi it was revealed that the drugs resiglitazone and pioglitazone caused extensive damage to the myocardium as evidenced by condensed chromatin, loss of mtyofibrils, vacuolization and aggravated doxorubicin-induced cardiomyopathy.
- In a study conducted on surface tailored nanoparticles for targeted delivery of acyclovir at Dr. H.S. Gaur University, Sagar, it was found that galactose conjugated PLGA nanoparticles can be used as vehicles for delivery of bioactives to the liver in its disorders. This work was facilitated by the SAIF, New Delhi
- In a research work done at AIIMS, New Delhi and facilitated by the TEM facility at the SA IF, New Delhi it has been found that cultured oral mucosal epithelial cells (OMEC) have the potential for autografts for ocular surface reconstruction in patients with bilateral ocular surface disease (OSD) and can prove beneficial to ameliorate the mucin deficiency state in dry eye.

- In a study facilitated by SAIF, Lucknow it has been found that antimony complexes [antimony (III) bis (dialkyldithiocarbameto) alkyldithiocarbonates] exhibit antibacterial properties against different human pathogenic bacteria strains.

DST and Research Council (RC-UK) Collaborative Research Activities

Since 2008, the Department of Science and Technology and the Research Council, UK (RC-UK) are actively engaged to initiate and promote the collaborative research activities between two countries. Through these collaborative activities through various programs like Science Bridges, Next Generation Networks, Solar Research Initiative, Fuel Cell, Bridging Urban & Rural Gap (BURD) etc. during last 4 years and an investment commitment of around 25-26 M UK Pound have been done by each country for these collaborative research activities. While the projects under the Science Bridges are coming to an end shortly, the projects under other collaborative areas are presently in progress between two countries.

1. Indo-UK Advanced Centre (IU-ATC) of Excellence in Next Generation Networks

Department Research Council, UK initiated the Indo-UK Consortium project in 'Next Generation Networks' at a investment of 5 M GBP by each DST as Indian Partner and RC-UK as UK Partner for 60 months. In 2008, the Phase 1 of this project was initiated at a total cost 2.5 M GBP by each country for a period of 30 months. Based on the success of this project in Phase I activities, activities at the Phase 2 of this joint project was commissioned at a total of about Rs 18 crores (Indian portion) in October 2012 with nine participating Institutes from Indian Side. Similar number of participating Institutions is also involved from UK side in this joint collaborative program as well.

Research Groups in both countries are mainly concentrating on three broad areas i.e.

1. Application and Services
2. Core Networks Systems
3. Heterogenous Wireless Access Networks (HELNET)

The IU-ATC project currently represents the largest scientific collaboration of its kind between the UK and India and provides the unique and internationally competitive research eco system in Phase 2. In the consortium, the partner institutions in India and UK that bring the necessary expertise required to work jointly to achieve the desired impact and associated resources that each partner brings. This project is expected to develop novel solutions for research, innovation in Next Generation Communication Technology and wealth creation opportunities between UK and India.

2. Research Initiative on Solar Energy

Based on the joint Workshop between the academicians and researchers of the two countries, in April 2009 both Department of Science and Technology, India and the Research Council (RC) of UK agreed to co-fund a joint research initiative in Solar Energy by investing 5 M GBP each towards fostering of genuine and mutually beneficial research to develop novel materials, devices and systems applicable to solar energy. The areas of mutual interest identified for cooperation include the following:

1. Thin Film Performance and Stability

2. PV power systems and distribution

3. Cost Effective isolated PV Systems

4. Low cost materials for PV and

5. Excitonic Solar Cells with focus on cost reduction

In Solar Energy Research Initiative, two projects with multi-institutes participations were supported with Lead Institute as National Physical Laboratory (NPL), New Delhi and Indian Institute of Technology Bombay, Mumbai at a total cost of about Rs 23.5 crores (Indian portion) for three years. The activities under these projects are continuing in full swing and monitored and reviewed regularly including the release of financial grants

The project "*Advancing the efficiency and production potential of exictonic solar cells (APEX)*" is partnering with National Physical Laboratory (NPL), New Delhi, National Chemical Laboratory (NCL) Pune, Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR), Bangalore, Indian Institute of Technology Delhi (IITD), Indian Institute of Chemical Technology (IICT), Hyderabad and Indian Institute of Technology (IIT), Kanpur. This project focuses on the development of materials, device structures, material processing and Photo-Voltaic panel engineering of Excitonic solar cells.

Similarly, the other project "*Stability and performance of Photovoltaic (STaPP)*" is being implemented at Indian Institute of Technology Bombay, Mumbai along with Solar Energy Centre, Delhi, Indian Institute of Technology, Kharagpur and Indian Institute of Technology, Kanpur. The project aims around the need to improve performance of photovoltaic systems and focuses to how photovoltaic installations could be realistically deployed. The project addresses the important issues such as Stability and degradation/changes in performance and life time of solar cells.

3. Research Initiative on Fuel Cells

As a follow up of the Ministerial level meeting held between two countries and on the basis of discussion meeting was held at DST with the delegation of RC-UK and DST, the Research Initiative on Fuel Cell was initiated in the year 2010 with an investment plan of 3M GBP each for collaborative research activities in this area. Based on the outcome of the joint Workshop and on joint announcement on theme areas like i) Fundamental of Fuel Cell Operation, ii) Durability & Degradation aspects of Fuel Cell, iii) System Integration, and iv) Fuel Flexibility, in March 2011 the Joint Panel on Fuel finally recommended for supporting of following four proposals under this program at the total cost of Rs 866 lakh for 3 years project duration. These projects have now been sanctioned and necessary funds have also been transferred to respective implementing organization.

In the current year, three more new areas like Advanced Manufacturing, Smart Grid and Storage Energy and Applied Mathematics have been identified for collaboration between Research Council, UK (RC-UK) and the Department of Science and Technology. An approximate investment of 8.5 M GBP by each country is expected to make for initiating these three new areas. Three Workshops (one for each area) were organized in the current year (one in India and two in UK) to identify the Theme areas of collaborations by both countries. Based on joint cell by the two countries, proposals thus received in each area are presently being processed as per joint format and expected to finalize by March, 2013.

S.No	*Project Title*	*Indian Lead Partner*	*UK Lead Partner*	*Approved Cost*
1	"Mind the Gap"- jumping the hurdles limiting polymer Fuel Cell performance and commercialization	Dr. N. Rajalakshmi CFCT Chennai	Prof. Anthony Kucernak Imperial College, UK	Rs 348.7 Lakh
2	Performance Optimization of IT-SOFC by Inkjet Printing on Porous Metal Substrates (JETCELL)	Dr. K. Balasubramaniam NFTDC, Hyderabad	Dr. R.V. Kumar University of Cambridge, UK	Rs 273.2 Lakh
3	Advancing Biogas Utilization through Fuel Flexible SOFC	Dr. Rajendra N. Basu CGCRI Kolkata	Prof. John Irvine, University of St Andrews, UK	Rs 156.83 Lakh
4	Modeling Accelerated Ageing and Degradation of Solid Oxide Fuel Cells (MAAD-SOFC)	Prof. Ranjit Bauri IIT Madras	Prof. R. Ormerod Keele University, UK	Rs 87.01 Lakh

Table : Joint Project under India-RC, UK Program in Fuel Cells

INTENSIFICATION OF RESEARCH IN HIGH PRIORITY AREA (IRHPA)

In Physical Sciences two projects, one to create a focused and effective programme for the applications of quantum field theory to elementary particle physics, condensed matter systems, quantum computation and at their interfaces; and another project to initiate and expand experimental activities in several growing areas in condensed matter physics, including semiconductor spintronics, nanoscale manganites, carbon nanotubes and grapheme, quantum dots/ wires, organic semiconductors were sanctioned.

A major project has been supported to establish a pilot scale facility & manufacturing technology for Lithium Ion Batteries with proven materials and develop novel anode, cathode, electrolyte materials & demonstrate their usage in Lithium Ion Batteries for improved performance. M/s. Ashok Leyland is also collaborating in this project to provide benchmark specifications and test prototype batteries under real life conditions in their buses.

Another major project to find a gate stack on high mobility Ge channels that meets sub-32nm node ITRS specifications by mapping out the trade-offs between capacitance (k-value), gate leakage (band offsets) and interface states for various advanced Hi-K dielectric materials & deposition techniques for logic applications and identify a viable RRAM stack by evaluating various oxides / electrodes using different processing techniques for memory applications was supported.

The project on 'Studies on the Troposphere features and Stratosphere Troposphere coupling processes over the Monsoon region using Stratosphere Troposphere (ST) Radar at Cochin' has completed the process of land allocation, identification of the vendors, etc for building construction, development and integration of various sub-systems. A National Facility for Low-Temperature Thermochronology has been developed at Department of Geophysics, Kurukshetra University, Kurukshetra.

PAC on Mathematical Sciences has provided major support to Centre for Mathematical Sciences (CMS) at Pala, National Centre for Advance Research in Discrete Mathematics at Kalasalingam University, Centre for Interdisciplinary research in Mathematical Sciences (CIMS) at Banaras Hindu University (BHU), Varanasi, Centre for Mathematical Biology at Indian Institute of Science, Bangalore, Centre for Mathematical Sciences at Banasthali University, Rajasthan, Centre for Mathematical Sciences at CR Rao Advanced Institute of Mathematics, Statistics and Computer science, Hyderabad.

MEGA FACILITIES FOR BASIC RESEARCH

This programme was launched to create Mega Science facilities and launch Mega Science programmes in and out of the country to improve access to such state-of-the-art facilities for the Indian scientific community, especially from the academic sector.

Under this programme, several important developments took place during the year.

Considerable progress was made on the project "*Facility for Antiproton and Ion Research (FAIR)*". An industry meet was organized involving a large number of people from Indian industry and FAIR representative (via video link from Germany) and detailed discussions were held on the scope of Indian industry at FAIR. Also, first contract was signed between ECIL-Hyderabad and BI-IFCC for design and building of 530 power converters. Detailed discussions took place among the members of 3 experimental communities i.e. CBM, PANDA, NUSTAR to identify and prepare DPR for their participation in respective FAIR experiments. 2 International collaborations meetings of CBM and NUSTAR experiments were also held at VECC and details of these experiments were worked out. Expressions of Interest were obtained from Indian industry for building ultra high vacuum chambers for FAIR. BHEL and L&T had detailed technical discussions with experts at VECC on design and building of large superconducting magnets. A website was also set up for FAIR related information. Deliberations continued by Indian members in various FAIR subcommittees (FAIR council, FAIR In-kind Review Board, FAIR Machine Advisory committee, FAIR science council and FAIR Admin and Finance committee which contributed significantly in various issues. One Indian Scientist was selected as vice-chairman of FAIR council, the highest decision making body in FAIR.

Assembling of beamline for macromolecular crystallography and high pressure physics at the Elettra Synchrotron Radiation Facility at Trieste, Italy along with procurement of crucial equipment items including detector continued during the year.

Support to CMS, ALICE and LHC Grid projects at the Large Hadron Collider (LHC) at European Centre for Nuclear Research (CERN), Geneva continued during the year. During the year, Indian Groups continued contributing in STAR and ALICE collaborative experiments through hardware and software development of the experiment.

The scientists working at the LHC at CERN discovered a new particle "Higgs Boson", also popularly known as God Particle. *Higgs* stands for British physicist Peter Higgs while *Boson* for famous Indian physicist Satyendra Nath Bose.

Indian efforts and investments through hardware, software and skilled manpower support made valuable contributions in the construction of LHC, the CMS (Compact Muon Solenoid) and ALICE (A Large Ion Collider Experiment) Experiments and the development of the LHC Computing Grid. India has initiated efforts to have *'Associate Membership'* of CERN which will help Indian scientific community in a big way in times to come like.

The process for financial sanction of the project "India-based Neutrino Observatory (INO)" initiated by DAE continued during the year.

The project by Indian physicists to collaborate in Neutrino Projects at Fermilab (USA) gained momentum during the year.

Scientific deliberations on other important projects - participation in construction of the Thirty Metre Telescope (TMT) at Mauna Kea in Hawaii, the Square Kilometre Array (SKA) and one arm of the Laser Interferometer Gravitational Wave Observatory (LIGO) etc. also continued during the year.

CHAPTER 3

STRENGTHENING OF HUMAN CAPACITY IN RESEARCH

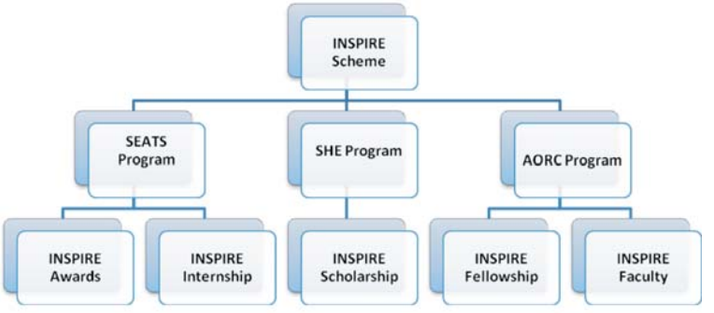
Recognizing the need to progressively increase the rate of generation of high quality skilled human resources at all levels, the Department of Science and Technology has initiated several initiatives to meet the shortages in skilled human resources in science and engineering. Highly skilled human resources are described as essential for the development and flow of knowledge and form the crucial links between technological progress and economic growth and environmental wellbeing. The country wishes to build a highly competitive and knowledge based economy in the world, capable of sustainable economic growth with more and better jobs and greater social cohesion. It is necessary to create suitable conditions for attracting and nurturing young talent to take up research and development and open the domain of knowledge to all irrespective of caste and creed. A number of unique pioneering initiatives by the Department includes the INSPIRE programme, International Olympiads, Fast Track Scheme for Young Scientists, JC BOSE National Fellowships, Ramanujan Fellowships, Swarna Jayanti Fellowship Scheme, Utilization of Scientific Expertise of retired Scientists (USERS) and BOYSCAST were implemented aimed at increasing the stock of the scientific community necessary for meeting future challenges and also stopping exodus of scientists from Indian Scientific Institutions. INSPIRE the flagship programme of Government of India aims towards dealing attrition in science and technology has supported more than 7.6 lakh awards for the age group of 10-15, 1.5 lakh internships for age group of 16-17, 28,000 scholarships for undergraduate studies in sciences for youth in the age group of 17-22, about 2900 research fellowships for doctoral research and 136 faculty awards for post doctoral researchers under the age of 32.

INNOVATION IN SCIENCE PURSUIT FOR INSPIRED RESEARCH

Introduction

Innovation in Science Pursuit for Inspired Research (INSPIRE) is a national programme implemented by the Ministry of Science & Technology for attraction of talent amongst the students to study Science and pursue career with research. The basic objective of the programme is to communicate to the youth of the country the excitement of creative pursuit of science, attract talent to the study of science at an early age and thus build the required critical human resource pool for strengthening and expanding the science and technology system and R&D base. The programme was launched by the Hon'ble Prime Minister on 13th December 2008. The implementation started during 2009-10.

Schematic representation of the INSPIRE Scheme is given below:



"Innovation in Science Pursuit for Inspired Research (INSPIRE)", a flagship program of the department developed and implemented nationally by the Department of Science & Technology aims to attract, attach, retain and nourish talented youth for strengthening the R&D base. INSPIRE has three schemes namely **a) Scheme for Early Attraction of Talents for Science (SEATS), b) Scholarship For Higher Education (SHE) and c) Assured Opportunity for Research Careers (AORC)** with five components e.g. INSPIRE Award, INSPIRE Internship INSPIRE Scholarship, INSPIRE Fellowship and INSPIRE Faculty Award**.** It was approved by the Government of India in the 11th Plan Period and is being continued in the 12th Plan Period.

1 INSPIRE Award :-

While the first component of the Scheme i.e. INSPIRE Award is being implemented centrally through the States / UTs, the other components of the Scheme are being implemented centrally by Department of Science & Technology (DST) through the concerned academic/research institutes & Universities etc.

1.1 Under this scheme, during the five year period two students are selected from every Middle and High School of the country for an INSPIRE Award of Rs.5000/- each for preparing a Science Project / Model. These awardees, who are students from classes 6th to 10th, then participate in a three tier competition: District, State and National Level. The projects exhibited are evaluated by a jury of experts. All the 28 states and 7 UTs are participating in the scheme. INSPIRE Award Warrant is issued directly in the name of selected student and sent to him/her through State/school authorities. Award amount includes cost of making a science project / model as well as cost of bringing the project / model at District level Centre for Exhibition / Display Competition.

1.2 All Awardees under the scheme participate in the District Level Exhibition and Project Competition (DLEPC). Best 5 to 10 per cent entries from the district are selected for participation in a State Level Exhibition and Project Competition (SLEPC). Best 5 per cent entries from the State/UT, subject to a minimum of 5, are selected to participate at the National Level Exhibition and Project Competition (NLEPC). At all levels, the projects are evaluated by a Jury of experts. Participation/merit certificates are issued to the selected awardees of DLEPC, SLEPC and NLEPC, as well as, mentor / teachers who guided them for the preparation of the projects. The entire cost of organizing exhibitions at district, state and national level is borne by the Department of Science & Technology (DST).

1.3 Merit based nomination of the students for INSPIRE Awards is done by Head Master/Head Mistress/ Principal of each school, who is required to send nomination of best children having aptitude for science, with requisite details, giving also the criteria adopted by the school for nomination and selection. District education authorities compile details of the schools in their jurisdiction in the prescribed format and send the proposal to DST through the State education authorities, for final selection.

1.4 All schools in the country, recognized by the District / State Education authorities, whether Government or private, aided or un-aided, run by Central Government or State Government or local bodies, and having classes 6 to 10 are eligible to participate in the scheme.

1.5 Proposals so received from the State authorities are processed in DST in accordance with the norms of the scheme and the list of the selected students is sent to the banker of DST for preparation of Award Warrants in the name of selected students. The Award Warrants so received from the bank are sent to State authorities for onward delivery to the selected awardees through district education authorities/ concerned schools.

1.6 More than 6.85 lakh Awards have been sanctioned. (State wise details is given at **Table-I).** About 48% of awardees are girls, and 25% SCs/STs.

1.7. Under the INSPIRE Award scheme, more than 5 lakh awardees have participated in the DLEPCs, and about 40000 best entries of DLEPC have participated in the SLEPCs. 688 science projects/models from SLEPCs participated in the 1st NLEPC held at Delhi during 14-16 August, 2011. Her Excellency, the then President of India was the Chief Guest for the Award Ceremony held on August 16, 2011. Out of the 688 projects which participated in the 1st NLEPC held during August 2011, 85 have been shortlisted by the Patent Facilitating Centre of TIFAC for detailed examination for possible patenting in some cases. 1064 science projects/ models participated in the 2nd NLEPC scheduled at Delhi from 21-23 October 2012. During 2nd NLEPC also, TIFAC has done preliminary identification of some models for protecting IP. Hon'ble Minister (S&T) was the Chief Guest.

1.8. Entire expenditure in connection with conduct of DLEPCs, SLEPCs and NLEPCs is borne by DST. An amount of Rs.442.69 crore has been spent so far on the scheme, out of which Rs. 86.49 crores has been released to the States/UTs to meet the expenditure in connection with DLEPC / SLEPC/ NLEPC.

1.9. **E-management of the INSPIRE Award Scheme.**

DST plans to e-manage the entire INSPIRE Award Scheme by using State-of-Art latest Information Technology. An E-management Agency has since been identified and a contract was signed between DST and the E-management Agency on 1st August, 2012 for development, supply, installation of an application software and other related activities for E-Management of INSPIRE Award Scheme for five years.

Annexure-I

INSPIRE Awards - Status as on 17.12.2012

S.No	State/UT/ Organisations	No. of Awards sanctioned	Total amount sanctioned for the awards (@ Rs. 5000/- per Award) (Rs. In lakhs)*	Amount released to States/UTs for organising competitions at various levels (Rs. In lakhs)
1	**2**	**3**	**4**	**5**
1	Andhra Pradesh	55125	2756.25	705.20
2	Arunachal Pradesh	438	21.90	11.56
3	Assam	4129	206.45	64.54
4	Bihar	27933	1396.65	107.07
5	Chattisgarh	35600	1780.00	525.52
6	Goa	398	19.90	5.60
7	Gujarat	58591	2929.55	155.65
8	Haryana	14837	741.85	261.02
9	Himachal Pradesh	9365	468.25	191.14
10	Jammu and Kashmir	8706	435.30	119.71
11	Jharkhand	11789	589.45	103.38
12	Karnataka	71432	3571.60	758.06
13	Kerala	10766	538.30	70.93
14	Madhya Pradesh	79480	3974.00	1008.67
15	Maharashtra	67336	3366.80	1171.47
16	Manipur	850	42.50	19.32
17	Meghalaya	1911	95.55	21.57
18	Mizoram	2407	120.35	46.57
19	Nagaland	292	14.60	7.52
20	Orissa	14760	738.00	317.02
21	Punjab	18358	917.90	165.16
22	Rajasthan	73902	3695.10	342.36
23	Sikkim	631	31.55	13.71
24	Tamil Nadu	33425	1671.25	438.75
25	Tripura	1717	85.85	41.58
26	Uttar Pradesh	58819	2940.95	1737.48
27	Uttarakhand	3708	185.40	26.87
28	West Bengal	12391	619.55	149.56
29	A&N Islands	264	13.20	5.88
30	Chandigarh	493	24.65	6.94
31	Dadra and Nagar Haveli	245	12.25	3.26
32	Daman and Diu	235	11.75	2.59
33	Lakshadweep	17	0.85	0.98
34	NCT of Delhi	2990	149.50	26.06
35	Puducherry	727	36.35	2.50
36	Kendriya Vidyalaya Sangathan	1018	50.90	14.53
	Total	**685085**	**34254.25**	**8649.70**

* INSPIRE Award Warrant is issued directly in the name of selected student and sent to him/her through the State Education machinery.

2 **INSPIRE Internship:** It has two components namely **INSPIRE Award and INSPIRE Internship.** It provides an opportunity for interactions with leading national/ international academicians and scientists including Nobel Laureates to more than 50,000 top one per cent meritorious students pursuing science at class XI standard.

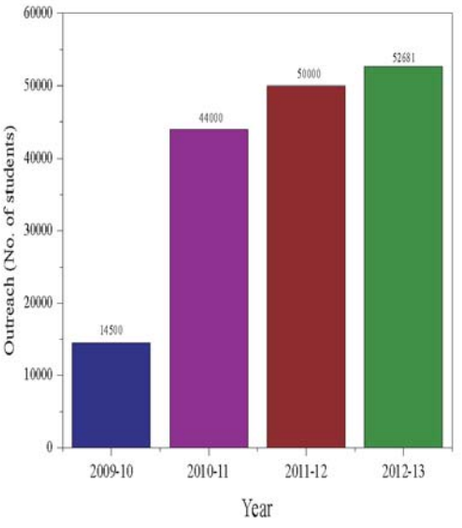


Fig. 3.1: INSPIRE-Internship: Growth Profile

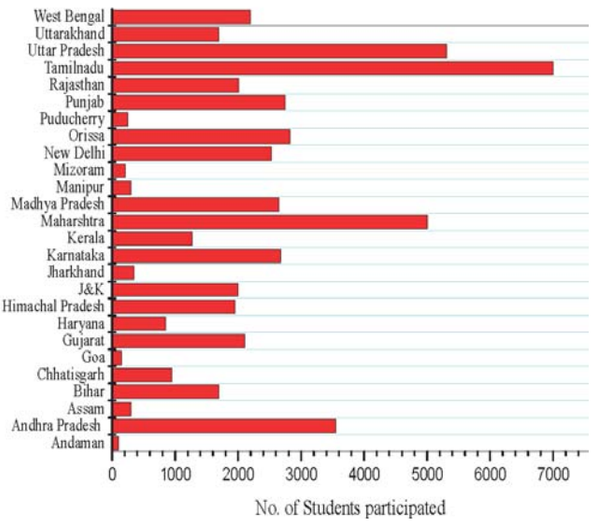


Fig. 3.2: INSPIRE-Internship: State-wise Distribution of Interns.

During the year under **INSPIRE Internship** more than 190 Science Camps organized so far covering 45000 students and more than 40 camps are in pipeline to organize till the end of the year so that the targeted number of 50,000 in the current year would be met (Figure 3.1 & 3.2). Also events like VIJYOSHI and Science Conclave at Bangalore and Allahabad respectively have been organized involving Nobel Laureates and International Scientists/ Academicians. In these INSPIRE Internship Camps students are given an opportunity for 5 days to interact with global/ national science leaders from India and abroad and discuss many exciting topics of science, engineering, medicine etc. Five Nobel Laureates along with more than twenty reputed International scientists had participated in these camps apart from many reputed Indian academicians and scientists.

3. **Scholarship for Higher Education (SHE)** scheme aims to enhance rates of attachment of talented youth to undertake higher education in science intensive program by providing scholarships and mentoring through summer attachment under the supervision of performing researchers. The scheme offers 10,000 Scholarships every year @Rs 0.80 lakh per year for undertaking undergraduate and post-graduate levels education in natural and basic sciences for the talented youth in the age group 17-22 years. The main feature of the scheme is in mentorship support being planned for every scholar through **INSPIRE Scholarship.**

During the current year, target strength of INSPIRE 10,000 scholarships are being awarded to the students for pursuing the science courses at the undergraduate level (Figure 3.3). Besides these, INSPIRE Scholarships to about 13,000 students are also being continued.

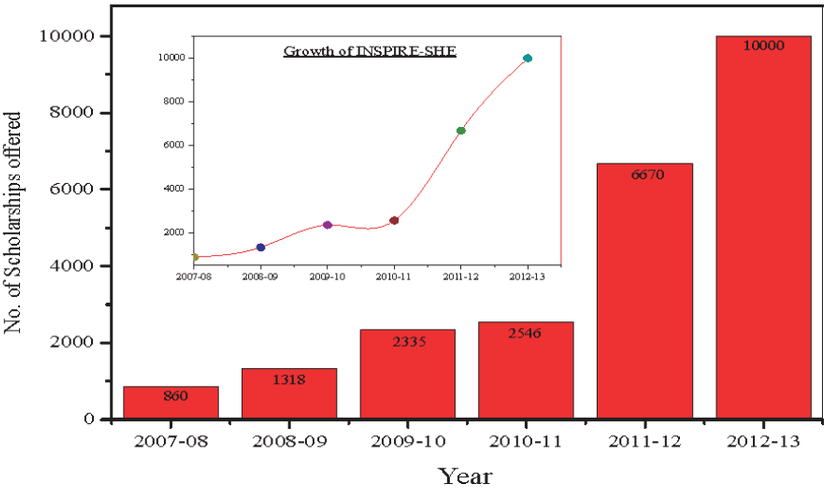


Fig. 3.3: INSPIRE-Scholarship : Growth Profile

4. Assured Opportunity for Research Careers (AORC) scheme has two components namely **INSPIRE Fellowship** and **INSPIRE Faculty Award.**

4.1 INSPIRE fellowship : The scheme envisages opportunities to the first Rank holder in their university level post-graduate programs in both basic and applied sciences including engineering, agriculture, veterinary, medicine etc., for pursuing doctoral degree at any recognized University and any other academic Institutions in the country. During the year 2012-13, total 1127 students have been selected so far including 461 provisionally selection for offering

INSPIRE Fellowships for pursuing their doctoral program at different Universities, Laboratories and academic Institutions in the country. Out of 1127 students selected by now, 666 INSPIRE Fellows have already been registered/ got admission in to doctoral program at the Universities/ Laboratories/ Institutions and availed the fellowship and other grants. Figures 3.44, 3.55, & 3.6 indicate the Growth Profile, Subject-wise Distribution and Gender-wise distributions respectively of the INSPIRE Fellows instituted during last three years of implementation of the component.

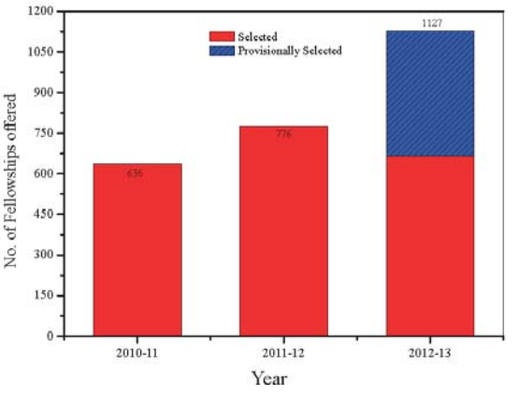


Fig. 3.4: INSPIRE Fellowship – Growth Profile

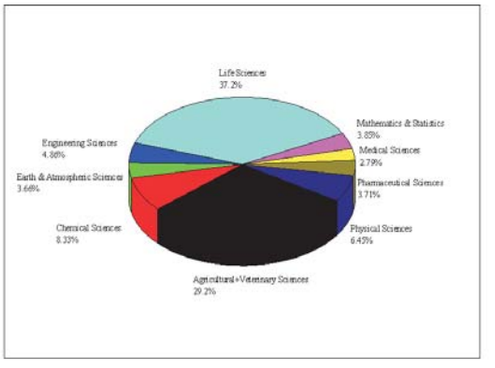


Fig. 3.5 : INSPIRE Fellows – Subject-wise Distribution

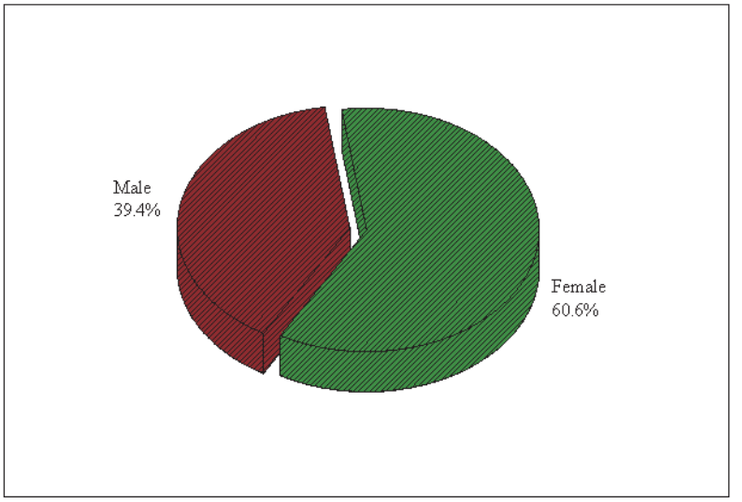


Fig. 3.6: INSPIRE Fellows - Gender-wise Distribution

4.2 INSPIRE Faculty Award is the second component of AORC Scheme which offers a contractual and tenure track positions to the doctoral students in both basic and applied sciences including engineering, agriculture, veterinary and medicine areas for pursuing 5 years independent research activities at any recognized University/ academic Institutions/ Laboratories in the country. During the current year in two rounds of selection process, 177 doctoral candidates have been offered the INSPIRE Faculty Award for pursuing their career in research activities independently at different recognized Universities, Research Laboratories and Academic Institutions across the country. Out of 177 candidates to whom the INSPIRE Faculty Award have been offered, presently around 136 candidates have already been positioned themselves at their chosen Host Institutes for the implementation of the Faculty Award and also received the award grant as well. The third round of selection process is in progress and is expected to complete by end-December 2012. Figures 3.7 & 3.8 indicate the distributions with respect to various Subjects and Gender of the selected INSPIRE Faculties so far in last two rounds of selection.

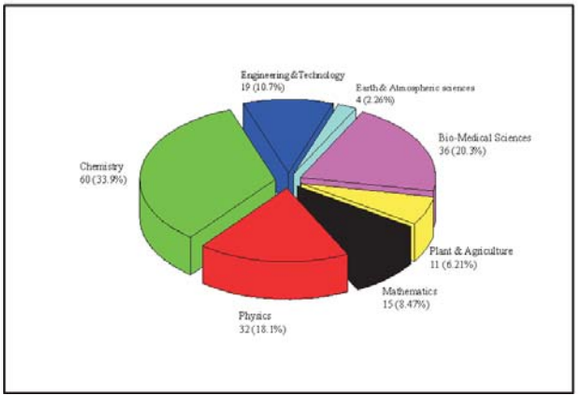


Fig. 3.7: INSPIRE-Faculty Award – Subject-wise Distribution

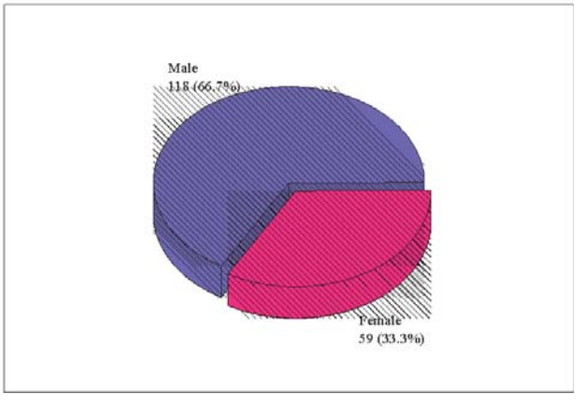


Fig. 3.8: INSPIRE Faculty Award - Gender-wise Distribution

Fig. 3.9: Photographs of Various Camps in the Country

THE JC BOSE FELLOWSHIP

To recognize active scientists and engineers for their outstanding performance and contributions, department instituted JC Bose fellowships. These fellowships are scientist–specific and very selective. J C Bose fellowship are open to Indian Nationals residing in India, with upper age limit of 68 years for completion of fellowship and are having regular positions in various institutions. The value of the fellowship is Rs. 25,000 per month in addition to the Fellow's regular income. In addition, it carries a research grant of Rs. 10.00 lakh per annum. 13 JC Bose fellows are supported this year in various science and engineering streams. The JC Bose fellows have average published 6.5 papers per year per fellow in journals of average impact factor 3.6, and have produced average of one PhD per year per person.

THE RAMANUJAN FELLOWSHIPS

Department instituted Ramanujan National Fellowships for brilliant scientists and engineers from all over the world to take up scientific research positions in India. It is especially directed at scientists and engineers below the age of 60 years, who want to return to India from abroad. The Ramanujan Fellows can work in any of the scientific institutions and universities in the country. The duration of Ramanujan Fellowship is five years. The value of the fellowship is Rs.75,000 per month. Each Fellow, in addition, receives a research grant of Rs. 5.00 lakh per annum. 29 scientists were selected for the award of this prestigious fellowship this year.

UTILIZATION OF SCIENTIFIC EXPERTISE OF RETIRED SCIENTISTS (USERS)

USERS scheme aims to utilize the expertise and potential of large number of Eminent Scientists in the country who remain active and deeply motivated to participate in S&T development even after their retirement. The main activity under this programme is preparation of books/monographs and state of art-reports. Several retired scientists have been supported and 19 projects were sanctioned during this financial year. Some of the important projects commissioned during the year include: Changing Indian Higher Education in Contemporary Scenario: Innovation, Excellence and Values; Health & Safety in Industries & Hospitals; Application of Clay Science in Industry Engineering and Environment; Principles and Applications of Quantum Chemistry; Virus and Virus-like Diseases of fruit crops and their Management; Elements of Green Chemistry with Green Laboratory Experiments; Characterization of Polycrystalline and Amorphous Catalytic materials using powder X-ray diffraction; Sex Differentiation in Fish, Part 2 Endocrine Sex Differentiation, Part 3 Environmental Sex Differentiation; and Statistical Methods - Preparation of New Enlarged Revised Edition, 3rd Edition.

CHAPTER 4

TECHNOLOGY DEVELOPMENT

The Department of Science and Technology has been engaged in promoting technologies developed by public funded institutions. Focused areas for development and deployment of technology solutions are water, solar energy, affordable health care, potash based fertilizer, homeland security. The Drug and Pharmaceutical Research Programme (DPRP), of the Department has promoted a number of Public Private Partnership (PPP) initiatives in drug research. A major outcome of the DPRP is in the commercial launch of a new anti-malarial drug (SYNRIAM) developed through indigenous research through public private partnership. The drug has been launched for global market and is expected to bring down the cost of treatment. The Department has started receiving royalty payment for the first time for the product developed under DPRP. Under the Water Technology Initiative (WTI) programme the Department aims to provide safe drinking water under real life condition and encourages indigenous research initiatives addressing issues related to water availability, purification and water use and recycling. Under the Solar Energy Research Initiative (SERI) the Department aims to provide 24x7 off grid power supply by promoting technological innovation and breakthroughs in the area of solar energy. A 256 kW decentralized power generation system based on hybrid technology solar energy during the day and biomass during the night for off-grid applications has been established in a village in Maharashtra, thus opening a possibility for 24x7 off grid power supply application.

DRUGS AND PHARMACEUTICALS RESEARCH PROGRAMME

The Drugs and Pharmaceuticals Research Programme (DPRP) was initiated by DST in 1994-95 for promoting Industry-Institutional collaboration in drug and pharmaceuticals sector. This programme aims at enhancing capabilities of institutions and the Indian Drugs & Pharmaceuticals Industry towards development of New Drugs in all systems of medicine. The specific objectives of this scheme are:

- To synergise the strengths of publicly funded R&D institutions and Indian Pharmaceutical Industry in developing drugs in areas of national relevance.
- To create an enabling infrastructure, mechanisms and linkages to facilitate new drug development.
- To stimulate skill development of human resources in R&D for drugs and pharmaceuticals.

Projects supported during 2012-13

Collaborative Projects

1. Replacement of herbal roots used in traditional ayurvedic formulation by substitution with other parts among National Institute of Interdisciplinary Science & Technology (NIIST), Thiruvananthapuram / Arya Vaidyasala Nilayam, Kotakkal.
2. Scientific validation of safety protective and curative efficacy of a patented folklore medicine “Savliv” developed for the management of hepatitic disorders - A preclinical Study among Sri Ramchandra University, Chennai / M/s Harshul Ayur Pharma, Ramnagar, Uttarakhand.
3. Product development of Phyllanthus niruri and Glycine max(L.), formulation for the management of diabetes and associated complications, its validation, standardisation, preclinical toxicology and

pharmacological evaluation among Sri Ramachandra University, Chennai / Viswa Bharati, Santiniketan / M/s East India Pharmaceuticals Works Ltd., Kolkata.

4. Genome wide association study to identify genetic variants conferring risk to cardiovascular disease - Indian population among M.S. University, Vadodara / ASHRAM, Eluru / Sri Ramachandra University, Chennai / M/s Laila Pharmaceuticals Ltd., Chennai

Loan Projects

1. Expansion and up-gradation of rodent and Beagle dog housing facility for breeding and pre-clinical evaluations with pharmaceuticals, agrochemicals, biocides, genetically modified food, feed, biopharmaceuticals, r-DNA vaccines and medical devices in compliance with Good Laboratory Practices to International Institute of Biotechnology and Toxicology (IIBAT), Chennai
2. Lead optimization, IND enabling studies and Phase-I Clinical evaluation of a novel Nicotinic acetylcholine receptor a4b2 antagonist for the treatment of major depressive disorders (MDD) (Current Lead - SUVN-F90403) to M/s Suven Life Sciences Ltd., Hyderabad
3. Development of topical solution of diclofenac for painful musculoskeletal conditions to M/s Troika Pharmaceuticals Ltd., Ahmedabad.
4. Design and synthesis of calebin A and novel calebin-A mimics with enhanced stability for prevention of neuro-degeneration to M/s Sami Labs Limited, Bangalore.
5. Development of Ayurvedic formulation for the prevention and management of Metabolic Syndrome to M/s Baijnath Pharmaceuticals Pvt. Ltd., Paprola, Himachal Pradesh.

National Facilities

1. Phase-II of Population study of Urban, Rural and Semi-urban regions for the detection of Endovascular disease and prevalence of risk factors and holistic intervention study by Sri Ramachandra University, Chennai
2. National facility for biopharmaceuticals services for bioprocess training and biopharmaceuticals characterization by G.N. Khalsa College, Mumbai.
3. Mechanism based screening and validation of herbal drugs using radiotracter technique by Hafkine Institute for Training Research and Testing, Mumbai.

Grants-in-aid to industry

A clinical drug development programme to evaluate and compare safety and efficacy of new regimens of Lifecare's Liposomal Amphotericin B (Fungisome TM) against currently accepted therapies for the treatment of Kala-Azar: Phase II - A prospective, open-label, non-comparative, sequential, Phase-II, Multi-centric study to assess safety of single dose regimen at two dose levels of FUNGISOME TM in treatment of Visceral Leishmaniasis (Kala Azar) of M/s Lifecare Innovations Pvt. Ltd., Gurgaon.

Important Conferences and Workshops

- Current Advances in Biotechnology and Medicine at Institute of Liver & Biliary Sciences (ILBS), Vasant Kunj, New Delhi.
- Leh Symposium 2012 with the theme of "The lung at high altitude' from cellular accilimatization to clinical disease at Leh (J&K) at Institute of Genomics and Integrative Biology, Delhi.
- International Seminar on "Clinical Research & Regulatory Affairs - Present Scenario" at Jadavpur University, Kolkata.

Achievements during 2012-13

A new anti-malarial drug "SYNRIAM" (Arterolane maleate 150mg + Piperaquine phosphate 750 mg) was developed by M/s Ranbaxy Laboratories Ltd. through public-private-partnership of Drugs & Pharmaceuticals Research Programme of DST and the industry. This was launched to the nation by Former Minister, Science & Technology and Earth Sciences, Late Shri Vilasrao Deshmukh and Hon'ble Minister of Health & Family Welfare, Shri Ghulam Nabi Azad on 25th April, 2012. This was the first of its kind, a New Chemical Entity, fully developed through indigenous R&D which has reached the market place.

M/s Bharat Serums & Vaccines Ltd., Mumbai successfully completed DPRP-DST funded projects of the clinical trial of Phase-III study of KalaAzar to assess safety and efficacy of infusion of Amphomul®. The company has already received the approval of DCGI for manufacturing and marketing license for this formulation.

For the first time DST received a royalty payment of Rs.18,565/- for the product developed under DPRP supported loan support to M/s Natural Remedies Pvt. Ltd., Bangalore. The company has brought out a herbal supplement for blood sugar management using Cinnamon Extract (Dalchini) and introduced in the international market in October, 2010.

Fig. 4.1: Facility on Biopharma developed at G.N. Khalsa College, Mumbai funded by DPRP

Fig. 4.2: Launching of New Malaria Drug "SYNRIAM" on 25th April, 2012 by Hon'ble Ministers Science & Technology and Health & Family Welfare

The project at Sri Ramachandra University, Chennai was implemented with the help of Departments like Preventive Medicine, Cardiology, Neurology, Bio-chemistry, Genetics, Physiology, Yoga Institute, National Institute of Siddha and the team in PURSE-HIS programme. The following findings are revelation of actual state of affair of population (8080) health in Chennai (urban, semi-urban and rural areas). It so happened during random selection the identified populations were from low income and middle income groups.

Findings :

1. It is alarming to see altered mental health like depression, anxiety and stress which seem to be significantly prevalent in all sections of society - Urban, Semi Urban and Rural.

2. Uniformly there has been loss of physical activity in all sections especially in Urban and Semi Urban.

3. With regard to nutrition, the main component of the balanced diet is Carbohydrate, next fat, significantly lacking in protein, fruits and vegetables and other minerals.

4. Because of globalization partly or wholly the skin fold thickness, BMI and body fat percent are statistically significant in all sections of society. Urban society showed a marginal increase.

5. There is an alarming increase in the prevalence of Diabetes Mellitus (DM), overt to DM / pre-diabetes as mentioned below :

	URBAN	SEMIURBAN	RURAL
DIABETES MELLITUS FBS>125 mg/dl And / or PPBS >199 mg/dl	19.32	17.82	12.05
IFG (FBS>95<126mg/dl)	8.09	9.6	12.02
IGT(PPBS>140<199mg/dl)	3.38	8.33	6.43
Combined IFG and IGT	15.31	23.25	24.23

The prevalence of Pre-Hypertension is as follows :

	URBAN	SEMIURBAN	RURAL
PRE-HYPERTENSION (BP 120–139/80–89 mmHg)	31.35	42.31	23.9

If the BP is taken 140/90 mmHg and above, the population in three sections is as follows :

	URBAN	SEMIURBAN	RURAL
HYPERTENSION (BP >/=140/90 mmHg)	18.64	18.1	15.24

In conclusion, this study revealed that economic growth of the population is not linearly related to the health of the population. Taking the above risk factors as a cluster, which fall into the category of metabolic syndrome or insulin resistance syndrome, it can be anticipated that the incidence of vascular disease affecting heart, brain, kidney or peripheral vessels by a factor of four will be a formidable task to manage for any developing country. Strengthening the Primary health centre area - the triumvariate – Diabetes, pre-diabetic state, Hypertension and hyperlipidemia should be identified and intervened along with advice on smoking will pave way for primary prevention of vascular diseases.

INSTRUMENTATION DEVELOPMENT PROGRAMME

The Instrumentation Development Programme (IDP) of Department of Science & Technology (DST), Government of India was initiated in **1975** and is a programme through which the Department of Science and Technology **(DST)** promotes **R&D programmes** for indigenous development of instrumentation. The thrust areas include Medical and Healthcare Instrumentation, Analytical, Industrial and Sensors & Allied Instrumentation.

Technologies Developed, Transferred and Commercialized under IDP

1. Membrane separation system for textile industry to reduce pollution by recycling developed at Synthetic & Art Silk Mills' Research Association (SASMIRA) and commercialized by M/s Permionics Pvt. Ltd., Vadodara

Fig. 4.3: Number of Membrane filtration systems installed in Textile Industry

Name and Address of Process House	Type of Membrane	Month	Year	Capacity Litre/Hr	% Recovery of water	Remarks, if any
CNATEX Processors Pvt. Ltd., Kongampara, Palakkad, Kerala	R.O	December	2011	15000	75 %	Waste water
CLARIANT PAKISTAN,Pakistan	U.F + R.O	February	2012	30000	75%	Waste water
CLARIANT PAKISTAN,Pakistan	RO	February	2012	50000	75%	Waste water
Wilhelm Textile India Pvt. Ltd., Delhi	R.O	April	2012	2000	75%	Dyeing process
Tamil Nadu Textile Cooperative Mills, Erode	N.F + R.O	August	2012	50000	75%	Process Waste water
Haren Textiles, Tarapur	R.O	October	2012	2000	75 %	Waste water

2. **A computerized instrument for measurement of fabric feel by nozzle extraction was developed by Department of Textile Technology, Indian Institute of Technology (IIT, New Delhi. M/s Texlab Industries, Ahmedabad**, has already started marketing the instrument and they have got their first order from NIT, Jalandhar.

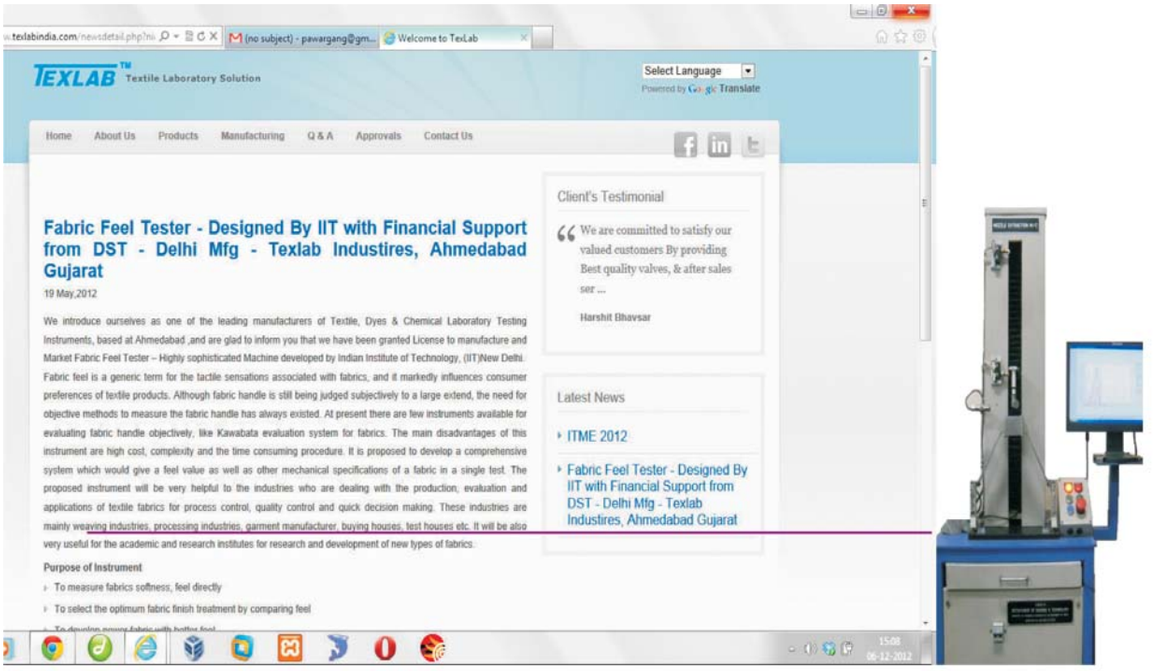


Fig. 4.4: Screenshot of the webpage of the company marketing the Fabric feel Tester

New Projects sanctioned under IDP

1. Development and Evaluation of Drying Systems for Important Spices of North Eastern States by College of Agriculture, Central Agricultural University, Imphal.
2. Development of mechanised system for effective sett/ bud treatment of sugarcane by Central Institute of Agricultural Engineering, TNAU Campus, Coimbatore – 641 003, Tamil Nadu and M/s Shri Annapoorna Agro Industries, Coimbatore – 641 005.
3. Motorized Seed Drill for Rice Fallow Pulse-Designing and Evaluation by Agricultural College and Research Institute, Madurai, Tamilnadu and Thandavan Engineering Works, Melur-625 106.
4. Instrumented Solar Hot Air Generator (ISHAG) for optimum thermal load in tea processing by Tezpur University, Assam and Biogen Industries (P) Ltd, Industrial Estate, K K Barua Road, Assam.
5. Development of mechanical unit for production of white pepper from green pepper by Indian Institute of Spices Research, Kozhikode, Kerala.
6. Design & development of cost effective in-situ induction motor efficiency monitoring system using the latest art of instrumentation by Central Scientific Instruments Organisation, Chennai Centre, Chennai and Beta Technologies India Pvt Ltd, 301, Gandhipuram, Coimbatore-641 012.
7. Ultrasound assisted ozonator for the processing of liquid foods by Central Food Technological Research Institute (CFTRI), Mysore.
8. Design and Development of Portable Pain Relieving Instrument by MCOAHS, MANIPAL UNIVERSITY, Manipal- 576102 and Techno Med Electronics Ltd, Perungudi, Chennai.

National facilities to Promote Commercialization of Developed Instruments

Sensor Hub, CGCRI, Kolkata: The Sensor Hub has been established at Central Glass and Ceramic Research Institute (CGCRI), Kolkata with the grant support from the Department of Science & Technology (DST), Government of India and Council of Scientific & Industrial Research (CSIR), New Delhi for a period of five years. The highlights of work done at this facility are as follows:

1. Product Description : Hand Held Electronic Nose (HEN)

Participating Institutes: CDAC, Kolkata and CGCRI

Hand-held Electronic Nose has been successfully implemented for quality evaluation of finished tea as well as end-point detection of tea fermentation process **(Fig 4.1)**. It has been developed on simple 16-bit microcontroller platform with low-power sniffing unit for online and field usage in the tea industry. A multitude of metal-oxide semiconductor (MOS) based sensors (Tin oxide (SnO_{2-x}) and zinc oxide (ZnO) based matrices, doped with a variety of metals) for the classification of black tea aroma have been investigated in CGCRI.. 5% CoO-ZnO and 1% CuO-ZnO sensors have shown highest affinity towards Geraniol, while 1% Pd-ZnO sensors exhibited selectivity towards trans-2-hexene-1-ol at 250^{o}C. MOS sensors developed by Sensor Hub, Kolkata have been used for their intended use in tea aroma classification. The six sensors given by Sensor Hub, Kolkata has definite sensitivity to tea aroma.

2. **Product Description : Arsenic Kit**

Participating Institutes: Calcutta University and CGCRI

Shelf life of Arsenic Kit has been increased to 6 months from 2 months. Kits were sent to IIT-KGP, NEERI, Jadavpur University and CGCRI laboratories for testing and validation. The specifications of the Kit are modified based on the results of validation for releasing the product in the market. A third kit for Arsenic Detection has been developed using silver nitrate and standardized the same for 10, 50, 100, 200 ppb arsenic. A Dip Stick Colorimetric Sensor for Detection of Arsenate in Drinking Water has also been developed and patent application filed

(Patent no.: 1139/KOL/2012.)

3. **Product Description : Methanometer**

Participating Institutes: BESU, Shibpur

Handheld portable methanometer has been designed with a microcontroller based signal conditioning circuit which will interface with commercially available methane sensors in an intelligent and energy efficient manner and display the methane gas concentration **(Fig 4.2)**. Validation by ERTL, Kolkata is under process. A packaged MEMS microheater **(Fig. 4.3)** with desired specifications has been fabricated using the facilities of BESU, CGCRI and IIT-B and characterized. Suitable gas sensing layer for methane or other gas detection is being developed.

4. **Product Description : QCM Sensors for tea aroma classification**

Participating Institutes: Jadavpur University

QCM sensors **(Fig. 4.4)** for detecting tea aroma chemicals like Linalool, Geraniol, Trans-2-hexen-al etc. have been fabricated in the laboratory and a prototype electronic nose with 8 QCM sensors and suitable pattern recognition module have been developed in the laboratory.

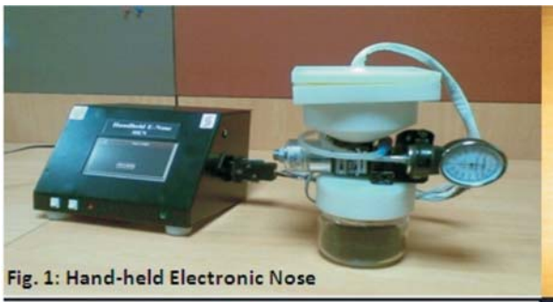


Fig. 1: Hand-held Electronic Nose

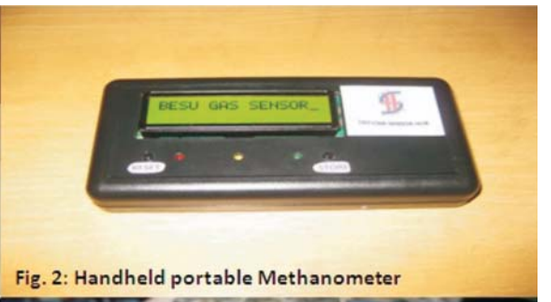


Fig. 2: Handheld portable Methanometer

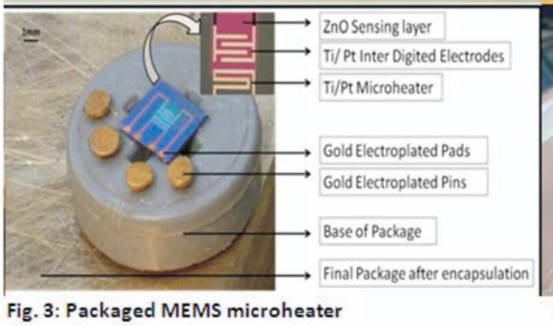


Fig. 3: Packaged MEMS microheater

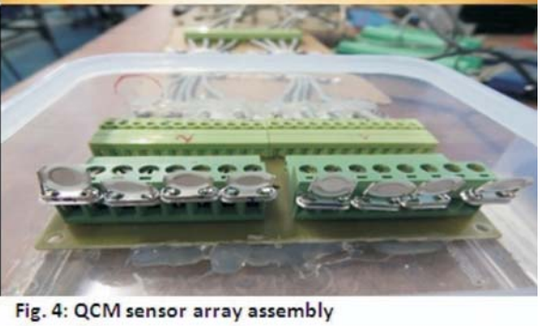


Fig. 4: QCM sensor array assembly

Fig. 4.2 to 4.4

National Hub for Healthcare Instrumentation Development (NHHID) at Anna University, Chennai : National Hub for Healthcare Instrumentation Development (NHHID) is a national facility established under Instrumentation Development Programme (IDP) of DST, Govt. of India at Anna University, Chennai to promote and accelerate development of indigenous healthcare instrumentation. The first year of the full-fledged activity after the sanction of Rs. 3.5 Crores in July 2011 has been achieved with significant outcome listed below in line with the objectives and expectations of the National Hub.

- **Progress of projects, prototype development for commercialization**

1) All the 20 projects sanctioned in the Hub have progressed well with three of the projects coming up with prototype instruments. Validation of the Antibiogram device by Trivitron Helathcare Ltd., has been completed and the process for technology transfer for commercial development has been initiated. Isothermal amplifier prototype for the detection of Chikungunya Viral Genome by loop mediated isothermal amplification (LAMP) technique. Hystero Electrical Mapping Device for Foetal ECG.

Imaging prototype for Antibiogram determination

Fig. 4.6

2) In platform technology, a generic microcontroller-based cuvette-type compact portable fluorimeter has been built for a variety of fluorescence assays and pathogen detection applications.

- **Industrial Association and revenue earning activities**

3) Industrial participation in device development, as the mandate of the Hub, is being achieved by having them as partners in the projects and experts in the review of progress. A Joint Development Agreement between NHHID and Trivitron Healthcare Ltd., Chennai has been prepared with 50:50 share in the revenue. A few more industries have expressed their desire to sign such agreement and discussions are on.

4) As the first revenue-earning model, DST entered into a business contract with Shree Kamdhenu Electronics Pvt. Ltd.. and developed a portable, milk protein estimator for quality assessment at the point of collection within the stipulated time of one-year. The initial trials have been satisfactory and the company would be engaging the NHHID for device development for dairy industry.

Fig. 4.7 Milk protein estimator

In a tripartite collaboration between Centre for Biotechnology, Anna University, Soft-condensed matter lab, Raman Research Institute and CEDT, IISc, partners in NHHID, a rapid (less than a minute per sample) handheld electrochemical prototype for the detection of adulteration in milk or synthetic milk has been developed for further validation by the diary industries.

Representative prototypes recently developed under the IDP

1. Table-Top Light Fastness Testing Equipment Developed at Synthetic & Art Silk Mills' Research Association (SASMIRA), Mumbai.

Fig. 4.8

Synthetic & Art Silk Mills' Research Association (SASMIRA) had commercially set up the developed Table Top Light Fastness Testers (4 Nos.) in the test houses. Three Equipments have been installed at various industrial test houses viz., Polynova Industries' R & D Centre, Goa, Powerloom service centre, Bhiwandi and Angadpal Industries Ltd., Tarapur processing units. Trials have been conducted and the samples have been parallel tested at SASMIRA on the similar commercial machine. One machine would be installed in Navi Mumbai processing unit. The commercial light fastness tester is a handy and accurate equipment for quick evaluation of light fastness for the process houses as per different standard test methods viz., ASTM, BIS, etc.

2. Health & Physical fitness Monitor Developed at PSG College of Technology, Coimbatore

Fig. 4.9 Health & Physical fitness monitor –First model (Screen - 1)

Fig. 4.10 Health & Physical fitness monitor –First model (Screen - 2)

Multi-parameter monitoring equipment is designed & developed by PSG College of Technology and M/s. Pricol Medical System Limited, Coimbatore. The Multi-parameter monitor systems will find wide applications in Hospitals - intensive care units, operation theaters, emergency and even in Ambulance. The equipment will be capable of measuring parameters like electrocardiogram (ECG), invasive and noninvasive blood pressure, pulse rate, pulse oximetry, body temperature, respiration rate, end-tidal CO2 and other specialized parameters. The equipment is integrated with sensors to measure, display and document physiological information about the patient. Currently, there is no indigenous manufactures of Multi-parameter monitors in India. Also, there is a need to develop cost effective indigenous multi-parameter monitors which will meet the hospital requirements both in urban and rural areas. The system will be an import substitute to international manufacturing. The final prototype will be launched by March 2013.

3. E-pick Counter for Power Looms Developed at Dept. of Textile Tech. & Processing Sarvajnik College of Engg. & Technology, Surat

Fig. 4.11

The instrument to be developed will be very useful to any weaving unit holder having Plain Power as well as Automatic shuttle looms. The instrument will provide on line details related to production of machine and defects in fabric to the user. Normally, in any weaving unit having shuttle looms, the unit holder will come to know about the production of machine and quality of fabrics produced only after 2-3 days i.e. after removal of fabrics from the loom. So, it will take about 2-3 days time to take any corrective measures in case of a loom/s found to produce less quantity and poor quality of fabrics. At present, there are about 20.00 lakh shuttle looms across the country.

4. Clubfoot Braces developed at Unit of Pediatric Orthopedics, Christian Medical College, Vellore and Centre for Electronics Design & Technology, Indian Institute of Science, Bangalore.

Fig. 4.12

The device is intended for use in children with clubfeet (who have been corrected by any surgical or casting method) for maintenance of correction of deformity. The technical novelty of this brace lies in the mechanical construct of the bar and shoe holder which allows greater degree of freedom while in the brace. The brace is equipped with a novel compliance monitor which monitors the efficacy of the brace and its wear by the child.

5. **Fabric Friction Tester Developed at Department of Textile Technology, Indian Institute of Technology (IIT), Delhi**.

Fig. 4.13 Photograph of developed fabric friction tester

A new instrument is designed and developed to measure the surface friction of textile fabrics based on friction clutch principle. This instrument is designed to simulate the angular movement of human fingers over fabric, in contrast to moving fingers along principle directions of fabrics practiced in commercial instrument. The multiple probes would be used to simulate that of human fingers (as one touches the fabric with few fingers to sense the roughness/smoothness/slipperiness).

6. **Design & Development of Electro-Active Sensor Fabrics for monitoring Body Kinematics and Vital Signs at Department of Textile Technology, PSG College of Technology, Coimbatore.**

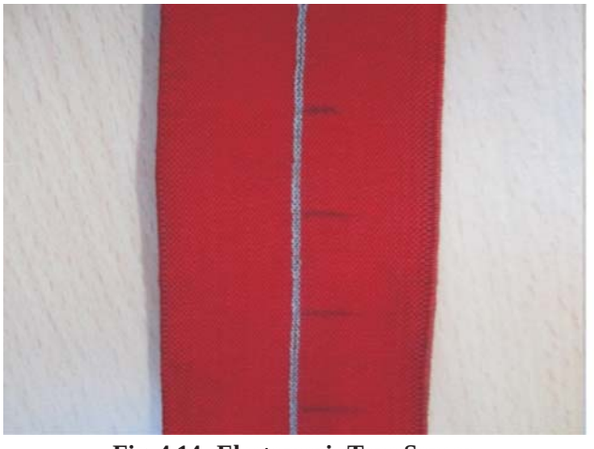


Fig. 4.14. Elastomeric Tape Sensor

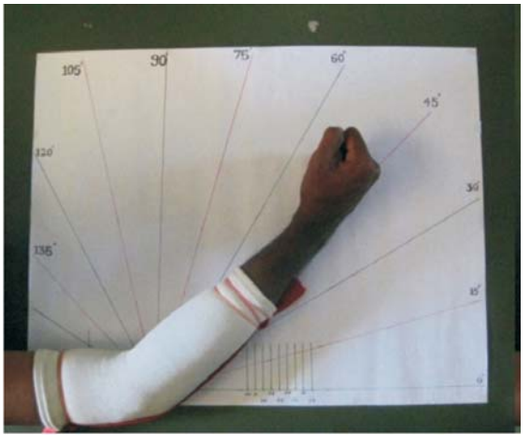


Fig. 4.15. Angle Measurement

The wearable strain sensor is a unique device to measure the kinematic movements of elbow angle / knee angle. The sensor measuring 250 mm x 38 mm is built using a narrow tape woven fabric incorporating conductive threads in between as shown in Fig. 4.14 and the measurements are shown in Fig. 4.15. The elbow angle recording will be useful to physiotherapist / rehabilitation centre for indicating improvements in elbow angle bending over a period of time or after a critical injury. It will also be useful for continuous monitoring of the angle flexed by the elbow or knee for any research relating to arthritis. Further, measurement of knee angle goniometry will be of use for sports persons and other patients opting for knee replacement surgeries.

7. Wireless Sensor Based Communication for Multichannel EEG Recording Developed at Dept. of Electronics & Communication Engineering, PSG College of Technology, Coimbatore.

Fig. 4.16 Prototype Tested with

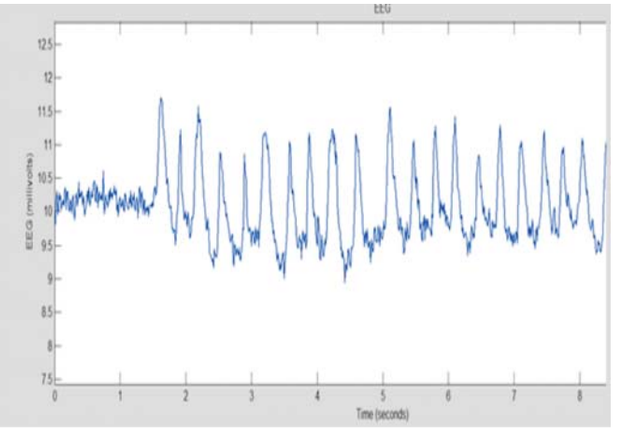


Fig. 4.17 Software Blinking of an Eye

A data acquisition system for acquiring bioelectric signals from the brain has been developed consisting of hardware and software modules. It is useful in remote diagnosis and monitoring in everyday situations-out of the lab or clinic. Further improvements to the system have to be made by extending the current single channel wireless interface to a multichannel EEG recording. The technical novelty of the project focuses on wireless technology and its advancement in protocol and standardization for health care.

8. Online Image Processing System for Finding Size Distribution of Pellets in a Pelletization Plant at Institute of Minerals and Materials Technology, and Kalinga Institute of Industrial Technology (KIIT), Bhubaneswar.

Equipment Name: CSIR-IMMT EYE ON PELLET

The "EYE-ON-PELLET" is an equipment indigenously developed which is very useful for monitoring iron ore pelletization plants. Pelletization is a process by which iron ore fines are converted to spherical balls. Normally, a human supervisor is engaged to monitor the balling shape and size for a set of pelletization discs, which leads to suboptimal performance of pellet production due to human error. However, our system is a camera based system which monitors the pellets while it is falling right at the disc and records the size distribution pattern for monitoring and future analysis. This is an aid to the supervisor of a pelletization plant.

Fig. 4.18 Prototype system (Eye-on-Pellet)

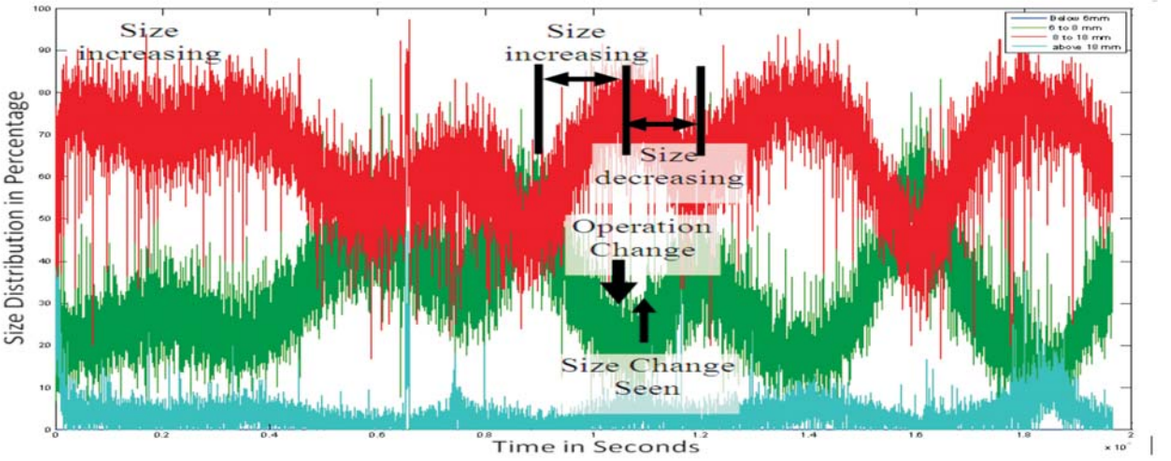


Fig. 4.19: Recorded size distribution result

9. Magneto-optic Material Based Current Sensor for Industrial Application at Birla Institute of Technology (B. I. T.), Mesra, Ranchi, Jharkhand.

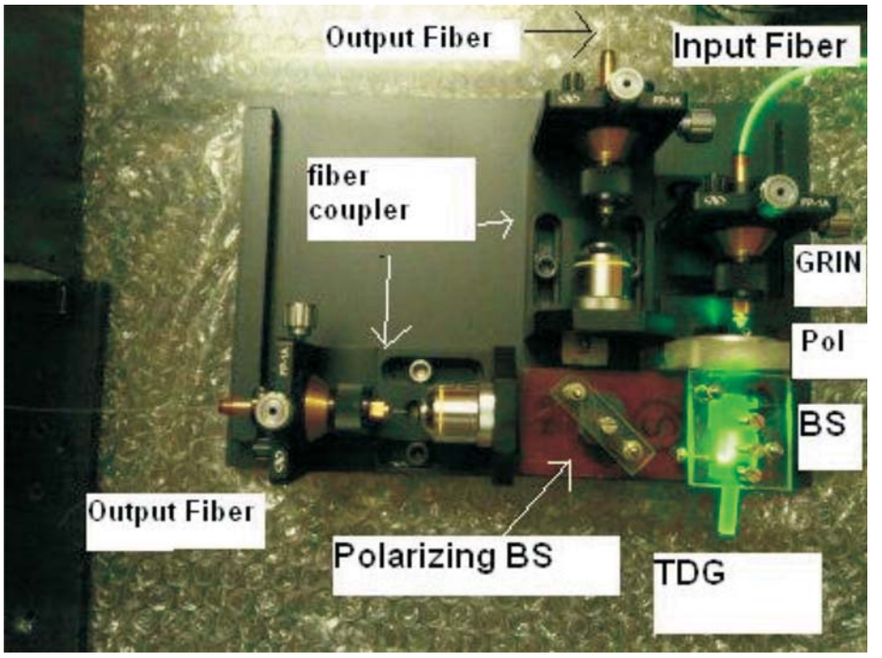


Fig. 4.20 Sensor Module

A magneto-optic current sensor is developed based on Faraday effect where the magnetic flux density produced by the current passing through a conductor causes the rotation of the plane of polarization of the light beam passing through Terbium doped glass (TDG) element. The dual quadrature polarimetric scheme was used to fabricate a compact industrial prototype of magneto-optic current sensor using TDG element and utilizing optical fibre as light transmission medium. The system is developed in three modules viz. source module, sensor module and detector module. The source module contains laser source coupled to an optical fibre for light delivery to the sensor module. The sensor module contains

TDG element and other polarization components and the output light is coupled to optical fibre for light delivery to detector module which contains photodetectors to convert optical power to electrical signal and pass on to a laptop for processing in LabView environment. The system is useful for noncontact current measurement as well as magnetic flux density measurement in high EMI environment.

10. Development of an Intelligent Recognizer for Component Analysis of Manhole Gas Mixture at Department of Computer & system Sciences, Visva-Bharati University, Santiniketan and Bengal Engineering and Science University, Shibpur

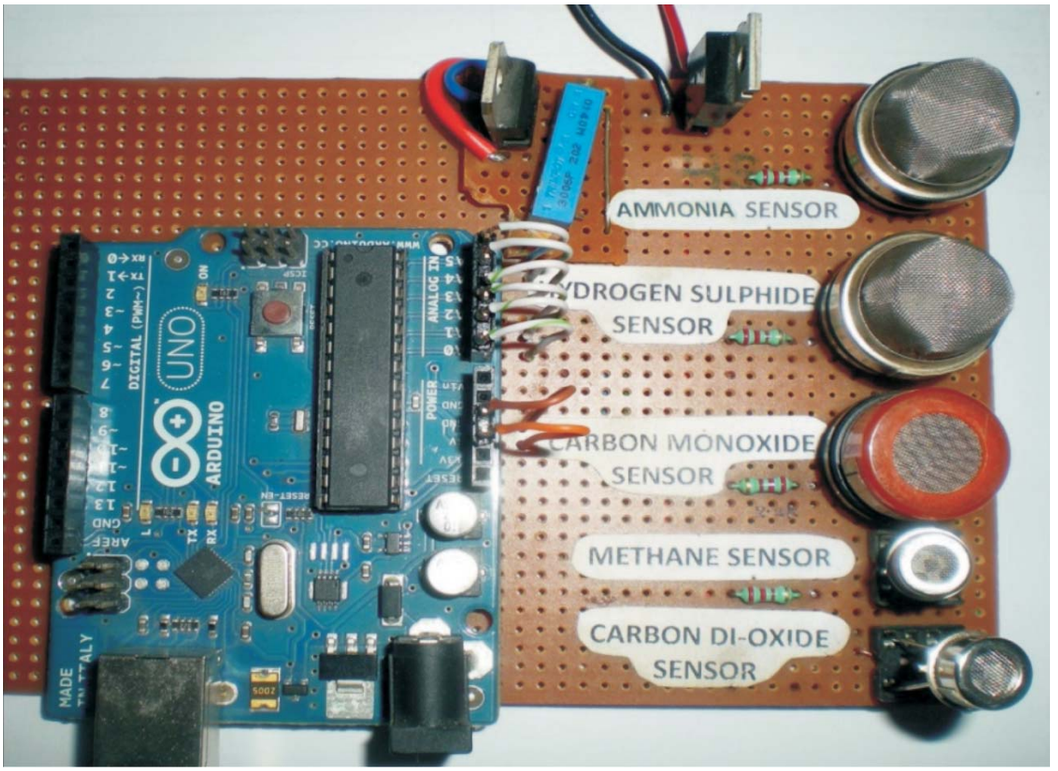


Fig. 4.21: Lab scale design of portable gas mixture analysis system with Sensor array & DAS

A portable intelligent electronic system is being developed which will provide a reliable result within a few minutes whether any toxic gas is present or not inside the manhole and if so, it will raise alarm and alert the workers. A safe and sophisticated gas mixture analysis system containing a panel for toxic gas cylinders with the carrier gas cylinder, gas mixing chamber with Mass Flow Controller (MFC) and a table top furnace has been designed to analyze the sensors with mixture of gases in various concentrations to get the response of the sensors due to their target gas and also due to other gases. Some technical novelty was found in the signal conditioning unit and intelligent pattern recognition algorithms to get accurate results very quickly by overcoming the problem of cross sensitivity. Manhole gas has been collected and analyzed in laboratory by conventional chemical process and gas chromatography machine to compare with the result of sensor output.

11. Automated Assay Unit for Antimitotic Activities Developed at Department of Electronic Systems Engineering (originally CEDT), Indian Institute of Science, and Department of Bio Technology, Sir M Visvesvaraya Institute of Technology (Sir MVIT) Bangalore.

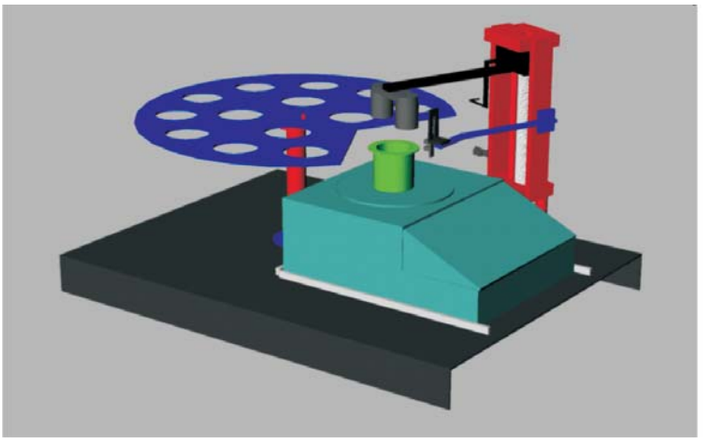


Fig. 4.22 The pick and place module.

Fig. 4.23 Seed Assay (Dry weight 250±5mg) Kokilaksha after 12 hours

A couple of standard runs with multiple seeds were done and the accuracy of the determination was better than single seed assay-using the same batch of seeds. Multiple seed assay found to be good in determination of antimitotic activity and has better statistical analysis along with this multiple seed assay we are able to answer antimitotic activity of herbal extracts in terms of gravimetry and also morphology of the seedlings. 5 seed assay seems to be adequate to measure the antimitotic activity. The unit shown above is ready. The packaging for field testing is being carried out. A second version of the improved prototype is getting ready. It may have applications in human health care in future. Currently, the use of hematological and biochemical parameters of blood analysis can be a very useful tool in investigating the mechanism of action of herbal extracts/Ayurvedic Kashayas.

12. Design And Development of Low Cost Wireless Polysomnograph Developed at Biomedical Engineering Department, PSG College of Technology, Coimbatore.

Fig. 4.24: Set up for Polysomnograph

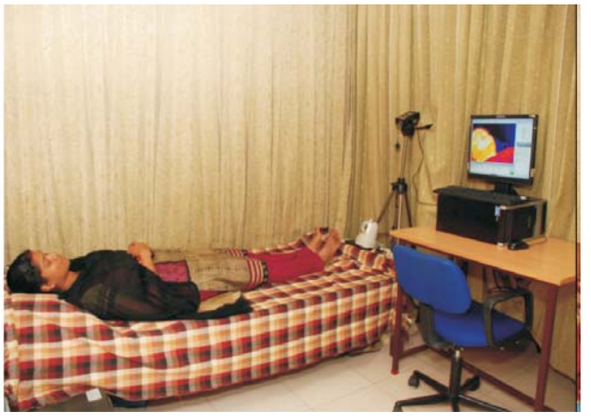


Fig. 4.25 : Imaging respiration

Polysomnography is a reliable and standard method to evaluate sleep quality. Conventional methods use Electrodes, Thermistors and Respiration belts to measure these parameters. These cause patient discomfort and also tether the patient to the bed. In our novel Non-contact methodology, as seen in the PCB in the picture it is designed to acquire the ECG, chin EMG, EOG parameters wirelessly. The non-contact IR camera replaces the conventional Electromyography of the limbs for diagnosis of leg movements namely Restless Leg Syndrome (RLS) and Periodic Leg Movement Disorder (PLMD). The thermal camera replaces the conventional methods of thermistors and respiration belts, for the respiration analysis. Thermal infrared imaging is a passive contact-free modality for respiration analysis, wherein the inspiration and expiration of the patient can be visually monitored as temperature variations from his thermal images. The snoring recorder is a contact free system for snoring analysis. Accelerometer is an alternative for analysis of respiratory thorax and limb movements. The Monitor displays respective waveforms for the circuits in PCB.

NATIONAL PROGRAM ON CARBON SEQUESTRATION RESEARCH (NPCSR)

This program was launched in 2007. During the year 2012-13, fifteen new projects were initiated. In consultation with the Program Advisory and Monitoring Committee (PAMC) a Brain Storming cum Project Formulation Workshop was organized at Hyderabad on 31st August – 1st September, 2012. In this workshop about 40 scientist from academic institutions, research laboratories, PSUs participated and presented their preliminary Project Concept Notes (PCNs). In addition, the thrust Areas of this program has been expanded / updated in consultation with PAMC, NPCSR. The updated list of thrust areas is as follows:

1. Carbon dynamics in different land use sector in the long term context of carbon sequestration; crop land, forest land, grass land, wet land and agro-ecosystem.

2. Modeling of carbon sequestration, carbon stock changes and fluxes in different land categories, land use systems, production systems, and lands subjected to land use change.

3. Development of forestry, agro-forestry, grass land management system and practices for long term carbon sequestration.

4. Assessment at National, State and Agro-ecological zone level, long term carbon sequestration potential; agricultural soil, agro-forestry system, grass land management, forestry, wet land and settlements.

5. Bio-logical carbon sequestration, including terrestrial, fresh water and marine forms.

6. Physical and chemical process for carbon capture or separation

7. Materials for carbon capture

8. CO2 capture from stack and industrial gases

9. Chemical mineralization

10. Effective carbon-dioxide use

11. Geological storage

12. Ocean acidification/removal of CO2

The salient achievements of some of the projects are listed below:

I. Title of the project: Study On Carbon Stock and Response Of Estuarine Phytoplankton to Iron Fertilization

Implementing Agency: Department of Marine Sciences, University of Kolkata, Kolkata

Important highlight/achievement of the work

In this study, the carbon contents in diatoms, dinoflagellates, cyanobacteria and green algae were compared in three different treatments (viz. control, iron fertilized and mangrove litter treated) ponds of Indian Sundarbans.

Methods

Cell carbon

The cell volume of diatoms was converted into cell carbon as per the expression cell carbon (pg) = 0.288 [live cell volume (ìm3)]$^{0.811}$. For dinoflagellates, the expression cell carbon (pg) = 0.760 [live cell volume (ìm3)]$^{0.819}$(Montagnes *et al.* 1994; Menden-deuer 2001; Davidson *et al*. 2002) was used. For phytoplankton species other than dinoflagellates and diatoms, the expression $Log_{10}C$= 0.76 Log_{10} V-0.29 (Mullin *et al.*1966) was used to estimate carbon content (*pg*)/ cell. The phytoplankton population (in No.l^{-1}) was enumerated simultaneously as per quantitative estimation of phytoplankton using Sedgwick Rafter Cell Counter as per the method of McAlice (1971). This approach is appropriate for larger phytoplankton species (>10-15µ) having relatively higher population densities (e"10^{5}cells/l). The species – wise carbon content per unit volume of water was calculated by the product of population and mean cell carbon content of each species.

Results

The cell carbon content of the phytoplankton ranged from 11.55 pg (*Asterionella japonica*) to 67007.15 pg (*Planktoniella sol*) in control pond, 17.592 pg (*Asterionella japonica*) to 57863.99 pg (*Planktoniella sol*) in iron fertilized pond and 3.192 pg (*Asterionella japonica)* to 73859.06 pg (*Planktoniella sol*) in mangrove litter treated pond. These data sets considered two seasons pre-monsoon (April – June 2012) and monsoon (July- October 2012). The relatively higher cell carbon content (species wise) in the iron fertilized pond compared to mangrove litter treated and control ponds is due to higher cell volume in the aquatic system of iron treated pond. Evidences suggest that iron triggers the uptake of nutrients from the ambient media resulting in the increase of cell volume which subsequently enhances the carbon content of the cell. This is evident from the significant positive correlation between cell carbon and cell volume in all groups of phytoplankton as shown in figures 4.26 to 4.31.

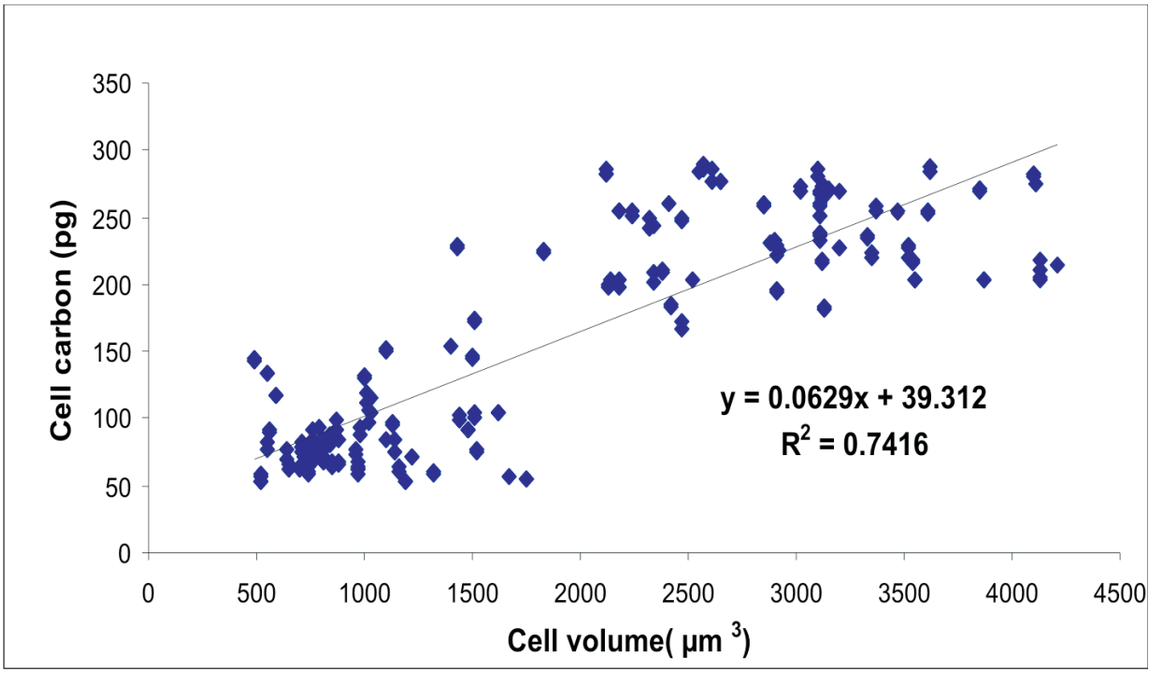


Fig. 4.26 : Inter-relationship between cell carbon content (pg) and cell volume (µm^3) for cyanobacteria & green algae during pre-monsoon (April – June 2012).

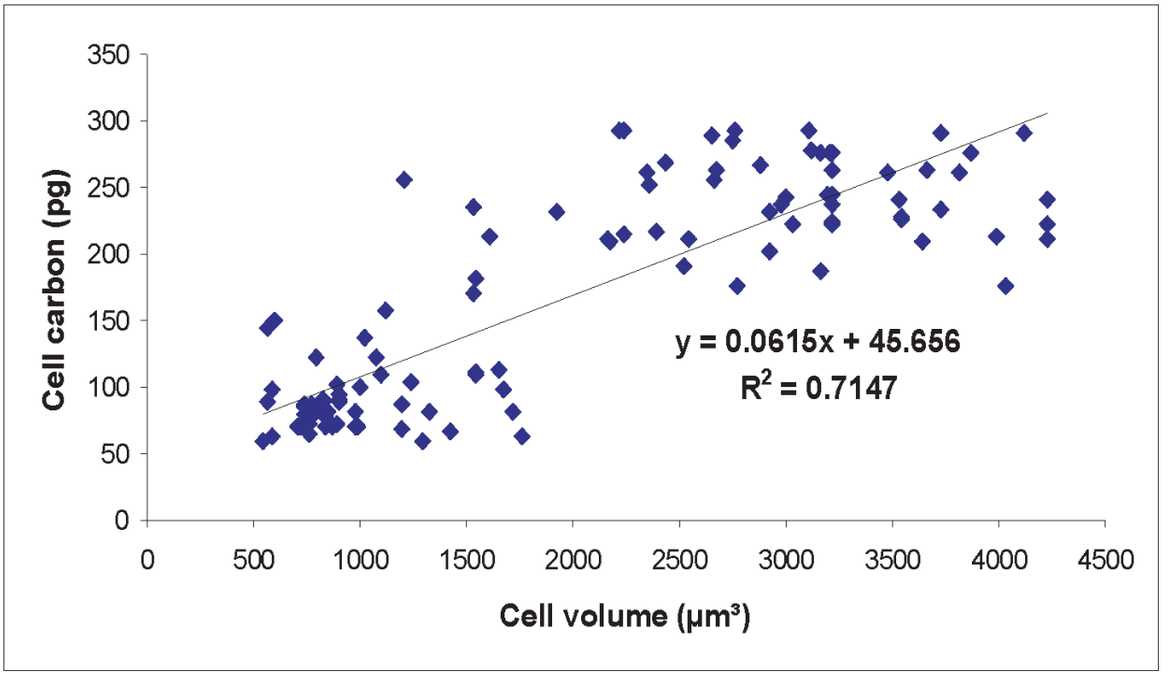


Fig. 4.27 : Inter-relationship between cell carbon content (pg) and cell volume (µm^3) for cyanobacteria & green algae during monsoon (July-October 2012).

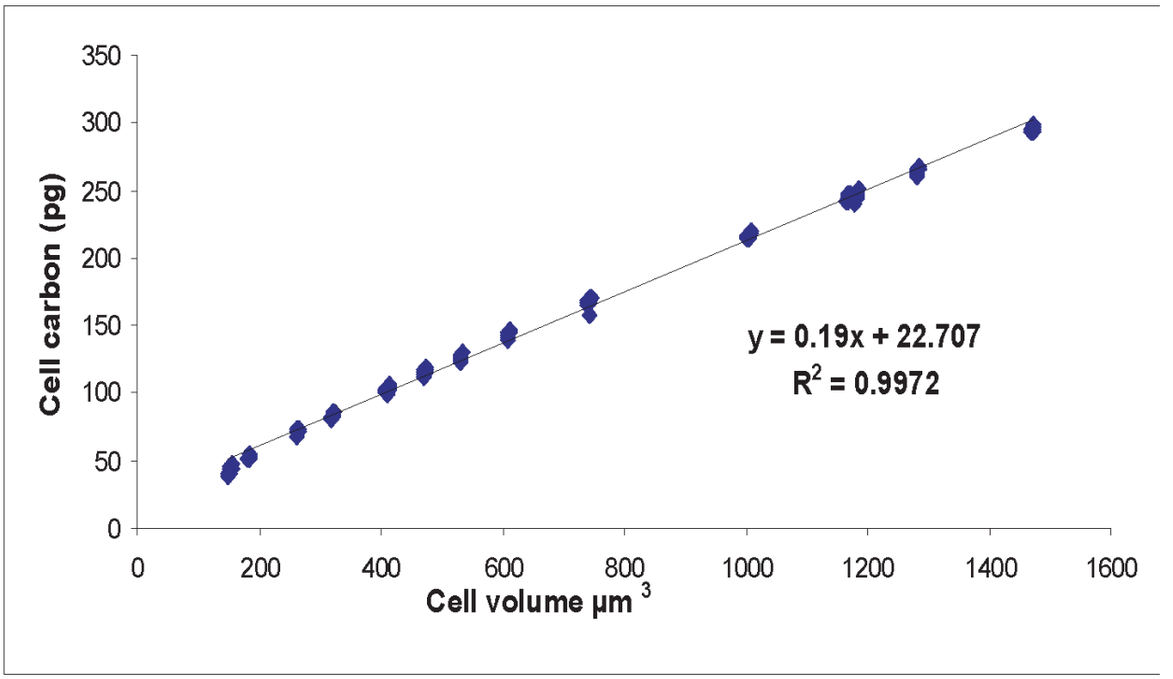


Fig. 4.28 Interrelationship between cell carbon content (pg) and cell volume (µm^3) for Dinoflagellates during pre-monsoon (April – June 2012).

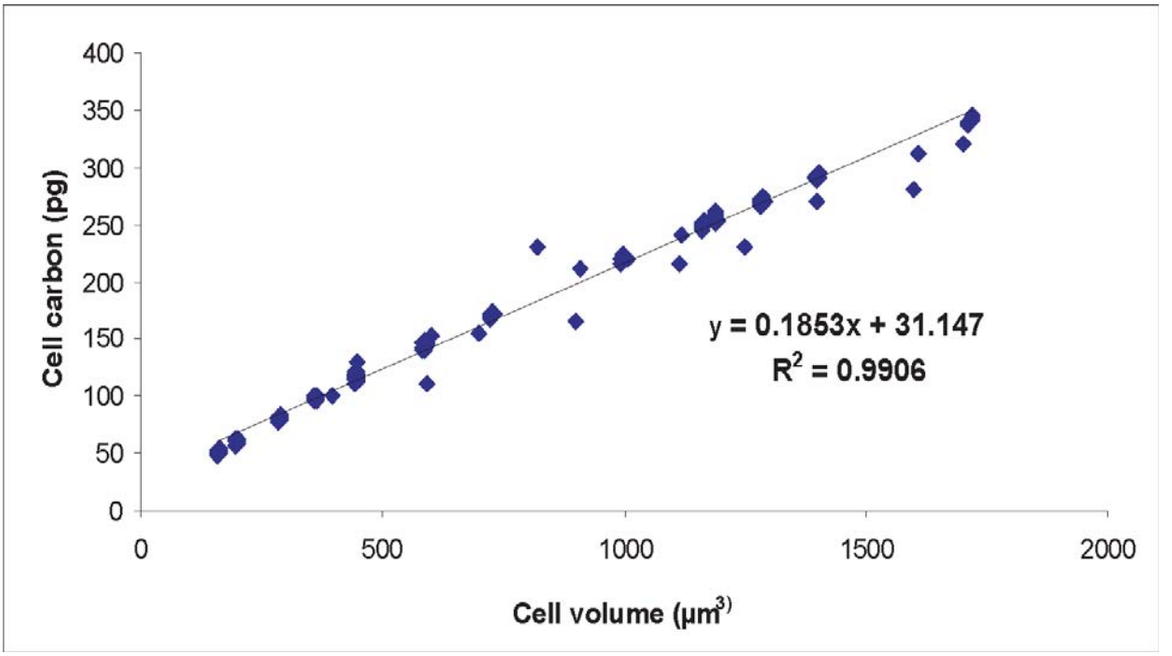


Fig. 4.29 Inter-relationship between cell carbon content (pg) and cell volume (µm^3) for Dinoflagellates during monsoon (July-October 2012).

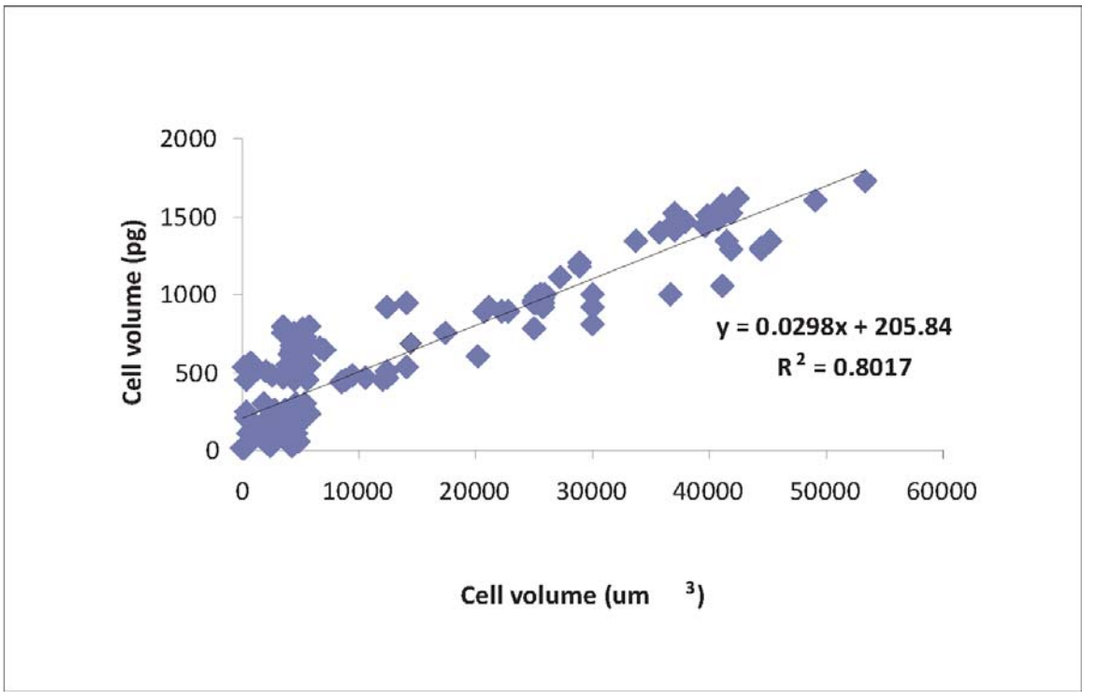


Fig. 4.30 Interrelationship between cell carbon content (pg) and cell volume (µm^3) for Diatoms during pre-monsoon (April – June 2012).

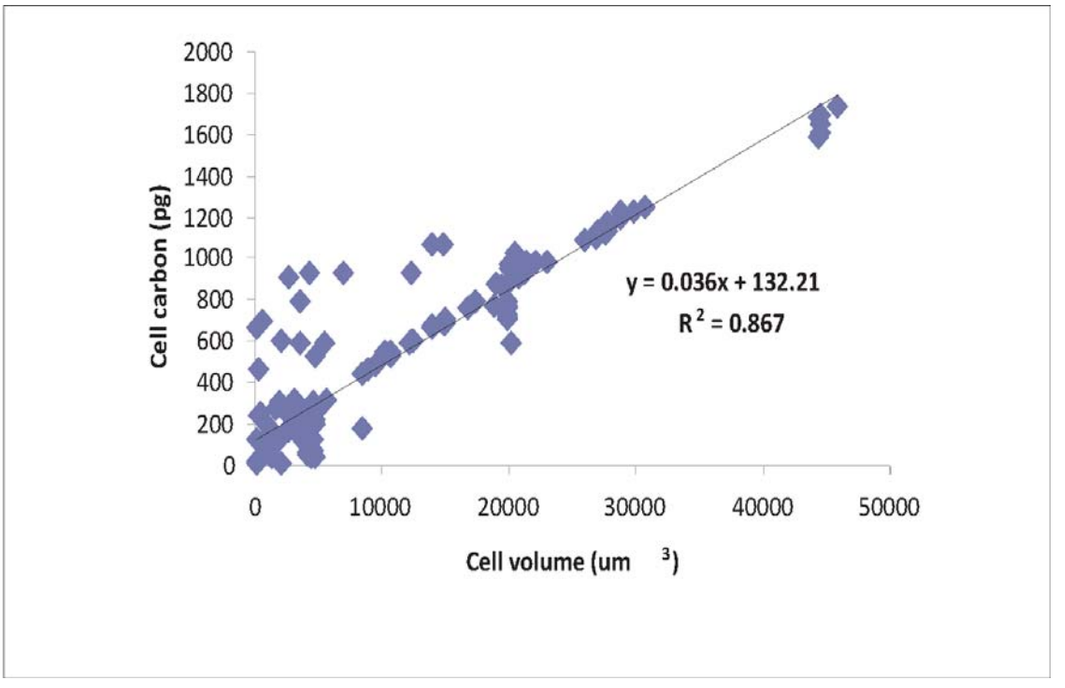


Fig. 4.31 Inter-relationship between cell carbon content (pg) and cell volume (µm^3) for Diatoms during monsoon (July-October 2012).

II. **Title of the project**: A Bio-electrochemical system for sequestration of carbon dioxide

Implementing Agency: Dr. D.Y.Patil Biotechnology and Bioinformatics Institute, Tathawade, Pune

Important highlight/achievement of the work

A Microbial fuel cell for the proposed work was fabricated and standardized for oxidation of sulphide. An improved model is now being fabricated which is expected to give better performance with respect to sequestration of carbon di-oxide. The performance of present fuel cell was monitored for 8 days using PGSTAT 390 Autolab system. The highest open circuit voltage recorded was 2.95 mV and a corresponding current of 66.2 nA was recorded. The proposed MFC model generated electricity with a highest power density of 0.0086 mW/L of anode solution. With increase in growth a corresponding decrease in sulphide level was observed. The sulphide concentration reduced from 340 ppm as measured on the setup day to 2.324 ppm after 8th day. A 99% reduction in level of sulfide was obtained using current model of MFC. Cyclic voltammogram (CV) analysis of bacterial pellet suspended in saline demonstrated that the voltage which was measured was indeed due to microbial activity. Absence of peak in the CV for supernatant indicates absence of mobile mediator which indicates the present MFC is a mediatorless system. Further absence of peak in the CV for whole broth indicates some medium components are interfering with electron transfer. SEM analysis of the electrode indicates presence of extracellular matrix which is generally polysaccharide produced by microbial colonies for bio-film formation. So the conditions on the electrode appear to be favorable for electron transfer. Presently, standardization of sequestration of carbon dioxide is being carried out.

An Abstract was published in proceedings and poster was presented at "3rd World Congress on Biotechnology" on September 13th – 15th, 2012 at Hyderabad, India.

III. **Title of the project**: Carbon allocation status in different components of selective tree species of Dr. BAM University campus in their different growth phases

Implementing Agency: Dr Babasaheb Ambedkar Marathwada University, Aurangabad

Important highlight/achievement of the work

The study of total Carbon sequestered in trees in Dr. B.A.M. University, Aurangabad. Campus is studied the biomass and total organic carbon of standing trees is estimated by non destructive method. The tree height and girth is taken into consideration for the measurement of biomass and carbon content. The height of the tree is measured by using a theoretical modeling and concept is used for actual measurement of 20 different tree species having diameter > 10 cm. Theodolite is used for the measurement of angle between tree top and observer. The total biomass and total organic carbon has been determined and compared with Allometric model. At the time of estimation of organic carbon storage by Allometric model. The study revealed that Allometric model based on theoretical model can success used to determine the tree biomass by non-destructive method.

IV. **Title of The Project**: Induction of UV-B Resistance in Commercially Important Microalgae and their application in Enhanced Carbon Sequestration and Synthesis of Secondary Metaboites

Implementing Agency: Center for Advanced Studies in Botany, University of Madras, Chennai

Important highlight/achievement of the work

Four different commercially important microalgae such as *Arthrospira platensis* (Nordstedt Gomont) (=*Spirulina platensis*), *Dunaliella* salina Teod., *Haematococcus pluvialis* Flowtow. and *Botryococcus braunii* Kutz were grown in Zarrouk's medium, DeWalne's medium, 3N-BBM+ V medium (Bold basal medium with 3 fold Nitrogen and Vitamins ; modified) and CHU-13 medium, respectively, under laboratory conditions ($30\mu Em^{-2}s^{-1}$ light intensity, $24+1^{o}C$ and 12/12 light dark cycle). All the four isolates were obtained from the algal culture collection, CAS in Botany, University of Madras except *H. pluvialis*. It was successfully isolated from the fresh water samples obtained from Himachal Pradesh and maintained. They were grown for a period of 30 days and at every 3 days interval different growth characteristics were recorded. *Arthrospira platensis* had a maximum total protein content of 1.2 g/L on 15th day; *D. salina* had â carotene of 80 mg/L on 30th day; *H. pluvialis* had astaxanthin of 23 mg/L on 24th day and *B. braunii* had total lipid content of 230 mg/L on 30th day. The amount of astaxanthin recorded from *H. pluvialis* isolated from Himachal Pradesh was compared with *H. pluvialis* obtained from Gottingen Culture Collection, Germany. It was found that the former had accumulated less amount of astaxanthin than the latter. It is intended to conduct experiments for the enhancement of astaxanthin from the former isolate under UV-B treatment. In addition the levels of Chlorophyll a, and total carbohydrate were recorded in all the test organisms. The levels of Chlorophyll b from *D. salina*, *H. pluvialis* and *B. braunii* and accessory pigments such as phycocyanin and allophycocyanin were recorded from *A. platensis*. Further fresh weight and dry weight were recorded during the study period. A simple technique has been developed for the induction of â carotene in D. *salina* by following two stage culture techniques. Initially the alga was grown in nutrient rich medium for maximum biomass productivity for a period of 15 days then supplemented with 2 volumes of plain seawater. Within a period of 2 weeks the accumulation of â carotene was increased up to 2 folds when compared to control. One of the primary objectives of the proposal is to assess the D1 and D2 proteins present in the thylakoids towards UV-B radiation. The Chloroplasts of all the test organisms were isolated successfully through sucrose density gradient centrifugation and further isolated thylakoid membrane proteins through SDS-PAGE. A separate culture room was dedicated to conduct experiments on UV-B radiation on the test algae. All the four microalgae were exposed to UV-B radiation at 1.0, 3.0 and 5.0 W/m^2 for 10, 15, 30, 45 and 60 minutes initially at a height of 30 cm and studied their growth characteristics. The tolerance of *B. braunii* towards UV-B radiation was 60 minutes; *A. platensis* - 30 min; and *H. pluvialis* -15 minutes. But the wall less *D. salina* did not survive at the above conditions and it found to be lethal. Therefore, another set of experiments were conducted for 2 and 5 minutes duration for *D. salina*. The tolerance of the alga was only 5 minutes. The order of tolerance: *B. braunii* > *A. platensis* > *H. pluvialis* > *D. salina*. Different parameters such as morphological features, biochemical characteristics including the secondary metabolites of commercial importance of the UV-B exposed test algae were compared with control. It is also intended to conduct experiments to adapt the cultures to high UV-B radiation levels by stepwise increase in intensity and duration to achieve maximum desired secondary metabolites of commercially important microalgae.

In addition to above projects, significant achievements of various completed projects during the year are also described below:

Project Title: **"CO_2 sequestration using microalgae technology"**

Implementing Agency: **Murugappa Chettiar Research Center, Chennai**

Under this projet technology" the technical feasibility of bio-fixation of CO_2 using suitable microalgae and determining the cost effective media for their growth was studied at MCRC Chennai. Accordingly, 4 microalgal species viz. *Chroococcus sp*., *Chlorella sp*., *Spirulina sp*. and *Scenedesmus sp*. were studied for their efficacy to utilize different dosages of CO_2 and algal growth in different media from synthetic BBM Medium, CFTRI medium to low cost media like modified CFTRI, ground water amended and seawater amended with urea. Out of these four algae species studied, *Scenedesmus* sp. grows well in industry effluent, a cost effective medium with the good algal productivity equivalent to that of synthetic growth media. *S. obliquus* not only able to sustain itself well, but also overpowers other algal species. Hence, *S. obliquus* was found as the best candidate adapted to most rugged conditions. The project could develop a pilot scale cultivation of microalgae using CO_2 in effluent established at M/s. EID Parry, Nellikuppam, Cuddalore district, Tamilnadu. The culture facility has the potential to treat 1000 L of effluent (pilot scale) in a sequentially batch mode transferred from one tank to another tank with a HRT of 72 hrs. With this facility, 1 – 1.5 Kg of dry algal biomass is produced utilizing ~ 8000 L of CO_2 and 1000 L of effluent in a land area of 80 m^2.

Project Title: **"Simulation studies of CO_2 sequestration using solar/ chemical methods"**

Implementing Agency: **National Institute of Technology, Tiruchirappalli**

Under this project studies were under taken to evaluate key design criteria and the technical feasibility of biofixation using micro algae at National institute of technology, Tiruchirapalli. Species identification was done for tolerance of high sun light intensity, high temperature and high CO_2 concentration. Five algae species viz., *Botryococcus braunii*, *Chlorella vulgaris*, *Euglena gracilis*. *Spirulina sp*. and *Scenedesmus sp*. *Botryococcus braunii* were studied for this. Out of these two sp. *Botryococcus braunii and Euglena gracilis* was not used in further study since the doubling time is more than 7 days in *Botryococcus braunii* and temperature tolerance is very low in *Euglena gracilis*. *Chlorella vulgaris* and *Scenedesmus sp.* were used for further study. Out of which *Scenedesmus* shows more tolerance to temperature, high sunlight intensity and resistance to contamination. Simulation studies completed for 20 cm dia tube of solar collectors showed that light penetration is possible up to 5cm depth from the surface of the collector. Hence tubular solar reactors fabricated with diameters varying from 4cm to 9cm. Four numbers of open pond reactors of 100 L capacity (surface areas 1m^2) were fabricated and tested with 14% CO_2. The results showed considerable increase in growth of algae.

Experimentation on tray studies proved that the thin film reactors for micro algae growth gives higher photo synthetic efficiency (at least twice the growth rate compared with the literature value for *Scenedesmus sp).* Concept and design of photo-bioreactor was achieved as the outcome of the project using the experimental and simulation results.

Project Title: **"Carbon dioxide sequestration through culture of medically useful microalgae in photo-bioreactors linked to gas outlets"**

Implementing Agency: **Andhra University, Vishakapatnam**

Studies carry out on Algal strains of medically important species that best sequester flue gas emissions were short listed after screening 20 different strains of both marine and fresh water strains. Some of the local marine isolates were also tried for flue gas absorption. Algal strains which have good economic importance and that grow fast using flue gas emissions - *Scenedesmus dimorphs* (rich in protein and lipid), *Neochloris oleoabundans* (bio fuel), *Haematococcus pluvialis* (astaxanthin) and *Tetraselmis sp*. (EPA and DHA rich) , *Synecococcus*, were selected for large scale cultivation. Nutrient medium of low cost and culture conditions were standardized for the short listed strains. Content of products of nutraceutical importance in these algal strains has been estimated under different culture media and culture conditions. Mass culture of these short listed strains, were carry out in an outdoor culture facility which was designed and fabricated using patented polycarbonate sheets that protects the cultures from overheating. Low cost methods were employed to fabricate outdoor ponds which use only an iron frame and tarpaulin sheet and are movable. Mock trials of mass culture of three microalgal species have been done in flue gas enriched water. Mass culture of microalgae in a photo-bioreactor linked to flue gas in Visakhapatnam steel plant is under progress.

Project Title: **"Integrated Biological and Chemical Carbon Dioxide Sequestration"**

Implementing Agency: **National Environmental Engineering Research Institute,Nagpur**

Under the project photosynthesis capability of microalgae with respect to CO_2 fixation at various CO_2 (0.03, 1.4, 3.0, 5.0, and 7.5), increase in calorific value at different CO_2 concentrations using two tier flask have been studied at NEERI Nagpur. The cultures used for CO_2 fixation and sequestration viv a vis calorific value of the biomass in order of higher calorific value are *Scenedesmus obliquus*, *Chlorella vulgaries*, *Chlamydomonas* sp and *Chroococcus* sp were 34 kJg-1 , 28 kJg-1, 27 kJg-1 and 21 kJg-1 respectively, in order of the CO_2 fixation rate are 1.81 $g^{-l}1^{-1}d^{-1}$, 0.36 $g^{-l}1^{-1}d^{-1}$, 0.04 $g^{-l}1^{-1}d^{-1}$and 0.06 g $g^{-l}1^{-1}d^{-1}$respectively at 1.4% CO_2. From the above screening studies *Scenedesmus obliquus was selected* for characterization of further parameters based on the higher biomass and CO_2 fixation rate (from 0.03, 3,0, 5.0, 8.0 and 12.0% CO_2) using Air lift photobioreactor (ALR).The removal efficiency (RE) was found to be increased in descending order with respect to percent CO_2 from 17% RE at 12% CO_2 to 90% RE at 0.030 % CO_2, with the CO_2 fixation rate of 0.1170 $g^{-l}1^{-1}d^{-1}$ and 0.1675 $g^{-l}1^{-1}d^{-1}$ for respective CO_2 concentrations. *Scenedesmus obliquus* was found to be most potential for CO2 sequestration experiments having CO_2fixation rate of 1.332$g^{-l}1^{-1}d^{-1}$ and CO_2 removal efficiency of 45% in ALR at 5 % CO_2 with light intensity of 260 µmol $m^{-2}s^{-1}$.

Project Title: **"Improving carbon and nitrogen sequestration: a transgenic approach"**

Implementing Agency: **Institute of Himalayan Bio-Resources Technology, Palampur,H.P.**

Studies on to lower green-house gas" were done at IHBT, Palampur. The project targeted to develop an alternative metabolic route to CO_2 sequestering in arabidopsis. Construction of appropriate constructs over-expressing phosphoenol pyruvate carboxylase (PEPCase) , aspartate amino transferase (AspAT) and glutamine synthetase (GS) under independent promoter and terminator in a transformation vector pCAMBIA 1302 and generated T3 generation of Arabidopsis co-over-expressing all the three genes. The transgenic plants exhibited significantly enhanced level of carbon

and nitrogen. Importantly, transgenic plants exhibited significant increase in the yield. **Patent has been filed (for USA, PCT countries):** "*A method for enhancing status of carbon, nitrogen, biomass and yield of plants*" by Anish Kachra, S.K. Vats, P. S. Ahuja and Sanjay Kumar.

SOLAR ENERGY RESEARCH INITIATIVE (SERI)

Initiated in 2008-09, Solar Energy Research Initiative (SERI) is aimed at promoting technical innovations and technological breakthroughs in the area of Solar Energy, 24x7 off grid power supply. In addition to development and technology demonstration of distributed solar energy systems in off-grid scenario, including hybrid solar power systems to validate their viability to meet rural energy needs, development of earth abundant and other novel solar materials, devices, coatings, storage options, grid connectivity, etc., for solar based system are pursued. The programme targets to promote indigenous research capacity to drive the costs of delivered solar energy, through technology innovations and take measures to build research capacity to create critical mass of researchers in the area of Solar Energy.

DST's initiative on Solar Energy is positioned upstream with thrust on enabling knowledge based R&D activities for entire gamut of solar technologies including balance of systems. Solar energy utilization for applications for both power as well as other than power generation with a view to provide convergent technology solutions under real-life conditions, are being explored and assessed. Some of the illustrative achievements of current year are given below:

1) S&T Inputs for Policy Formulation

The first of its kind demonstration plant, in association with M/s Thermax Ltd., has been commissioned. The 256 kW Plant at Village Shive in Khed Taluka of Pune district is under the Public-Private-Community Partnership (PPCP) mode. The plant uses solar energy and biomass, reducing cost of solar-biomass hybrid option. Attempts are being made to provide enabling conditions for running the plant 24 x 7 through interaction with utility. The exercise is expected to work out the viability gap and provide insight for solar thermal based energy generation in rural environment both for yet to be electrified villages as well as villages facing electricity shortage.

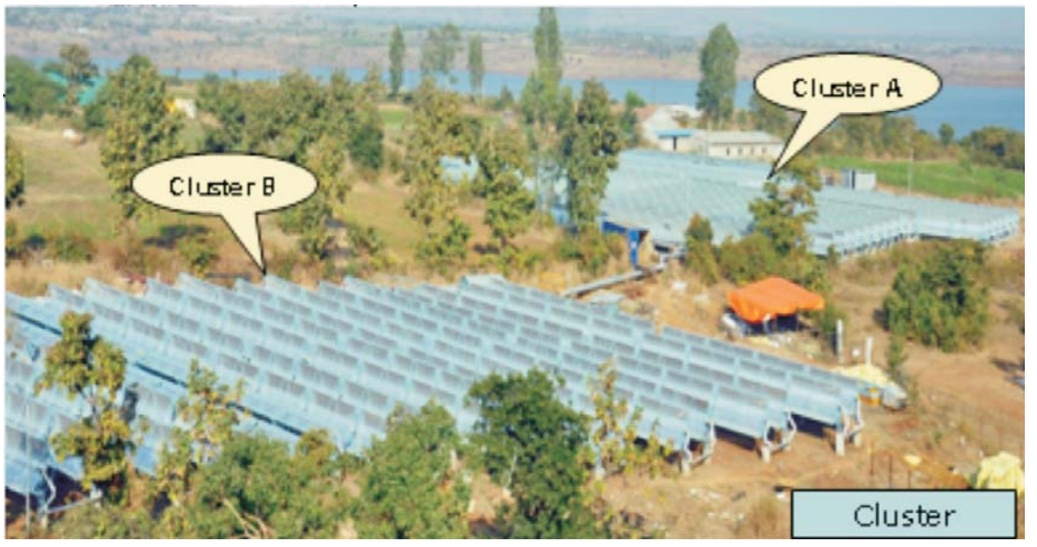


Fig. 4.32: Solar Field at Shive

2) Precompetitive Research & Technology Up-gradation

The PAN IIT initiative aims at developing pre-competitive research capacity and further improving current status of technology in synchronization of Solar Power generation with grid and focuses on cost reduction through technology paradigm. In this endeavour, various partners of PAN IIT intend to build capacity through development of knowledge network of elite institutions by focusing on technology innovations to drive the costs of delivered power from solar energy plants for supplementing the efforts of National Solar Energy Mission in driving the costs down through scale up. So far, the significant projects, supported with limited funding focused on lab scale development for smart grid are listed below.

- ❖ Re-synchronizable Autonomous Grid: Active Power Filters
- ❖ Re-synchronizable autonomous grid: DC-DC conversion for Solar PV including MPPT and battery charge controller
- ❖ Re-synchronizable Autonomous Grid : DC-AC Conversion and grid side paralleling

3) Basic Research led Disruptive Technologies

As stated earlier, as part of pro-active approach to promote indigenous capacity in Solar Energy Research, DST has shaped a PAN-IIT Initiative. A knowledge network of about 40 faculties from 6 IITs have emerged. As a result of this exercise, various interesting and promising ideas have been compiled in the form of an Aspirational Document. Through this initiative, DST aims to promote basic research led disruptive technology options through ideas generated by PAN IIT Group initially and to expand to other institutions subsequently. DST has adopted request for proposals model for promoting cutting edge science in Solar Energy research in the country. It is now proposed to expand this initiative for other public funded R&D institutions to promote innovations which could leapfrog current state-of-art. During the year, the programme has been expanded beyond IITs and more institutions have been enrolled in this effort.

4) Enabling R&D for Solar Technologies

It has emerged that supporting enabling R&D is essential for advancement of Solar Technologies in the country. This initiative takes thematic area based research in the area of solar energy and quantifiable targets are set as yardstick. The areas for the themes identified are energy storage, battery technology, micro grid, newer materials and availability of low cost silicon etc. Accordingly, promotion of enabling R&D for solar energy by various academic institutions, with focus on advancement of technologies, devices and technological capabilities, is being pursued. Some of the important initiatives include Solar Energy Hub at Bengal Engineering and Science University (BESU), Kolkata for development of large area coating systems. Multilayer coatings for enhanced solar thermal absorption for various power and non-power processes are also being developed with academia-industry interface. Steps have been initiated to set up a Solar Energy Hub at IIT Madras.

5) INDO-U.S. JOINT CLEAN ENERGY RESEARCH AND DEVELOPMENT CENTRE (JCERDC)

Recognizing the need to address climate change, ensure mutual energy security, and build a clean

energy economy that drives investment, job creation, and economic growth; Prime Minister of India and President of USA launched the U.S.-India Partnership to Advance Clean Energy (PACE), under the U.S.-India Memorandum of Understanding to enhance cooperation on Energy Security, Energy Efficiency, Clean Energy and Climate Change. As a priority initiative under the PACE umbrella, the U.S. Department of Energy (DOE) and the Government of India signed an agreement to establish the **Joint Clean Energy Research and Development Center (JCERDC)** on November 4, 2010 to promote clean energy innovation by teams of scientists and engineers from India and the United States. The overall aim of the JCERDC is to facilitate joint research and development on clean energy to improve energy access and promote low-carbon growth. To achieve this objective, the Indo-US JCERDC supports multi-institutional network projects using a public-private partnership model of funding. The JCERD has **an** estimated funding of Rs. 125 Crore (US Dollar 25 million) by the Indian Ministry of Science and Technology and the U.S. Department of Energy to be matched with equal share from consortia spread over 5 years The program is being administered in India by the Indo-U.S. Science and Technology Forum (IUSSTF). The thrust areas of JCERDC are solar energy, building energy efficiency and second generation biofuels. **DST is coordinating programmes on Solar Energy and Building Energy Efficiency of JCERDC while biofuel programme is coordinated by DBT.**

Solar Energy Research Institute for India and U.S. (SERIIUS)

The vision of the *Solar Energy Research Institute for India and the United States (SERIIUS)*, co-led by the Indian Institute of Science, Bangalore (IISc) and the National Renewable Energy Laboratory (NREL), Colorado (USA) is to create an environment for cooperation and innovation "without borders" to develop and ready emerging and revolutionary solar electricity technologies towards long-term success of India's Jawaharlal Nehru National Solar Energy Mission and the U.S. DoE's SunShot Initiative. The overall goal of SERIIUS is to accelerate the development of solar power technologies by lowering the cost per watt of photovoltaics (PV) and concentrated solar power (CSP) through a binational consortium that will innovate, discover, and ready emerging, disruptive, and revolutionary solar technologies that span the gap between fundamental science and applied R&D, leading to eventual deployment by sustainable industries. SERIIUS will address critical issues in fundamental and applied research, analysis and assessment, outreach, and capacity building. Throughout this joint effort, a key element is engaging a significant base of Indian and U.S. industry, that is dedicated and committed to developing solar energy for both countries.

The Thrust Areas of the initiative are:

- **Sustainable Photovoltaics:** Develop next-generation materials, devices,and manufacturing processes tailored to India's needs, environment, and resource availability
- **Multiscale Concentrated Solar Power:** Overcome critical science and engineering challenges for reliable multiscale (including small 25–500 kW) CSP systems
- **Solar Energy Integration:** Identify and assess key technical, economic, environmental, and policy barriers to enable a research agenda for technical readiness in India.

U.S.-India Joint Centre Building Energy Research and for Development (CBERD)

The U.S.-India Joint Centre for Building Energy Research and Development (CBERD) co-led by the CEPT University-Ahmedabad and Lawrence Berkeley National Laboratory, Berkeley (USA)

will conduct collaborative research and promote clean energy innovation in the area of energy efficiency in building with measurable results and significant reduction in energy use in both nations. CBERD will focus on the integration of information technology with building controls and physical systems for commercial/high-rise residential units. The R&D tasks are intended for technology acceleration and include building energy modeling and simulation, Monitoring and benchmarking of buildings, Communication and controls integration, Building envelope and passive design, Advanced HVAC (heating, ventilation, and air conditioning) and lighting technologies, Thermal comfort, Grid responsive buildings and Renewable energy source integration in buildings **.**

6) Smart Energy Grids and Energy Storage (SEGES) Programme

DST in collaboration with the Research Councils UK (RCUK) led by the Engineering and Physical Sciences Research Council (EPSRC), is aiming at strengthening collaboration between UK and Indian research institutions. As a step towards promotion of research collaboration DST and RCUK had jointly invited proposals for research projects focusing on Smart Energy Grids and Energy Storage with an estimated funding of £5 million by both DST and EPSRC. Both Smart Energy Grids and Energy Storage have been identified by India and the UK as areas of significance in providing solutions to the problem of meeting future energy needs. An interaction meeting on Smart Energy Grids and Energy Storage was held on 27-29 June, 2012 at Bath, UK. Based on the recommendation of the meeting, proposals were invited in one or more of the 4 areas, namely, **Appropriate distributed storage technologies, On/off grid energy systems, DC networks and Control & communications.** 14 research proposals have been received under the programme. These are now being processed for possible funding, which is expected by March, 2013.

7) Solar Technologies for Non-Power Applications

DST has supported a project to develop and demonstrate a solar thermal desalination plant which harnesses solar energy, concentrates it and produces steam which in turn is used for desalination of sea water. This Multi Effect Distillation (MED) with Thermo Vapour Compressor (TVC) desalination system consists of a Linear Fresnel Reflector (LFR). KG Design Services (KGDS), Coimbatore and National Institute of Ocean Technology (NIOT) is implementing the project. This plant will produce desalinated water at the rate of 6000 liters/ hr.

Fig. 4.33: Solar – Biomass Hybrid Sea water desalination plant in Ramanathapuram district of Tamil Nadu

In the trial run, the plant has been successful in bringing down salinity from 26000 ppm to 2 ppm. Land has been identified in Kuthiraimozhi village near Narippaiyur, Ramanathapuram. After successful trial run at Coimbatore, the MED plant has been established at this site.

Projects supported during the current year with industrial collaborators

- Development of Textured Zno thin films for solar cells front contact applications using sputtering technique and the demonstration of its performance in silicon thin film solar cells

Project supported to research labs and academic organization

- Development of CZTS (Cu2ZnSnS4) based solar cell using magnetron sputtering
- Development of Nanopillar-based PhotovoltaicCells-Process development to deposit thin films of high quality CdTe and CdS
- Development of Textured Transparent Conducting Oxide Thin Films for Solar Cell
- Fabrication and Characterization of 2D and 3D Metamaterials for Solar Applications
- Spectroscopic Studies on Light Harvesting Hybrid Materials and Potential Application in Dye-sensitized Solar Cells
- Development of Solar collector field for a solar thermal power plant (Phase-1)
- V-trough concentrator as technology platform – Case study for enhanced output from photovoltaic array powering a community scale reverse osmosis unit
- Nano-Patterned Conductive Adhesive for Metal-Polymer Inter-Connectors in Solar Cell
- Experimental study of flat plate solar collector using nano-fluids
- Development of Solar Tri-generation System for Cooling, Heating and Potable Water

WATER TECHNOLOGY INITIATIVE

DST is implementing Water Technology Initiative (WTI), a research based programme aimed at development and proving of low cost convergent technology solutions for domestic application to ensure safe drinking water quality under real life conditions. The programme encourages indigenous research initiatives for addressing issues related to water availability, water purification and water reuse and recycling. The initiative also encourages scientific evaluation of technologies and preparing of database of technologies for referencing them in specific social context. Capacity Building of Academic/ R&D Institutions and State S&T Councils in conducting R&D activities for addressing water challenges also falls in the mandate of the programme. The programme activities thus include development of database to recognize and rank water purification technologies for decentralized applications, capacity building of indigenous R&D institutions and academics, development, field assessment and pilot testing of technology options for drinking water purification. The focus of the programme has been on design and development of low cost solutions for domestic use of technologies for ensuring safe drinking water.

Achievements of XI Plan

Around 330 proposals were mobilized, since the inception of the programme and 145 projects have been supported so far. The programme has expanded to all the states except Jammu and Kashmir. The activities supported under the programme include Research and Development, Demonstration, Upscaling & Replication, Scouting of Technologies, Evaluation of Technologies and Capacity Building etc.

The specific achievements of the programme during XI Plan related to technology options for stand alone drinking water purification systems for rural schools, field assessment of technological solutions for arsenic, fluoride, iron and desalination of brackish water as well as sea water, scientific evaluation of various indigenously developed water purification technologies in academic institutions, laboratories etc.

On the directions of Hon'ble Supreme Court, Winning, Augmentation and Renovation (WAR) for Water Programme, to come out with research based technological solutions for addressing various water challenges in different parts f the country, was taken up. As a part of this intervention, 23 projects across 10 States, were taken up to address 17 different kinds of water challenges, related to various chemical, micro-biological, and physical contaminants, less per capita availability of water, mis-matched withdrawal of water, etc. In addition, challenges to meet low per capita availability, surface runoff due to geological terrain, storage capacity for seasonal variations, rain water harvesting, seawater intrusion, augmentation of water resources for irrigation through utilization of seawater for high salt resistant species, management of reject water, etc. are also addressed. 11 of these projects have since been commissioned serving the drinking water and other needs of nearly 1.50 lakh people in about 25 villages. Some of the notable achievements as well as initiatives to address these issues are elaborated below:

I. Development and proving of Convergent Technology Solutions:

a. **Buja Buja(AP), Mamsapuram (TN) and Thiruppattur(TN):** The key water challenges were low per capita availability, high levels of salinity, dissolved solids, bacteria, fluorides, seawater intrusion, etc. The water treatment is achieved by pre aeration and pre chlorination, pre settling, multimedia filtration, micron filtration, Reverse osmosis and UV treatment to produce good quality product water. The process design ensures that more than 90% treatment efficiency is achieved in terms of suspended solids, hardness, Iron and total dissolved solids and more than 99% efficiency in bacterial/virus removal from the product water. Reject water from the treatment plant and entire wastewater generated in the village is treated and made good for irrigation. Through this intervention, 3000 families are able to get adequate drinking and domestic water and the treated waste water meets irrigation needs of nearly 2000 in Buja Buja, Andhra Pradesh. The villagers pay regular contribution for maintenance of the water treatment plant as well. A similar facilities in Mamsapuram and Thiruppattur, both in Tamilnadu, are serving over 11000 families through supply of safe drinking water and about 4000 farmers are reaping the benefit of irrigating lands through treated wastewater, which otherwise flows through the villages causing pollution and health hazards.

Fig. 4.34: Birds eye view of the WTP at Buja Buja

Fig. 4.35: Inauguration of Water Plant at Buja Buja

b. **Assam/Bihar/UP/WB*:*** The key water challenges were High levels of Arsenic, bacteria. Aresnic removal technologies based on iron adsorbents require a ratio of Fe/As of 250 or more to achieve low arsenic concentrations in treated water. High Fe/As ratios generate more sludge leading to higher costs for its disposal and cumbersome maintenance. Arsenic filter used in the process has Fe/As ratio of 10, reducing the cost of the units and easy to maintain. Based on the feedback from the villagers, the pilot plants were modified extensively to real site conditions with the use of locally available materials that can be fabricated by plumbers/masons within the village. The arsenic free water produced by Arsenic Removal Units (ARUs) deployed in the villages, generating 25 times less sludge compared with other processes, costs about Re 1 for 1 KL (average monthly requirement for a family of 5). Through this intervention, 6000 families in 42 villages are able to consume Arsenic free water, providing relief from gastic problems, indigestion, skin allergy, lesions and visible marks on body, etc.

c. **Pacheri Cluster and Beenchiri Cluster (Rajasthan):** The water challenges here were Low per capita availability and over exploitation of ground water. People now are able to get fresh water from the constructed easy to maintain rain water harvesting structures and Kunds within their premises, ensuring availability round the year saving considerable effort and time otherwise spent of collection of water farm a place, which in many cases is 3-4 km away from home. Villagers in this arid zone, more so those beyond the age of 50, used to feel pain in the joints due to high level of total dissolved solids or Fluoride in the water, reported relief after consuming this water collected and stored in the Kunds. Through this intervention 700 families in 9 villages are able to reap the benefit of getting drinking water round the year. Through similar intervention of harvesting rain water from hill-slopes and its storage in community-based tanks, is benefiting 2500 families across 7 villages in Bichhiwara Cluster (Dungarpur District, Rajasthan), and 6 villages in Rupaichari Cluster (North Tripura District, Tripura), both in hilly terrain of tribal areas.

d. **Augustmuni and 3 other villages (Uttarakhand):** The water challenges here were Low per capita availability, high levels of suspended solids, bacteria, etc. Abstraction of water from near-riverside wells is not favoured in the hilly regions on the assumption that the thickness of aquifer is insufficient to get enough yield. In River Bank Filtration (RBF) Project, recent

experiences have been incorporated into a new concept, comprising methodological stage-wise phases of visual site reconnaissance, geodetic surveys, field and laboratory investigations, parameter determination and groundwater modeling, in planning new sites in hills. Use of fast and economical overburden drilling, with eccentric bit and percussion drilling technique, found suitable for construction of production wells in high-energy fluvial environments, typically encountered in hilly areas, were adopted, leading to good yield of water free from turbidity. 25% of the project cost has been met by the Uttarakhand Jal Sansthan (UJS), who executed the works and also replicating in other parts of state as well on other river banks in other States. Significant potential for the replication of new RBF schemes exists across various rivers, streams, lakes, etc. Significant improvement quality of water round the year in removal of turbidity and pathogens by RBF compared to direct surface water abstraction was noticed, based analysis carried out at UJS Departmental Lab, and other NABL accredited Labs. Through this intervention 5800 families in 4 villages are able to get about 70 liters per head of water, free from both physical and bacteriological contaminants, every day.

Fig. 4.36: River Bank Filtration well at Karanparyag

e. **Naripayuur/Ervadi (Tamilnadu):** The water challenges here were high salinity of sea water. The process adopted was Solar Multi Effect Distillation (MED), which was being done for the first time in the country. This 6000 lph, plant is in advanced stage of commissioning and 7000 people are to be provided with 15 LPCD for drinking and domestic use. Also, a two stage indigenous RO process of 6000 LPH capacity for Sea–water desalination using indigenous membrane developed by CSMCRI, Bhavnagar has been fabricated and installation is in progress at Ervadi village panchayat. The work for second plant is in progress at the laboratory. The automation and pressure energy recovery system is being optimized.

II. International Cooperation

Department of Science & Technology along with Research Agencies of Belgium, Finland, France, Netherlands, Germany and Spain had initiated joint proposals under India -EU Networking Pilot Programme (New Indigo). Based on mutual consultation, a call for proposals named as 'Water

Related Research' was launched focusing on "***Waste Water Management including Industrial and Agriculture***" and "**Green Chemistry applied to Water Purification including Drinking Water Purification**". The proposals received in response to the calls were shortlisted based on the qualifying criteria and shortlised proposals were evaluated individually by both the sides. Subsequently, 21 shortlisted proposals received under the above Call and 9 projects were supported.

III. R&D Projects

Some significant R&D Projects, supported under WTI and WAR for Water, during the current year are listed below:

- ❖ Silver nanoparticle-based point of use test for Cr (III) determination in tannery contaminated waters.
- ❖ Design consideration and field performance validationof high arsenic removal water filter packed with lab-bech develoed materials.
- ❖ Ion-Specific Resins and Membrane based systems/process to bring the level of Arsenic to WHO limits in drinking water.
- ❖ Scientific Understanding of Defluoridation Employing Indigenous Resin and Comparison with Activated Alumina
- ❖ Development of Low Cost Magnetic and Nano-magnetic Biochars for water Defluoridation
- ❖ Advanced molecular methods for detection and identification of bacterial contaminants in potable water purification
- ❖ Development of Nanoparticles related water Quality Framework for Protecting Source Drinking Water
- ❖ A Pilot scale study and Installation of a Pilot for treatment of wastewater Polluting River Ganga in Varanasi city using a Novel Technology
- ❖ Installation of Rainwater Harvesting System in Nagaland
- ❖ E-Tongue based detection and estimation of Arsenic in contaminated water
- ❖ Development and Scaled up Synthesis of Anionic, Cationic and Nano-ionic Flocculants based on Amphoteric Amylopectin for Mineral Industry Effluents and Municipal Waste Water Treatment.
- ❖ Design and Development of a Buoyancy driven Distillation Unit Powered by Solar Combi-collector.
- ❖ Laboratory investigation ad field application towards the effective defluoridation of water using appropriately tailored sorbents
- ❖ Sustainable Treatment of wastewater using Micro-algae and Bio-coagulant for bio-crude production

- ❖ Development of effective adsorbents from waste rubber tire for waste water treatment
- ❖ Rainwater harvesting at Hmunpui(Mizoram)
- ❖ Management Plan for sustainable Development of Unidentified Heterogeneous Aquifer System of Ghaziabad Tehsil, Ghaziabad District (Uttar Pradesh)
- ❖ Ensuring safe drinking water to the tribal households in Koraput Region of Odisha
- ❖ Rainwater Base Community Managed Sustainale Solution for Selected Water Scarce Villages of Mewat District (Haryana)
- ❖ Establishing water plants in Mudshi, Halodhar, Mota Kanthariya and Limbda (tribal areas with surface run-off due to geological terrain), Sabarkantha Dist (Gujarat)
- ❖ Ground improvement of dune sand fields for water harvesting and moisture retention
- ❖ Novel Low Cost Adsorbent materials for Defluoridaton of drinking water
- ❖ Development of amine based polymer adsorbent for Defluoridization of drinking water
- ❖ Innovation demonstration and training: Development of a water positive facility
- ❖ Impact of industrial growth on water and soil quality and its health risk assessment with special reference to heavy metal contamination
- ❖ Assessment and Strategies for sustainable Management of water Resources using remote sensing and geographic Information systems
- ❖ Water quality and its role in endemic kidney disease in coastal Srikakulam (Andhra Pradesh)- A synergic perception for assessment and remedies
- ❖ Prediction of Lean Season Discharge of Springs for Efficiently Managing it to Fulfill Water Needs of the Mountain Inhabitants (Sikkim).

TECHNOLOGY SYSTEMS DEVELOPMENT (TSD) PROGRAMME

Technology Systems Development (TSD) Programme supports activities aimed at developing and integrating technologies to evolve technology systems both in the advanced/emerging areas and in traditional sectors/areas. Under the Programme, the focus is on inter-disciplinary, multi-institutional technology feasibility and development of technologies in certain identified areas, assessment of feasibility of fresh ideas/ concepts for their potential conversion into useful technology/product. The specific objectives of the Programme are to:

- develop and integrate technologies following a holistic approach in identified areas;
- promote application of modern/advanced technologies to socio-economic problem solving;
- promote modernization of traditional technologies, tools and skills;
- facilitate enhancing quality and performance of the traditional/non-traditional items;

- encourage developments in application of R&D activities; and
- promote activities aimed at improving technology, technique, material, methods and other appropriate activities conducive for development of technology status in identified areas.

During the year, following broad sectors were focus of TSD Projects for development of state of the art technology systems .

- Water Purification
- Surface Engineering modification and rejuvenation of Traditional Crafts
- Information and Communication Technologies
- Innovative Civil Infrastructure Technology Systems
- Glass Technology Upgradation Programme
- Bio-molecular & Conducting Polymers Devices including Platform Technologies
- Ceramic Technology Upgradation Programme
- Development of Microwave based systems
- Waste Utilisation
- Miscellaneous Technologies

Summary of the progress made in some of the important areas, which were taken up for technology development is given below:

1. **Water Purification**

The focus is primarily on removal of arsenic, fluoride, salinity and iron from water. An integrated plant based on ceramic microfiltration membrane (80000 LPD capacity) and brackish water reverse osmosis membrane (30,000 LPD capacity) for drinking water supply was installed on the bank of Ichhamati River at Taki Muncipality, Kolkata, West Bengal. The plant has been implemented by CSIR-CGCRI and CSIR-CSMCRI in association with the local bodies of Taki Muncipality, Taki and Public Health Engineering Department, Hasnabad Subdivision, Govt. of West Bengal.

a) Bio-degradable/Bio-medical Polymers :

These polymers, due to their outstanding characteristics, are finding increasing applications in household, transport, industrial and agricultural fields. They are also increasingly used as artificial organ and transplant in various biomedical applications. One of the solutions is to use biodegradable polymers based on microbial/agricultural/forest resources. This technology is recent one and is being fervently pursued in every part of the world. In addition to the Community level Water Technology Development Programme projects, progress of the on-going projects sponsored under this Core-group were reviewed during the year.

2. **Alternate Fuels:**

The department has carved out a niche area to address various technological aspects related to bio-fuels. The focus of activities under this programme is mainly on technology related applications and system integration in bio-fuels. Department has initially focused on potential and problems related to the application of Straight Vegetable Oils (SVOs). The department has the mandate to support R&D related to development, demonstration and field trials of various technologies related to bio-fuel for various applications and activities to promote the use of bio-fuels and utilization of their by-products to produce value added chemicals. Following projects were supported in this area during the year:

- HCCI mode of operation to reduce emissions in internal combustion engines: Experimental and numerical investigations
- Production of Green Diesel from Non-Edible Oils Using Supported Nano Metal Catalysts
- Physico-chemical Characteristics and Storage Studies of Jatropha and Karanja Seeds, Oils and Biodiesel
- Industrial Scale Production of Biodiesel by the Transesterification of Jatropha/Castor Oil Over Nanocatalysts
- Fuel Spray and Combustion Visualization Using Endoscope in Biodiesel Fuelled Direct Injection Engine for Optimal Fuel Injection Strategy and Emission reduction
- Valorization of glycerol for biodegradable base Addition to Biodiesel via biolubricants
- Installation of novel biomass pyrolysis pilot plant and its performance evaluation for bio-oil production using different biomass feedstocks
- Design and Development of Horizontal Gasifier for Biomass materials
- Glycerol-based Carbon Acid Catalyst for the Production of Ethanol and Value-added Chemicals from Biomass
- Development of a mode switching biogas – biodiesel/diesel HCCI engine with a high pressure common rail injection system
- Studies of Thumba (Citrullus Colocyntis) Seed Oil on Engine Performance, Combustion and Exhaust Emission Characteristics.

i) Development of a mode switching Biogas – Biodiesel / diesel HCCI Engine with a high pressure common rail injection system

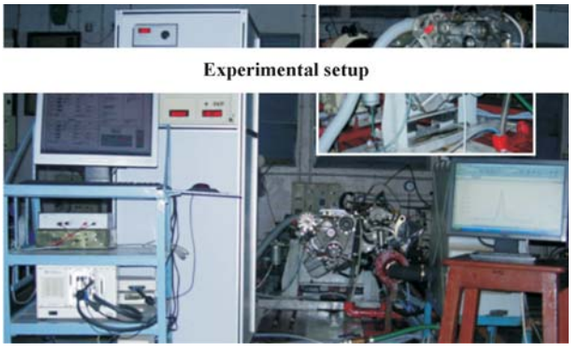


Fig. 4.37

In this project a state of the art automotive common rail diesel engine was modified to operate in the HCCI and dual fuel modes with biogas as the main and diesel as the auxiliary fuel. A special real time controller based on a FPGA system which can give complete flexibility in all injection parameters was developed and interfaced. Experimental setup Experiments and simulation studies are being conducted in the HCCI mode. The final deliverable will be an engine that will maximize the use of biogas with minimum emissions by automatically switching between diesel, HCCI and dual fuel modes.

iii) Combustion, Material Compatibility, and Engine Tribology Investigations in a Biodiesel Fuelled Turbo-charged Transportation Engine

This project looks at the possibility of using biodiesel in a modern transportation diesel engine based on common rail direct injection (CRDI) technology, where the fuel injection pressures are as high as 1400-1600 bars. This study also explores the effect of using variable injection timings and exhaust gas recirculation on the performance and emissions of such modern transportation engines.

This study is conducted by IIT-Kanpur in collaboration with Tata Motors Pune on a modern automotive CRDI diesel engine (Fig.4.38). Approximately 1000 liters of biodiesel has been produced in-house in Engine Research laboratory of IIT Kanpur for these engine tests in pilot plant (Fig. 4.39). This project also evaluates engine performance, emissions, power and torque characteristics, fuel consumption, lubricating oil degradation etc. for biodiesel and compares it with the baseline data from mineral diesel.

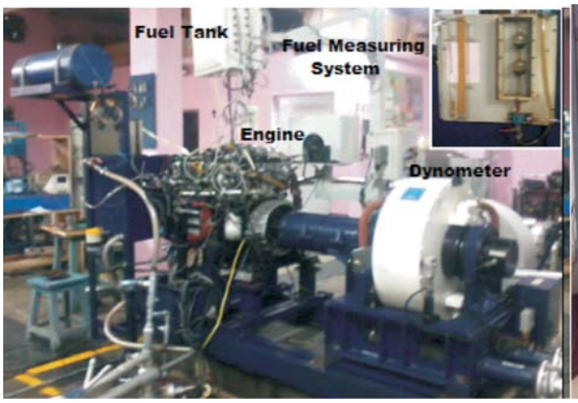


Fig. 4.38: CRDI Diesel Engine coupled with Eddy Current Dynamometer and Controller

Fig. 4.39: Biodiesel Pilot Plant

3. Information & Communication Technology (ICT) Systems:

Under this area, the focus is on developing technologies, which promote application of information technologies for the benefit of general masses especially rural people. Following projects were supported in this area during the year:

- Internet Multimedia Search Engine for information retrieval in distributed environment.
- Development of Computational Framework for the Automated Quantitative Analysis of Cardiac MRI
- An Efficient Multimodal Human Identification System with Reduced Recognition Time

i) Development and implementation of a model telepsychiatry application for delivering mental health care in remote areas (using a medical knowledge-based decision support system)

This project aims to develop and implement a model telepsychiatry application to deliver mental healthcare to underserved population of remote areas using a medical knowledge-based decision support system. The project involves development of a net-based, logically linked clinical

diagnostic and management decision support system that would function as the **e-psychiatrist** or a **virtual psychiatrist**. For this, the Tata Consultancy Services Ltd is the collaborating partner. The telepsychiatry application, i.e. the '**E-psychiatrist model'** has been developed as a bilingual (English and Hindi) expert system for identifying and managing 18 human psychiatric disorders.The project is being piloted at three sites i.e. Bilaspur in Himachal Pradesh, Srinagar in Uttarakhand and Srinagar in Jammu & Kashmir. The **"E-Psychiatrist Model"**, **which is unique and first ever such system in the world**, would greatly serve the purpose of the Ministry of Health & Family Welfare, GOI, for effective delivery of mental health care in remote areas.

4. **Surface Engineering modification and rejuvenation of Traditional Crafts:**

The program includes demonstration of technology initiatives at micro-level, training of the community and creating local technology base. Highlights of some of the specific projects include

- Development and setting up of a proto-type plasma system for surface modification of Angora rabbit fibre to improve processing at Kullu.
- Setting up of eco-friendly plasma system to coat brass articles by silica coating at Metal Handicraft Service Centre, Moradabad
- Preparation characterization and performance study of solid lubricant and wear resistance surface coatings on textile machinery components at local textile cooperatives at Coimbatore.
- Plasma nitriding for the improved performance of cutting machinery in tyre industry at Kottayam.
- Development of an eco-friendly protective coating for wood crafts in india by Shriram Institute of Industrial research, New Delhi

i) Plasma Treatment of Brass Valves to Enhance Rubber to Brass Bonding

Department of Science & Technology and Industry (M/s Triton Valves) jointly sponsored this project. The objective of this project was to scale up eco-friendly plasma etching process to treat brass valves to improve rubber to brass bonding to an industrial scale (5000 valves per batch). FCIPT has successfully developed and commissioned industrial scale reactor at M/s Triton Valves Ltd. Mysore. The plasma treatment provides extremely good rubber to brass bonding. The plasma process is environment friendly thus, eliminate the use of hazardous chemicals.

Fig. 4.40 : Industrial Scale Plasma System to treat 5000 Brass Valves per batch commissioned at M/s Triton Valves, Mysore

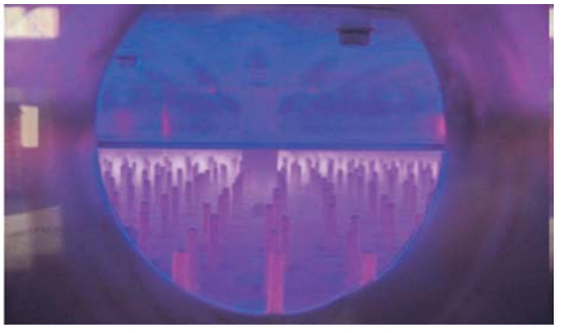


Fig. 4.41: Plasma Treatment of Valves in Vacuum Chamber

ii) Development of Industrial Scale Atmospheric Pressure Air Plasma System to Treat Angora Wool for HIFEED, Ranichauri and Weaver's Society, Kullu:

A prototype system was successfully established in the Angora Cottage Industry at Kullu in 2009 for spinning of 100% Angora yarn and making newer products with the support from Central Wool Development Board, Ministry of Textiles, Govt. of India. Since then there has been demand from Angora Farmers for establishing such plants amongst Angora industry clusters of the country.

This project was sanctioned by DST to develop and demonstrate industrial scale atmospheric pressure air plasma treatment system to modify the surface properties of 1 m wide Angora web to improve processing of Angora wool. FCIPT,IPR transferred the know-how of the technology to M/s InspirOn Engineering Pvt. Ltd.

The full scale industrial plasma system for processing of Angora wool has been developed by M/S Inspiron Engg Pvt. Ltd., under technology license from FCIPT-IPR and NID. This system has been installed at HIFEED, Ranichauri, Uttarkhand and Weavers Society, Kullu. This state of the art industrial scale system is the first one in the world for Angora wool processing using plasmas.

5. Innovative Civil Infrastructure Technology Systems:

TDT Division of DST has established a core-group on "Development of Civil Infrastructure Technologies" to find sustainable, energy efficient and cost effective solutions in four distinct sectors viz Housing, Roads and Traffic Engineering, Bridges and Fly-overs and Civil Construction Materials. The core-group has organized two round table workshops at Chennai and Jorhat and a result over 20 projects are under active consideration.

Following projects were supported during the year:

- Eco-friendly bricks: A new material in Civil Engineering
- New Building System for Affordable Mass Housing using Glass Fibre Reinforced Gypsum (GFRG) panels.
- Health Monitoring of Buildings using Wireless Sensor Network.
- Development of Technology for making flooring and wall tiles using Kota Stone waste.
- Experimental and Analytical studies for the short and long - term behaviour of Epoxy bonded steel- concrete composite bridges.
- Development of response evaluation system for RC frames with masonry infills under dynamic loading conditions
- Development of warrants for the use of modified binders for improved performance of flexible pavements.
- Analysis and Modelling of Risk for Tunnel projects.

- Guidelines for the use of Geo-cells in flexible pavements.
- Segmental composite Slabs for bridge decks.
- Restrained earth structures for sustainable infrastructure.

i) **Development of technology for making flooring and wall tiles using kota stone waste".**

Global growing industrialization is generating variety of waste causing environmental pollution. Environmental concerns are very vital area to consider in a great way. In the construction industry, large numbers of natural resources are used widely. Stone is amongst one of them. Kota stone which is mostly produced in Rajasthan at Kota, Jodhpur, Sawai Madhopur, Bundi, Jhalawar etc. is producing huge amount of waste in the form of broken pieces, dust and slurry. Around 2 million tons of finished kota stone for construction is being produced in these areas annually. Out of this around 2-7% of waste is also generated annually affecting the environment in a big way. CSIR-CBRI, Roorkee has taken initiative jointly with Rajasthan State Pollution Control Board (RSPCB), Jaipur to develop an appropriate solution and come-up with a focussed R&D proposal. The outcome of this project would be an appropriate pilot level technology for making flooring and wall tiles through value addition. This will not only reduce the load on natural resources substantially but also generate employment along with added profit to industry. The outcome will be utilized by existing kota stone industry of Rajasthan by adopting the developed pilot level technology

ii) **Development of Fiber Bragg Grating (FBG) Based Distributed Strain Sensor System for Concrete Bridges**

The planned outcome of the project is design and preparation of FBG sensors arranged in array/mats for sensing distributed strains in a structure. This also involves bonding fixtures for FBG sensor mats, mounting system for packaged sensors in cementitious structures apart from strain and temperature discrimination technique. This will ensure the wider usage of FBG sensor for distributing strain sensing for bridges and other modes for civil-infrastructural applications in public domain (society) and industry for their safe operation. The FBG sensors are to be installed on laboratory beams as well as in a real bridge.

Simultaneously, a box girder bridge over the Hindon River near Ghaziabad belonging to Ghaziabad Development Authority (GDA) has been chosen. The following sensors were installed (embedded in concrete) in the soffit of the one of the span (P2-P3) of the box-girder bridge as shown in Fig. 4.42.

Fig. 4.42: A View of FBGs and other Sensors onthe Soffit of the Box Grider Bridge

a. **Fig. 4.42: A View of FBGs and Other Sensors on the Soffit of the Box-Girder Bridge**
VW- sensors across the middle section of the box-girder- three numbers across the width were installed in the longitudinal direction.

b. At the same location FBGs were also installed near the VW-sensors.

iii) Health Monitoring of Buildings using Wireless Sensor Network

The present assignment envisages the development of methodology to monitor the physical parameters using wireless technology to describe the health of complex building. Further, the research work aims to develop numerical model using FE technique based on measured response thereby assessing the health of building by performing modal updating. The evolved technique will be implemented on existing building to establish the sensitivity of system under ambient & forced condition.

Experimental investigations have been attempted on a steel cantilever beam (Fig.4.45) for damage identification. The dynamic monitoring of a cantilever steel beam has been carried out under free and forced-vibration condition. The forced vibration was introduced using Long stroke-shaker connected close to the fixed end of the beam. The experimental setup consists of a cantilever beam (1000X75X8mm), Wireless accelerometer motes (Microstrain), Base-station and signal display & processor, Long-stroke shaker and signal generator.

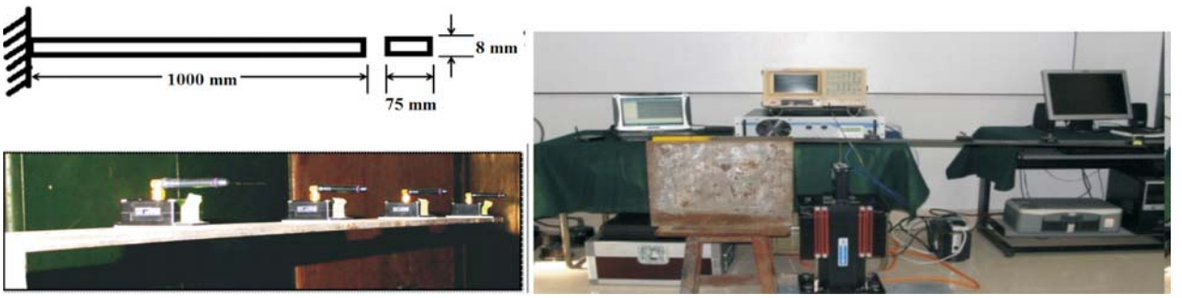


Fig. 4.43: Geometry and Experimental setup for cantilever steel beam along with sensor placement

iv) New Building System for Affordable Mass Housing using GFRG Panels

There is a tremendous need in India to develop technologies for affordable mass housing that enable rapid construction and contribute to sustainable development, by using eco-friendly materials and minimizing the use of cement, steel, river sand and water. IIT-Madras has come up with such a proposal, using prefabricated panels made of Glass Fibre Reinforced Gypsum (GFRG) that are made from processed phospho-gypsum (recycled industrial waste from fertilizer industries). Also, a GFRG/Rapidwall Building Structural Design Manual has been recently published by BMTPC, based on the research already carried out at IIT Madras.

v) Eco-friendly Bricks: A new material in Civil Engineering

To cater the need of rapidly growing and demanding infrastructure industry, microbe based formulation 'Charuzyme' has been developed for eco-friendly preparation of bricks at Department of Biotechnology, PDPIAS, CHARUSAT. The soil type used for brick preparation is restricted to fertile soils (Farm Soil) only. Soils were collected from different part of Gujarat and characterized. The technology developed save time and cost as duration of conventional brick preparation takes 15-20 days while developed process takes only 4-5 days and with reduction in cost up to 50%. Semi automated brick molding machine has been installed with capacity of 10,000 bricks per day.

Figure Legends

Fig. 4.44: Different types of soils used for brick preparation

Fig. 4.45: Mass production of CHARUZYME

Fig. 4.46: Pre-processing of soil and CHARUZYME before brick preparation

Fig. 4.47: Different types of Molds used

Fig. 4.48: Drying of Bricks

6. Glass and Ceramic Technology Upgradation Programme:

Under this programme, projects aiming at technology upgradation and development have been initiated in the areas of optical glass, ophthalmic glass and unorganized small sector glass industry of consumer items (Firozabad glass industry). The objective of this programme is **t**o develop commercially viable technologies of interest to either existing industries or start-up companies. Progresses of the on-going projects were reviewed during the review.

i) Development of new designs and products based on the indigenous materials, skills and infrastructure of Purdilnagar bead cluster

This proposal has its genesis in one of the visits made by the Group of Experts (GOE) on Technology based intervention, to Glass Bead unorganized micro and small scale industry cluster.

This cluster is located in Purdilnagar, in Hathras District of Uttar Pradesh. Overall this project aims to contribute to the employment generation for the region; considering its indigenous skills, technology and infrastructure as the important aspects towards the earnings of the sector and eventually its sustainable development. Project also explores the craftsmanship (each bead and bangle being handmade) as a unique value and will celebrate the same in the product outcome. Project is also exploring new markets for the craftsmen; taking them to the venue for selling the developed products and sharing their skills with the larger audience through demonstrations.

ii) Development of Production Technology for Protective Coated Precision Plastic Bi-aspheric Lenses for Indirect Ophthalmoscopy

The broad objectives of this project includes development of the indigenous technology for large volume production of cost-effective high quality protective coated precision plastic bi-aspheric lenses (PBLs) for indirect ophthalmoscopy of powers 20 & 28 diopters. The design studies are completed by CSIR-CSIO; inserts / dies are being developed by CSIR-CSIO & CIPET, flow and shrinkage analysis completed at CIPET; optimization of Injection Molding is in progress at CIPET; similar optimization studies for Sol-Gel Coating are in progress at ARCI. Few batches of injection molded and precision coated lenses are produced and evaluated. Comprehensive Tolerancing analysis is being initiated by the participating institutes. The project is progressing as scheduled with encouraging results. This analysis will be followed by field trials at pre-designated eye-care centers for evaluation of Injection Molded & precision Protective Sol-Gel Coated PolyCarbonate Bi-Aspheric Lenses of powers 20D & 28D for Indirect Ophthalmoscopy.

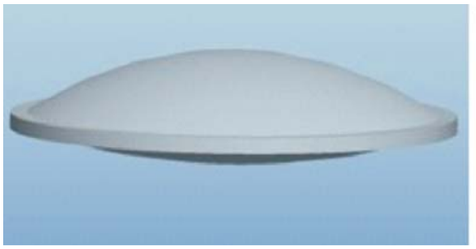
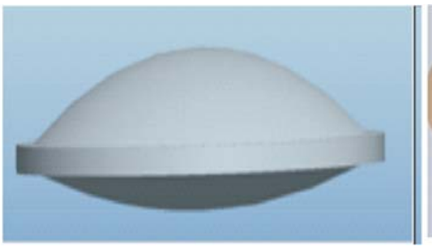


Fig. 4.49:*CAD model of 20D & 28D Bi-Aspheric Polycarbonate Lenses*



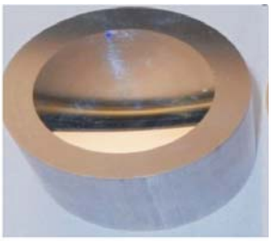


Fig. 4.50: Cr-Zr-Cu inserts

Fig. 4.51: Upper Portion Uncoated & Lower Portion

Fig. 4.52 : Sol-Gel Coated Injection Molded Bi-Aspheric

Fig. 4.53 :

Fig. 4.54:

iii) Development of Magnesia Hercynite bricks.

Rotary kiln is used as the main equipment for the production of Portland cement. Out of various alternative materials, Magnesia-Hercynite brick is one which can replace Magnesia Chrome brick for use in the burning and transition zone of cement rotary kiln, due to its thermo-elasticity property and compatibility with molten cement clinker. Hercynite is a spinel group of mineral which is not available in nature and it is synthetically prepared by sintering as well as by fusion route in EAF. In this project magnesia hercynite brick has been developed by using synthetically prepared fused hercynite through plasma fusion route to replace the Magnesia Chrome bricks for application in cement rotary kiln.

iv) Development of Magnesia Galaxite bricks for Cement Rotary kiln.

Rotary kiln is used as the main equipment for the production of Portland cement. Generally Magnesia Chrome bricks are being used in the burning and transition zone of rotary kiln. Chromite poses a great environmental problem due to its carcinogenic nature. To overcome this problem scientists have been working to develop alternative refractory materials. Out of various alternative materials, Magnesia-Galaxite brick is one which can replace Magnesia Chrome brick for use in the burning and transition zone of cement rotary kiln, due to its thermo-elasticity property and compatibility with molten cement clinker. Galaxite is a spinel group of mineral which is not available in nature and it is synthetically prepared by sintering as well as fusion route in EAF. In this project magnesia galaxite brick has been developed by using synthetically prepared fused galaxite through plasma fusion route to replace magnesia chrome bricks in cement rotary kiln.

Fig. 4.55 :

Fig. 4.56:

v) Development of improved quality glass, compatible lamp Torch and High surface finish Dies and Moulds"

The project aims at upgrading the quality of Glass beads to match the international standards. As of now, there is variety of glass compositions and colors available. It would, therefore, be necessary to lay the foundation by identifying base glass compositions, which would primarily be based on Soda Potash & Barium Glass compositions. Subsequent to that the colorants would be identified to get the desired stable colors in the glass. Apparently, the new glass composition would require a change in the work practices which may involve redesigning of lamp torches and suggest a methodology to bring about the desired changes in the shortest span of time with due regard to adaptability by the Artisans, Entrepreneurs ,etc. To improve the surface finish of beads, it would be necessary to identify the suitable materials for the dies & moulds with requisite surface finish, which shall form the integral part of this project. Glass developed have low thermal expansion, high durability and higher refractive index compared to local glasses, therefore, the beads of two or more glass combination are compatible with each other to do not crack during the making of beads by flame work. Beads made of these glasses shine better and do not weather during the course of its application. Developed dies gave requisite shining on the surface of beads. The observations of bead makers were also recorded.

Fig. 4.57: Drawing Of Molten Glass

Fig. 4.58: Making Of Glass Rod

7. Molecular Electronics, conducting polymers and Non-invasive and other biosensors program:

This programme aims to establish the technical feasibility of emerging concepts in the areas of Biomolecular sensors, conducting polymer based microactuators/artificial muscles, molecular electronic devices such as Memory Switching, Logic Gates, diodes, Organic electronics devices like Light Emitting Diodes (OLEDs), Organic Field Effect Transistors, Organic Thin Film Transistors (OTFTs), Organic Photovoltaics (OPVs), Biofuel Cells, Bio-photonics, Ion Selective FET (ISFET), Electronic-Nose-Tongue-Vision, Bio-metrics, polymer based sensors for Biological Fluids, Bio-chips, Tactile Sensors; Microfluidics, Energy Devices, Super Capacitors, Information storage (memory) devices based on conducting polymers, Self-assembled Monolayers, Langmuir-Blodgett films and other Thin films. The Molecular electronics is a fast emerging area of nanotechnology which is concerned with the electronic and optoelectronic properties exhibited by several class of organic molecules, fullerenes, carbon nanotubes, graphene, conducting polymers and biological materials such as proteins and

nucleic acids. Biomolecular electronics is a sub-area which integrates the biomolecules with the electronics through a transducer. A major outcome of research in biomolecular electronics is the development of biosensors for health care diagnostics especially of non-invasive type.

Progresses of all the projects sanctioned under this Core-group were reviewed during the year. Following projects were sanctioned during the year:

- Development of nanopiezoelectric sensor
- Organized assemblies of peptides and proteins immobilized in nanoporous templates: Designing a tool to study fibrillogenesis
- Flow Injection Analysis – Electro-chemical Detector (FIA - ECD) for Biochemical Analysis
- Design, Development and Technology Transfer of high power diode pumped Nd: YAG laser with frequency doubled output
- Performance Appraisal of a FGMOS Transistor by using QD Floating Gate in 45nm Regime
- Development of electrochemical based biosensor for detection of lymphatic filarial parasite, Wuchereria bancrofti, in vectors.
- Demonstration of energy storage prototype hybrid supercapacitor device using nano hybrid materials.
- Design and development of multimodal optical microscope using fourier optical image processing.

i) **Bacteriorhodipsin – A status report**

Rhodopsin, as the fundamental photosynthetic protein in the retina of the eye for vision purposes, was known for a long time. The fact that they can be produced using bacteria like the Halobacterium Salinarum was observed about forty years ago. Due to its unique properties, this protein and its mutants have potential applications in developing all optical memories, switches, logic-gates, sensors, optical limiters etc. Availability of this protein to develop these technologies is extremely difficult and also is very expensive. There have not been much focused efforts in the country to produce this protein in the past.

A group of investigators were encouraged to develop techniques for the production of base materials and then optimize the same for larger production. Innovative methods had to be developed for this purpose. An initial seed grants were given to three institutions to develop this material. Two of the institutions were more successful in doing so. These groups are being encouraged to set-up production plants to supply the protein to end-users for device development. Similarly, end-user groups are also being formed. These teams are focussed on making thin films, optical devices, memories etc. There is considerable progress in these efforts too. There have been many focused discussion meetings under the auspices of DST to further this program.

Photoactive biomolecules are in great demand for the development of optical and electro-optical sensors. In this regard, Rhodopsins which are proteins and vital to animal and human vision are particularly important owing to their sensitivity to light and optical capabilities unmatched by synthetic molecules. In fact, several countries are intensely, but somewhat covertly working on these molecules, bacteriorhodopsin extracted from purple bacteria in particular. So much so, suddenly there is a dearth of commercial sources for these molecules and where it is available,

it is sold at an exorbitant cost. Ability to make and manufacture rhodopsin based photonic components for device applications go a long way in establishing technological supremacy in the areas of Molecular electronics devices. The program was funded with two major objectives. (a) To prepare BR molecules from purple bacteria (b) simultaneously develop photonic devices based on the already established properties and to use available films for the high-end applications.

The following are the outcome of the efforts during this period:

1. A small scale production facility was set-up for bR at IMTECH, Chandigarh.
2. A process for production of bR has been developed at UAS, Dharwar.
3. A process to develop bR film is being developed at SSIHL, Prasanthi Nilayam. The films are tested for their optical absorbance quality and found to be comparable to the imported film.

ii) **Field testing and commercialization of polymer-gel-based PbO_2-Carbon Ultracapacitor System for rural lighting and ride-through in power conversion applications"**

Under this project a Ultacapacitor based lighting system that has been developed has wide range of power conversion applications especially for rural and remote regions. The Hybrid Ultra Capacitors (HUCs) are conceptualized and tested at IISc. The conventional pasted-type lead-acid battery electrodes require slow charge (C/10 rate) and discharge (C/5 rate) schedules for sustaining the desired cycle-life. These HUCs can be fast charged and have shown long cycle-life. The hybrid battery –ultracapacitor system is a novel cost-effective substrate-integrated PbO_2 positive plates are used to replace the conventional plates to circumvent the aforesaid problems. Lead sheets are used as substrate for positive plates that are subjected to electrochemical formation cycles during which a thin layer of PbO_2 is formed on the lead substrate. Such electrochemically formed substrate-integrated PbO_2 positive plates have several advantages over the conventional positive plates; in particular, SI-PbO_2 plates can be charged and discharged quickly with high faradaic efficiency and exhibit high cycle-life in addition to their high power density. SI-PbO_2 plates are easy to prepare and hence are cost-effective. Among Pb-C HUCs with flooded, AGM and polymer gel the Pb-C HUCs with gel configuration exhibit the best long-term performance.

About 10 units of 12V/200F PbO_2-AC HUCs were assembled, sealed and tested.

Fig. 4.59:HUC based LED lighting systems being tested

Fig. 4.60:Pedal chargers for the HUC

iii) Development of micro-electrode arrays for electrochemical application.

Microelectrode arrays have excellent electrochemical sensitivity for the detection of ultra low concentrations of analytes in biological samples, toxic wastes, Industrial effluents, ground water etc., Gold microelectrode arrays, of electrode diameters, starting with 250 microns and progressively decreased to 100, 50. 25 and 12 microns, have been produced at IIT Madras. Circular arrays with a maximum of 9000 electrodes and rectangular arrays with almost 21,000 electrodes have been fabricated. These have been tested for the electrochemical sensing at CECRI, Karaikud for applications with very good results, with ppb levels of lead, cadmium and zinc as well as bio molecules such as dopamine detected successfully. Electrodes of diameters less than 50 microns are not readily available commercially even internationally and so the product has the potential in global market.

iv) **Development of fabrication facilities for optoelectronic devices based on molecular, polymeric and composite materials**

A state-of-the-art inert atmosphere glove box system was designed. This glove box is fabricated by the combination of three specially designed glove boxes inter connected with each other through large and small anti chambers and enable fabrication, deposition of organic, inorganic and composite materials and their electrical, electrochemical and optoelectronic characterization in-situ..

Fig. 4.61: DST Sponsored Centre at IIT-Guwahati.

This complete laboratory was funded by Department of Science and Technology and is housed at the Center for Nanotechnology, Indian Institute of Technology Guwahati and has been named as "Center for Organic Electronics".

v) **Low cost Dye Sensitized Solar Cell Technology: An alternative of Silicone Based Solar Cell**

Dye Sensitized Solar Cell (DSSC), a third generation photovoltaic technology has emerged as a subtle alternative for the contemporary Silicon based technology in terms of production and costing. Under this project, low cost purely organic dye molecules as a light harvesting material in dye solar cell has been developed. These dyes are easy to synthesize in laboratory as well in bulk without using precious metals either as catalyst or in dye itself.Moreover, DSSC was scaled up to 3 cm^2 in order to power a motor. DSSC can be fabricated on the flexible plastic substrate to yield a flexible solar cell for many indoor and outdoor applications.

vi) Quantum dots based hybrid organic - inorganic light emitting diodes

Organic light-emitting devices (OLEDs) have been identified as a dominant new technology poised to realize the next generation of flat panel displays. OLED performance is exemplified by

wide viewing angles, high color contrast, and low power consumption as compared to emissive liquid crystal displays. The aim of the project is to develop quantum dots based hybrid organic-inorganic light emitting diodes. Quantum dots, when excited by electrons and photons, emit bright, steady light at a narrow wavelength band while drawing very little power. Using a self-assembled single monolayer of QDs, sandwiched between two thin films of molecular organic semiconductors, the QDs function exclusively as lumophores. Integration of QDs into organic LEDs has the potential to enhance the performance of thin film light emitters, and promises to be a rich field of scientific endeavour.

8. Waste utilization, recycling and Management:

Waste management in its entirety represents a big agenda for the country involving the Governments, every segment of the society and every individual. Keeping technological intervention in view, PAC of the Technology System Programme has identified the following three areas, to begin with, to invite project proposals, the first two being in toxic category: i) Electronic Waste, ii) Hospital Waste, iii) Plastic Waste. The aim of this area was to develop technologies and processes which not only dispose off the waste but are also equally effective in value recovery from the waste. In addition, certain Hazardous Waste with industry focus was also identified for technology development. Progresses of the following projects were reviewed during the year:

- Utilization of Banana Stem for Paper Making.
- Recycling of plastics waste from electrical and electronic equipments (WEEE): Life cycle analysis & strategies to reduce the environmental impact.
- Adapting a suitable technology for the re-cycling of the Paper Pulp and Textile dye Industry wastes

i) Recycling of Plastic Waste from Electrical and Electronic Equipments (Weee): Life Cycle Analysis and Strategic to Reduce the Environmental Impact

The proposed research broadly focuses on separation of plastic components and parts from the e-waste, value addition of the same through blending with various other additives such as compatibilizers, impact modifiers and nanomaterials (as fillers) for various end-use applications. Toxicity analysis of the plastics derived from e-waste is another approach to check their effect on the environment. The present study would also propose potential application arena wherein these e-waste plastics shall be effectively utilized.

i) Utilization of Banana Stem for Paper Making

India being the largest producer of banana in the word, about 10.0 million tonnes of oven dried material is generated as waste from banana plant. The pulp also has a blend of long fibers and short fibers in equal proportion. After fractionation, short fiber fraction of the pulp was found suitable for making glassine, greaseproof and barrier papers as it has very high air resistance even without any mechanical treatment. Long fiber fraction of the pulp has very high double fold values and physical strength properties like tear and tensile strength. As such banana stem can be blended with wheat straw or bagasse up to 10% prior to pulping, which may reduce the use

of imported softwood/hardwood pulp, used as reinforcement fibres in agro residue based paper mills. Suitable device for dewatering banana stem was fabricated (Fig. 1). Wet cleaning of dewatered banana stem was found effective to preserve the fiberous material for longer period of time (Fig. 2).

Fig. 4.62: Dewatering device for banana stem

Fig. 4.63: Wet cleaning of banana stem fibers

9. **Development of Microwave based systems:**

Design and Development of 42 GHz, 200 kW CW/Long Pulse Gyrotron

A 42 GHz, 200 kW CW output power Gyrotron is being to be developed for electron cyclotron resonance plasma heating for an Indian TOKAMAK system through multi-institutional project, with the sponsorship from Department of Science and Technology (DST). The participating institutes are CEERI-Pilani, BHU-Varanasi, SAMEER-Mumbai, IIT-Roorkee, and IPR, Gandhinagar. The design methodology has been established for 42 GHz Gyrotron using in-house developed and commercially available software. The electrical designs of all the components such as magnetron injection gun, cathode, beam tunnel, interaction structure, nonlinear taper, and collector have been completed. After successfully completing design of first Indian gyrotron, the developments of all components have been taken up. Till date, fabrications of all the related components such as magnetron injection gun (MIG), cavity, beam tunnel, nonlinear taper, collector, RF window (SAMEER), demo collector cooling duct along with procurement and mounting of vacuum bell jar system have been completed.

10. **Miscellaneous Technologies**: Following new projects were sanctioned during the year:

- Development of Uniaxial Pressure and Modified Bridgman Anvil Devices for Transport and Magnetic Measurements
- A study of BF slag chemistry and mineralogy with respect to its flow characteristics for optimizing BF operation
- Development of immunology and molecular tools for diagnosis and management of Aspergillus flavus infection and aflatoxin contamination in foods and feeds
- Development of a compact liquid nitrogen plant unit of 7-10 litre/hr capacity utilizing the successful conceptual design

- Development of cost effective process for enhanced dye production from selected micro fungi *Curvularia, Phoma, Pestalotiopsis* sp., large scale testing and formulation as industrial textile dyes
- Development of diagnostic and therapeutic protocols for various ophthalmic affections in veterinary practice.
- Development of Microbial Fuel Cell for Direct Electricity Recovery During Wastewater Treatment
- Biometric Based Unique Key Generation for Authentic Digital Watermarking.
- Design and Development of Biodegradable Polymers from Renewable Agricultural Resources.
- Ethernet Hardware for Automobile Applications.
- Synthesis of calcium sulphate pigment from industrial waste and its utilization in paper industry.
- Development of novel lignin and silica degrading microbial consortium for enhancing paddy straw digestibility and biogas generation.

i) Development of a compact liquid nitrogen Plant unit of 7-10Litre/hr capacity utilizing the successful conceptual design.

The proposal intends to study Reproducibility and feasibility of indigenous development of low cost liquid nitrogen plant (7 litter/hr.) for application in the area of public health food & nutrition, Biological material preservation and a variety of small scale industrial application. A cryogenerator will first be built comprising of regenerator(reversing flow heat exchanger), compressor , oil pump, expander, hydrogen cooler, condenser/liquefier etc It will be coupled with a PSA unit for separation of nitrogen gas from air. Purity of the gas is to be measured by a gas chromatograph. The pure nitrogen will then be fed to the cryogenerator for liquefaction and for continuous production of liquid nitrogen.

Fig. 4.64: Main critical components

Fig. 4.65: Regenerator

Fig. 4.66: Dom Head

ii) **Test bed for integrated production of 0.75 TPD FCO grade SOP (Sulphate of Potash), 0.75 TPD of ammonium sulphate and 0.3 TPD of ultra pure magnesia from seawater bittern-based mixed salt through patented process.**

Potassium is an essential plant nutrient. MOP (Muriate of Potash - KCl) and SOP (Sulphate of Potash - K_2SO_4) are the popular forms of potassic fertilizer, the latter being acknowledged as

agronomically superior fertilizer containing twin nutrients (50% K_2O and 18% S) with lowest salt index (46.1) but the former being preferred because of its lower cost. India's total requirement of about 5 million tons of Potash is met through imports. Bittern produced after harvesting of common salt contains 20-25 g/L KCl and can be processed further for recovery of Potash. As sea brine contains sulphate which makes the recovery of potassium in form of MOP complex, CSMCRI developed and patented an integrated process for recovering it from bittern in form of SOP along with other co-products such as ammonium sulphate, and high purity magnesia.

- Setting up of test bed for integrated production of 0.75 TPD FCO grade SOP (sulphate of potash), 0.75 TPD of ammonium sulphate and 0.3 TPD of ultra pure magnesia from seawater bittern-based mixed salt through patented process at CSMCRI, Bhavnagar. The financial outlay for the project is Rs. 800 lacs. The major equipments have been procured, electric connection for 275 KVA is obtained, substation installation completed, mixed salt raw material is being produced and civil construction work is about to start. The project is contemplated to be completed by June 2013.

- Setting up of test bed at Tata Chemicals, Mithapur, for integrated production of 3TPD FCO grade SOP (sulphate of potash) and caustic calcined magnesia (MgO) from seawater bittern-based mixed salt through patented process. DST will support upto 75% of total equipment cost in this project. The demonstration of the process on 30 kg SOP scale has been completed. The detailed design of the plant and equipment is about to be completed and procurement of long delivery equipments is in progress. Civil construction work has been started.

iii) Generation of Solar Hydrogen

The project entitled *Generation of Solar Hydrogen* is a multi-institutional research project undertaken by a consortium comprising of IIT Kanpur, IIT Madras, Dayalbagh Educational Institute Agra, IIT Jodhpur, CECRI, Karaikudi and BARC, Mumbai. Under the project, modular prototypes wherein experiments as well as testing can be carried out will be fabricated. These modular prototypes will be replicated for large area solar energy conversion to hydrogen. At the heart of solar hydrogen reactor is a photocatalytic converter. The photoreactor will deliver hydrogen to a storage device. Apart from the photocatalytic route, an electrolyzer integrated to photovoltaic modules will also be developed. Catalyst materials for sulfuric acid decomposition and electrode materials for aqueous SO_2 electrolysis are also being developed as a part of the solar-thermochemical cycle for hydrogen generation.

iv) Facility for Rheo Pressure Die Casting

CSIR-CMERI, Durgapur in collaboration with IISc-Bangalore, Jadavpur University-Kolkata and Mahindra & Mahindra-Nashik have been working on the project sponsored by DST-New Delhi to develop the facility for rheo pressure die casting system at CSIR-CMERI for manufacturing of automobile components out of aluminium alloys. Fig. 4.67 shows the newly installed high pressure die casting machine as part of the rheo pressure die casting system being integrated. Rheo pressure die casting process starts with the production of equi-axed globular grain semi solid slurry. The equi-axed globular grain semi solid slurry is formed by cooling the molten alloy in the liquidus- solidus region as it flows down the cooling slope. As the molten alloy touches the colder cooling slope, primary aluminium phase starts and due to shear driven

Fig. 4.67: The installed pressure die casting machine as part of the Rheo Pressure Die casting system

flow on the cooling slope primary phase becomes globular inhibiting the formation of dendrites when the temperature falls below the liquidus temperature. Then component is cast using this semi solid slurry in the die casting machine. Due to processing in the semi solid region, gas entrapment, micro segregation and shrinkage cavity formation associated with conventional casting reduces drastically. Moreover, formation of equi-axed globular grain improves the mechanical properties of the cast components.

vi) FERRO-FLUIDS R&D PROGRAMME – NEW INITIATIVES

In the quest for novel domains of S&T exploration, FERROFLUIDS is found to be an exciting area of scientific and technological pursuit with excellent academic interests, research opportunities, developmental challenges, application avenues, device innovation prospects, and business openings etc. In the global scene, monumental work is done in Ferrofluids, their Flow Behavior, Magneto Rheological Fluids, Magneto Rheological Finishing, Electro Rheological Fluids, Magneto-Hydro Dynamics, Magnetic Ionic Liquids and many associated areas of ferrofluids in terms of synthesis, characterization, application areas, device innovation and development. May patents have been filed and good number of commercial activity is also in progress, using the fruits of S&T pursuits in this area.

DST has sanctioned the following R&D Projects. In each project, the investigating teams have identified clearly their respective Collaborators, User Agencies, Other Beneficiaries and the Industries Involved:

I) MATERIALS: SYNTHESIS & CHARACTERIZATION:

- Ferro Fluids: Science & Technology Application - Charotar University of Science & Technology-CHARUSAT, Gujarat
- Preparation & Characterization of Ferro-Fluids for Energy Conversion Application - CSIR-National Physical Laboratory, New Delhi

II) FERRO FLUIDS: APPLICATIONS FOR ENERGY SECTOR:

- Development of solar power generator using rare-earth magnets & ferro-fluids - Amity University, Noida

III) FERRO FLUIDS FOR STRATEGIC APPLICATIONS:

- Exploration of ferro-fluids for strategic applications: Athermalization in advanced optical systems - CSIR-Central Scientific Instruments Organisation, Chandigarh & Bhavnagar University, Gujarat
- Design and Development of CNC Magneto-Rheological Finishing (MRF) system – Indian Institute of Technology, Delhi
- Exploration of ferro-fluids for magneto-rheological finishing in advanced optical systems with strategic applications - CSIR-Central Scientific Instruments Organisation, Chandigarh & Bhavnagar University, Gujarat

vi) Development of LTCC materials for General Purpose Applications

Low temperature Co-fired Ceramic (LTCC) is a very useful multilayer ceramic fabrication technology, widely used for compact multilayer circuits and packaging of devices. The applications of this technology encompass a wide spectrum, including, 3D microwave circuits covering integrated passive components, chip scale packaging, MEMS packaging for microfluidic, optical and mechanical sensors, multi-chip modules etc. The project will establish a prototype fabrication facility for tapes and Ag based pastes at C-MET Pune**.** In the end, this project aims achieving self sufficiency in the area of LTCC materials.

(vii) Alternative Analytical Technology (AAT) for testing Soil nutrients

The project focuses on establishing region specific database, improving the accuracy level and popularizing AAT in villages, organizations and universities. The significant developments include enhancement of system performance by predicting the soil nutrients based on a new set of extracted features and upgraded software. The Mobile Alternative Analytical Technology (MAAT) visited 22 districts of Tamil Nadu and 15 farm groups in Pondicherry. Nearly 2800 soil sample were collected, analyzed on the spot and reports distributed along with fertilizer recommendations to the farmers within 24 hrs. This technology is being developed as a portable kit " ***Portable Alternative Analytical Technology (PAAT)*** " with adequate sensitization among users.

Fig. 4.67: Portable Alternative Analytical Technology (PAAT)

JOINT TECHNOLOGY PROJECTS WITH OTHER MINISTRIES/ DEPARTMENT

Project Title**: Use of Continuous Induction Furnace (CONTIFUR) Technology for Production of Steel**

Implementing Agency**: M/S ELECTROTHERM India Ltd. , Ahmedabad**

Supported by: **DST and Steel Development Fund (SDF), Min. of Steel**

Important highlight/achievement of the work

CONTIFUR facility has been set up earlier at the plant site of M/S Electrotherm India has started functioning fully and test runs for steel production by replacing 25% sponge iron by sinter as pellet plant is still under trials. The CONTIFUR operation with 75% sponge and 25% sinter is continuing and the hotmetal with 3-3.5% carbon is being produced.

The members of the Empowered Board (EB) constituted for this project has already visited the facility for observing and monitoring the CONTFUR and Pellet plant trials in the month of November, 2012. Two teams of private entrepreneurs/steel producers has also visited the facility in the month of December. Some of the relevant photographs are reproduced below.

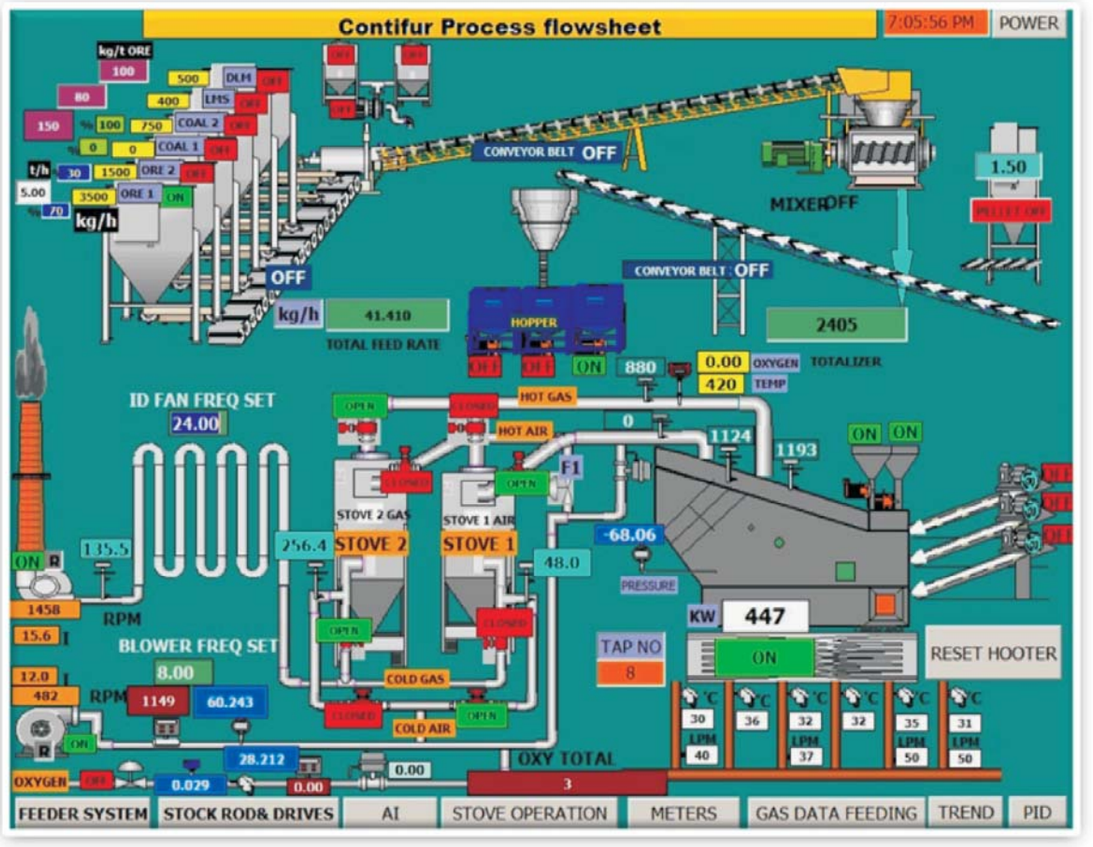


Fig. 4.68: Continuous Induction Furnace (CONTIFUR) Process Flow Sheet

Fig. 4.69: Main CONTIFUR with control room

Fig. 4.70: Metal tapping from Contifur

Fig. 4.71: Process flow sheet of Pellet plant

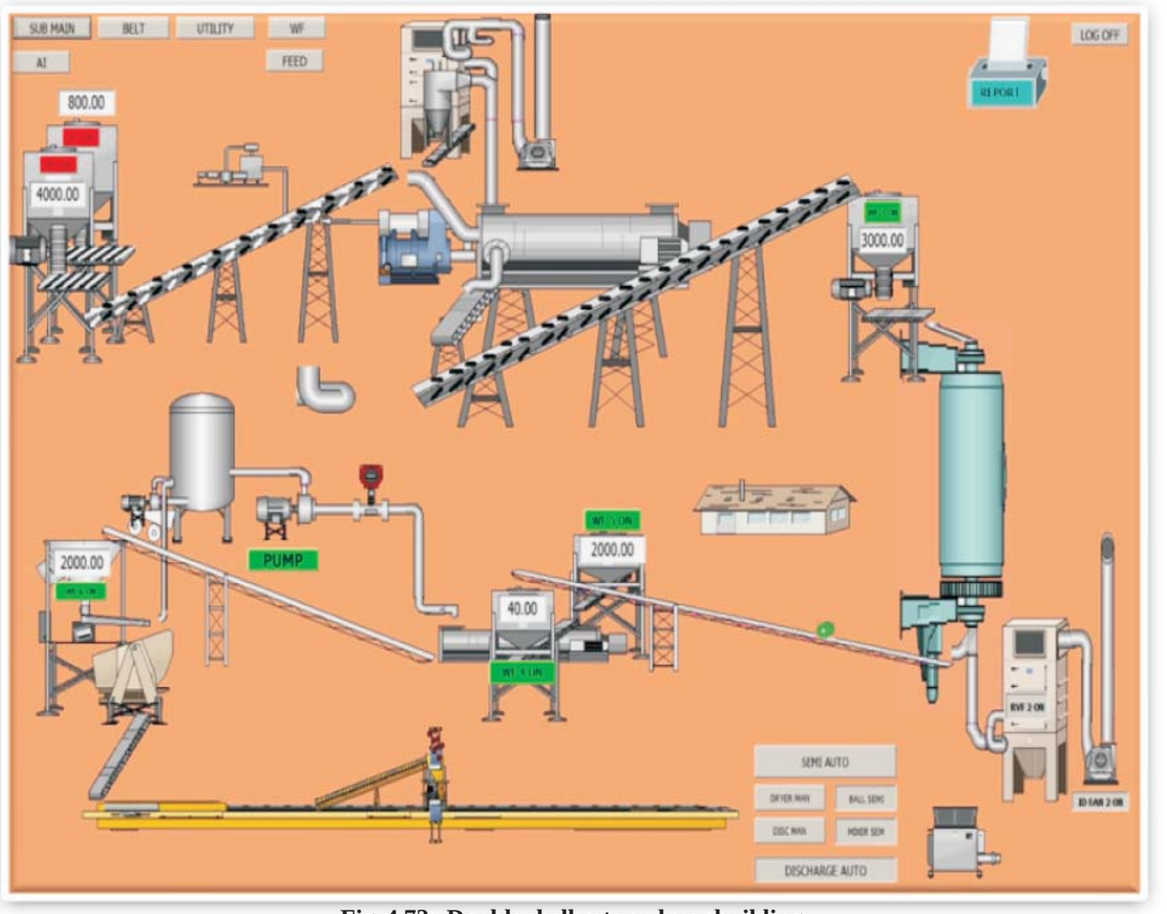


Fig. 4.72: Double shell rotary dryer building

Fig. 4.73: Cyclone and Bag house

Fig. 4.74: Hot air generator

Fig. 4.75: Disc pelletiser building

Fig. 4.76: Mixer building

Fig. 4.77

COGNITIVE SCIENCE RESEARCH INITIATIVE (CSI)

Cognitive Science Research Initiative is exploring new avenues by supporting projects of various fields of Cognitive Science like Neuroscience, Psychology, Linguistics, Bio Engineering, Social Engineering, Education, Computer technology & Artificial Intelligence. CSI programme covers various aspects of support and not only provide financial assistance to individual projects, multi-centric major projects, Post-doctoral Fellowships but also promote schools, conferences, symposia etc.

In 2012, out of 146 individual projects Department supported 32 projects and Eight (8) Post Doctoral Fellowships were recommended. In 2012, Department has adopted a new approach to call for submission of 'Concept Notes' instead of detailed proposals. As this is an emerging area of research, therefore, large number of scientists and academicians submitted their ideas in the form of concept notes. Three Hundred Forty Eight (348) Concept Notes have been received, out of which, 190 investigators have been called to present their ideas before Screening Committee to select relevant concept notes in order to submission of full-fledged proposals for further consideration. Finally, 64 concept notes have been selected and their investigators have been asked to present their detailed proposals before Task Force. Department has supported one school on '*IBRO-UNESCO Inter-regional School on Computational and Theoretical Neuroscience*' conducted at University of Hyderabad, Hyderabad.

This year 19 ongoing individual projects have been monitored and the Task Force recommended 2 - Very Good, 7 - Good, 9 - Satisfactory. Presently, 2 multi-centric co-ordinated mega projects namely, "*Language and brain organization in normative multilingualism*", and "*Generativity in cognitive networks*" are running and this year both have been monitored by Management Advisory Committee (MAC). Both projects were recommended as 'Very Good' by MAC. The results of both projects have been published in 38 Research Papers in various national and international journals.

Salient Achievements of Some Projects under CSI:

1. A project on 'Quantitative EEG changes in mild cognitive impairment and Alzheimer's disease' assessed cognitive decline, acute and chronic stress levels, stress reactivity, memory and stress load, changes in sleep architecture in MCI & AD patients and compared them with age matched elderly subjects. Study showed cognitive decline is significantly higher in AD compared to MCI and Control. Acute stress level and working memory score is higher in MCI and AD in comparison to control. However, no difference is found in scores of chronic stress level.

2. A project entitled 'Executive function and genetic polymorphisms in dopaminergic genes: a family based approach in eastern Indian ADHD subjects' is helpful in categorization of ADHD probands based on genetic makeup and cognitive/behavioural attributes. In long term the study will facilitate Psychopharmacological intervention of ADHD probands.

3. Effect of yoga on heart rate variability and attention task is studied in project on 'Mapping neurophysiological, neurochemical and cerebral blood flow changes in attentional processes related to yoga'. After cyclic meditation, parasympathetic activity has reduced and sympathetic activity has increased. The improved performance in the stroop task suggests better response inhibition, interference resolution, word reading and activation. The study enhances the understanding attentional processes in meditators would facilitate exploring underling mechanisms of stress reduction and cognitive enhancement caused by the practice of meditation.

4. A project on 'Neurocognitive changes associated with perception, spatial orientation, speech and language process in visually challenged subjects using fMRI' is aimed to examine whether the lack of visual experience since birth may lead to changes in neural efficiency in relation to the processing of non-visual sensory information. The method of eliciting non-visual-information for different tasks throw light on the understanding of tactile perception and language modalities in visually deprived individuals. In long term, this would help in appropriate designing of tactile aids.

5. Another project is aimed to find out different neurocognitive aspects in two different phases – major depression and mania. With the help of fMRI, affected areas of brain are located in the patients and control subjects. This may helpful in planning specific treatment protocols and management strategies in future for these disorders.

6. A project entitled 'Electrophysiological changes and autonomic response variations to happy and sad emotion induced via music' is trying to establish the impact of various ragas of Indian classical music on the overall Alpha power in musically untrained subjects. These findings will contribute significantly for future studies examining impact of music on other cognitive functions as well as therapeutic effect of music.

7. A project entitled 'Thyroid hormone and cognition: in vitro study in quest of molecular events induced by T3 in synaptosomes isolated from adult rat brain cerebral cortex' is aimed to understand the role of thyroid hormone (T3) on synaptic plasticity and on neuroprotection. Understanding of the mediation of TH in neuroprotection will help to develop therapeutic means against cognition failure of various origins, including the hypothyroid condition, cardiovascular failure and in neurogenerative brain diseases.

8. A project entitled 'Swarm Intelligence for Optimization' cover the area of bio inspired computing and investigates the structure and functioning of intelligent behaviour of swarms. This resulted into

development of new swarm intelligence algorithms, which is helpful in solving complex optimization problems qualitatively.

New Initiative:

In 2012, Department has conceptualised and formulated a new co-ordinated project **"A National Programme on Educational Neuroscience"** on Learning Disorder under top-down approach. This will be a multidisciplinary programme to address and understand the cognitive deficits of Learning Disabilities. Two Brain Storming meetings have been conducted in order to understand the actual problem of LD through different stakeholders and followed by a series of meetings, consultations and discussions. This mega project is now at the verge of final stage of its launch.

TECHNOLOGY DEVELOPMENT BOARD

The Government of India constituted the Technology Development Board (TDB) in September 1996, under the provisions of the Technology Development Board Act, 1995. The mandate of the TDB is to provide financial assistance to the industrial concerns and other agencies attempting development and commercial application of indigenous technology or adapting imported technology for wider domestic application.

The financial assistance from TDB is available in the form of loan or equity; in exceptional cases, it may be grant. The loan assistance is provided up to 50 percent of the approved project cost and carries 5 percent simple rate of interest per annum. In the alternative, TDB may also subscribe by way of equity capital in a company, subject to maximum up to 25 percent of the approved project cost. The financial assistance is provided during the commencement, start-up or growth stages of an industrial concern.

In addition to the direct support to industries for commercialization of indigenous technologies, TDB continued to network with technology focused Venture Capital Fund (VCF) to support technologically innovative viable ventures with the objective to spread itself by providing support to early stage ventures for SMEs having innovation and innovative products/services.

TDB also took growth-oriented initiative and provided financial assistance to Technology Business Incubators (TBIs) and Science & Technology Entrepreneurs Parks (STEPs) under Seed Support System for Start-ups in Incubators to incubate technological ideas. The assistance is positioned to create techno-entrepreneurs apart from acting as a bridge between development and commercialization of the technologies. The scheme has progressed well and is being continued.

So far TDB has provided financial assistance of Rs. 100 lakh each as grant to 36 (Thirty Six) Technology Business Incubators (TBIs) and Science & Technology Entrepreneurs Parks (STEPs) aggregating Rs. 3600 lakh under Seed Support Scheme. This scheme has benefited entrepreneurs from STEPs and Incubators in various fields.

During the year 2012-13 (up to December, 2012), TDB signed 17 agreements (including 2 with Venture Capital Funds) with commitment of Rs. 118.57 crores out of total project cost of Rs. 487.47 crores and disbursed Rs. 80.09 crores to the assisted companies for implementation of the projects. TDB's support covers the sectors of economy namely, Health, Biotech, Chemical, Engineering, Agriculture, Energy & Waste Utilization, Telecommunication and Information Technology.

MAJOR ACHIEVEMENTS

In the recent past TDB has provided financial support to commercialise following innovative technologies:-

Recombinant Monoclonal Antibodies & Cell Derived Antigens

M/s Yashraj Biotechnology Ltd., Navi Mumbai has been provided financial assistance from TDB for development and commercialization of Recombinant Antigens, Recombinant Monoclonal Antibodies and Cell Derived Antigens based on technology developed in- house by the Company. The innovative initiative of this young enterprise uses the proteins purified from human biomedical waste as reagents for the development of ingredients used in manufacturing diagnostics kits.

Fig. 4.78:

Indian IVDD (In Vitro Diagnostic Device) manufacturers rely heavily on imported IVDD reagents. This endeavor would contribute towards reducing our dependency on imported and expensive kits. The recombinant technologies for production of various proteins and monoclonal antibodies of diagnostic and therapeutic applications have uniqueness of providing DNA- based products with great consistency.

Low cost disposable laparoscopy trocars

M/s Alfa Corpuscles Private Limited, New Delhi has been provided loan assistance by TDB for "Development and commercialization of indigenous low cost disposable laparoscopy trocars". The company has been involved in innovation and development the "First Indian Disposable Laparoscopy Trocar" under the brand name of endoXS™ Disposable Laparoscopy Access System and successfully marketing the easymesh™ Hernia Repair System throughout India using a distribution network that is being catered to by its Product Specialist and sales team.

Fig. 4.79: Disposable Laparoscopy Trocar

The company also plans to cater to the export market by being the first Indian company to export such a product with specific focus on the developing and transitional nations that share similar socio-economic market dynamics such as India, and where the cost of the current product encourages reuse and hence serves as a vehicle for transmitting infections.

The product has been appreciated by laparoscopic surgeons all across India for its quality and proposed cost. The Critical Cost Advantage is expected to push the product as a truly disposable port. The product proposes patient safety, surgeon comfort and profitability for the hospital.

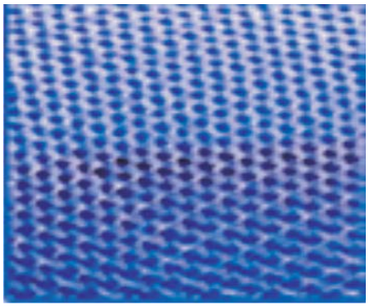


Fig. 4.80: Hernia Mesh System

Efficient Cooking System

M/s Sanjay Techno Plast Private Limited, Pune, has been provided loan assistance by TDB for development and commercialization of Efficient Cooking System. The Company proposes to develop and commercialize Eco Cookers of 4 Ltrs, 40 Ltrs, and 120 Ltrs capacity. The products can have an option of using multiple fuel option such as gas (LPG), kerosene, coal, wood or even biogas. The company has completed the development with LPG & Biomass as the fuel options, and products will be launched in phases with these two fuel options. In the first phase, the company will start commercialization of 40 Ltrs Eco Cookers for which the prototypes have been developed and trials have been conducted.

Branchless Banking & Financial Services for the Unbanked & Under-banked

M/s Eko India Financial Services Private Limited, New Delhi has provided loan assistance from TDB for its project on "Branchless Banking & Financial Services for the Unbanked and Under-banked" based on technology developed in- house by the Company.

Fig. 4.81

Eko has developed a low-cost payment infrastructure to enable instant small value financial transactions over a mobile phone. Eko leverages existing retail shops, telecom connectivity and banking infrastructure to extend branchless banking services to the common man.

Eko's proposed products are solutions to Financial Institutions like Banks, Microfinance Institutions which include EDIC (Eko Distribution Information Center), OkeKey booklet and SimpliBank platform, which are sold to various banks, other financial institutions and Government Agencies in order to meet the financial needs of the under-served as well un-banked people in the country.

Commercialization of Virtual Reality based skills training SIMULATOR

M/s Virtual Logic Systems Pvt. Ltd, Bangalore, has been provided loan assistance by TDB for the project entitled 'Development and commercialization of Virtual Reality based skills training SIMULATOR (COMET SIMULATOR), aimed at the skill development of maintenance technicians across industries'.

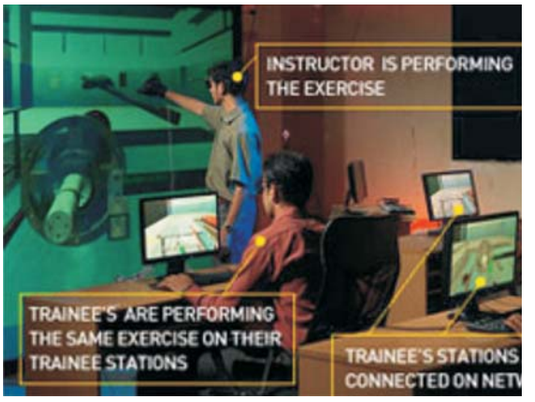


Fig. 4.82

The intent of the COMET simulator project is to develop the COMET simulator software a long with editor and engine which can be deployed on the COMET simulator hardware. The COMET Simulator is used for training personnel on the Construction, Operation, Maintenance and Troubles hooting aspects of different equipment or machinery. The Simulator is used to captivate and engage end users for specific purposes: acquire knowledge and/ or enhance skills.

Healthcare access technologies for cellular and broadband networks

M/s i2i TeleSolutions and TeleMedicine Private Limited, Bangalore, has been provided loan assistance by TDB for the project entitled 'Development and commercialization of technologies for a TelePACSTM based Healthcare Exchange for internet and mobile based healthcare access'.

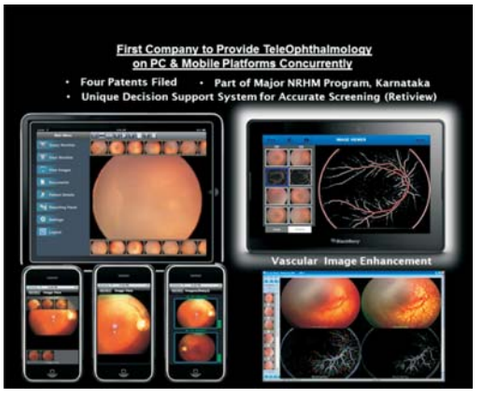


Fig. 4.82

The Company proposes to provide commercial end-to-end TeleOphthalmology solution on iPhone and iPAD. The Company has developed healthcare access technologies for cellular and broadband networks providing secure encrypted transmission, storage and retrieval of medical images for remote diagnosis and reporting. The Technology was developed at the development center in Bangalore, India. The Company has successfully obtained CE certification and is in the process of obtaining FDA approval

Advanced Drug Delivery based Anti-Cancer Product

M/s Panacea Biotec Limited, New Delhi, Mysore has been provided loan assistance by TDB for "Manufacturing Facility for Commercialization of Advanced Drug Delivery based Anti-Cancer Product PacliALL (Paclitaxel)".

The company intends to construct dedicated facility for cycotoxic products at Baddi, Himachal Pradesh, India, complying with regulatory standards of India, EU and USFDA standard and other emerging markets. Technology involves preparation of polymeric nanoparticles by high pressure homogenization, giving the product advantages of tumor targeting due to Enhanced permeation & retention (EPR) effect & no cremophor induced toxicity & no paclitaxel induced-alopecia in case of paclitaxel. Preparing nanoparticles of these highly hydrophobic drugs would solve solubility problems, thereby greatly increasing the surface area of the particles and improving dissolution.

NEW INITIATIVES DURING THE YEAR

During the National Technology Award Day 2012 function organized by Department of Science & Technology on 11th May, 2012, the Chief Guest, Dr. A. P. J. Abdul Kalam, Former President of India launched the following two new programmes participated by Technology Development Board in Public Private Partnership (PPP) mode:-

(a) Global Innovation & Technology Alliance (GITA)

In order to stimulate private sector's investment in R&D, an innovative pilot project named Global Innovation & Technology Alliance (GITA) was initiated by CII and Technology Development Board, Department of Science & Technology (DST), Government of India in 2007-08.

GLOBAL INNOVATION & TECHNOLOGY ALLIANCE

DST under its bilateral & multilateral Science &

Technology Cooperation agreements with many countries (more than 70 countries) launched industrial R&D programmes with Canada and Israel, as Pilot Project where India and these countries allocated fund to support industries for joint industrial R&D projects. In these country-specific programmes, if one industry from India and one industry from the Canada and Israel proposed jointly to do R&D for developing a marketable product, both the governments provided financial support up to 50% of project cost to their respective industries, once the project is jointly approved.

Looking at the successful role played by GITA project and also based on the growing response from various countries for entering into bilateral industrial R&D collaborations with India, it was felt and considered necessary that GITA may be institutionalized as an independent legal entity to be able to address the innovation needs of Indian industry in a comprehensive manner.

The sub-committee of PM's council on Trade & Industry recommended that "The currently deployed project initiative 'Global Innovation and Technology Alliance' (GITA) could be launched as an 'Alliance Initiative' of the Government and the Industry. GITA could be developed into an industry-driven body for supporting competitive innovation clusters, administering a National Innovation Fund under a PPP model, promotion of venture capital industry, promotion of open source innovations for social inclusion, IP acquisition by the government for non-exclusive licensing for public and social good, sectors of R&D and promotion of innovation culture in centers of excellence."

And finally, GITA has been institutionalized as a legal entity; and it was incorporated as a private limited company under Section 25 of the Companies Act 1956 on 29th November 2011, promoted jointly by CII and Technology development Board (TDB) of Department of Science & Technology, Government of India. CII and TDB hold 51% and 49% equity respectively in GITA.

(b) The Millennium Alliance Programme

The Millennium Alliance (MA), an India – U.S. innovation Partnership for Global Development, jointly promoted by Technology Development Board, Federation of Indian Chamber of Commerce and Industry (FICCI) and United States Agency for International Development (USAID).

MILLENNIUM ALLIANCE
Inspiring Innovation. Sharing Solutions.

The MA is an inclusive platform to leverage Indian creativity, expertise, and resources to identify and scale innovative solutions being developed and tested in India to address development challenges that will benefit base of the pyramid populations across India and the world. The MA is a network to bring together various actors within India's social innovation ecosystem including, but not limited to, social innovators, philanthropy organizations, social venture capitalists, angel investors, donors, service providers, and corporate foundations, to stimulate and facilitate financial contributions from the private and public sectors and offer a range of support to innovators.

The Alliance will provide innovators with services such as seed funding, grants, incubation and accelerator services, networking opportunities, business support services, knowledge exchange, and technical assistance, and will facilitate access to equity, debt, and other capital.

Through the Millennium Alliance, USAID, FICCI, TDB, and other partners, will help realize India's role as a global innovation laboratory.

TECHNOLOGY DAY FUNCTION AND PRESENTATION OF AWARDS

The Former President of India, Dr. A. P. J. Abdul Kalam gave away National Awards on Technology to the industrial concern for developing indigenous technology on the occasion of Technology Day instituted by Department of Science & Technology on 11th May, 2012 at New Delhi.

National Award 2012 of ' 10 lakhs for the successful commercialization of indigenous technology by an industrial concern was awarded to:

M/s Scanpoint Geomatics Limited, Ahmedabad, Gujarat

The National Awards of Rs. 10.00 lakhs for the year 2012 was awarded to M/s Scanpoint Geomatics Limited, Ahmedabad, Gujarat for indigenous development and commercialization of Integrated GIS and Image Processing Software: IGiS developed jointly in collaboration with Space Applications Center, ISRO, Satellite, Ahmedabad.

Fig. 4.83: Dr. A.P.J. Abdul Kalam presenting the trophy for the National Award 2012 to M/s Scanpoint Geomatics Limited, Ahmedabad, Gujarat on 11th May 2012.

Award to SSI Unit 2012 of Rs. 5.00 lakhs each for the successful commercialization of a technology based product was given to the following units:

M/s Zen Technologies Limited, Sanathnagar, Hyderabad

For commercializing a range of cost-effective Simulators for various applications, especially the Zen Driving Training simulator (Zen DTS) for Overseas market (with motion platform that offers six degrees of freedom) meeting the stringent CE standard, utilizing indigenously developed technologies of international standards.

M/s Diaonics Automation (I) Pvt. Limited, Nasik Road, Nasik

For commercialization of DIAON: Energy Saving MAG Coupled Induction lights with Wire-free Lighting Management monitoring Station with inbuilt intelligent feature of Auto Dimming facility, which is Real Time Clock Microcontroller based technology. The product saves on account of energy consumption substantially as compared to conventional lighting system.

On the occasion, The Union Minister of Science & Technology and Earth Sciences, Late Shri Vilasrao Deshmukh emphasized that country needs technological self reliance, affordable innovations and global competitiveness in critical technology areas. He said that Technology Development Board has developed fruitful partnerships with the private sector. This needs to be further strengthened. He said, greater participation of Indian industry in R&D and development of new technologies is a must. The Government would encourage public-private partnerships as a catalyst for achieving this objective. The Minister of State for Science & Technology and Earth Sciences, Dr. Ashwani Kumar also addressed the function.

CHAPTER 5

S&T AND SOCIO-ECONOMIC DEVELOPMENT

The Department has been playing pivotal role towards improving the quality of life at the grassroots level through supporting science based NGOs and institutions. The major focus of the departmental activities towards societal upliftment has been referencing of the already available technologies to the social context in which these technologies need to be adapted as per the requirement of the region and the local residents, replication of the technologies in states through synergy with state S&T councils, active promotion of knowledge based and technology driven entrepreneurship amongst S&T persons through establishment of S&T Entrepreneurship Parks and Technology Business Incubators, attracting and nurturing young talents to science for societal development. Departmental activities and programmes have also led to improved livelihoods, skill up gradation and income generation of weaker sections of the society especially schedule caste and tribal population including women and elderly.

To inculcate the scientific temper and popularize science and technology among the society a train named 'Science Express' runs across the country attracting a large number of school children. This year the Science Express has been used for spreading the message of Biodiversity in collaboration with Ministry of Environment and Forests. Through its gender mainstreaming initiative the Department has been successfully working towards bridging the gaps of gender parity in science and technology through well designed fellowship schemes, capacity building and training programmes. National Resource Data Management System (NRDMS) in association with Survey of India (SoI) and National Spatial Data Infrastructure (NSDI) have been working towards the development of large number of thematic maps and their applications for national resource mapping and management.

SCIENCE FOR EQUITY, EMPOWERMENT & DEVELOPMENT (SEED)

1. Science and Society Programme (SSP) This scheme aims at facilitating development of promising S & T based field groups and innovative technologies for addressing societal needs. Programmes operational under this scheme are:

1.1 Long Term Core Support: Technological Advancement for Rural areas (TARA)

It is evident that for the country to develop inclusively S & T applications need to be geared not only for innovation and enterprise promotion, but also for effective delivery of need based technology through grassroots level institutional arrangements to benefit the society at large.

Keeping this in view the Department of Science and Technology has been implementing a long term core support programme since the past two decades to foster science and technology based organizations/VOs to undertake adaptive R&D at the rural level and develop and propagate innovative technologies for field level applications. Such S&T field groups are expected to cascade the seeds of

science and technology in rural surroundings. Currently 21 core groups are being supported under this programme in various parts of the country (Fig. 5.1). It is evident that for the country to develop inclusively S & T applications need to be geared not only for innovation and enterprise promotion, but also for effective delivery of need based technology through grassroots level institutional arrangements to benefit the society at large.

A matrix analysis has been done on the contribution of the core support to congregate technology needs and diffusion in rural settings. The core groups are evaluated annually through group monitoring and/or field visit by expert team. This process also involves-physical verifications and discussion on-the-spot with beneficiaries and functionaries/scientific manpower available with the organization. Based on the discussion on the spot with expert team and other stakeholders, core activities are fine tuned further to develop and deliver appropriate technologies ensuring forward and backward linkages involving community and other stakeholders.

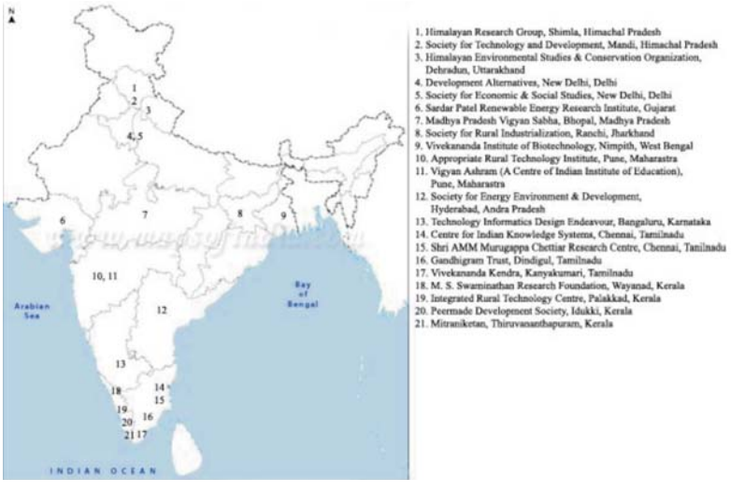


Fig.5.1 : Distribution of Core Supported Groups (TARA-21)

Highlights of Achievements

Some of the activities focusing on innovation and diffusion of location specific rural technologies by core groups are given below:

Himalayan Environmental Studies and Conservation Organization (HESCO), Dehradun (Uttarakhand) has taken up the initiative to strive **Resource based Mountain Development** and to develop/improve traditional technologies for the local communities involving grassroots voluntary organisations residing in Western Himalayas. Watermill Up-gradation and its multiple Use, Agriculture & Value Addition, Horticulture and so on many small livelihood related activities like Bee-Keeping, Bakery, Resource Education etc. are some of the ongoing activities of the organization. In water mill technology, about 30 watermill owners were trained on new applications of turbine developed with the technical collaboration of CIC Switzerland to overcome the low voltage problem. This turbine is reported to be more efficient to traditional one and can work on low head too. However, cost need to be compromise and efforts are being made by HESCO to make it available at affordable cost.

The Technologies interventions made by HESCO have their origin from within villages as priority areas and also developed with participation of community. These factors make technologies more

acceptable within community. Therefore, different technologies developed by HESCO under core support have spread in **3 District of Uttarakhand.** A total of **23 partners** were identified in different eco-climatic zones to work under this initiative. A total no of **1181 villagers** were covered, which adopted the simple innovative rural technologies as mentioned in Box. 1. A group of voluntary organisation and marginal farmers initiated a single window Service System "Kisan Bank" and various institutes were linked in this programme.

Vivekananda Institute of Biotechnology (VIB), Nimpith, West Bengal working essentially in 24-Parganas district has focussed its core activities on biofertilizer technology, tissue culture, horticultural biotechnology, renewable energy and aquatic biotechnology etc. VIB has been able to domesticate cultivation of Catenella repens, a marine algae having high industrial value was standardized protocols for large scale multiplication. Through its efforts, VIB has been able to develop rural entrepreneurs by involving local youths on hardening of micro-propagated plantlets, freshwater fishery management, livestock management, vermitechnology, apiary and mushroom production etc.

Appropriate Rural Technology Institute (ARTI), another core group based in Pune, Maharashtra has developed **viable system for converting agricultural and other waste into high grade fuels** in collaboration with Patpert Teknow Systems and Earthsoul India Pvt. Ltd. The capacity of the system has been designed to force 30 to 50 kg of dry agricultural residue. While operating the system, the temperature of system rises to 300 to 350^{o} C within 30 to 40 minutes. 10 per cent of oil can be extracted within 2 hours of duration. It takes 3 to 4 hours to cool down to ambient temperature then charcoal is recovered upto 30 per cent of dry weight. In another initiative, ARTI has also worked on electricity generation by using biogas on two types of engines e.g. 3.5 HP diesel engines and 1400 watt portable Honda genset (output 1200 watt.) with some modifications done in carburettor. Initially engine was started on petrol and kept idling for 10 to 15 minutes to heat up slowly then biogas is introduced to run engine on 100 per cent biogas. For its efforts to develop energy efficient systems for rural application, ARTI has received Vasundara Mitra Award 2012 for Environment by Kirloskar Vasundhara International Film Festival.

Likewise, **Society for Energy, Environment & Development (SEED),** Hyderabad working in R & D on **solar drying and solar food processing technologies** has developed and standardized protocols for development of solar fruit processing of fruits grown in Himalayan Region for value addition and long shelf life in collaboration with Himalayan Environmental Studies & Conservation (HESCO), Dehradun. Accordingly, this core group has also standardized protocol for solar food processing of non-timber forest produce such as Gum Karaya, Satavari, Neelavemu and Maredugaddalu for value addition and income generation to benefit tribal farmers in collaboration with Kovel Foundation, Visakhapatnam. For its work on "Solar Food Processing and Dryers", SEED has received recently a prestigious NABARD award for Rural Innovation 2012.

Centre for Indian Knowledge Systems, Chennai, Tamil Nadu has developed organic cultivation packages for five crops namely Black gram, Green gram, Chilli, Banana and SRI method of paddy cultivation. While, **MSSRF's centre at Wayanad**, a new core supported group is working on **Conservation, Cultivation, Consumption and Commercialization in bio-resource management** particularly on medicinal & aromatic rice varieties; wild and traditional tuberous and leguminous crops/species; pepper and ginger varieties to ensure the food and nutrition security and livelihood enhancement of selected marginal farming communities in and around Wayanad, Kerala.

In non-farm sector, **Mitraniketan** located at Thiruvananthapuram has been able to develop jack fruit cutter thus helping rural women to minimize the drudgery involved in jackfruit processing.

Fig. 5.2: Women workers using the Jack fruit cutter developed by Mitraniketan: Reduced drudgery with value addition

1.2 TECHNOLOGY INTERVENTIONS FOR ADDRESSING SOCIETAL NEEDS (TIASN)

ALL-INDIA COORDINATED RESEARCH PROGRAMME (AICRP) ON NON-EDIBLE OILS (NEO)

The Biodiversity of trees and shrubs, in the country is very large. Many of these yield several MFP's including Non-Edible Oils (NEO). These NEO resources are poorly utilized due to lack of technology. In a few places where non-edible oilseeds are utilized by industrial units for making soaps, lubricants, paints and varnishes, medicines etc. local tribals, forest-dwellers or other rural poor obtain a pittance for collecting the materials while all value-addition and employment generation takes place in urban-industrial areas.

The SEED division of DST had therefore initiated a major Coordinated Research Programme (AICRP) on Non-Edible Oils (NEO). Centre for Technology & Development (a division of the Society for Economic & Social Studies, New Delhi) or CTD/SESS, a Core Support Group of SEED Division, DST provided support both technical and in monitoring.

The AICRP itself was conducted in two phases. Phase-1 from 2005-08 saw deployment of the technology package at 7 pilot projects run by partner NGOs in different regions networking with local farmers, forest-dwellers and other beneficiaries. Major achievements in this phase were: networking of beneficiaries for raw material collection, primary processing and establishing supply-chain; optimization of equipment/machinery and process protocols; standardization of oil properties as required by industrial buyers; and training and capacity-building of local beneficiaries and NGO personnel. Innovative features include a Multi-Seed Technology Package covering 16 non-edible oil seeds with a Variable Decorticator for separation of kernel from shell of different oilseeds of 4mm-

20mm diameter and a Hammer Mill for de-shelling of Apricot seeds, as well as a hub-and-spoke supply chain.

Phase-2 of the AICRP from 2009-12 saw inclusion of 3 new field projects pertaining to hitherto uncovered NEO varieties and demonstration of a regional 3-tier hub-and-spoke enterprise model in one location (Dehradun). Oilseed varieties covered under the programme are summarized in the accompanying Table.

In a few cases depending on availability of adequate raw materials, aromatic oils were also distilled to diversify the product range. All 10 field projects were scaled-up through decentralization of value-added de-shelling operations and related machinery to village-level SHGs mostly of women who then supply kernel rather than seeds to the nodal unit which expresses the oil in an expeller and filter press. Advanced technical training for all 10 field groups with special focus on lab testing and quality control was conducted by Harcourt Butler Technology Institute, Kanpur. Manufacturing and sales to local industrial units have been scaled-up and all field projects are equipped with small functional labs for oil testing. Several of the units have already achieved viability, generating new jobs or additional incomes for over 120-150 beneficiaries each through the utilization and value-addition of otherwise little-used resources.

Discussions are underway on follow-up work towards further value-addition to the oils in the form of treated oils or various finished products.

Field Projects and Oil-bearing Varieties covered under AICRP on NEOs

Field ProjectStates/Partner NGO	**Produce Profile(main produce selected for viability)**
HP (STD)	Wild Apricot (Prunus armeniaca), Marigold, Geranium
WB (FOSET)	Karanj (Pongamia glaubra), Kusum (Scheichera oleosa), Neem (Azadirachta indica), Mahua (Bassia latifolia & spp.), Wild Castor (Ricinus communis)
MP (MPVS)	Mahua, Malkangni (Celastrus peniculatas), Karanj, Bhilawa (Semicarpus anacardium) (+ neem, kusum)
TN (CSD)	Rubber (Hevea brazillensis), Undi (Callophyllum inophyllum), Karanja, Neem, Mahua
UK (GSKSS)	Citrus Peel, Wild Apricot
JHA (Abhoy Ashram)	Sal (Shorea robusta), Kusum, Mahua, Karanj, Ratanjyot (Jatropha curcas)
MIZ (KTCPIA)	Tung (Aleurites fordii)
ORI (CARD)	Simaruba (Simarouba glauca), Eucalyptus Nilagiri, Karanj, Mahua
RAJ (RIHAE)	Jojoba (Simmondsia chinensi)
Dehradun (CTD)(Hub-and-Spoke Cluster Model)	Wild Apricot, Wild Castor

Fig. 5.3 : Hammer Mill for Apricot

Individual projects under TIASN:

1. Under project entitled "**Artificial Glacier Technology**" in Leh covering two blocks of Leh & Kharu, water bodies have been constructed to conserve and manage the sustainable use of water for livelihood generation and irrigation purposes. Now the water bodies are being operated in full swing and in use by the local community.

2. Development of a low cost high efficiency gas furnace with accessories for melting bell metal to be used by rural artisans

   In the Bastar region of Chhattisgarh, the traditional bell metal craft using investment casting is highly energy intensive craft with use of two fuelwood based furnaces: one for melting the bell metal to a temperature of about 1000°C and the other for preheating the mould to 600-700°C. The artisans desired to switch to an LPG based furnace, but commercial furnaces are too expensive for them. A prototype was installed in the Bastar area about 4 years back. The artisans appreciated the furnace but wanted some improvements in the same. Besides, they wanted another furnace for preheating of the mould as well. The current work with funding from DST was taken up for the purpose of improving upon the first prototype and designing an integrated unit along with a mould pre-heating furnace.

   The new integrated unit designed, installed and tested at IIT and already installed in the field and due to be testes has four components: (i) improved furnace for metal melting (ii) improved furnace for pre-heating the mould used for investment casting (iii) two waste heat recovery units one with each furnace for pre-heating the crucible and the metal to be melted using the exhaust gases from the respective furnace. The main advantages of the new unit are:

   Increased efficiency of the unit due to the following reasons:

   a. closed structure of the furnace

   b. low thermal inertia walls using rat-trap bond

c. light weight insulation.

d. Waste heat recovery unit allowing pre-heating of the crucible and metal hence saving energy.

e. Drastic reduction in emissions due to replacement of solid fuel by gaseous and cleaner fuel – LPG.

f. Improvement in the working environment due to complete containment of the furnace zone and hence cutting down of the exposure of the workers to the radiative as well as convective heat losses from the furnace.

g. Better control of the heating rate through easy regulation of LPG and air flow.

h. No need of electricity for operating the furnace except during start-up.

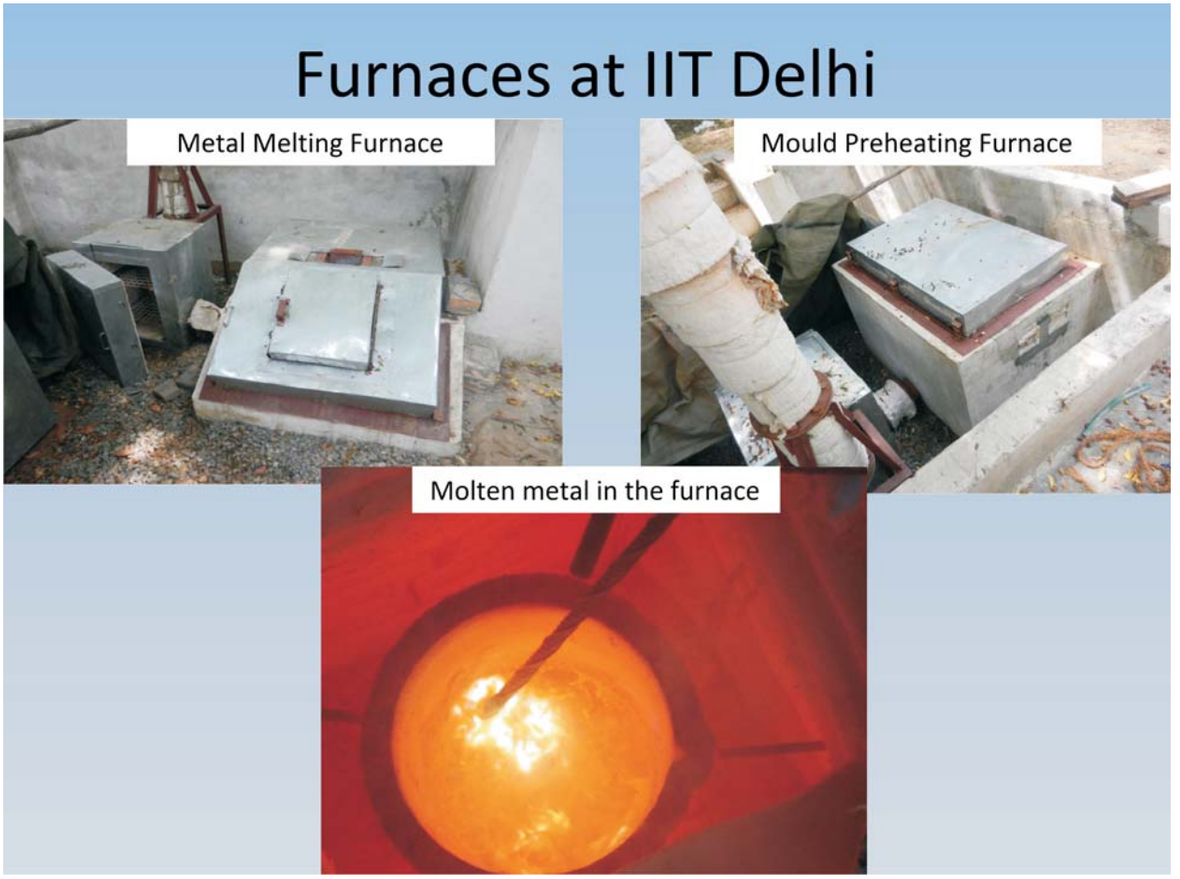


Fig. 5.4

TECHNOLOGY INTERVENTIONS FOR DISABLED AND ELDERLY (TIDE)

The "**Technology Interventions for Disabled and Elderly (TIDE)**" programme under the scheme "Technology Interventions for Addressing Societal Needs (TIASN)", in addition to providing technological solutions with multidisciplinary approach to resolve the problems and improve quality of life of the elderly population with focused initiative on S&T interventions, also aim in providing individual autonomy and independence to persons with disability through holistic development by creating enabling environment for

their empowerment through application of Science and Technology

Design and development of cost effective and affordable assistive devices for elderly and disabled, preventive technology packages for persons having disabilities, development of multi-disciplinary research materials/R&D programmes for disabled, field testing of newly developed technologies and modulation of existing technology specific for use of elderly and disabled to suit Indian conditions are a few aspects which have been take up for appropriate interventions.

An attempt has been made by Center for Dental Education and Research, All India Institute of Medical Sciences under the project "**Assessment of Maxillary & Mandibular alveolar ridge resorption in implant supported overdenture with different attachment systems**" to address the usual problems associated with tissue supported complete denture specially in cases with severely resorbed ridges, neuro-muscular inco-ordination (Parkinsonism, Belly's palsy), deficient ridge (due to trauma or surgical resection) in elderly population. Insufficient retention causes intolerance to loading by mucosa, pain, difficulty in eating and speech, loss of soft tissue support and altered facial appearance. In order to reduce these problems to the elderly, a new technique of denture retention using dental implants has been developed. The use of implant supported dentures is a big help for people with severely resorbed ridges. Under this project two or four implants with three attachment designs (locator, dalla bona and bar and clip) will be used in addition to evaluation of the amount of bone loss with each system. This will be able to guide future treatment planning to restrict the movement of overdenture and thereby minimize the bone loss in same and opposing arch.

Maxillary Edentulous ridge

Metal housing with locator attachment

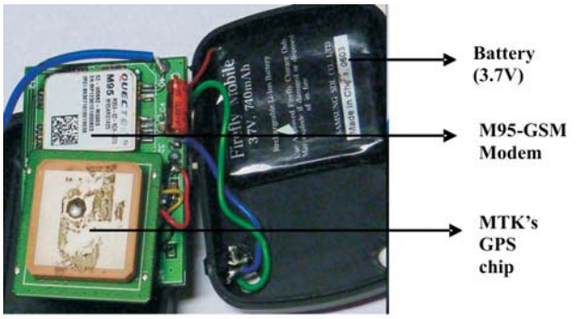
Customized surgical stent

Final Denture

Fig. 5.5

Modified bar design, ball abutment assembly with a silicon O ring instead of rubber one to provide better retention and durability and customization of surgical stents will also be developed under this project.

ii. A prototype locator and communicative device for tracking dementia patients has been developed under a project "**Development of Locator and Communicative device for Dementia Patients**". RFID with GSM and GPS with GSM technologies are developed for patient tracking application:



Prototype of locator device

Fig. 5.6

The technology developed can also be modified like telemedicine and development of vital sign monitors and can be implemented in other advanced geriatric care centers with the help of the State Government and other private players. The communicative device will be of great help to Dementia during emergencies.

The caregiver can also know the whereabouts of the patient using the locator device. The SMS alert arrived on the care taker's mobile phone when clicked, gives the location in Google maps also. Attempts are also being made to incorporate voice communication feature to this prototype and also a dedicated web server for this application.

SPECIAL INITIATIVES TO ADDRESS THE NEEDS OF PEOPLE LIVING IN DIFFICULT AREAS

Indian deserts have remained unique human ecosystems as all the life-forms have survived the harsh environmental conditions by evolving a delicate relationship with this fragile ecosystem.In India deserts have been classified into hot deserts and cold deserts as per the data analysis done by various agencies and National Bureau of Soil Survey and Land Use Planning. The Department of Science and Technology through its special initiative programme has tried to address the location specific intervention necessitated by these geographical areas of the hot and cold deserts. Under its need based programme the Department has launched two Co-ordinated network programmesto cater to the needs of the people living in the Arid and Semi-arid Regions "ASAR" and the Cold Desert Regions "CODER". The thrust area of these programmes is:

1) Enhanced Livelihood opportunities

2) Health &Nutrition (Epidemiology, Prophylactics and Therapeutics for Stress adaptation, nutrition specially related to children and elderly, validation of both human and animal indigenous health practices)

3) Soil and water management

4) Sustainable Agriculture/Horticulture practices including post-harvest and value addition

5) Technology inputs for artisanal sectors

Under its societal initiatives plans to initiate S&T driven programme with an aim to provide S&T solutions to address issues/problems of people living in the desert regions of India the Department has invited the EOIs from consortia of academic/R&D institutions and Panchayati Raj Institutions, NGOs, industry, State Government Organizations in order to enhance the quality of life for people of the desert regions. In the 1st phase of the programme the areas identified for the S&T based interventions in the **Arid and Semi-arid Regions identified for intervention are:**

a) Jaisalmer, Barmer, Jodhpur, Nagaur, Banswara, Dungarpur (Rajasthan)

b) Kutch, PanchMahal,Dahod, Banaskantha (Gujarat)

c) Ratlam, Jhabua, Mandsaur (Madhya Pradesh)

Cold Desert Regions are:

a) Ladakh and Kargil (J&K)

b) Lahaul & Spiti & Bharmaur Track of Chamba District (Himanchal Pradesh)

The SEED division received a large number of Expression of Intrest under both the programmes which were screened by the expert panel and the short listed candidates were invited to submit full proposals followed by the evaluation of the proposal on the basis of the technical presentation by the PI/Co-PI before the Sub Expert Committee. The programmes can be extended to cater the need of the other regions of the hot and cold deserts in the 2nd phase.

The Sub Expert Committee meeting of the "ASAR" programme was held at Arid Forest Research Institute, Jodhpur. The institute has been involved with the development of the programme to provide the technical inputs towards the need of the society.

The Sub Expert Committee meeting of the CODER programme was held at CSK Himachal Pradesh Agriculture University, Palampur. The Department have utilized the expertise of the university experts as they have enormous experience in developing and implementing projects in the cold deserts due to the presence of the university field station in Lahaul and Spiti. The meeting was covered by leading newspapers of the Himachal Pradesh.

SCHEME FOR YOUNG SCIENTISTS AND TECHNOLOGISTS (SYST)

The main objective of the scheme is to motivate young scientists and technologists to utilize their expertise towards the societal development. The scheme has been promoted among the various institutes and universities during the group monitoring workshop and meetings. Achievements of some projects accomplished during the financial year are:

- Fodder bank and fodder nursery model under the project entitled "Strengthening fodder resources and developing a pilot model for reducing drudgery of rural women in Kedarnath Valley, Uttarakhand" has been established at Maikhanda village to reduce drudgery of rural women. The efforts have been well receptive by the women and farmers of the village as it aims towards the nutritive fodder throughout the year and reduction in drudgery. The model can be replicated in the other sites as well.

- An organic liquid fertilizer (Humus) and solid humic acid (vitamate) has been developed under the project entitled "Production and formulation of organic fertilizer (Humus) using local resources for

income generation to rural farmers". The humus can be applied as foliar spray to crops and has shown promising results in the paddy field.

- Schizothoraxrichardsonii is the fish species which has been widely distributed among the foothills of Himalaya but recently due to the overexploitation of the natural bioresources the fish species has become endangered. Under the project entitled "Genome scale mining of phylogenetic markers of Schizothoraxrichardsonii fish species for formulation of selective breeding programme" genome scale mining was done using protein encoding genes of mtDNA. The five populations studied using mtDNA markers revealed that Bairanga populations have higher genetic variability as compared to other populations and can be used as parental stock for breeding purpose. The study is of societal relevance as it will lead to the genetic improvement of Schizothoraxrichardsonii species through breeding which is of cultural interest to people of the area and is at the verge of decline.

2. Technological Intervention for Tribal Empowerment (TITE)

The TITE Scheme under the "Tribal Sub Plan" of the Department of Science & Technology aims at improving living conditions of scheduled tribes based on sustainable science and technology activities. Under this initiative location specific and need-based projects are supported for socio-economic upliftment of tribal communities. During the period, 11 new projects were sanctioned for pilot scale technology application to enhance and improve existing livelihoods emphasizing on sustainable use of local resources with value addition. Highlights of achievements made under some projects are given below:-

Individual Projects:

Development of Biomass Based Stove for Leaf Moulding Machine: The project has led to the development of environment and user friendly biomass burning metallic stoves suitable for heating dies in leaf moulding process. The machine does not require electricity for moulding operation with the improved heat transfer and combustion efficiency of the developed stove. This new portable metallic stove model requires only one time feeding of the fuel (powered leaf-litter) with load of 2.5 kg at a time with continuous burning for 2 to 2.30 hours. Such an environment friendly device has helped to reduce biomass fuel consumption and indoor air pollution with immense utility in non-electrified areas. These fuel efficient stoves are successfully being experimented by linking it with biomass machine developed by IIT, Kharagpur under field conditions in 5 tribal villages of Mayurbhanj (Baripada), District of Orissa State.

Fig. 5.7: New Design of portable fuel efficient metallic stove for making leaf plates.

Value addition to local Agri produce for income supplementing in tribal area of Jaunsar Bhabhar focusing on women and youth in Uttarakhand: This project has a focus to establish community owned common facility centre with quality control for processing of locally grown horticultural produce like chilli, ginger, garlic, mango, lemon and turmeric. Project has enabled women to make value added products locally with enterprising skill in networking mode in Lakhsyar village, Kalsi block, Dehradun District.

Pilot initiative for sustainable livelihood generation of rural community through production of value added products from commercially important plants: This project is being implemented covering 7 villages a of Khurda district, Orissa. **The** project focuses on adoption of a biotechnology based alternate livelihood generation approaches through mobilizing the community in production of value added products (like essential oils, curcumin, and oleoresin) from their agriculture produce ginger, turmeric and kaempferia using quality control measures. Women and rural youths in 10 SHG groups have been trained in scientific extraction of value added products, marketing of the products and sharing the benefits by setting up micro-enterprise at the village level. The positive response of field functionaries, community youth and women as well as buyers has been encouraging towards proper implementation and sustainability of the project as indicated below.

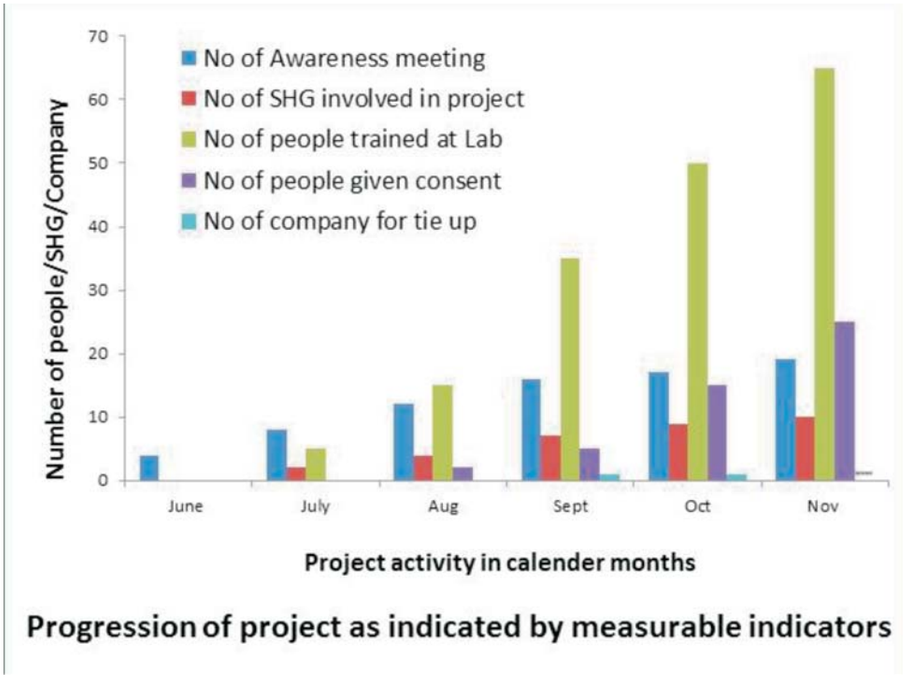


Fig. 5.8

Enhancement of livelihood of tribal farm households of Panchmahals district, Gujarat State through agricultural diversification: Project is being implemented by Central Horticultural Experiment Station, Panchmahals district, Gujarat. Through a PRA exercise identification of existing livelihood strategies and technological interventions specific to enhance the livelihood security of the tribal households of Kyaria village, Panchmahals district have been identified. The tribal of the village have been introduced to fruit crops, kitchen gardening, improved breed for backyard poultry and to reduce the vulnerability through scientific goat rearing.

Fig. 5.9: Capacity building involving community for PRA exercise to initiate need based technological interventions.

S & T Intervention for Sustainable Ecosystem Development in BR Hills: Another initiative has been taken in BR Hills, Western Ghats to enable tribal communities to improve livelihoods and enhance biodiversity. Project has given emphasis on development and demonstration of rural agro-biotechnology model at Muratipalya village of Yelundur range of BR Hills for cultivation of important medicinal and aromatic plants to address primary health care needs traditionally used by the Soliga tribe. Twelve species were prioritized for cultivation in the agro biotechnology model viz., Aegle marmelos, Acorus calamus, Asparagus racemosus, Decalepis hamiltonii, Embelia ribes, Gloriosa superba, Gymnema sylvestre, Nothopodytes nimmoniana, Oroxylum indicum, Rauvolfia serpentina, Terminalia arjuna and Withania somnifera. Tribal communities are also being trained to make use of polyhouse technology and homestead farming techniques; soil and water conservation measures using ecological methods and scientific harvesting practices to meet their livelihood needs and nutritional aspects as well.

Scientific Organic Cultivation of Cardamom among the Tribal Farmers of Idukki District, Kerala

Under this project, a complete Package of Practices (PoP) has been developed for the organic cultivation of Cardamom using bioagents to cure pest attacks and disseminated standardized packages among the farmers belonging to Mannan, Urali, Ulladan and Paliya tribal communities of Kannampady, Kumily Mannankudi and Chakkupallam of Peermade and Udumbanchola taluks of Idukki district, Kerala. Some of the practices developed/transferred are as follows: (1) Entomo-Pathogenic Nematodes (EPN) was found effective for control of cardamom root grubs. Heterorhabditis sp. of EPN was tested for the field trials. A dosage of four cadavers per plant was found to be effective and economical (2) Tithonia diversifolia, a common weed (wild sunflower) in the area was found effective for control of cardamom root grubs. 2-3 kg of the foliage was given as mulching for the cardamom plants. (3) Planting of castor (Ricinus communis) plants 30-40 plants per acre gave encouraging results as a trap crop against shoot borer of cardamom. (4) The technology for controlling cardamom

root grubs by using Metarhizium anisopliae, a fungus that grows naturally in soils has been popularized through the project. All the above mentioned technologies were found to be effective in controlling the cardamom pests.The farmers in the area have slowly started adopting these eco-friendly technologies.

CoP-11 - Programme on People & Protected Areas (PAs):

The Eleventh Conference of Parties (CoP-11) of the Convention on Biological Diversity (CBD) was held at the Hyderabad International Convention Centre, Hyderabad from 1-19 October 2012. During the conference an event on "Integrating Conservation and Livelihoods around Protected Areas through Scalable Technological Solutions" was jointly organized by DST and WWF – India to showcase outcome models of its multi-locational network programme on "People & Protected Areas" implemented at 13 locations in different parts of the country. Event attended by national and international participants highlighted about the role and effectiveness of technology with local institutional arrangements in addressing issues around conservation vis-à-vis livelihoods. A report of this programme depicting successful case studies on emerging diverse models with technological solutions for livelihood diversification activities to reduce dependency of community on forest resources was released by Dr. T. Ramasamy, Secretary, Department of Science & Technology. The programme implemented at the pilot scale has effectively demonstrated innovative approaches and mechanisms based on appropriate technological inputs that have successfully enhanced sustainable local livelihoods for local and indigenous communities living around PAs across the country. The programme has been able to bring together the community, grass root voluntary organizations and technological groups at the same platform for discussing local conservation and livelihood issues and developing appropriate technology for the The models established under this programme have potential for replication not only at the local but also at the global level where similar issues related to conservation and livelihood exists.

Fig. 5.10: Release of Outcome Report on People & Protected Areas Programme by Dr. T. Ramasamy, Secretary, DST

4. SCHEDULED CASTE SUB-PLAN FOR THE DEVELOPMENT OF SCHEDULED CASTE POPULATION (SCSP)

Social Equity principles demand special attention and careful intervention to facilitate scheduled caste community in their developmental aspirations. Programmes focused on enabling the community realize their aspirations need to be developed with sufficient measure of empathy and sensitivity backed up by the supply of adequate resources. The community at times has variations in basic knowledge, linguistics and capacity and hence intervention for promoting social equity need to be designed taking into account the intervening strengths of the community. Keeping these facts in mind, the Department of Science and Technology has been implementing a Scheme, viz Scheduled Castes Sub-Plan (SCSP) with a view to empower SC population through the input of Science and Technology, since 1992. Over the years, the scheme SCSP has achieved breakthroughs in developing and demonstrating technology packages in several sectors with the association of S&T based field groups and S&T institutions for improving the quality of life of the economically weaker sections of scheduled caste communities in urban/rural areas. Due to the efforts made in the past years, this programme of DST has made a distinct impact due to its unconventional approach and involvement of S&T- based voluntary organizations having strong linkages at the grass root level.

➢ Skill development and Livelihood Activities for SC Population

- In a project at Bomikhal, Odisha utilization of the Nalia Grass in Coastal Tidal Regions of the state has been taken up to enhance livelihood of the SC Communities. The project identified opportunities such as manual plantation of Nalia to sustain raw material supply chain a huge potential for this exists in the form of swampy areas influenced by tidal action .This would lead to multiple ecological benefits both economic and in terms of bank stabilization.

Processed Nalia , ready to use for the craft

Finished Nalia product

Fig. 5.11

- In a project in South Goa, skill training in various trades to SC community has helped them to scientifically learn a particular trade and then seek self/wage employment. The training mainly targeted in achieving the skills of the trade practically by way of latest technologies available. All the trades are competency based. Training methods used are appropriate to the development of competencies. The focus of the programme is on "performing" and not only "knowing". The training method is individual-centred so as to make each one of them truly competent in the trade concerned. The core curriculum is comprehensive and covers kitchen equipments, quality control,different types of menus, culinary terminology, safety consciousness, work ethics, leadership, time management, creativity and Customer service satisfaction.

- In a project at Minicoy Island of Lakshadweep islands, production of dried tuna (Masmin) and value added products from Masmin has been taken up. Lakshadweep islands with its large lagoon, territorial waters and economic zone attached to it, offers very high potential for tuna. It is estimated that only less than 10% of the fishing potential is actually being tapped from this area. The demand for dried tuna (Masmin) manufactured only in Lakshadweep in India and ready- to-serve fish products are increasing day by day in our country. There is o scope for export, as these products as they are widely consumed in Sri Lanka, U.A.E, Malaysia, Philippines. Tuna-based fish products prepared under the most hygienic conditions and seasoned with spices will have an average shelf life of one year. The USP of this intervention good quality processed Masmin products such as Fish Pickle, Dried Tuna chutney, Dried Tuna Fry, Tuna Flakes, Fish powder, Tuna Extract Fry, Tuna Fish wafers, saving of fuel, eco friendly management of fish waste. The fish wastes generated is being utilized for making: (a) Pet feed:

- The bones, small pieces of cut fishes will be treated with 1% formic acid to digest the bones and the digested slur will be mixed with rice barn and dried hygienically and packed.

- Dried bones are powdered and packed. This calcium rich materials are used for fortifying poultry feed.

Fresh Tuna Fish cutting **Tuna Loins for boiling** **Boiled loins for smoking** **Smoked loins in drayer**

Fig. 5.12

This project has the potential to provide large scale employment in transporting, manufacturing, packing, marketing activities in a cooperative mode.

In a project at West Bengal a model for anaerobic digestion of food, vegetable and municipal solid for generation of biogas has been designed for pilot level testing of biogas production. 1400 L bioreactor (Fig.12.) was fed with cow dung and water (1:1 ratio) to build up an initial microbial flora (methanogenic bacteria) for 10 days Hydraulic Retention Time and 40 days Solid Retention Time. The total amount of feeding materials with required dilution, using vegetable waste instead of conventional feeding material i.e. cow dung, was more effective. 3 time feeding instead of single time feeding per day (per day feeding amount is constant) was done, which yielded 30% more biogas. Separation of slurry was done through a chemical process ($FeCl_3$ / Alum) and the fresh feeding material was partially (30%, 40% and 50 %) replaced by the fresh one.

Digester with 1400 L capacity **Separation of slurry by $FeCl_3$**

Fig. 5.13

Coordinated Programme on Resource Management and Development for the Empowerment of Scheduled Castes in different parts of the country:

A network programme on Resource Management and Development for the Empowerment of Scheduled Castes in different parts of the country' has been initiated involving the Scheduled Caste communities living below poverty line, and having large variation in terms of their traditions, practices, economic and educational satus. Through the All India Coordinated programme (AICP), an attempt has been made to provide S&T inputs and the required handholding to help the community to benefit from the available opportunities.

In this backdrop, the programme was initiated under the Scheduled Castes Sub-Plan (SCSP) scheme aiming to mobilize the SC Community to utilizing and value add to local resources using appropriate technologies. The programme was initiated through an orientation workshop to NGOs from twelve states of country in 2007, 2008, 2009 and 2012. The overall objective of the programme is to create Scheduled Caste model villages through the application of Science & Technology and utilization of local resources to create employment, reduce poverty, and improve the quality of life of members of the Scheduled Caste communities.

These projects are located in Andhra Pradesh, Bihar, Gujarat, Himachal Pradesh, Jammu & Kashmir, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Odisha, Puducherry, Rajasthan, Tamil Nadu, Uttarakhand and West Bengal where the selected SC communities are mostly engaged in unskilled seasonal labour. The target area includes costal villages, hilly areas, and plain/drought areas.

The integrated development approach followed in the program includes the following:

a. Awareness creation, mobilization and organization of the community: Organizing the community in each village as a Development Group is the basic focus of the programme so as to empower themselves for self help. This also aims for collective work for availing the opportunities meant for SC community from Government at the local and State level. Awareness on Social issues is an integral part of the programme.

b. Micro enterprises promotion for expanding the economic activities / opportunities utilizing the local resources.

c. Skill development / upgradation of local youth for employment creation.

d. Adoption of viable technologies which include the following:

- Skill development in non-farm technologies for better income
- Up gradation of traditional skills by introducing new tools and simple machineries
- Biomass utilization to generate energy, compost etc
- Introduction of ground water recharging technologies
- Introduction of community water treatment plants
- Introduction of rain water harvesting technologies
- Introduction of locally suitable sanitation/ sanitary latrines
- Breed improvement in local animals like goats, poultry, rabbits
- Backyard poultry and kitchen garden for better nutrition etc.
- Value addition of local fruits and vegetables

The period covering the initial years of AICP witnessed resounding success in mobilizing the community and also in developing leadership and ownership feeling in the community, which is essential for the sustainability of the project activities. The initial years of AICP has concentrated more on developing and managing Micro-Enterprises for income generation among the members of the SC communities. But, due to the difficulty in managing the micro-enterprises, the next few years of AICP has concentrated more on asset creation among SC communities through livestock development along with other development activities.

Fig. 5.14 : A Micro enterprise managed by women entrepreneurs – Low-cost cattle feed production unit at Thenali (A.P)

NATIONAL SCIENCE AND TECHNOLOGY ENTREPRENEURSHIP DEVELOPMENT BOARD (NSTEDB)

The National Science & Technology Entrepreneurship Development Board (NSTEDB), established in 1982 by the Government of India under the aegis of Department of Science & Technology, is an institutional mechanism to promote knowledge driven and technology intensive enterprises. The Board, aims to integrate innovation and entrepreneurship in academia, through various initiatives with a view to translate knowledge to wealth and convert "job-seekers" into "job-generators" .

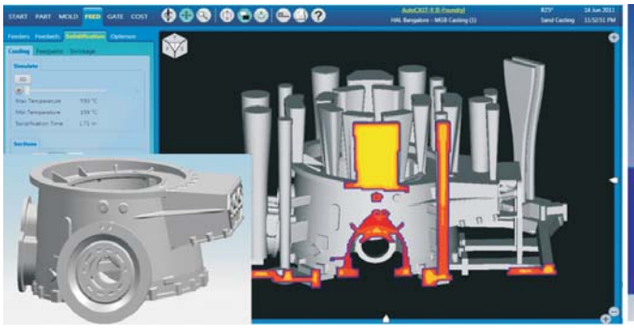
The programmes of the Board and the related achievements during F.Y 2012-13 are summarized below.

1. **Technology Business Incubators (TBIs):** Technology Business Incubator (TBI) is a programme of NSTEDB for fostering innovative and knowledge based start-ups into sustainable businesses by involving interactions from academia and providing specialized support services, early stage financing, networking among stake holders etc.

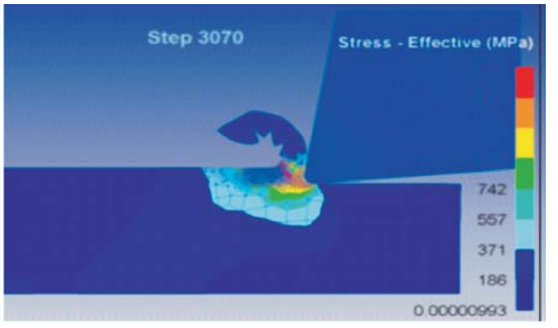
   So far 66 TBI's have been supported which are usually located in and around an R&D or academic institution. During a review of these TBI's in the current financial year, it has been found that TBI's were able to create a country wide impact with number of start ups being more than 1600, out of which 900 companies have graduated resulting in employment generation for more than 28,000 persons with tentative turn over of Rs.817.00 Crores. Thus, the efforts made have been successful in creation of an ecosystem to nurture and cultivate techno-entrepreneurship in the country.

   The new TBIs being established during the F.Y.2012-13 are at Technopark, Kollam Campus and Sathyabhama University, Chennai.

2. **National Centre for Aerospace Innovation and Research (NCAIR)** is established at IIT Bombay with a goal to develop a vibrant aerospace ecosystem in India in collaboration with **t**he Boeing Company. NCAIR has started functioning and the key achievements at NCAIR include- design and development of commercial scale aviation design and manufacturing oriented technologies i.e new Ti -Al-V alloys, special material machining processes and enhancing mechanical properties through advanced heat treatments etc.



Simulation of Metal Flow in Aerospace Casting



Ultrasonic Vibration Assisted Machining of Titanium

Fig. 5.15: Different technologies developed at NCAIR.

3. **Seed Fund to Incubators** : The basic idea of providing Seed Fund is to equip the STEP/TBI with the much needed early stage financial assistance to be provided to deserving ideas/technologies of start-ups under incubation. This would enable some of these innovative ideas/technologies to graduate to a level where they can then be fit for seeking normal lending commercial banks /FI's route in their way to the successful commercialization process. Thus the proposed assistance is positioned to act as a bridge between development and commercialisation of technologies.

So far , 14 STEPs/TBIs have been supported with the seed support since its initiation in the year 2008. 2 new TBIs namely, IT-BHU, Varanasi and Global Incubation Services , Bangalore were provided seed funding during 2012-13. By getting timely support of the seed fund, over 60 start-up companies have taken their ventures to the next level by way of enhancement in total revenues , validating prototypes, securing market orders and raising external funding through angels/VCs.

4. **Intel DST Asia Pacific Challenge 2012**

The **Intel DST Asia Pacific Challenge 2012** supported by Intel and National Science & Technology Entrepreneurship Development Board (NSTEDB), Department of Science & Technology, Government of India and organized by Asia Pacific Incubation Network (APIN) during August 6-10, 2012 is a competition for high Tech, high Growth technology and social innovations in specified themes across Asia Pacific Region, the winners of which get an opportunity to showcase their projects at "Intel UCB Global Challenge Programme".

The technology challenge programme was organized in 12 countries that include Bhutan, Singapore, India, South Korea, Indonesia, Sri Lanka, Japan, Taiwan, Malaysia, Thailand, Philippines and Vietnam. The event witnessed 24 teams from the mentioned 12 countries and the teams from India, Philippines and Indonesia were the winners of the Intel DST Asia Pacific Challenge 2012 in the grand finale held at Bangalore.

The five day event includes - **2-day Micro pitch Training Programme at IIM Bangalore** for an exposure for all the finalists on how to pitch their idea by having individual interaction with profound mentors before they enter into the grand finale; **2 day Asia Pacific Entrepreneurship Summit** on various aspects of Entrepreneurship with participations from 18 countries and One day Mentor School for BI Manager for a finer refinement.

Fig 5.16. Intel DST Asia Pacific Challenge 2012.

5. The Power of Ideas 2012

National Science and Technology Development Board partnered with The Economic Times and Centre for Innovation, Incubation and Entrepreneurship for implementation of India's largest entrepreneurship promotion programme- The Power of Ideas 2012.

The program was launched with The Economic Times extensively advertising the call for applications from aspiring and existing entrepreneurs in India. The program was well received with more than 14,000 applicants registering for participation. The applications were evaluated by more than 500 knowledgeable mentors and experts and 504 applications were selected for a month long mentoring. A second round of evaluation through pitch presentation resulted in 75 teams being invited for a 10 day intensive workshop at IIM Ahmedabad where India's leading expert on various management aspects helped them improve their business strategy and solve the business issues.

40 promising startups were chosen for awards of Rs.5 lakh each while 10 brightest ideas were chosen for awards of Rs. 2 lakh each. Apart from these awards, 20 startups also received seed funding offer of Rs. 20 lakh each.

Fig. 5.17. The Power of Ideas : Start-up Conclave, 18 October 2012 , N. Delhi

More than 500 aspiring entrepreneurs were further provided an opportunity for capacity building through workshops held in various cities by partner TBIs like RTBI Chennai, JSSATE-STEP Noida, GINSERV Bangalore, Venture Center, Pune and TBI- University of Hyderabad.

Within a short time, the initiative has developed into a platform which brings all the stakeholders in the ecosystem like startups, mentors, incubators, and investors together and is proving to be an engine of growth for the entrepreneurial culture in the country.

6. **DST-Lockheed Martin India Innovation Growth Programme (IIGP) 2012:** The India Innovation Growth Programme (IIGP) 2012 added impetus to the ongoing efforts of IIGP as it saw participation from sectors as wide as industrial goods and machinery, clean energy, information technology, healthcare as well as agriculture and forestry. A total of 819 applications were received under the programme as a result of conducting pan India roadshows and interacting with leading incubators in India. After following a rigorous selection procedure comprising of technology validations and in-depth Quicklook reports, 50 innovations were shortlisted. The selected 50 innovators were given advanced training in technology commercialization strategies, venture formation, venture finance, technology marketing, competitive technical strategies and presentation skills through a week long Technology Commercialization and Entrepreneurship workshop held during 12-16 March 2012 at Goa. The top 50 innovators then presented their innovations to a panel of judges comprising renowned technologists and commercialization experts from India and the United States held during 26-29 March 2012 at New Delhi. At the end of the competition, 30 best innovations were awarded a cash prize of INR One Lakh each and were taken forward to the business development stage.

An expert team of business development managers from the IC^2 Institute at the university of Texas and FICCI has since then been working with the selected innovators which has resulted in the signing of over 60 Business Engagement Agreements connecting innovators to potential industry and funding partners. In addition to services for innovators, the program also offered basic and advanced international incubator management training to 15 incubation managers, which was organized by the global Commercialization Group during 8-19 September 2012 at San Antonio and Houston. The program comprised of a series of lectures, exercises and experiences designed to expose senior officials, professors and incubator managers to key topics in entrepreneurship and technology incubation.

Fig. 5.18 : IIGP 2012 Award Function in New Delhi

7. 8th Intel Global Challenge : UC Berkeley, USA , Nov. 8, 2012

The Intel Global Challenge partners with the best research institutions around the world and affiliates with regional business plan competitions to find the technologies and teams that can have the greatest impact. Founded in 2005, the Intel Global Challenge at UC Berkeley is a joint project of Intel and the UC Berkeley Lester Center for Entrepreneurship. The project is designed to motivate young entrepreneurs to develop innovative technologies that solve real-world challenges, build viable business models and move that technology out of university labs and into the market.

The 8th Annual Intel Global Challenge was held on November 8th, 2012 att the Haas School of Business at UC Berkeley. The competition this year had 25 finalists' teams from 16 countries.

Greenway Grameen Infra, a team of student entrepreneurs from India, won the grand prize of USD 50000 at this global technology business plan competition. The winning team of entrepreneurs created efficient, biomass-based cooking solutions. In India and elsewhere around the globe, indoor open fires and traditional mud stoves are still used for cooking by nearly 3 billion people, leading to negative impacts on the environment and economy. The team's flagship product, the Greenway Smart Stove, incorporates a unique air-flow generator that saves fuel consumption by up to 65 percent and reduces smoke output by 70 percent. Since it commercially launched in December 2011, Greenway Grameen Infra has sold more than 12,000 units. The company plans to add two new stove designs and a waste heat-to-electricity converter to its product line.

Greenway Smart Stove: Making meals healthier and happier: A product by Greenway GRAMEEN INFRA

Fig. 5.19: Winner of the 8th Intel Global Challenge held at UC Berkeley USA, Nov. 2012

The second team nominated from India; **Linksmart India** for the Intel Global Challenge 2012 has built a security technology that won both praise for its innovativeness as well as interest from large global corporations looking to deploy their solution for their own logistics processes.

Both the teams were nominated for Intel Global Challenge 2012 after winning the **Next Big Idea (NBI)** competition jointly hosted by Intel India, Department of Science and Technology, Government of India and Indian Institute Management, Bangalore (IIMB). The NBI showcases technology business plans with the greatest potential for a positive impact on society through the commercialization of new and truly innovative technologies. Besides cash prizes, winning teams received invaluable mentoring and feedback from Silicon Valley's leading venture capitalists.

8. STED Programme

Science & Technology Entrepreneurship Development (STED) project, socio-economic development in a region by promoting entrepreneurial temper and motivating the youth for establishing micro enterprise based on innovative skills and technology. The project involves a scientific survey of a selected district/region for identification of opportunities, matching of the material and the human resources of the region and usage of Science & Technology inputs for efficient utilisation of the opportunities.

During 2012-13, STED projects at 12 new different locations have been initiated. A publication entitled **Enterprising India** has been brought out, which is a compilation of select success stories of micro-enterprises promoted by various projects under the STED programme.

9. Innovation and Entrepreneurship Development Centres (IEDCs)

Innovation and Entrepreneurship Development Centre (IEDC) have been promoted in education institutions to develop institutional mechanism to create entrepreneurial culture in academic institutions to foster growth of innovation and entrepreneurship amongst the faculty and students. The IEDCs aim to promote innovation amongst the students of S&T. The students are encouraged to take up innovative projects as a part of their curriculum and are supported to developed a working prototype. During the year, 27 IEDCs have been supported across the country.

10. Training Programmes on Entrepreneurship : For sensitization, awareness creation, capacity building and knowledge enhancement on various aspects of entrepreneurship , NSTEDB supports organizations for conducting various modules of training programmes across the country. In F.Y. 2012-13, a total of 1415 training programmes have been supported to train 81,225 participants.

Type of Training Programme(F.Y. 2012-13)	No. of programmes sanctioned	No. of participants
1. Entrepreneurship Awareness Camp (EAC)	922	69150
2. Entrepreneurship Development Programme (EDP)	82	2050
3. Woman Entrepreneurship Development Programme (WEDP)	80	2000
4. Technology based Entrepreneurship Development Programme (TEDP)	189	4725
5. Faculty Development Programme (FDP)	132	3300
TOTAL	**1415**	**81225**

NATURAL RESOURCES DATA MANAGEMENT SYSTEM (NRDMS)

NRDMS Programme aims at promoting R&D in emerging areas of Geo Information Science and Technology. Studies supported under the Programme contribute to the development of systems, methods, and techniques for operationalising the concept of Geospatial Governance (g-governance) and building the required human resource base in support of this strategy. Sharing of spatial data by data providing agencies in the framework of Spatial Data Infrastructure (SDI) is an essential prerequisite. The National Spatial Data Infrastructure (NSDI) has thus been a major initiative of the Department in this direction. NSDI is now being upgraded and re-oriented to support implementation of the National Geo-spatial Information System (NGIS) during the XII Five Year Plan. An inter-departmental initiative of Ministry of Earth Sciences (MoES), Department of Space (DoS), Department of Information Technology (DIT), and Department of Science & Technology (DST), NGIS is expected to provide in a Mission-Mode the required information support to translate the concept of g-governance into a reality.

Several activities have been completed towards the above goals during the year 2012-13. Based on the provisions of the National Data Sharing and Accessibility Policy (NDSAP), a mechanism has been established for sharing of data sets generated through public investments by creating data.gov.in. In order to provide web-based access to seamless 1:50,000 topographic data of Survey of India, the Surveykshan portal has been operationalised. A regional Geo Portal prototype towards development of the North East Spatial Data Infrastructure (NESDI) has been demonstrated. Web-enabled Gender Atlas and Geo-visualisastion Tools for landscape analysis and groundwater resource management have been developed. Results of studies covering various aspects of landslides and tsunami including inundation modeling and urban flood management have been useful in providing real time information for management of the geo-hazards by the authorities. Technical capacity has been built through a series of training and user awareness workshops amongst the scientific and the end user communities.

National Data Sharing & Accessibility Policy (NDSAP)

The National Data Sharing & Accessibility Policy (NDSAP) has been approved by the Union Cabinet and published in March 2012. Aimed at facilitating access to Government of India owned shareable data in a proactive and periodically-updatable manner, the Policy makes it mandatory for all Ministries/ Departments or public-funded agencies to bring out a negative list containing the data sets those are not shareable in the public domain. Following the publication of the Policy, a mechanism has been set up by creating a data.gov.in portal through the National Informatics Centre (NIC) to help discover and access both geo-spatial and non-spatial data assets for developmental decision-making. The data assets could be used for developing a state-of-the-art National GIS for provision of value-added services for use by stakeholders from Government, Academia, Industry and the Public.

Study on perspectives for a National Geographic Information (GI) Policy

Setting up of a National Geographic Information System (NGIS) capability requires back-up of an all-encompassing and comprehensive Geographic Information (GI) Policy. Based on consultations held with many experts from Government, Industry, Academia, and Civil Society, a framework for a possible National GI Policy has been developed along with a draft policy covering imaging, mapping, surveying, and GIS. The draft framework seeks to ensure that benefits of GI are available as a g-governance service in the form of customized GIS-based decision support applications meeting needs of governance, citizens

and enterprise; real-time availability of seamless and updated GIS asset is assured to support real-life decision-making; and leadership in GI technology and applications is maintained towards discovering new knowledge and bringing competitive advantage to the Indian industry.

GIS data assets in domains of Topography and Forestry

As a part of the NSDI initiative, GIS data assets from Survey of India (SOI) and Forest Survey of India (FSI) have been made accessible and discoverable as OGC-compliant Web Map Service (WMS) from the newly launched Surveykshan Portal (www.surveykshan.gov.in) of Survey of India and the data portal of Forest Survey of India. Surveykshan was released by Shri Ajay Maken, Hon'ble Union Minister

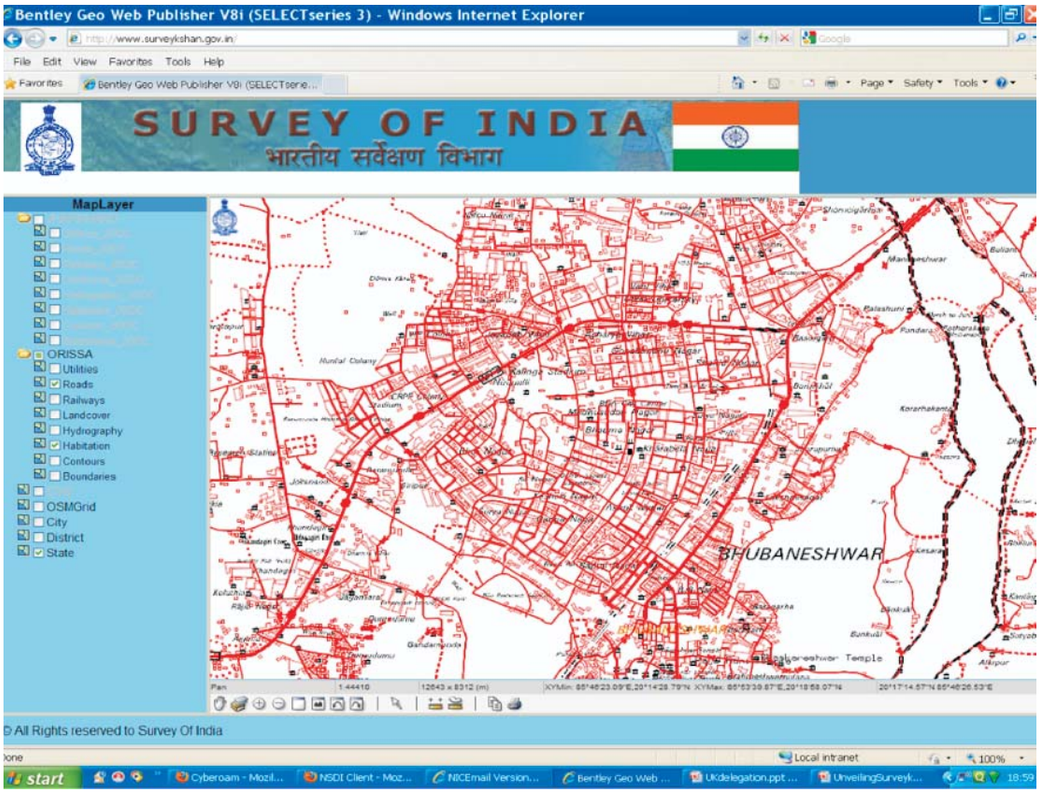


Fig. 5.20: (Web Map Service from SOI's Surveykshan Portal showing 'road' and 'habitation' layers from 1:50,000 OSM sheets of Bhubaneswar, Odisha)

for Housing & Urban Poverty Alleviation in NSDI-2012 organised on 20-21 December 2012 at New Delhi in association with the Census of India. The Portal will be useful for accessing and visualizing seamless 1:50,000 topographic maps of Survey of India concurrently with the satellite imageries and other data layers from various data providing agencies accessible on NSDI's India Geo portal. Experimental provision of Web Feature Service (WFS) was demonstrated for selected layers of 1:50,000 SOI topographic sheets and FSI's Forest Cover/ Crown Density maps in the OGC-compliant Geography Mark up Language (GML) format. A Content standard on Soils was also released by the Hon'ble Union Minister during the event. Standardised WFS/ GML and content standards for various domains from the data providing agencies will be a vital input for setting up of the National GIS and State GIS capabilities.

State Geo Portals

A prototype of the Geo Portal under development for the North East (NE) comprising of the seven NE States and Sikkim has been demonstrated. Open Source tools have been used in the development of the prototype being used for training of the scientists and personnel from the concerned State Governments. The prototype framework will be used for setting up of the State data nodes for providing access to geo-spatial data sets owned by the State Governments. State SDI Committees have been constituted in Assam, Meghalay, and Arunachal Pradesh and Nodal Agencies identified in all the 8 States to coordinate the activities. To facilitate operationalisation of Uttarakhand Geo Portal and sustenance of the information flow

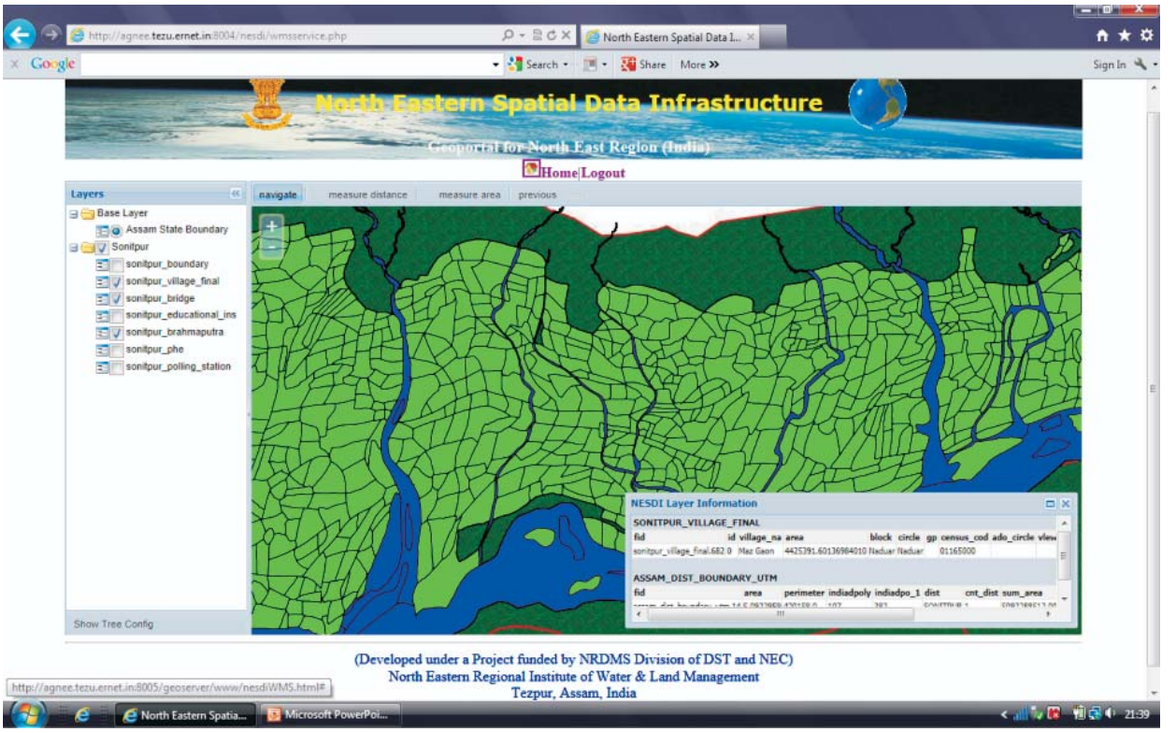


Fig. 5.21: (NESDI Geo portal showing village boundaries of Sonitpur district of Assam with attribute information as WMS on an Open Source tool)

from the Districts to the State Geo Portal, District GIS Cells have been set up in Almora, Nainital, and Rudraprayag with the identification of geo-spatial information needs of the end users through three separate workshops. The Karnataka Geo Portal is being re-oriented towards development and demonstration of value-added services to the end users in the sectors of 'Watershed Management' and Health' on mobile devices. Geo Portals of West Bengal, Haryana and Jammu & Kashmir are under development.

Gender atlas

A web-based atlas using the Open Source Tools and Open Standards (OGC-compliant WMS specifications) has been prepared on gender vulnerabilities across class, caste and social locations. The Atlas is expected to help identify spatial concentration of vulnerabilities in order to eventually develop a micro-level model for policy intervention. The atlas is aimed at providing vulnerability information in easily understood formats to the policy makers, planners, members of NGOs and civil society and grass root

level workers over the web for effective use. Variables used in the preparation of the Atlas have been classified under (i) population and demography; (ii) literacy, education & skills; (iii) employment & livelihood; (iv) survival, health & well-being; and (v) living environment. A Gender Deprivation Index has been developed using the three variables like sex-ratio (0-6), gender disparity in literacy rate; and average age of mother at the first birth for a districtwise comparison of gender vulnerability.

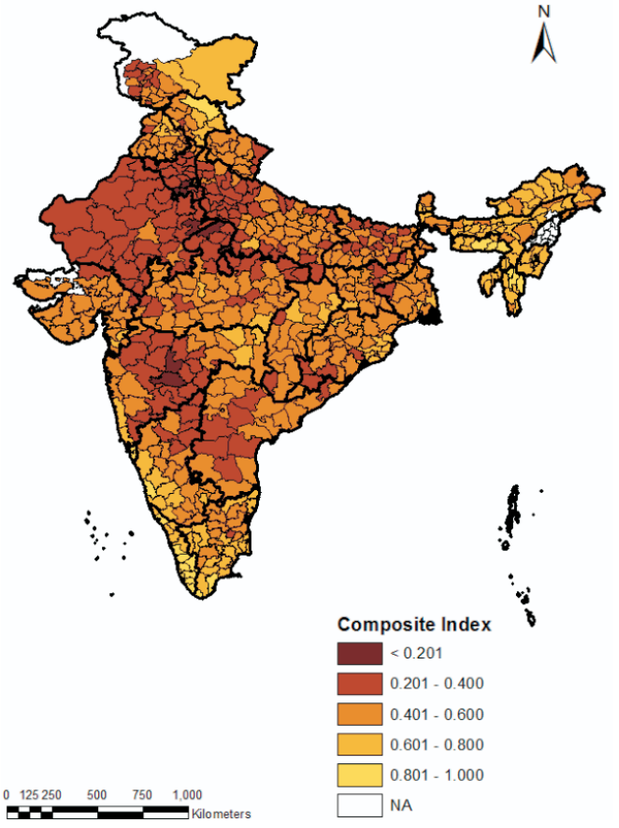


Fig. 5.22: (Districtwise Gender vulnerability based on a composite gender deprivation index using 2011 Census data)

Advanced Lab on Geo-Information Science & Engineering (GISE)

Ontology-based agro-advisory solution to cotton farmers, secured supply of drinking water using geo-spatial analysis in Thane district (Maharashtra), GIS-based building evacuation planning tool, and 3D campus GIS have been some of the activities pursued at the Advanced Lab set up at IIT Bombay during the year. An ontology for cotton crop was constructed to represent knowledge on good and bad farming practices, farming techniques; soil & climatic conditions; recommended varieties for specific locations; reasons, symptoms, and cure for various related diseases and pests to support providing faster agro-advisories to farmers. The ontology also contains concepts like hoeing, sowing, irrigation, fertilizing, spraying, harvesting along with their timeliness so that the farmers could be advised on the activities and practices based on the local conditions like weather or attack by diseases and pests. A flexible query system has been developed to store information on the past records of the farmer like varieties sown, time of sowing, fertilizing, irrigating, spraying of insecticides/ pesticides etc. Capable of responding to farmer's queries

using a graph-based search on the above ontology and the farmer's information, the query system returns the best suitable match meeting the exact requirement of the farmers. Such activities are pursued in the Laboratory by the Masters and Research students of the Department of Computer Science that also offers courses on Geo-information Science & Engineering as a part of regular curriculum.

Tsunami wave propagation and inundation modeling

Modeling of tsunami waves generated by earthquakes using Danish Hydrologic Institute (DHI) MIKE 21 Nested grid approach involves calculation of initial conditions and application of numerical settings for tsunami wave propagation and inundation. The model has been used to study the tsunami waves inundating the Nagapattinam and Chennai coastal areas of Tamilnadu. Effects of bed resistance based on land cover are derived and implemented as Manning's number. A comparison between the MIKE 21 Nested Grid

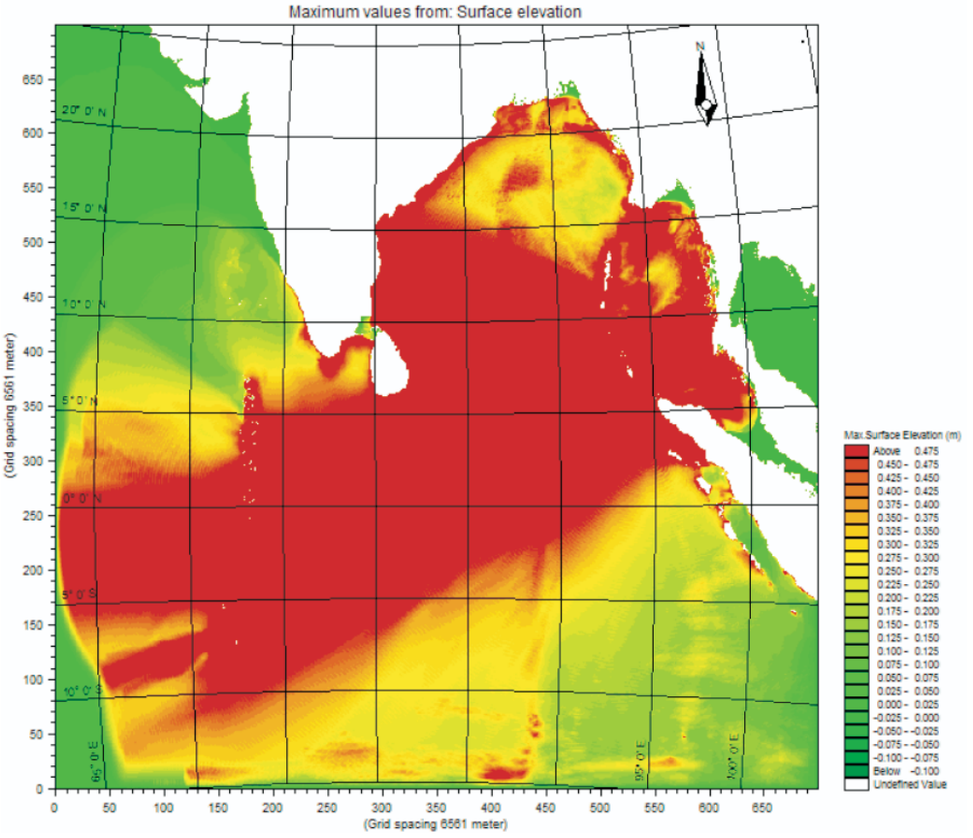


Fig. 5.23: (Maximum surface elevation of the given source Mw 9.3)

approach and NGI comMIT models has been carried out. Given appropriate initial conditions, the MIKE 21 Nested grid could be used to efficiently simulate the propagation of tsunami waves generated by earthquake. Results at 02:34:31.6 Hours after the earthquake describing phase characteristics of the sea level changes along the selected profiles have been in good agreement with the ComMIT model. Comparison of the inundation pattern for the two different models MIKE 21 and ComMIT at two different times of propagation for the Mw9.3 source has been shown in the Figure 5.23.

Rainfall induced landslide study in Ooty

Under the Landslide Hazard Mitigation Programme, the prominent Linga landslide in Ooty (Tamilnadu) has been studied for monitoring and developing the rainfall landslide relationship. Fully automatic rainfall monitoring device has been installed to record the real time rainfall data and studying the impact of intensity of rainfall on the occurrence of landslides. The relationship is potentially useful in developing the landslide early warning system for the area around Ooty. In this process, efforts have been made to collect rainfall data with the time and observe triggering condition arising out of high rainfall intensity in shorter periods of time. A sound co-relation between rainfall and the induced landslide has been built. Similar test sites in Himachal Pradesh and Kerala have been selected for rainfall-induced landslide monitoring and validation of the relationship.

National Geotechnical Facility

With the recruitment of scientists and research personnel and procurement of hardware & software, the facility is currently operational at the Wadia Institute of Himalayan Geology (WIHG), Dehradun.

Projects in support of SC/ST

R& D projects have been supported to study and provide scientific solutions to the problems being faced by the SC/ST communities and improving their socio-economic conditions in different States like Haryana, Madhya Pradesh and U.P.

Training and Capacity building

A set of 22 training programmes have been organized to train about 600 participants from the faculties of universities and engineering colleges on the emerging tools and technologies. A national portal has been set up for providing access to training materials on GI Science & Technology. Development and demonstration of test-beds around the upcoming interoperability specifications like Web Processing Services (WPS), RESTful Web Processing Services, GeoSMS, and IndoorGML from the Open Geospatial Consortium (OGC) have been initiated to support development and demonstration of value-added interoperable services and provision of training to staff and personnel in this emerging area.

NATIONAL COUNCIL FOR SCIENCE & TECHNOLOGY COMMUNICATION (NCSTC)

The National Council for Science & Technology Communication (NCSTC) is mandated to communicate science & technology to masses, stimulate scientific and technological temper and coordinate and orchestrate such efforts throughout the country. The programme of the Council aim at building capacity for informed decision making in the community and promote rational thinking. The Council is devoted towards societal upliftment through dissemination of scientific knowledge in an informal manner and builds programmes with the help of different media which percolate down to every nook and corner of the society.

NCSTC encourages research in S&T communication and impact assessment of various programmes, for diverse target group. It also support programmes aimed at school and college level popular science, Community level general S&T and others. Books, manuals, posters, exhibitions, films, radio programmes and television programmes are regularly produced to reinforce these efforts. NCSTC recognizes outstanding efforts through awards and incentives all over the country.

INITIATIVES & PROGRAMMES FOR MASS AWARENESS & SCIENTIFIC LITERACY

SCIENCE EXPRESS - BIODIVERSITY SPECIAL

As the current decade has been declared as United Nations Decade on Biodiversity and with India hosting 11th meeting of Conference of the Parties (CoP-11) to Convention on Biological Diversity during 8-19 October 2012 in Hyderabad, it was the most opportune time to showcase our wide array of biodiversity, threats to its sustenance and the conservation measures adopted thereof. Thus, Department of Science & Technology (DST), in a unique partnership with Ministry of Environment & Forests (MoEF), launched an innovative exhibition mounted on its Science Express rake as Biodiversity Special. The

Fig. 5.24

collaboration envisages running the train in two phases to cover at least 110 locations on Broad Gauge network of Indian Railway across the entire length & breadth of the country.

Of the 16 coaches of Science Express- Biodiversity Special, 8 are solely dedicated to showcasing the myriad biodiversity spread across the bio-geographical zones, viz. Trans-Himalaya & the Himalayas, Gangetic Plains, North East India, the Desert & Semi-Arid Zone, Western Ghats, Deccan Peninsula and Coasts & Islands with a focus on range of Biological diversity, critically endangered species, biodiversity hotspots, domesticated biodiversity, biodiversity & livelihoods, bio-culture; threats/challenges, conservation measures, success stories & unique experiences. Four other coaches have interesting & informative exhibits on Climate Change, Energy and Water conservation while another coach houses Joy of Science Lab in which students are guided to perform various experiments & activities to understand concepts in science besides a demonstration-cum-training facility for capacity building of teachers.

Science Express- Biodiversity Special (SEBS) was launched on World Environment Day (5 June 2012**)** from Delhi Safdarjung. During its first phase which ended on 22 December 2012, this only-of-its-kind train had made halts of 3-4 days duration each at 51 locations and over 23 lakh people, including 6 lakh students and 32000 teachers from 7000 schools who have been able to enjoy the interesting & informative exhibits. The train was also stationed at Secunderabad during 9-19 October 2012 to host visiting COP delegates & dignitaries besides the local populace.

Print, electronic and digital media gave special attention to this programme with over 500 stories/ news items in all leading national & regional newspapers including vernacular besides most TV Channels and major related websites. Thus this flagship venture of NCSTC was able to reach out to even those who could not physically visit the train but were made aware of its content by the extensive coverage in media.

Science Express was originally custom-made for DST by Indian Railways. Since 30 October 2007, when it was flagged off by Hon'ble Prime Minister of India and German Chancellor, DST organised four tours across India, the last one culminating on 16 June 2011. It hosted a world renowned exhibition created by Noble laureates from Max Planck Society Germany (MPS). However, after displaying it to over 63 lakh people at 222 halts in 800 exhibition days, it was converted into its present version.

Fig. 5.25

Fig. 5.26

Science Express- Biodiversity Special: An analysis of the print media coverage (5 June– 21 December 2012)

Print media analysis was carried out on **735** newspapers which covered the journey of SEBS from **5 June 2012 to 21 December 2012** including Hindi, English and vernacular (various regional languages). After scrutinizing all the available newspapers data, the following points are highlighted.

Total number of articles (with photograph):	656
Total number of articles (without photograph):	79
Total number of only photographic presentation (without articles):	147
Total number of articles in Hindi:	299
Total number of articles in English:	130
Total number of articles in regional languages: -	306
Most credits given to:	DST/MoEF

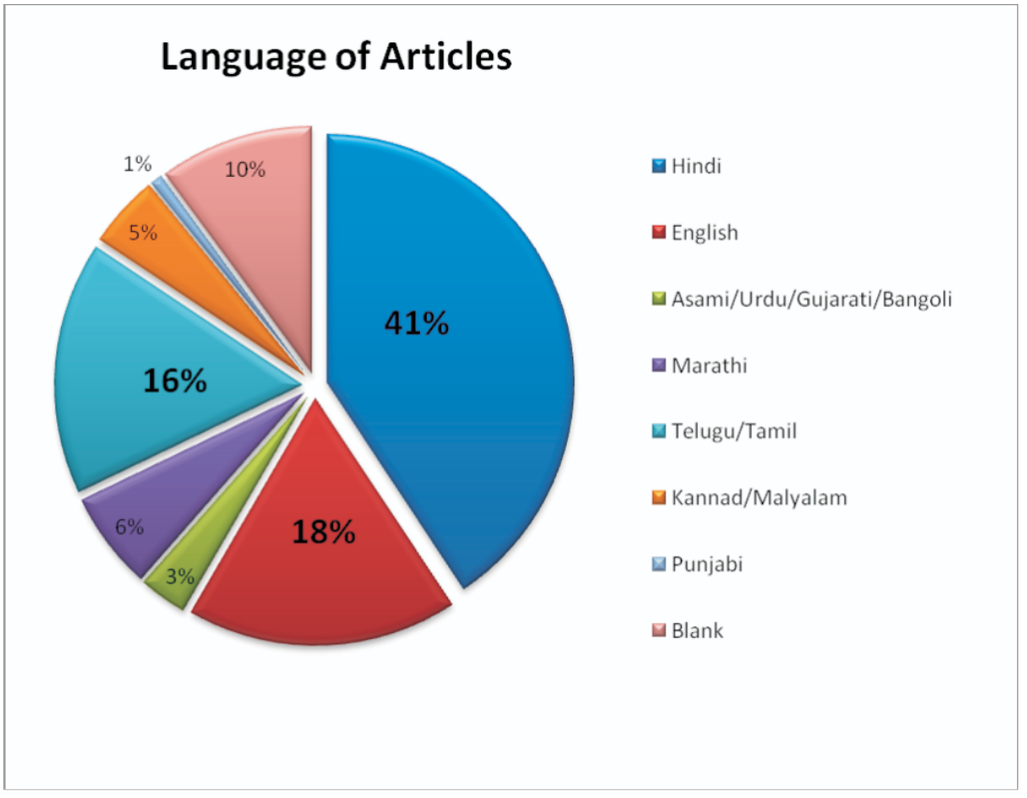


Fig. 5.27: Pie graph shows the languages in which news was covered

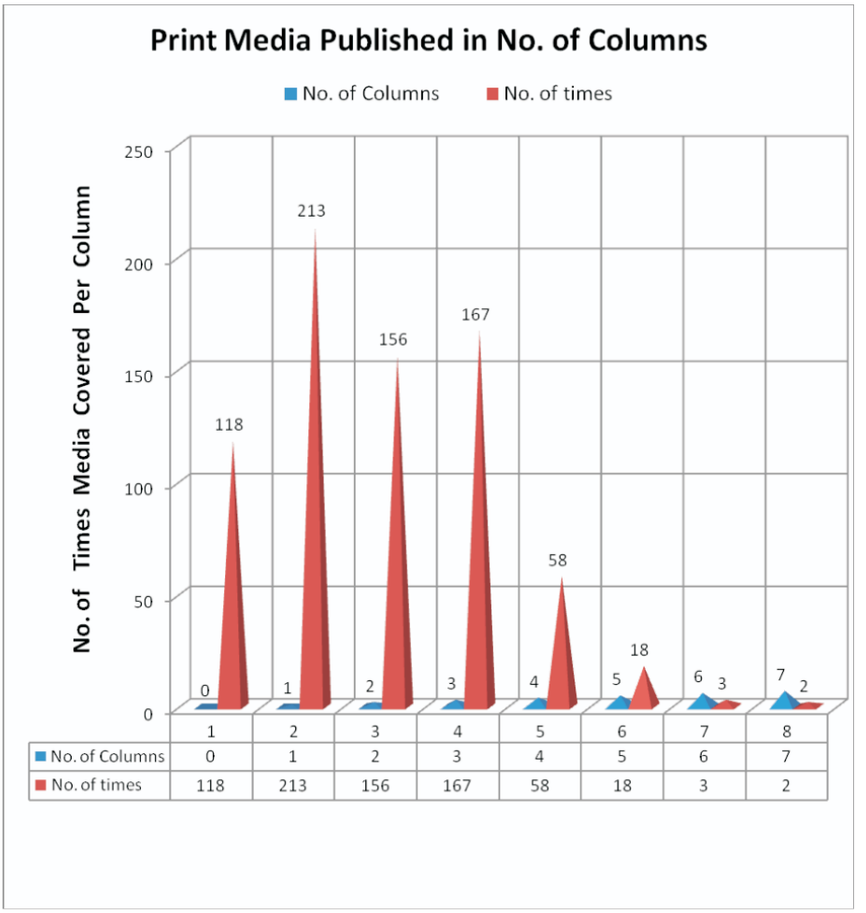


Fig. 5.28: Graph showing the average size of news covered

NATIONAL SCIENCE DAY

The National Day is celebrated every year on February, 28 to commemorate the discovery of the Raman Effect. A number of events start or culminate on this day or it is beginning of year long activities to create the awareness amongst varied target groups. The theme for celebration of NSD 2012 was "Clean Energy Options and Nuclear Safety". NCSTC supported the programme is various states by giving grant to its state S&T Councils for organization of variety of programmes like lectures, quizzes, open houses etc. based on the theme of NSD.

NSD 2012 was celebrated in more than 20 states in various schools, colleges, national science laboratories and other scientific institutions through their respective state S&T Councils. The theme for National Science day 2013 is "Genetically Modified Crops and Food Safety".

NATIONAL YEAR OF MATHEMATICS

As 2012 was declared as the National Year of Mathematics, a number of programmes were initiated, conceptualized and sanctioned to celebrate National Year of Mathematics and Ramanujan Chandrashekhar's Legacy in Science. A workshop and exhibition on Sir Sriniwas Ramanujan and Dr. S. Chandrashekhar's

legacy in science was organized by the Tamil Nadu Science and Technology Centre, Chennai. Around 400 students and teachers were exposed to digital exhibition, colourful panels and movies on the life and works of these renowned scientists, attended lectures by eminent scientists.

A workshop for teachers on innovative teaching methods in mathematics, Mathemagic 2012 – a school college based mathematics festival type of programme, and Joy of Mathematics – wherein 20 district level workshops are being catalysed and supported in Gujarat with the help of Vikram Sarabhai Community Science Centre in Ahmedabad.

3 National level workshops for teachers of Mathematics are being organized in different parts of the country by Association of Mathematics Teachers of India, Chennai.

Punjab State Council for S &T is working to organize 10 district level workshops all over Punjab for the celebration of 2012 as year of Mathematics. Around 400 students and teachers will benefit from these workshops.

WOMEN'S SCIENCE CONGRESS

Second Women Science Congress during Centenary year of Indian Science Congress from 4th to 6th January, 2013 on the theme entitled "Women empowerment for the development of the country" was organised. The event was inaugurated by Shri S. Jaipal Reddy, Hon'ble Union Minister for Science, Technology and Earth Sciences. Dr G. Kalonji, Assistant Director General, UNESCO, Paris was the Guest of Honor. Presidential address was delivered by Dr T. Ramasami, Secretary, Department of Science and Technology, New Delhi. Panel discussion on Gender Empowerment – Policy Issues and four sessions namely, Women from Academic Sector; Showcasing contributions of women, Women health and science and 43 posters in the poster session were the highlights of the congress. Eminent women scientists who have made significant contributions in their chosen disciplines of science from various research laboratories, universities, NGOs, space, atomic energy were present during the conference. Scientists, administrators, legal experts, policy makers, media personnel also participated in the congress.

S&T DEMONSTRATIONS ON I –STEM

With a view to enlarge the role of NCSTC in Technology Communication & Demonstration of S&T and to have guidance on content, form, impact of proposals being received, generated and evaluated and related policy matters an expert committee has been constituted for S&T Communication on "i – STEM Demonstration" [Innovation and STEM (Science, Technology, Engineering & Mathematics) Demonstration. 1st Meeting of Technical Advisory Committee for S&T Communication on "i – STEM Demonstration" [Innovation and STEM (Science, Technology, Engineering & Mathematics) Demonstration] was held on 14th & 15th December, 2012 at Homi Bhabha Centre for Science Education (HBCSE), Mumbai.

ECO & WaSH (WATER, SANITATION & HYGIENE) FUTURES

The programme has sparked innovations in science communication practice for handling issues of developmental nature & the future related to eco-resources and water, sanitation & hygiene, especially in-

- Ecological efficiency, innovation, inherited knowledge & wisdom for better WaSH Practices
- Eco-water resources & environmental sciences

- Water conservation, purification, re-use, recycling solutions
- Watershed management & harnessing water cycle
- Sanitation & hygiene support solutions

Thrust Areas: For promoting a multifaceted and multilevel approach to behavioural change, based on field action research, the following thrust areas are being promoted -

a) Research & S&T Communication Software

b) Trainings & Demonstrative Communication -Best practices in protecting Eco-systems, Preserving & restoring watersheds, water bodies & water quality, water conservation, etc.

c) Outreach: Outreach models for inaccessible & remote areas (Eco-zonation based target areas); Institutional Capacity Building through various media & institutional innovations- Jal Saksharta Kendras, Jal Chaupals, Watershed Watch & Care Groups, Paani Panchayats/Water User Associations, Swachhta Chaupals, Swachhata Vigyan Sarathis, Complementing IWRM & TSC in States).

Projects continue to yield models for scale up in Gujarat, Rajasthan, U.P., Madhya Pradesh, Karnataka, Tamil Nadu, and Andhra Pradesh. Resource material like flip charts, CDs & community videos (Jal Chaupals) have been brought out and disseminated to people at large. The communicative guidance on water quality monitoring has been developed. Consequently, resource material on relative utility of test kits and lab methods is being brought out for training of young citizen scientists in water quality monitoring with participation of communities. S&T Communication Trainings for Water Educators are being initiated in Odisha, Gujarat & Rajasthan.

Role of State S&T Councils has been enlarged under six month long special package on 'Networking for WaSH'. States like Chhatisgarh, Uttar Pradesh, Karnataka, Andhra Pradesh, Tripura, Manipur and Punjab have come forward for the package.

14th & 15th Meetings of Technical Advisory Committee (TAC) were organized for consideration of new proposals, at Shimla & Vadodara respectively. Nationwide invitation of concept notes has been announced more than 150 concepts were received and evaluated by a committee of experts based on stringent criteria. Short listed concepts have been presented as detailed proposals before TAC. The Committee also acted as mentoring mechanism. This effort has helped in enlarging geographical spread and reach of the programme, while enabling new institutions to join the initiative.

Fig. 5.29: 14th TAC meeting held at HIPA, Shimla 30th-31st May 2012, with noted environmentalist Sh. Anupam Mishra

A national initiative for capacity building has been formulated to further cover the capacity scarce regions in the country, by grooming Water Educators & Water Educator Fellows.

Fig. 5.30: 'The Dabhoi initiative', has resulted from a discussion and exposure visit at Saptamukhi Vaw, Dabhoi in Vadodara, Gujarat. A national plan is being formulated in collaboration with experts from Archaeological Survey of India for 'Heritage & Water Values-Communicating Science' as a means for public engagement with science behind ancient water regimes and outreach with the lessons derived for the innovations required for future.

OCCUPATIONAL HEALTH

Training Workshops, Field Visits, Exposure visits, Follow-up Support/Guidance are being designed for three hundred Salt pan women workers to address their two main health related problems –visual and ergonomics in Surendrangar district and its 3 talukas Patadi , Dhangadhra and Halvad . One video programme each and other training material like flash cards and charts are being prepared. To have co-ordination and to establish linkages with barefoot link workers and government health functionaries, one training programme will be conducted at district level. The reference material kit: Information Education Communication (IEC) and Behaviour Change Communication (BCC) will be prepared. Two TV Programmes of 20 minutes each 04 quickies each of 40 to 60 seconds in local language/dialect with jingles, slogans, catch phrases etc, for effective communication will be prepared. . Flash cards, flip charts

and other print material- Visual, graphics-minimal use of words and sentences Manual Equipping trainers in their tasks of capacity building will be important output of the programme for its replication in other parts of the country.

An innovative programme involving eminent doctors of All India Institute of Medical Sciences and local doctors from hospital at Leh has been initiated for imparting awareness among people of Leh, Kargil and Nubra Valley of Ladakh. A questionnaire has been designed to conduct survey pertaining to the current knowledge of the inhabitants of these areas and awareness generation package will be designed containing posters, hand outs, charts, video film. The people living in these difficult terrains will highly benefit from such a programme.

A manual for women working in Call centers has been prepared in consultation with experts in the area. A large number of women working in Call centers in Chennai have been trained. The manual will be used for training women in other parts of the country also.

PERFECT HEALTH MELA

In order to communicate science and technology achievements among the public-urban and rural population, NCSTC conducted a series of science exhibitions in different parts of country. The Council also participated in the popular Perfect Health Mela organized by Heart Care Foundation of India, New Delhi during 02nd to 11th November, 2012 in New Delhi and put up its activity corners that attracted thousands of visitors.

MOTIVATIONAL PROGRAMME

Motivational programmes have been organized with the help of eminent scientists for students of local schools and colleges for Bundelkhand region of U.P. The topics like career opportunities in various science and mathematics courses, interaction with eminent scientists, field trips, hands on experiments and other interesting programmes will be organized as a part of these motivational programme.

AGARSAR LECTURE DEMONSTRATION PROGRAMMES

30 lectures and demonstration by experts on topics related to understanding of weather and climate change and health issues related to different segments of the society were organized in different districts of Orissa.

An awareness programme on climate change and related issues has been initiated in Kullu, Himachal Pradesh for Banjar Block of Kullu, the programme is meant for school children, farmers and women. The programme involves organization of awareness camps, sensitization meetings and seminar/awareness programmes in schools and public places.

RASOI KASAUTI PROGRAMMES

Department of resource management and Consumer Sciences, College of Home Sciences, ANGRAU, Hyderabad organized 4 batches of training workshops for teachers, voluntary activists and NGOs of various districts of Andhra Pradesh. Topic like detection of adulteration in food stuffs, their harmful effects on humans, reuse of kitchen waste, food safety and other related issues were discussed and demonstrated during the programme. Further participants were also given adulteration testing kits to disseminate the activity further.workshops on topics related to food adulteration, nutrition and food safety were organized.

VOLUNTEERS PLUS

Regional level Training programme on disaster preparedness and related aspects was organized at DRTC, Bhubneshwar, for NCC and NSS programme officers, teachers, college students and voluntary activists, in which more than 40 officers from West Bengal, Jharkhand, Bihar, Sikkim and Odisha participated. The course content included the science behind disasters, environmental aspects leading to natural hazards, first aid and safety measures, building construction and safe structures, safety from fire and other accidents and prevention of man made disasters,

FIELD PROGRAMMES IN SCIENCE COMMUNICATION ON BIODIVERSITY, MEDICINAL PLANTS, ENERGY MANAGEMENT & NATURE CAMPS

Inculcation of scientific temper and awareness generation for identification, importance and conservation of biodiversity among students, youth and common public, continued in various parts of the country during the year. Science quiz, essay writing, poster and painting competitions are being organized for training school going students and their teachers in 20 districts of Uttar Pradesh. Various articles and poems from different magazines and newspapers will be collected and compiled in the form of a booklet for wider circulation.

A three day state level seminar on cultivation and conservation of the medicinal plants was organized under the overall guidance of Central Institute of Medicinal and Aromatic Plants,Lucknow at Imphal in Manipur. Four nature camp workshops to inculcate deeper understanding of various biotic and a biotic components of nature through hands on activities were organized in Pallikonda, Sholingur etc. in North Tamilnadu. Another nature camp is being organized in remote area of Himachal Pradesh. Four Nature camps will be organized in two districts of Orissa.

Essay writing, painting competitions, on the spot lecture on theme of Biodiversity and lectures by experts are being organized for high school students of rural areas of Kalimpong hill region of Darjeeling district, West Bengal.

School and college going youth in Delhi and NCR region are being trained for better energy management practices. As a part of the project, training programmes comprising of awareness raising training modules will be developed. The comprehensive tools like Interactive games, audio visuals, study material, cartoons, quiz etc. to generate & maintain interest in movement towards energy management will be developed. Through the training program, knowledge, attitude and behavior level of participants will be targeted. The changes in the said criteria will be measured by administering appropriate tools, both pre-training and post-training. The difference between the result of the pre and post-test would provide evidence to the knowledge, attitude and behavior change during the training. A tool for training evaluation will be used to get feedback on the overall reaction of the participants to the training program.

PROMOTION OF INNOVATION AMONGST CHILDREN AND ENRICHMENT OF SCIENCE TEACHING

NATIONAL CHILDREN'S SCIENCE CONGRESS (NCSC)

The 20th National Children's Science Congress started with a brainstorming workshop at Tezpur University, Tezpur, Assam, on development of Activity Guide for the year 2012 and 2013. The 137 pages guide with focal theme "Energy: Explore, Harness and Conserve" contains NCSC guidelines, norms,

guidelines, illustrations and suggested activities which can be carried out by the children of 10 – 17 years age group both in Hindi and English was developed and distributed to all the stakeholders to the level of district. 25 Experts worked on 6 Sub-theme – Energy Resources, Energy System, Energy in Society, Energy and Environment, Energy Conservation and Management and Energy Planning and Modelling.

National Orientation Workshop was conducted at Regional Institute of Education, Mysore for 150 resource persons (3-4 from the states) who would conduct similar workshop independently in their respective state/region/district levels. 2 best project were selected from CSC in each state for their participation in Indian Science Congress (Rashtriya Kishore Vaigyanik Sammelan) during 4th to 6th January, 2013 at S.N. Bose Centre for Basic Sciences, Kolkata (West Bengal). The 20th NCSC is being organized at Banaras Hindu University, Varanasi, UP. Nearly 800 selected projects came through district and state level congress and will now participate in national grand finale. Nearly 250 participants attended the 100th annual session of Indian Science Congress held from 3 – 7 January, 2013 at Kolkata. 10 member countries of ASEAN also sent 44 participants.

A new chapter to CSC has been added by providing the fellowship to highly potential 20 projects for continued pursuit of the work by child scientists including the group members in some of the leading centres/laboratories in different parts of the country. The department will provide mentor as well as the laboratory facilities commensurate with the project study.

NATIONAL TEACHERS' SCIENCE CONGRESS (NTSC)

The Sixth NTSC was held at Banaras Hindu University (BHU), Varanasi, during 8-11 Nov. 2011. There were five plenary sessions in which the experts talked about the challenges of science teaching in rural areas; current trends in teaching biology and research career options; different physical conditions prevailing in India and its correlation to crop production; National Curriculum Framework-2005 in light of teaching science; and the critical role of children in the teaching-learning process.

EMPOWERING THE NEXT GENERATION OF INNOVATORS - IRIS

Initiative for Research and Innovation in Science - IRIS is a public private partnership program heralded by Department of Science & Technology (DST), Confederation of Indian Industry (CII) and Intel. IRIS promotes, recognizes, rewards and nurtures science and outstanding scientific research amongst young Indian innovators studying in grades 5 – 12 who interact with some of the best scientific minds in the country. The fair is managed by a the Scientific Review Committee (SRC)of eminent scientists.

Under this programme a National fair was conducted this year,at Bal Bhawan in New Delhi from 29 November to 2 December 2012. The Fair, which was inaugurated by the father of India's Green Revolution, Prof M S Swaminathan Member of Parliament and Dr. T Ramasami Secretary Department of Science & Technology, attracted more than 3,000 visitors - students, teachers, and scientists. Among the distinguished visitors were Shri Janardhan Swamy, MP from Karnataka, who graced the Awards Ceremony with his presence; Dr Y S Rajan, Chairman, National Board of Accreditation, Dr. B P. Singh and Dr D K Pandey from Department of Science and Technology, and Dr Y P Viyogi, from the Department of Atomic Energy, Kolkata; and senior officials from key ministries. Mr Gregory Bryant Vice President Intel Asia-Pacific, Ms Debjani Ghosh Managing Director, Intel South Asia and Mr Ashutosh Chadha Director Corporate Affairs Group Intel South Asia led the Intel presence at the Fair. This year special awards were sponsored by three ministries of the Government of India—the Ministry of Chemicals and Fertilizers, the Ministry of Information Technology, and the Ministry of Environment and Forests

111 projects were selected to present at the national fair from students of 157 cities across 26 states. 6 winning projects of the Gold category will be sent to represent India at the International level at the Intel International Science & Engineering Fair (ISEF) in Arizona in May, 2013. Intel ISEF brings together more than 1,600 high school students from 71 countries, regions, and territories to display their independent research **and compete for more than US$4 million** worth of prizes and scholarships. The winners at ISEF are awarded Minor Planets on their names by Lincon Labs USA. Till date 16 young Indian students have Minor Planets named after them courtesy their initial participation in IRIS. The selected projects were the result of the inventiveness and perseverance of the young geniuses - they covered a wide gamut, from detecting mangoes that were artificially ripened to developing algorithms to find the acoustic properties of a non-ideal room using tone bursts.

Fig. 5.31: Dr. T Ramasami Secretary Department of Science & Technology and Mr Gregory Bryant Vice President Intel Asia-Pacific inaugurating IRIS National Fair 2012

INDIA INNOVATION INITIATIVE – i3

India Innovation Initiative - i3 is a Public-Private Partnership (PPP) initiative of Department of Science & Technology, Government of India (DST), Confederation of Indian Industry (CII) & Agilent Technologies Ltd. For last 3 years, i3 has provided a unique platform to upcoming innovators by connecting them with organizations for incubation, funding, technology refinement and marketing. Last year (2011), 2 innovators were successfully incubated by Indian Angel Network (IAN). This year i3 has broadened its scope for incubation and technology commercialization support by partnering with Technology Business Incubators of National Science & Technology Entrepreneurship Development Board (NSTEDB), Department of Science & Technology (DST) across the country. Young Indians (Yi) has been the partner in this initiative from the beginning and supported with cash awards and a wider outreach of this program.

This year (2012) around 600 innovations entries were received from across the country from students, industry professionals, individual & grassroots innovators in various fields such as Life Sciences, Electronics & Communications, IT, Energy and Engineering Technologies. After a first level of screening by online jury, top 196 innovations were given opportunity to participate at 4 Regional Fairs held at JSS Academy, Noida, IIT Powai, Mumbai, RTBI, IIT Madras and Exhibition Grounds, Bhubaneswar. Out of 4 regional

fairs top 42 innovations were selected to participate at the i3 National Fair held on 3rd December 2012 at IIT Delhi. A panel of Jury selected top 5 innovations for i3 Awards and top 3 young innovators for Yi Awards based on the technical feasibility, market potential of the innovation and its impact on the Industry, society and environment. The top 5 innovations at i3 were awarded with a certificate & cash prizes of Rs 1 lakh (1st prize), Rs 75000 (2nd prize), Rs 50000 (3rd prize), Rs 25000 (both 4th & 5th winner). Yi awarded the winners with a certificate & cash prizes of Rs 25000, Rs 15000, & Rs 10000 to the 1st, 2nd & 3rd winners respectively.

Fig. 5.32

TRAINING MODULES FOR RESOURCE TEACHERS

Microorganism : Let us Observe & Learn

A low cost and easy to handle microorganism kit was developed in collaboration with ASTEC, Guwahati and Botanical Hobby Centre, Cotton College, Guwahati.

Vermicomposting

Training workshops on open-ended experiments in life sciences using vermin-composting as a base were organized to train the resource teachers so that they can pursue the activity with children as science and eco-club activities. Such workshops were organized across the country.

Simple Tasks, Great Concepts and making life science learning and livelier

A module titled as 'Simple Tasks, Great Concepts' was designed and developed in a simple and presentable form where nearly 100 experiments were tried, experimented and documented with possible illustrations targeting the children at high school level. To implement this programme, a national orientation

training workshop has been organized from 19th to 22nd January 2011 at Chennai & 30 resource persons trained.

SCIENCE BEHIND MIRACLES

NCSTC continued to support short duration projects whereby the participants get trained in demonstrations of so-called miracles followed by their explanations including over 115 tricks, generally exploited by self styled God-men.

MOBILE PLANETARIUM

NCSTC supported acquiring of mobile planetaria to popularize astronomy and its related activities in rural schools of Uttarakhand, Assam, Uttar Pradesh, Orissa, Maharashtra, Rajasthan, Jammu & Kashmir, Madhya Pradesh. Mobile planetarium are being acquired from NCSM, Kolkata, for such demonstrations across the country and demonstrations continued.

VIGYAN JATHA

2 regional Vigya Jatha were catalyzed and supported in Northeastern Region and Bundelkhand Region mobilizing science awareness campaigns.

BEST (BUILDING EDUCATORS FOR SCIENCE TEACHING)

In order to recognize the best performance, primary, TGT & PGT science teachers of Kendriya Vidyalayas were awarded on 7th November, 2012 at New Delhi.

MANPOWER DEVELOPMENT

12th Indian Science Communication Congress

The 12th Indian Science Communication Congress (ISCC-2012) with the theme of 'Risk Communication and Development' was organized at Indian National Science Academy (INSA), New Delhi during December 17-21, 2012 attracting over 200 participants from India and abroad with some 100 presentations, including a special session for young researchers.

Science Communication Workshops

20 training workshops were organized in different parts of country involving 1,000 direct beneficiaries 1,000, and indirect 20,00,000 beneficiaries.

Science Communication Course

Science communication courses were continued with an emphasis on developing trained manpower; some 150 students have qualified the courses.

Science Media Centre

A science media centre has been established at IISER, Pune. It would cater to the needs of budding science communicators especially for media and also undertake research in Science Communication.

SCIENCE COMMUNICATION RESOURCES

Community Resources & Alliances in S&T Communication

Erstwhile scheme on Vigyan Sanchar Kendra has been scaled up and re-cast as "Community Resources & Alliances" in S&T Communication. It aims to augment, synergize & harness community resources for S&T Communication through out the country with organizations that can partner in NCSTC alliances and establish linkages among agencies like village panchayats, science based voluntary organizations, CSR units of private enterprise, academia & R&D organizations, etc.

The programme strives to strengthen the science communication capacity of the host institution as well as its outreach arms/Offspring Resource Agencies in the adopted target areas. A dedicated Award & Advisory Committee of experts would be steering the programme. The focus of impact is on "Alliances", "Networking" and "Interactivity" between different institutions and regions.

Popular Science Publications

Support was extended to popular science magazines and publications to spread science awareness through print medium.

INCENTIVE SCHEMES

National Awards for Science & Technology Communication

Honble Minister for S&T and ES honored the winners on the occasion on National Science Day in New Delhi. Outstanding efforts in S&T communication are recognized with national awards. The National award for outstanding efforts in science & Technology Communication through print media including books and magazines (Category B) was awarded to Sh N.S Chidambaram, Chennai and Sh Arpan Dutta, Guwahati. The National award for outstanding efforts in Science & Technology popularization among children (category C) was awarded to Smt. Najeema Unnikammu, Trissur. The National award for outstanding efforts in translation of popular Science & Technology literature in languages mentioned in the eight schedule of the constitution of India and in English (Category D) was awarded to Sh V. T. Santhosh Kumar, Kozhikode. The National award for outstanding efforts in Science & Technology Communication through innovation and traditional methods was awarded to Sh. Balaram Sahu, Bhubaneswar (Category E). The National Award for Outstanding efforts in Science & Technology Communication in the electronic media (Category F) was awarded to Sh K. K. Vasu, Trivandrum.

Unesco Kalinga Prize

UNESCO Kalinga Prize Awardee 2011, Dr Réne Raúl Drucker Colin, Mexico, has been invited to India under Kalinga Chair to visit 3-4 cities and deliver lectures to various target groups namely, young scientists, media personnel, women scientists etc. Dr Réne Raúl Drucker is likely to arrive in India early next year.

A Search-cum- Selection committee with eminent scientists, Administrators is being constituted to select the candidate for nomination for the award of UNESCO Kalinga Prize to UNESCO, Paris, who through a jury system would take a final decision. Fellows of Indian National Science Academy, recipient of NCSTC science communication awardees and past recipient of UNESCO Kalinga Prize and Directors

of the organization dealing with science communication will be requested to nominate suitable candidates. The contribution of Department of Science & Technology, Government of India, Government of Odisha and Kalinga Foundation Trust totaling a sum of Rs. 17,87,453/- has been released to UNESCO, Paris through Permanent Delegate of India to UNESCO, Paris. The process of receiving the applications from the eligible candidates has also been initiated.

Ten thousand copies of book entitled "UNESCO Kalinga Laureates for universal peace" were printed for wider circulation free of cost among science communicators, colleges, schools to motivate young scientists to take up science communication as a profession.

Rajat Jayanti Vigyan Sancharak Fellowship

The programme has generated enthusiasm among young scientists who are creating awareness generation among various target groups. Fifteen young scientists were awarded Rajat Jayanti Vigyan Sancharak Fellowships for the period of one year to communicate science and technology among various diverse groups in the society and various topics. The wide areas covered are: health awareness from teachers to people via students; solid waste minimization; conservation of water resources; for prevention of diseases due to inculcation of hygienic practices; educating school children for reducing the level of toxic substances at home etc. These candidates belong to 12 states and 8 different languages. Some of them are working in the difficult terrain and remote areas of the country.

The process for award of the fellowship for next year has begun. More than 100 applications have been received due to the advertisement in the newspapers countrywide and requesting nominations from eminent scientists in the country. The process of short listing and selection of the candidates is on. The work of current awardees will be reviewed towards end of the year.

BUILDING EDUCATORS IN SCIENCE TEACHING (BEST)

The programme was successfully launched in 2012-13. It would now focus on (i) upgrading skills of science teachers in order to make science education more enjoyable, purposeful & meaningful, (ii) motivating teachers by complementing their work with resource materials, (iii) building a stream of science teachers who can feel the excitement of science learning & teaching, (iv) promoting investigatory kind of project learning, (v) Identifying dedicated science teachers & recognize their services by Government & other agencies at public platform, (vi) developing resource materials/teaching aids by involving science teachers/ educators/ experts and providing a platform to teachers to share their experiences.

A pilot project was conducted with Kendriya Vidyalya Sangathan. In order to recognize the best performance, primary, TGT & PGT science teachers of Kendriya Vidyalayas were awarded during a function held on 7 November 2012 at New Delhi.

Year of Mathematics

(i) National Mathematics Day: To commemorate the great contributions made in Mathematics by Ramanujan, 22 December was declared National Mathematics Day by Hon'ble Prime Minister. The Day was celebrated with much enthusiasm across the entire country. To strengthen the interest, curiosity and novel way of Maths teaching, a new initiative covering simple and complicated concepts of various topics, may be designed and developed for primary and secondary students.

(ii) Appreciating Mathematics in Everyday Life: To strengthen the interest, curiosity and novel way of Maths teaching, a new initiative covering simple and complicated concepts of various topics, are being designed and developed for primary and secondary students. To popularize mathematics among general public, different programmes are in pipeline such as, play on life and contribution of Ramanujan, 27-part radio serial on mathematicians (in 18 languages through number of AIR stations).

(iii) Radio Mathematics

The main objectives of the project are to create curiosity and interest among the school going children in Mathematics, to find out the efficacy of community radio in creating an interest among the rural children and urban poor, create awareness amongst community about mathematics, its importance and provide teachers with an informal tool to make mathematics easier to understand for children and to reduce the fear of mathematics amongst them including reducing the mathematics drop out rate amongst children from marginalized communities. An Orientation–cum-interaction of the functional CRS in the country was held during 17-18 September, 2012 at Shyamala Vani, run by Subbalakshmi Lakshmipathy College of Science, TVR Nagar, Aruppukottai Road, Madurai to develop a similar strategy in popularizing Mathematics through community radio. Four community radio stations situated in various parts of India has been selected for this purpose. They are, North Zone: IIT Kanpur, East Zone: Jadavpur university Kolkata, West Zone: Mumbai university, Mumbai and South Zone: Shyamala vani at Subbalakshmi Lakshmipathy college of Science in Madurai.

These programs will involve pre primary, secondary and higher mathematics syllabus. Apart from these, non formal programs will also be produced to create awareness amongst people about mathematics and other disciplines like its historic references, its application in music, art, sports and daily life etc. These will be produced in Hindi, Marathi, Tamil, and Bangla languages in the first phase.

Science on Radio & Television

(i) SciMind India: A 27 part quiz programme in reality show format was produced in which bright & talented student from schools across the country participated. Efforts are being made to get this serial televised.

(ii) Health & Nutrition Programme through Community Radio: Science for women's health and nutrition to 30 community radio stations every year would be provided, thereby reaching a figure of 150 stations in five years in 12th Plan. Over 27,000 hours of original health related audio software in all major languages is targetted to reach around 15 crores women. The radio magazine programs including phone-ins and community skits are being aired on diverse themes related to health & nutrition. As part of the programme, baseline studies and capacity building workshops together with pre survey was done by CEMCA at 9 community radio stations in different states including Bunkar Vikas Sansthan, Chanderi, M P; People's Association for Rural Development, Madurai, TN; Jadavpur University, Kolkata, West Bengal; Wayanad Social Service Society, Wayanad, Kerala; Sarang Community Radio, Mangalore, Karnataka; SEWA Trust, Ahmedabad, Gujarat; Young India, Konark, Orissa; Manav Rachna Edu Society, Faridabad, Haryana; and MS Panwar Institute of Comm & Management, Solan, H P. Broadcast from these stations will be starting very soon.

Transit of Venus-2012

It was a unique opportunity once again to watch the Transit of Venus of June 06, 2012 as the next transit will take place in 2117. On June 08, 2004 also we had an opportunity to witness 'Transit of Venus' across the Sun as there is no person living today who has witnessed such a transit before, the last one having taken place 121 years ago. Transits are among the rarest of planetary alignments – indeed, only seven such events have occurred since the invention of the telescope (1631, 1639, 1761, 1769, 1874,1882, 2004). To capitalise on the tremendous possibilities offered by the event for S&T popularisation, NCSTC and Vigyan Prasar, New Delhi (an autonomous organisation under the Department of Science & Technology, established to take on large scale S&T communication/popularisation tasks) had organised activities that included a variety of programmes for students, teachers and the general public through active participation of government and voluntary organisations. Awareness programme was spread over for six months including the phenomenon on June 06, 2012 throughout the country.

Five zonal level awareness training camps for Master Resource Persons were organised by NCSTC in collaboration with Vigyan Prasar and state S&T Councils/Departments at Chandigarh, Mumbai, Shillong, Bhopal and Chennai during April-May 2012. The master resource persons (over 70 at each places) trained at these camps conducted training programmes for resource persons and various activities in their respective states. The participants had a high degree of motivation and interest in S&T communication activities with a good background in science and a strong interest in astronomy. The state level training programmes were also organised in 22 states and UTs. Many school science teachers were trained who in turn gave lectures in the neighboring schools. Essay, debate, poster, quiz competitions were held for secondary students. Lectures on various astronomical phenomena were also delivered by resource persons and experts. The entire activity was well received and the people were encouraged to observe the Transit on 6th June 2012. An observation camp was organized at Leh, Laddakh where more than 500 students and teachers gathered to witness the rarest phenomenon. The astronomical phenomenon provided an opportunity for reinforcing interest in science and reducing ignorance and the attendant myths.

Database and Website on Science Museums and other Permanent Science Popularisation Sites

A database and website (http://www.sciencemuseums-ncstc.in) on Science Museums and other permanent science popularisation sites spread over as many as 28 states/UTs of the country is developed and prepared by Alternative Futures, New Delhi. The website presents 154 science popularisation sites and includes 4000 exhibits. It virtually constitutes a detailed science encyclopedia for school and college students and others.

GENDER INITIATIVES

1. SCIENCE AND TECHNOLOGY FOR WOMEN

The Scheme "**Science and Technology for Women**", is one of the oldest gender enabling programs, being implemented by the Science for Equity, Empowerment and Development (SEED) Division, under the of DISHA scheme of the Department of Science and Technology . The prime objective of the scheme is to promote gender equality and empower women through application of science and technology through research, development, transfer of proven technologies and adaptation of technologies to enhance the Socio-economic development of the women, especially in rural areas.

Appropriate technology packages for women for improved livelihood prospects, drudgery reduction, health issues specific to women etc. have been/are being developed in conjunction with R&D Institutions, Universities, Colleges and S&T based field groups (NGOs). Numerous priority areas, with women as specific target groups, have been identified for proper scientific/technical interventions in the existing methodologies for empowerment and sustainable livelihoods.

Besides sponsoring time bound projects for technology development, up gradation, modulation and replication, the scheme also focuses on All India Coordinated Programmes (AICP) based on replicating successful technologies, Women Technology Parks (WTP), Scholarship Schemes (WOS – A,B & C) and National Awards for Women's Development through application of Science and Technology. Coordinated programmes on production technology of low cost sanitary napkins, alternate livelihood options through utilization of marine bio-resources, post harvest technologies through biomass dryers for income generation, prevention of anemia through green leafy vegetables are being implemented at present.

About 30 projects in diverse technology areas like agriculture (including fisheries, animal husbandry, horticulture technologies etc.), aromatic and medicinal plants, forestry, alternate livelihoods, Post harvest technologies, natural resource management, health and sanitation, occupational hazards, construction, energy, management of natural resources, rural development, rural industry, rural engineering, micro enterprise, sustainable agricultural practices etc. were supported during the year.

Health and Nutrition

Under the Coordinated programme on "**Prevention and management of anaemia through nutritional inputs and awareness among young rural women in India**" a community based anemia control program with Directly Observed Home Based Daily Iron Therapy for lowering prevalence of anemia and improving preventive health attitudes in rural population has been taken up in Nahan Tehsil, Sirmour district of Himachal Pradesh. In the present study, 40 hilly hamlets were coalesced into 32 distinct geographical clusters and then randomized to receive either controlled intervention (n=16 intervention clusters, subjects=524) or unsupervised self treatment with iron therapy (n=16 control clusters, subjects=535). The target group selected was already well proved for its vulnerability to the iron deficiency which has measurable negative health consequences and would be responsive to interventions. The blood samples of all the enrolled subjects (n=1059) were drawn and Hb measurements were done by standard direct cyanmethemoglobin method in the field laboratories. Also using a 'population based approach' in 148 randomly selected anemic subjects, hematological (peripheral blood film) and biochemical investigations further confirmed iron deficiency in all of them (based on low Hb with at least one abnormal biochemical indicator).

All anemia subjects were treated with a stat dose of Albendazole (400 mg) at the onset of trial. Duration of daily iron therapy was 90 days with dose of 100 mg elemental iron daily for mild to

moderate anemia and 100 mg twice daily for severe anemia. Age and reproductive status of enrolled anemic women was statistically similar in two trial arms at baseline. Severity of anemia and various biochemical indicators of iron deficiency also were statistically not different in two trial arms (Fig. 5.33) at the start of iron supplementation.

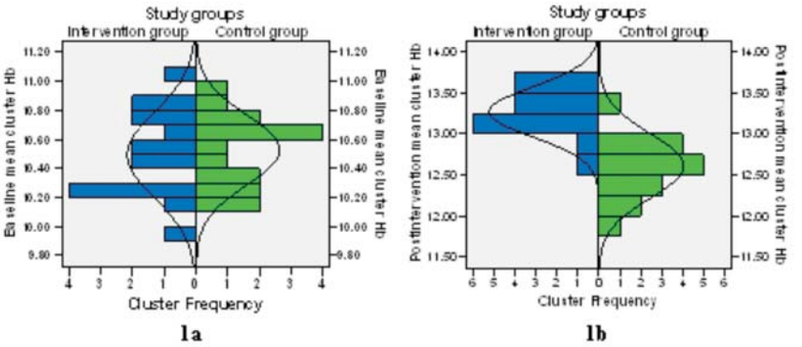


Fig. 5.33: Population Pyramid plots showing frequency distribution of mean Hb for each cluster in both trial arms; at baseline (1a) and after iron supplementation (1b)

Follow up results after completion of 90 days of iron supplementation showed statistically significant lowering of prevalence of anemia in intervention clusters (16.8%) as compared to control clusters (35.3%) on intention to treat analysis. Daily compliance was 93% vs. 60% in intervention and control clusters. Side effect frequency was halved in intervention clusters (3.5%) as compared to control clusters (6.7%). It may be concluded that directly observed home based iron therapy could be game changer for disorders like anemia in rural settings.

A project to "**Improve the quality (micronutrients) and quantity of the diet of women and children attending ICDS through promotion of homestead gardens, backyard poultry, ready-to- cook complimentary foods and IEC"** has bee taken up in the backward region of Telangana in the state of Andhra Pradesh. Homestead gardens and poultry have been shown to improve household food security by increasing access to these nutritious foods

This project aims in addressing malnutrition in preschool children, and women; high incidence of low birth weight; and dietary inadequacy of micronutrient –rich foods; through science and technology-based education, and interventions like homestead gardens, back-yard poultry, and food processing, that would increase access to nutritious foods. Organic methods of farming like vermi composting and use of botanical pesticides (neem seed decoction, chilli garlic decoction) is yet another technical intervention to stress the importance of environment friendly farming. A low cost night shelter for poultry, based on cement rings with holes and a lid has been developed. Nutrition and health education based teaching (Fig. 5.34) aids (pamphlets, power point shows in local language) are being developed.

Fig. 5.34

The project developed technology transfer and education which combines three interventions for improving household food security and infant feeding. Since 6-24 months old children who cannot articulate, are the most vulnerable, and mother is not aware of their dietary needs; the project targets this group besides the pregnant women specifically using the ICDS spring board. The project has demonstrated that there is a Change in knowledge attitude and practice as judged by initial and final KAP survey, acceptance of home gardening and backyard poultry and improvement in child feeding practices that reduced the incidence of low birth weight.

Agriculture and Allied Activities

Soil related constraints and acute water scarcity due to erratic and uneven rainfall are associated with lowering soil productivity and natural yield of plants in Red and Lateritic Zones of West Bengal. The project "**Socio-economic upliftment of SC/ST Women through back yard citrus cultivation by pitcher pot irrigation under runoff and domestic waste water**" was undertaken with a view to uplift of the rural backwards communities through backward citrus cultivation by pitcher pot irrigation, collected runoff harvesting and /or house hold waste water. The participatory program has been initiated with 80 (eighty) SC/ST women. Modified pitcher pots were made and buried up to neck near each sapling (Fig. 5.33). Waste water, from kitchen has been collected through earthen tiles channel into the earthen pots. During rainy season the runoff water was collected in the underground or buried synthetic tank of varying capacities.

Fig. 5.35

As a part of the study, Determination of optimum season wise requirement of water for citrus plants, evapotranspiration rates in different seasons, soil moisture in three different depths (0-20 cm, 20 – 40 cm and 40 – 60 cm) and physiochemical properties of soil were also determined for better crop yields.

The evapotranspiration demand of citrus plant varies from 1.0-2.0 mm during raining seasons, 3-4mm during winter and 4-6 mm during summer seasons. Each plant was tested with 1-3 numbers of pitcher pots for irrigation. It was found that one pitcher pot with interval of 15 days in winter seasons and 10 days in summer season for refilling with water were suitable for efficient irrigation to back yard citrus plant. The result of fortnightly soil moisture content over the year at two soil depths of 0-15 cm and 15-30 cm under pitcher pot irrigated soil and fallow soil indicated that higher amount of soil moisture content has been found in pitcher irrigated soil than fallow soils during October to May (winter and summer seasons).

To increase agricultural productivity and to meet the ever-increasing demand of food production using sustainable and eco-friendly technologies, bio fertilizers and bio control agents are highly essential. In addition, creating sustainable livelihoods among small, marginal farmers and agricultural labourers through the establishment of agri-based entrepreneurships is important. A project "**Formulation and Production of liquid-based biofungicides and biopesticides in the laboratory, demonstration of its efficacy in fields and promotion as an ecoenterprise to WSHGs at Kannivadi**" has been conceived to identify the low-cost and most suitable liquid substrate for the production of Pseudomonas fluorescens, Trichoderma viride, Metarhizium anisopliae and Beauveria bassiana.

Standardization of liquid based formulations of Bio agents: Preliminary experiments for the standardization of liquid formulations of Trichoderma viride were done. The mycelia mat was removed from the jaggery and yeast molasses medium and ground in a mixer and finally suspended. Three different cell protectants, Glycerol (4%), Polyvinyl pyrollidine (2%) and Aloe vera oil 10(%) was added to 100 ml of T. viride cell suspension. Each treatment was replicated thrice. The CFU was checked at every 30 days interval. Among the cell protectants, addition of 2% PVP in Jaggery medium recorded higher level of spore survival throughout the period of observation followed by Aloevera oil. Trichoderma culture was grown in four different edible juices alone (Fig. 5.36) and its combination.

Fig. 5.36

Growth of T. viride on different natural substrates: Eight mm mycelia mat was inoculated in 50 ml of the selected juices (250 ml) and incubated for 7 days at 30°C. The moisture content, biomass and spores were recorded. T .viride produced spores in the entire medium tested but highest production (2.34x109) was observed in palm juice alone followed by sugarcane juice. Least spore count was observed in banana stem juice. Among the various concentration of sugarcane juice 25-50% produced the highest spores. In the combined effect of the palm juice and sugar cane juice, T. viride produced highest spore in the combination of 25% sugarcane and 75% of palm juice

Fig. 5.37: Production by Fermentor

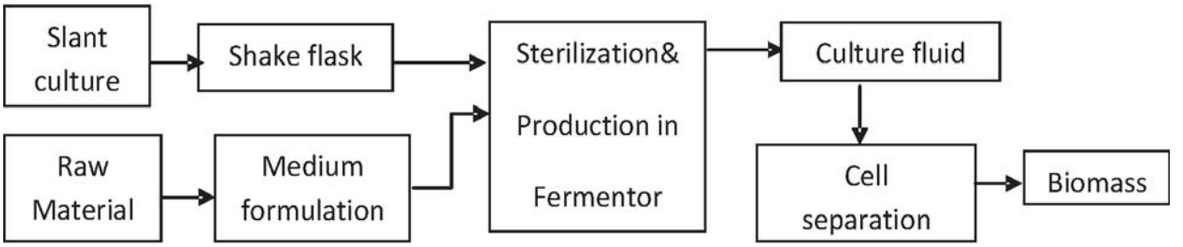


Fig. 5.38

Standardization of the mass production of P. fluorescens and M. anisopliae using fermentor: Fermentation process was standardized with King's B and molasses medium. Medium composition is as follows: Peptone 20g/l; MgSo4 1.5g/l; K2HPO4 1.5g/l (King's B) and molasses 30g/l was used for the large scale production.

Sporulation of the selected fungal bioagents was enhanced in liquid medium under the submerged condition and production of Pseudomonas and Metarhizium using fermentor (Figure 5.38) to mass produce the strains without cross contamination. Qualitative and quantitative analysis of the fermented broth was determined based on the CFU analysis. The steps involved in production method is depicted in flow-chart below

The Women Self Help Groups are already producing carrier based powder formulations. Demystification of liquid formulation technology will be done and will be transferred after imparting training to women in production process and to farmers on the use of liquid formulations of bio agents. The skill up gradation would help them in generating more income and become eco – entrepreneurs.

Aseptic culture of plant cells and organs has gained considerable prominence in research and commercial application. The technique has been tremendous potential for large scale propagation of plants including banana. An attempt has been made through the project "**Large scale production of Banana through shoot tip culture and marketing through Women Self Help Groups**" to address the bottlenecks encountered in expansion of conventional commercial banana cultivation due to shortage of quality planting materials (suckers).

Three local cultivars of Assam viz. Bharatmoni(AAA), Amritsagar (AAA) and Kanaibasi (AA) were propagated in vitro for rapid multiplication and large scale production of quality planting materials. In vitro established shoot tips were transferred in to the multiplication medium, until the production of sufficient numbers of plantlets. Then they were transferred to the rooting medium. Thereafter the plantlets were transplanted in the natural environment after a process of hardening. Shoot tips of 2-3 months old suckers of the mentioned varieties were cultured mainly on modified MS medium containing different concentrations and combinations of auxins and cytokinins (Fig. 5.39). Maximum frequency of explants were survived and resume growth on modified MS medium with 3 µg/ml BAP (6-Benzylaminopurine) and 1 µg/ml IAA (Indole-3-acetic acid) along with 0.3 % activated charcoal (Fig. 5.40).

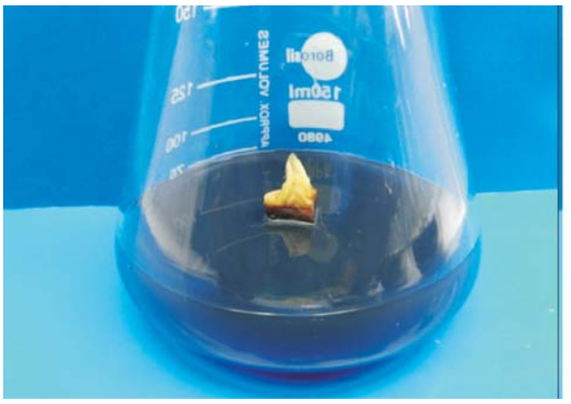


Fig. 5.39: 1/4th of a shoot tip of banana inoculated in MS media

Fig. 5.40: Established banana shoots in cultured media

After 4 weeks, the established explants were transferred to the same basal medium with BAP (5µg/ml) and IAA (0.1µg/ml) for shoot multiplication. About 15-20 plantlets were multiplied from a single shoot within 4 weeks of incubation (Fig. 5.41). Addition of activated charcoal (0.3 %) and casein hydrolysate (0.05%) in multiplication media resulted in better growth of shoots. Healthy Root system was observed within fifteen days by sub culturing shoots in to half strength modified MS medium with 2 µg/ml IBA (Indole-3-butyric acid). Regenerated plantlets were transferred to soil under natural condition after 1-2 months of hardening (Fig. 5.42).

Fig. 5.41: Multiplication of shoots along with roots in MS media

Fig. 5.42: In vitro grown plantlets of banana transferred to soil

The project thus engage more women in the process of hardening and nourishing of the tissue cultured banana plants by developing cost reduction techniques including commercialization and popularization of local banana cultivars paving way for income generation by the sale of extra produce and to develop a framework towards self sufficiency in the long run.

Post Harvest Technologies

Value addition to agricultural produce has assumed vital importance due to diversity in socio-economic conditions, industrial growth, urbanization and globalization. Significance of Post-harvest technology

lies in the fact that it has the capability to meet food requirement of growing population by eliminating losses making more nutritive food items from raw commodities by proper processing and fortification.

A project titled "**Popularization of Solar Tunnel Dryers for Copra Production in Pollachi Region (Tamil Nadu)**" has been taken up to construct community model solar tunnel dryer retrofitted with a stand by biomass burner and to develop drying protocols for coconut for copra production in Pollachi Taluk of Coimbatore District, producing more than 100 million nuts per year from 45,500 hectares. The solar tunnel driers have been established at six village's viz. Kanjampatti, Devanampalayam, Mandrampalayam, Kondegoundenpalayam, Sulakkal and Manakkadavu. The detailed drawing of the dryer showing the innovations is shown below

The community model solar tunnel dryer developed can dry 5000 nuts in one batch. Studies have been conducted with the solar tunnel dryer for evaluating its performance. The variations of temperature, relative humidity, air velocity and solar radiation have been measured (Fig. 5.44). The temperature inside the solar tunnel dryer was found to be 20 – 25ºC more than the ambient temperature and the peak temperature attained was 54º C. The drying air temperature during night hours, while operating with the biomass burner was observed to be 50 ºC .Coconut fronds having a calorific value of 3000 Kcal/hr was used as fuel @ used at 7 kg/hr. The relative humidity of the air inside the tunnel dryer was very less compared to atmospheric air, indicating great drying potential.

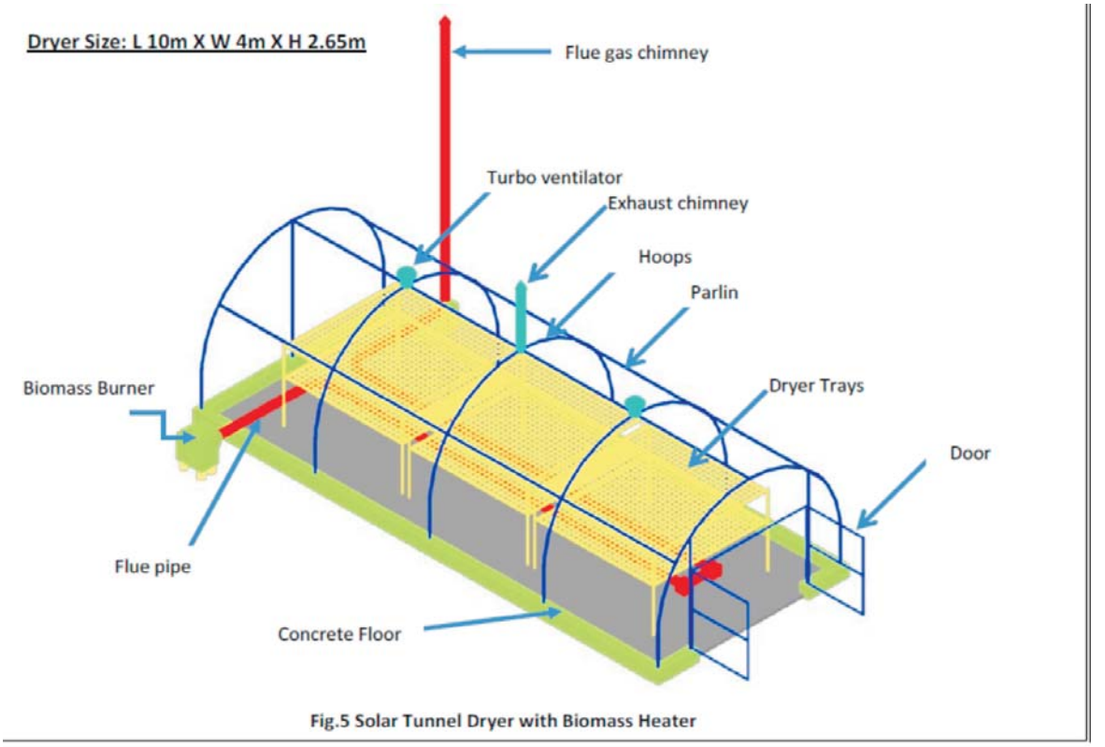


Fig. 5.43

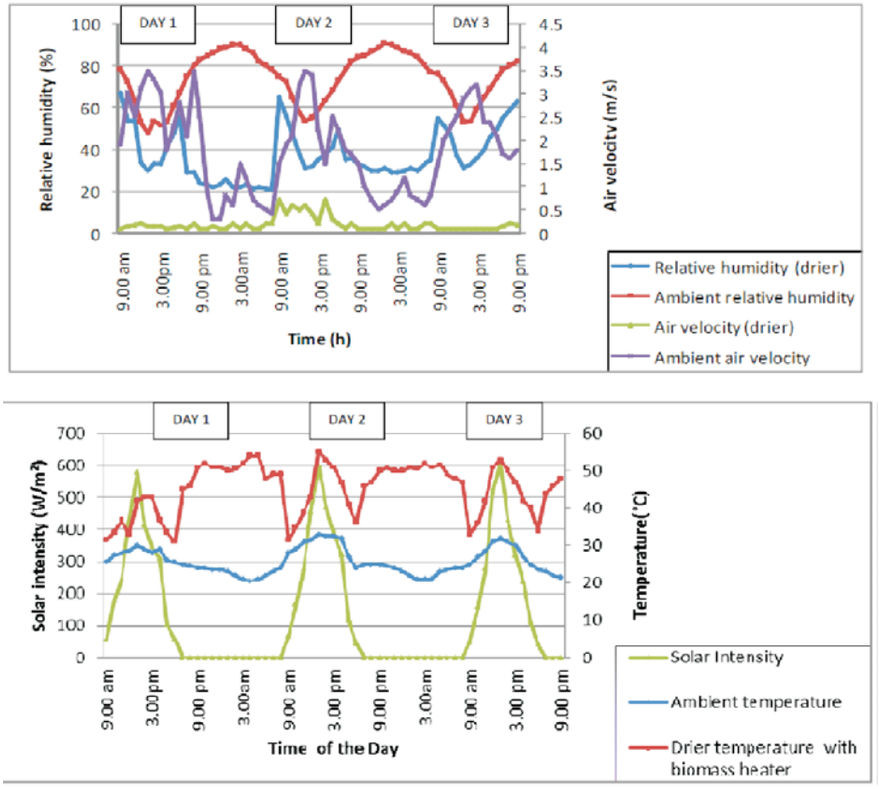


Fig. 5.44: Graph showing the variations of solar intensity and temperature vs time

The drying characteristics of coconut with the solar tunnel dryer and those with other traditional methods were compared for their moisture content. It was found that the copra could be dried from an initial moisture content of around 54% (w.b.) to a final moisture content of about 7% (w.b.) in 63 hours as compared to 250 hours required in open sun drying during the month of November 2012 (Fig. 5.45). The quality of copra obtained from solar tunnel dryer was superior compared to the open sun-dried copra (Fig.5.45).

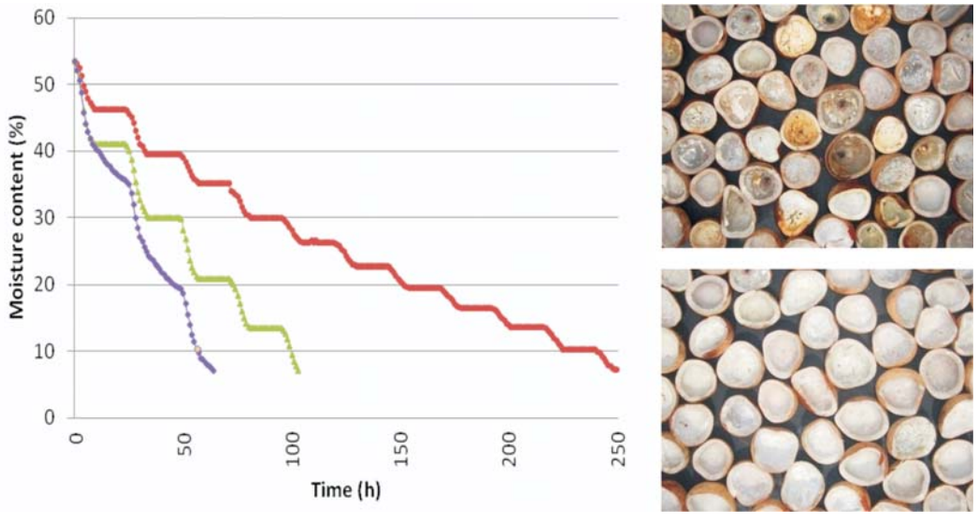


Fig. 5.45

The solar tunnel drier fitted with stand-by biomass heater is a new technology for drying of copra in place of the conventionally used open sun drying method. The project thus help women reduce their drudgery as the time taken for drying the copra is considerably reduced (3-4 days) compared to open sun drying (6-10 days). The technique is environment friendly technology as no fossil fuel is used for drying. Superior quality copra is produced as the drying takes place under closed, hygienic environment and hence premium quality oil is produced and drying is independent of weather conditions and unaffected by rain and wind.

2. WOMEN FELLOWSHIP SCHEMES

The Department of Science and Technology adopted the Women Component Plan in 2002 with a separate allocation for compliance and implementation of various government led programmes under gender budgeting. Since then the Department of Science and Technology has been spearheading several pioneering initiatives with an aim to bring gender parity in science. This has given the much needed boost to women oriented initiatives at national level. The following schemes are proactively managed by the Department of Science and Technology:

1. Re-entry Opportunity for Women in Research and Development Sector
2. Capacity Building and Training
3. Entrepreneurship Development
4. Nourishing pipe line of Women Scientists by Strengthening R&D Infrastructure
5. Refresher Training Courses for Scientists as Career Advancement Measure

The Department of Science and Technology has taken steps further to nurture the ecosystem by taking up new initiatives to addresses the challenge of mobility which hampers women in their continuation, retention and sustenance of the professional career and adding another scheme where the women will be able to take up science communication as a career and will contribute directly towards the awareness of scientific facts to the society. The Department is also planning to make these fellowships as an alternate career path for women by making the changes in the existing schemes collectively under the "DISHA" program me. This is a way forward and it illustrates the futuristic approach of the Department to identify and contribute the potentials and knowledge strength of these women scientists towards the developmental processes of the country.

2.1 WOMEN SCIENTIST SCHEME – A (WOS-A)

'Women Scientist Scheme- A (WOS-A)' has completed a decade of support and encouragement through S&T to women having break in their career and provide them opportunity to come back in main stream of science by pursuing research in Science & Engineering.

Since its inception, the Department has received **7149** proposals against which **1511** projects have been supported in different disciplines - Life Sciences: 820, Chemical Sciences: 223, Physical and Mathematical Sciences: 199, Engineering Sciences: 177, Earth and Atmospheric Sciences: 92.

This year the Department received a total of **1108** new proposals (Life Sciences – 681, Chemical Sciences – 151, Physical and Mathematical Sciences – 92, Earth and Atmospheric Sciences – 37,

and Engineering Sciences – 147) against which a total number of **214** projects have been sanctioned. The subject-wise distribution of sanctioned projects is: Life Sciences – 126; Chemical Sciences – 30, Physical and Mathematical Sciences – 15; Engineering Sciences – 32; and Earth and Atmospheric Sciences – 11. It indicates approx. 20% of approval rate.

Approximately 40% women scientists achieved Ph.D. degree with the help of WOS-A project which show the relevance and popularity of the scheme.

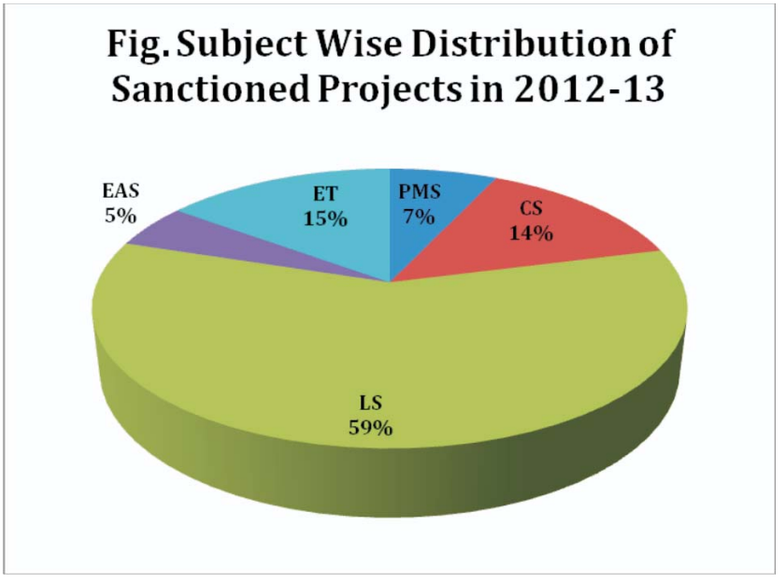


Fig. 5.46

During the year, the Department has also monitored **162** ongoing projects funded under this Scheme. Out of these, 23 were graded very good, 38 – good and 58 were graded as satisfactory.

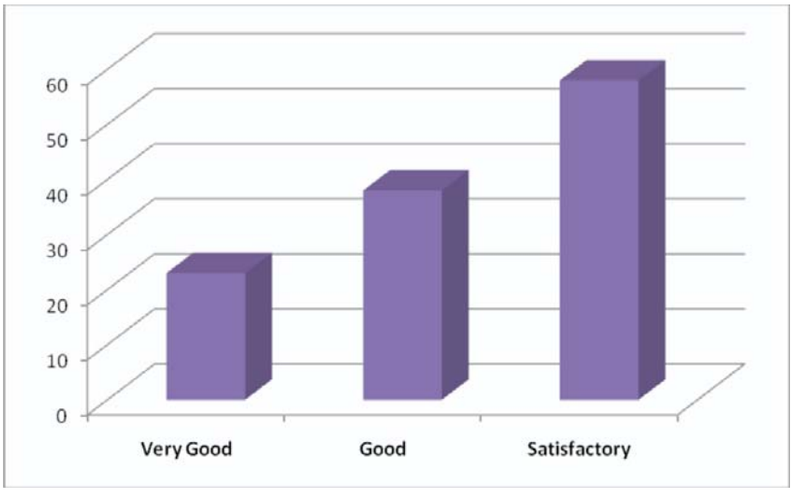


Fig. 5.47

Special efforts made during last year by conducting a series of Sensitization Workshops at different places to identify and encourage women scientists. These meetings have showed their impact this year and resulted into receipt of large number of proposals from various parts of the country which were not associated earlier.

New Initiatives under WOS-A:

The SECs of different subjects felt that there is a need to conduct some specified training programmes for PIs of Women Scientist Scheme as they have re-entered in the main stream of research after a break. Therefore, it is essential to train them with new tools and techniques of the concerned subject. In 2012, Division has started two such training programmes on "Statistical and Mathematical Modeling including Data Collection and Analysis" in Life Sciences and "Geomatics : Technology and Applications" in Earth & Atmospheric Sciences. This year Four (4) Training Programmes on 'Statistical and Mathematical Modeling' has been conducted and **68** Women Scientists have been benefited from this training programme. On the other hand, Training on Geomatics has completed one workshop with good response.

2.2 WOMEN SCIENTIST SCHEME – B (WOS-B)

Women Scientists Fellowship Scheme is an initiative of Department of Science and Technology to motivate the women scientists who have had break in their career and bring them back to scientific main stream. The awareness regarding the scheme is being done by organizing orientation workshops at four major cities of the country to guide the women applicants regarding the how to shape up their ideas in the form of a project. The workshop has been attended by approximately 300 likely women applicants.

The scheme has supported 18 new projects in the year 2011-12. In July, 2012 the progress of the 31 ongoing projects was reviewed by the expert committee.

A two tier selection process which includes call for applications, screening of the applications and presentation by the applicant has been adopted for smooth and transparent implementation. The next Selection Committee meetings for the are scheduled year 2012 was organized in four different places of the country. A total 212 application have been received against the advertisement for 2012. Out of 212, 127 have been screened in by the through screening committee.

The fellowship schemes being implemented by DST since 2002 are being recast and reenergized during 12th plan to provide a long term option as an alternate career path in basic & applied sciences and in societal applications of science. It is planned to identify and select the prospective women scientists and provide sufficient institutional training before implementation of the project. The training will focus on sharpening their skills in research areas and implementing the projects of societal importance.

Brief progress report on some projects

1. Assessment and modulation of knowledge attitude and practice of oral hygiene and prevalence of oral lesions in the rural population of Lucknow:

   The project aims at assessing the dental hygiene and modulation of knowledge attitude and practices of oral hygiene in 12 villages in Kakori Block, Lucknow district in general and creating awareness amongst the rural fold regarding hazards of tobacco leading to cancer, educate the community about the hazards involved in oral cancer genesis through tobacco, betel quid, pan-masala and on teaching people the importance of maintaining good oral hygiene and developing skills for self mouth examination technique.

   In order to reinforce dental hygiene issues, innovative message campaigns such jingles, nukkad nataks, interactive games and short documentary are being used. To ensure the community mobilization and active participation of villagers in the camps, Gram Pradhans of these village and primary school teachers have been roped in. More than 500 patients have been contacted in these villages and on preliminary analysis, it was found that most of the patients did have very poor oral hygiene with lack of awareness about the maintenance of oral hygiene and use of tobacco leading to oral cancer. As part of the project, rural dental camps are organised in these villages and the patients are followed by clinical treatment, if needed.

2 To investigate the antiepileptic role of melatonin and its comparison with herbal formulations and commonly used drugs for prevention of epilepsy in temporal lobe epileptic model system.

   PI has successfully undertaken in vivo studies of neuro-transmitter imbalance and neuro-degeneration in epileptic animal model system. Investigation of potential anti-epileptic role of melatonin, herbal formulations and commonly used drugs in epilepsy has also been successfully attempted. Interaction, history examination and assessment were carried out with different patient groups for their life style, behaviour etc.

   In the next phase the PI will undertake hippocampal plasticity and mechanism of excito-toxicity for the development of better treatment strategies to prevent severity in seizures and neuronal loss in temporal lobe epileptic model system.

3. Popularization of productive bivoltine silk-worm double hybrid "Krishnaraja" with the farmers of Karnataka

   Though, Karnataka is a traditional sericulture practicing and leading silk producing state in India, most of the silk is obtained from multivoltine x bioltine silk-worm hybrid cocoons, which are quantitatively and qualitatively inferior as compared to bivoltine silk of international standard. Bivoltine silkworm hybrids especially double hybrid has clear advantages over bivoltine silkworm hybrid as well as traditional multivoltine x bivoltine hybrid, with high egg recovery, crop stability in varied environmental conditions and inherent genetic potentiality to produce quality silk.

PI has successfully raised the parental breeds in the laboratory. The raised larvae were distributed to the farmers for further rearing. The PI performed the scientific crop monitoring by the use of lime powder, bleaching powder and maintaining hygienic conditions in the rearing house. The reared cocoons were purchased back from the farmers and were subjected to reeling analysis at Central Sericultural Research and Training Institute, Mysore.

2.3 WOMEN SCIENTIST SCHEME – C (WOS-C)

The selection process for the women scientists under the WOS-C Scheme for the seventh (7^{th}) batch has completed to provide the training to 120 women scientists in IPR & related areas about 500 applications were received screened through written examination held across the four centres at Delhi, Pune, Chennai and Kharagpur. The training of the 120 selected candidates has been started from January 2013.

CHAPTER 6

SCIENTIFIC SERVICES

The Department of Science and Technology is offering a diverse array of scientific services through Survey of India (SOI), National Atlas and Thematic Mapping Organization (NATMO), Technology Information Forecasting and Assessment Council (TIFAC), Vigyan Prasar (VP), National Science and Technology Management Information System (NSTMIS), National Accreditation Board for Laboratories (NABL) and Good Laboratory Practice (GLP).

Survey of India (SOI), one of the oldest scientific department of Government of India has evolved over the years and generates, manages and disseminate the Topographical Data for integrated development of our country.

NABL and NGCMA are the nexuses of the laboratories and test facilities in the country with the regulatory authorities. As India has gained full membership of Organization of Economic Cooperation and Development (OECD) for Mutual Acceptance of Data (MAD) in March 2011 the clinical data generated in the country is now accepted by all OECD member countries this has unlocked new avenues for Indian pharmaceutical companies and Contract Research Organizations (CRO). The country now has 24 GLP certified test facilities. This year six new test facilities have been granted GLP-compliance status.

TIFAC, an autonomous institution of DST supports Technology Refinement and Marketing, Collaborative R&D and also supports a Patent Facilitating Centre, thus creating awareness about intellectual property rights (IPR) in the country. This year Patent Facilitating Centre of TIFAC have filed 85 patent applications from the concepts showcased in the INSPIRE exhibition organized by DST in 2011.

Vigyan Prasar continues to play a key role in the popularization of science and technology throughout the country through print and digital media which includes monthly science magazines namely Dream 2047, VIPNET News and digital library Vigyan Prasar Information Systems.

SURVEY OF INDIA

Survey of India (SOI) is India's national survey and mapping organization under the Department of Science & Technology has been engaged in the systematic surveying and production of multi-scale topographical maps of the country – which has provided the base and foundation for various agencies to further undertake thematic mapping, spurring wide-range satellite/aerial image analysis and establishment of Geographical Information Systems (GIS) projects in the country. SOI is also responsible for Geodetic Control (Horizontal and Vertical) and Geodetic and Geophysical surveys; Topographical Control, Surveys and Mapping within India; Production of Topographical Maps and Aeronautical Charts; undertaking specialised surveys for Developmental Projects; demarcation of the external boundaries of India, ensuring their accurate depiction on maps published in the country and also advice on the demarcation of inter-state boundaries. Highlights of activities during 2012-13 are as under:

SCIENTIFIC RESEARCH

i) Antarctica Expedition

Initiative:

Survey of India started participation in Indian Antarctica Research Programme from **10th Expedition,** since then a network of Ground Control Points and Large scale mapping has been carried out during all Expedition.

Achievement: During 31st Expedition 7 days GPS observation were carried out at Maitri 'S' the main GPS Reference Station. Data was processed using precise ephemerides with IGS stations Data. Detail survey on 1:5,000 scale with 5 m contour interval was carried out for an area of 2.0 sq. km in the Schirmacher Oasis. This field collected data has been further processed at Geodetic & Research Branch, Survey of India Dehradun under different stages for publishing the final large scale Topo map of the Schirmacher Oasis Region (Near Indian Station, MAITRI, Antarctica) on 1:5,000 scale with 5 m Contour Interval.

AREA COVERED WITH MAPPING DURING 31ST EXPEDITION

Tasks Assigned for 32nd Expedition, Large scale mapping on scale 1:10,000 with contour interval 5 meters will be carried out in Schirmacher Oasis using combination of GPS Technique & Conventional Method (Plane Tabling). The prime objective of this team is to complete the mapping in un-surveyed areas and fill the gaps, so as to provide a complete 1:10,000 scale map sheet to NCAOR, Goa.

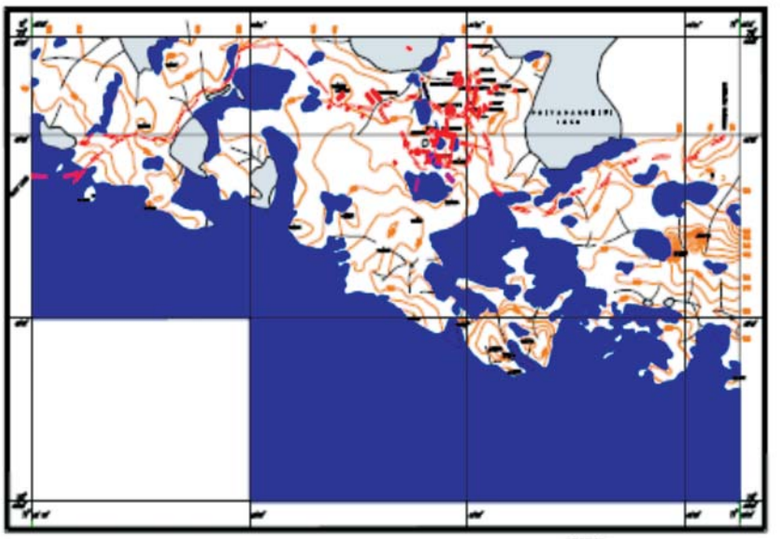


Fig. 6.1

HUMAN RESOURCES FOR INDIAN S&T ADVANCEMENT:

Indian Institute of Surveying & Mapping (IISM), the capacity building arm of Survey of India is now recognised as the prestigious training establishment in the field of Surveying and Cartography to impart training to the Officers and Staff of Survey of India and Government Organisation, Private Individuals and Scholars from other Afro-Asian counties.

The Institute also conduct M.Tech (Geomatics) and M.Sc. (Geospatial Science) Academic two years Post Graduate Programme in collaboration with Jawaharlal Nehru Technological University, Hyderabad.

IIS&M courses are held in high esteem by Scientific Department and organizations. Total 444 persons including 04 foreign trainees were trained during 2012-13.

TECHNOLOGY DEVELOPMENT PROGRAMMES

i) Open Series Map (OSM) and Defence series Maps (DSMs) on Scale 1:50,000: Initiative

As per the New National Map Policy, 2005 Survey of India has been mandated to prepare Open Series Maps (OSMs) on WGS-84 Datum and UTM Projection for public use without restriction and Defence Series Maps (DSMs) on Everest / WGS-84 datum and polyconic / UTM projection with heights, contours and full content on various scales, i.e. 1:250,000 / 1:50,000 / 1:25,000 / 1:10,000. The Defence Series Maps (DSMs) will mainly cater for defence and national security requirements. Defence series of maps (in analogue or digital forms) for the entire country will be classified and the guidelines regarding their use will be formulated by the Ministry of Defence.

Achievements:

Survey of India has completed updation of DTDB of 4756 Sheets on 1:50K by using field updated data and by using latest satellite Imagery where field work is not possible. Open Series Maps (OSMs) on WGS-84 Datum and UTM Projection for all the updated Sheets and DSMs of 4500 sheets have been completed.

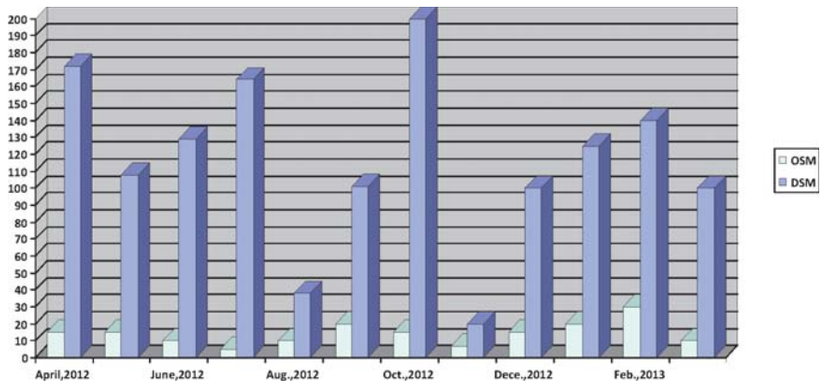


Fig. 6.2: Progress of OSM and DSM during 2012-13

ii) Digital Topographical Base on 1:25,000 Scale:

Initiative: Generation of Digital National Topographical Database on scale 1:25 K by digitizing existing maps available in the Hard copy form as Printed maps, PT section, Air survey section, Scribing section etc to fulfill the purpose of the National Map policy (NMP) which is to promote a flourishing geo- spatial industry with participation from academia, NGOs, Private sector etc. Therefore the NMP encourages the user not only to access the map freely but also add value to them.

Achievements:

Survey of India has completed Digital Topographical Data Base (DTDB) on 1:25,000 Scale of 7000 Sheets up to march 2012 and 1000 Sheets during 2012-13.

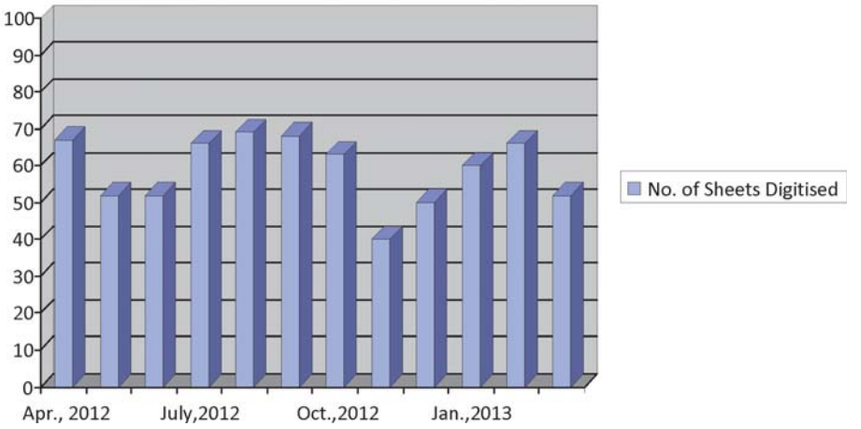


Fig. 6.3: Progress of Digitisation of 1:25K during 2012-13

(iii) Mapping on 1:10,000 scale for micro-level planning and National GIS

Initiative: Survey of India (SOI) was primarily addressing to base mapping needs of the country using topographic maps largely upto 1:50 K and partially in 1:25K. Therefore, SOI data represents primary National GIS-Asset upto 1:50 K and its readiness for National GIS Version 1.0 is of prime importance. Topographical Mapping on 1:10 K proposed to be carried out by SOI is next level of GIS-Asset for National GIS project and the basis for National GIS Version 2.0.

Survey of India had taken initiative for generation of maps on 1:10,000 scale for the entire country. To complete the above task during 12th Five year Plan survey of India has submitted a Plan Scheme "Generation of National Digital Topographical Database on 1:10,000 Scale**"** to DST.

Achievement : Survey of India has completed a pilot Project of 1:10k mapping and the map content, data model, alternate source material and their availability and technical methodology to be adopted have been finalized, based on that, Standard Operating Process (SOP) has been prepared. Data Model & Symbology Library for 1:10,000 Scale mapping has been prepared.

iv) National Standardised Control Framework

Initiative

Survey of India is in process to develop a GPS Control network throughout the country which will help state cadastral department and other agencies engaged in generating geo-spatial information to carry out their job in a national geodetic reference system.

Survey of India is the only government agency, which provides Geodetic Control throughout the country and also provides data to the various governments and other national orgnisations including defence forces, according to their requirements.

With the introduction of GPS technology, Survey of India Prepared a Plan Scheme "Creation of National Ground Control Points (GCP) Library for India" during 10th and 11th Five year plan to carry out the job in two phases. The first phase envisages the establishment of 300 well spread high precision Ground Control Points (GCPs) at a spacing of 250-300 km apart. In the second phase to densify it with 2200 precision Ground Control Points at a spacing of 30 to 40 km apart.

In the third phase, it will be further densified to 65,000 GCPs connecting all the tri-junction village boundary pillars available on the ground and Survey of India has submitted a Plan Scheme **"**Densification of Redefined Vertical Control**"** to DST in continuation of "Creation of National Ground Control Points (GCP) Library for India" and is proposed to be implemented during XII Plan period**.**

Achievement : Survey of India has completed the observation at 300 Ground Control Points (GCPs) covering the entire country in 1st phase during 10th Five year plan and densification of first order network at a spacing of 30 to 40 km. apart, 2200 precision Ground Control Points in 2nd Phase during 11th Five year plan.

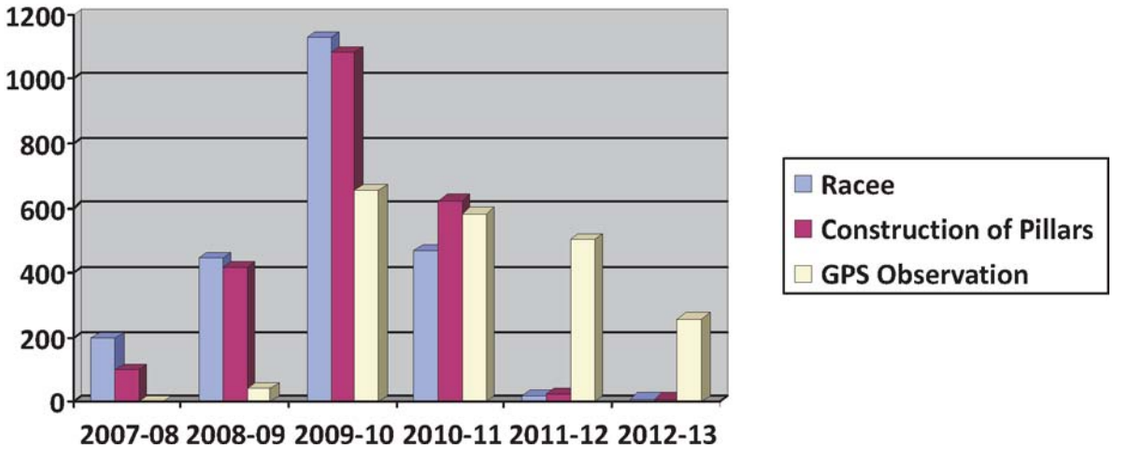


Fig. 6.4: Progress of GCP Library during 2007-08 to 2012-13

v) Tidal Data.

Initiative: Survey of India takes the initiative to modernize the Tide gauge stations during 10th and 11th Plan and Prepare a plan Scheme "Modernisation and expansion of Indian Tide Gauge network with special reference to storm Surge Modeling and Tsunami Warning System".

Achievements: Survey of India has equipped the 30 nos. out of 36 Tide gauge stations with digital tide gauges co-located with GPS receiver to monitor sea level variation and crustal movement. Real time data communication facilities have been established at National Tidal Data Centre, Dehra Dun as well as at several remote locations along Indian coastline and Islands.

vi) Scheme/Programme under Plan :

a) Scheme/Programme under XI Plan Period :

Initiative: Fast changing technologies coupled with the introduction of the state-of-the-art digital technologies in every aspect of surveying/mapping, Growth in demands of geospatial

data and products, Competitive market forces for rendering services, Achievement of Technical & Productive efficiency to meet the requirement, Survey of India has to take necessary step to upgrade the technologies in terms of latest instruments, HW/SW, Digitisation of available data and creation of accurate Ground control network.

Due to non-availability of adequate funds under the Non-Plan head, SOI is unable to meet the above mentioned requirement as the funds available under the Non-Plan head are in-sufficient. The funds available under the Non-Plan head are meant for the Departmental mandatory works. To meet the budget requirement Survey of India prepare the Schemes/ Programme under Plan head.

Achievements: Scheme/Programme under XI Plan Period are as under :

Sl. No.	Name of the Scheme/Programme	Actual Achievements Up to 11th Plan	Major Programmes proposed during the 12th Plan (2012-17) and 2012-13
1.	Updation of maps using satellite imagery and Aerial Photographs. Replacement of old & obsolete Photogrammetry Instruments.	-Digital post field updation of 4756 nos of 1:50k sheets. -Patterning of 4490 sheets on 1:50k scale. -Procurement of Satellite imagery/aerial photograph.	Digital updation of 150 Nos. of 1:50K sheets from field updated data and AMC of Photogrammetric Scanner is proposed for duration of 2012-17. -Digital updation of 150 Nos. of 1:50K sheets from field updated data and AMC of photogrammetric Scanner are proposed for duration of 2012-13.
2.	Conversion of One Field Party of each Topographical circle into Geodetic party and Upgradation of Technology in field wings	-80 nos of GPS receivers,30 nos Digital level,121 nos of Laptop,100 nos of Personal Computer -Procurement of 50 nos rugged Laptop. -Procurement of GPS receiver Type I,II,III-119,40,100 respectively,GPS receiver type III integrated with Tablet PC-100 nos, 155 nos of Total Stations.	Procurement of more nos of above equipments/instruments as most of equipments/instruments have outlived their designated life.
3.	Implementation of new National Map Policy	-Digital Topographical Data base of 7673 sheets.	- Digital topographical data base of 7000 sheets is to be generated during 2012-17. - Digital topographical data base of 1000 sheets is to be generated during 2012-13. -Procurement of Servers/ Computers/ UPS/ Com. Chairs & Tables etc. for various GDCs as per their requirement.
4.	Modernization of Tide Gauges	Modernization of 28 Tide Gauges observatories have been copmpleted. -Procurement of spares of Tide gauges/ Maintenance of Tidal observatories.	Modernization of 08 Tide Gauges stations are to be completed during 2012-2017. - Maintenance of Tidal observatories and Tide Gauges at 36 Ports are to be executed during 2012-2017. - Modernization of 02 Tide Gauges stations are to be completed during 2012-2013.

Sl. No.	Name of the Scheme/Programme	Actual Achievements Up to 11th Plan	Major Programmes proposed during the 12th Plan (2012-17) and 2012-13
			- Maintenance of Tidal observatories and Tide Gauges at 28 Ports are to be executed during 2012-2013.
5.	GCP Library	-45,000 lin km fore and back leveling. -Recce of 2271(Phase II) pillars have been completed. -Observation of 1991 GCP pillars have been completed.	GPS observation of remaining 376 stations is proposed for the duration of 2012-13.
6.	Patterning and Conversion of Digital data into Geo-database.	-Procurement of 25 nos of Mercator Prepress S/W. -Patterning of 2703 nos of 1:50k sheets and CYMK generation of 2694 sheet on 1:50k has been completed	-

b) New Scheme/Programme proposed for 12th Five Year Plan:

Beside above mentioned Plan schemes continuing for 12th five year plan, the following new proposals has been submitted to DST for approval and the same will be executed during 12th five year plans after getting approval from DST.

1. "Generation of National Digital Topographical Database on 1:10,000 Scale" .
2. SFC memo for procurement /upgradation of Instruments/software as per Equipment Policy.
3. SFC memo for execution of various Projects during XIth & XIIth Plan period.
4. SFC memo for maintenance of National Tidal Data Centre and Indian Tide Gauge Network with real time data transmission facilities.
5. SFC memo for densification of re-defined vertical control. This scheme is in continuation of existing scheme National Ground Control Points(GCP)Library of India.
6. Establishing National Museum on Surveying and Mapping.

INTERNATIONAL SCIENCE AND TECHNOLOGY COOPERATION

The effective use of geospatial information helps many of the current humanitarian, environmental, and developmental challenges facing by the world, such as climate change, natural disasters, population displacement, peace and security, food and economic crises which are a cross-border nature requiring both global and national policy. Survey of India represents at various International conferences/Seminars to promote the growth of geospatial data/information and introduce the latest technology of surveying for optimum results.

Shri Chandra Pal, Deputy Surveyor General participated in the "18th meeting of PCGIAP and 19th UNRCC-AP conference held at Bangkok, Thailand during 29.10.2012 to 01.11.2012.

NATIONAL SCIENCE AND TECHNOLOGY MANAGEMENT INFORMATION SYSTEMS (NSTMIS)

i) Mapping and Delineation of Hazard Line:

Initiative

The objective of the project is to delineate, map and benchmark the coastal hazard line all along the mainland coast of India under World Bank Assisted "Integrated Coastal Zone Management" (ICZM) project, where SOI has to generate a 0.5 meter elevation contour map on 1:10,000 scale as base map to delineate the Hazard Line for the entire mainland coast of India upto the maximum width of 7 km from shore line on the landward side.

Achievement

1 . Tidal data pertaining to 40 years (as available with G&RB) for extraction of maximum annual elevation and extra-pullation for 100 years pertaining to 20 ports (converted to MSL heights as compiled by G&RB) has been submitted to MoEF.

2. Primary and secondary control consisting of GPS and levelling work of the entire coastal area is completed.

3. Aerial photography of the project area almost completed, QA/QC is under Process.

ii) Coal Mine Project

Initiative: - Survey of India is going to generate up-to-date digital topographical maps of Major Indian Coal fields covering an area of 26,400 sq.km. in five years time for Central Mine Planning & Design Institute, a subsidiary of Cold India Limited using aerial photographs and adequate ground checks.

To generate the Topographical maps of the major coalfields on 1:5000 scale with 2 meter contour interval in Plains (in case of hilly terrain contour interval may be 3-5 meter as practical) in GIS digital format based on Digital Photogrammetric Techniques using high resolution aerial photographs and adequate ground verification.

Achievement:- Ground Control Points (Plan & height) and Aerial Photography for Phase-I comprising 10 Coal Fields. (Bisrampur, Lakhanpur, Korba,Chirimiri, Sonhat, Sohagpur, Talcher, Hasda, Arand,,I.B. Valley & Mand–Raigarh) has been completed and Aerial Triangulation and 2D feature extraction is under process.

iii) Urban Mapping for NUIS

Initiative

The Ministry of Urban Development (MoUD), hosts the National Natural Resources Management System (NNRMS) Standing Committee on Urban Management (SC-U) and the proposal to develop

National Urban Information System (NUIS) Scheme was mooted by the SC-U to be taken up in a National Mission Mode. The objective of the project is to develop attribute as well as spatial data base for various levels of urban planning and decision support to meet requirements of urban planning and management.

Survey of India has taken up the work to generate and supply the geo-spatial data required for the project. Databases has to be developed at two levels, on 1:10,000 scale GIS database for Development/ Master Plan for 152 selected towns using remote sensing satellite imagery and on 1:2,000 scale GIS database for detailed town planning schemes using high resolution remotely sensed data sources (Aerial Photographs) for the same 152 selected towns.

Achievement

1:10,000 Scale Survey:-

Geo-referenced Satellite Imagery of 152 towns has been sent to NRSC, Thematic mapping of 143 towns and final product of 142 towns has been sent to State Nodal Agency after security clearance from GSGS.

1:2,000 Scale Survey:-

Photography of **133** towns, Ground control of **139** towns, Aerial Triangulation of **133,** Feature Extraction of 126 towns and 04 towns by Ground survey has been completed . Final maps of 130 towns has been send to State Nodal Agency (SNA).

Fig. 6.6

Stake holders workshop was conducted at Dehra Dun, Nagpur, Kolkata, Bangalore & Jodhpur and participants from 20 states & 6 UTs attended. SOI, ISRO, NRSC, RSCs also involved in the workshop. One workshop will be conducted at Shillong for the benefit of 8 NE states. Secretary, MoUD has taken keen interest on this workshop. He interacted with the participants through Video conferencing at the end of workshop.

Fig. 6.6: Delegates of NUIS stakeholder's workshop at ISRO, Bangalore, on 12th December, 2012.

SCIENCE AND TECHNOLOGY PROGRAMMES FOR SOCIO – ECONOMIC DEVELOPMENT

(i) Topographical activities during 2012-13:

(a) Control Work:

- Traverse ... 160 linear km
- Levelling ... 11,449 linear km

(b) International boundary Surveys:

- Boundary demarcation(Indo-Pak) … 25 pillars found intact and 4 pillars reconstructed.
- Boundary demarcation(Indo-Bangladesh) .... 280 pillars position provided.
- Boundary demarcation(Indo-Bhutan) .... BP-2 to BP-9, BP-51/7 to BP-57
- Boundary demarcation(Indo-Myanmar) ..... 12 pillars

Rapid verification on 1:25K ,50 K .... 41 sheets

(c) **Printing:**

- Printing of various types of maps ... 787 Maps

ii) Digitisation and creation of Digital Cartographic databases

- Departmental maps on various scales ... 1000 Maps on 1:25,000 scale
- Extra Departmental maps on various scales ... 140 Project maps

iii) Geodetic and Geophysical surveys:

a) Geodetic surveys for monitoring of progress of various developmental projects are in progress.

b) During the year, Survey of India is committed to carry out the following tasks as departmental commitment:

- GPS observations - 1443stations
- Precision Levelling - 420 linear km
- EDM Traverse - 136 linear km
- Gravity observations - 275 stations
- Installation of Tide Gauges - 19 Stations

SCIENCE AND TECHNOLOGY BASED SERVICES

The following projects based on latest available technologies have been taken up by Survey of India.

a) Hydro- Electric Projects:-

Large scale survey with provision of precise height and planimetric controls for planning of various Hydro-Electric Projects at different places have been taken up.

(i) Loktak Downstream Project (Tripura, Manipur & Mizoram) :- Providing plan & Height control points. DT Leveling 108.82 lin.km. and GPS Control 7 stations completed.

(ii) Kadwan Project (Uttar Pradesh**):-** Supply of Control data (Co- ordinates, BMs &Hts,) & Field verification. Work is completed.

(iii) Khauli H E Project : Providing plan & Height control points & Mapping on 1:200 scale. Work of Field surveys i.e. GPS, levelling work, Plane Tabling and digitisation on 1:200 scale have been completed and data has been supplied to Indentor.

(iv) Thana – Plaun & Beri – Nichli H E Project : Providing control work by GPS and leveling for 27 points. Work completed and data has been supplied to Indentor.

c**) NRSC Project:-** Convertion of Digital Topographical Data base of 2890 maps on 1:50,000 scale from DGN to Arc Geo data base and supply to National Remote Sensing Centre.

d) **Andhra Pradesh Election Commission Project:** Collection of data of polling booths for various Assembly and Parliamentary Constituencies in Andra Pradesh. Work of data collection in 496 Sheets completed.

NATIONAL ATLAS & THEMATIC MAPPING ORGANISATION

National Atlas of India (NATMO), a subordinate office under Department of Science & Technology, is the sole authority of depicting National framework data in the form of thematic maps and atlases to cater the actual picture of the development and planning initiatives of the country among the users.

Keeping pace with the modern-state-of-the-art technologies and also to achieve the goal as per its mission to the path forward in the arena of geo-spatial technologies, NATMO has already progressed a lot in its axis in respect of both, the vertical growth of user base and demands. It is an opportunity as well as the responsibility to NATMO to reach the most of the citizens of our country to educate and make them aware of the different aspects of development and plan in the path forward of our country through pictorial projection of thematic mapping and also in electronic (digital) form in Hindi and in all regional languages.

The main objective of NATMO is to educate the people of India and to make them conscious about the changing scenario of the physiographic, hydrologic, climatic, administrative, political, social, agricultural, industrial, cultural and economic changes in the country. The Organization motivates the planners and decision makers to use maps as complimentary documents for developmental planning at national, state/ UT, district, sub-division and even at block level. NATMO is also the pioneer of Urban Mapping in India. Using high resolution satellite data rectified by GPS recordings, large scale city maps are being prepared with detailed information collected from field survey. To promote tourism, industry, tourist atlases, maps, trekking route maps, maps showing the detailed plan/information on national parks and wild life sanctuaries, etc. are being prepared and also being updated on regular basis.

TECHNOLOGY DEVELOPMENT PROGRAMMES

A) GOLDEN MAP SERVICE (GMS)

Initiative:

Accumulating the cartographic base, generated in pieces over the years under several projects, and with the help of the remote sensing data, now available under the Indian Remote Sensing Satellites (IRS) series, particularly the panchromatic data of IRS 1C, 1D and P5 along with the recently launched Cartosat-1 & 2, (the resolution has come to 5.8 and 2.5 metres and 1metre), NATMO has been taken up this project of Golden Map Service with the following objectives

Objective :

(a) Primary : To provide location maps of any site of the country in black and white on web either by place-names or by geographical co-ordinates.

(b) Secondary : To provide route maps between two points in the country.

(c) Tertiary : To provide a basis for a variety of social, economic, administrative operations related to elections, crime, rural marketing, relief and supply etc.

Fig. 6.6.1: Officers of NATMO reading GPS data during fieldwork at Kullu

Achievement:

NATMO has almost completed site selection for GCP for adjustment of GPS data covering whole of the country. State/Region wise field survey has been going on in the final stage. GMS Kolkata, GMS-Mahakashi, GMS- Mysore, GMS-Sylvassa, GMS-Gorakhpur, GMS-Bharatpur have been published in Themaitc Map (paper print) format during the year. Conversion and patterning of the digital format is going on. Year-wise progress of the project is shown below;

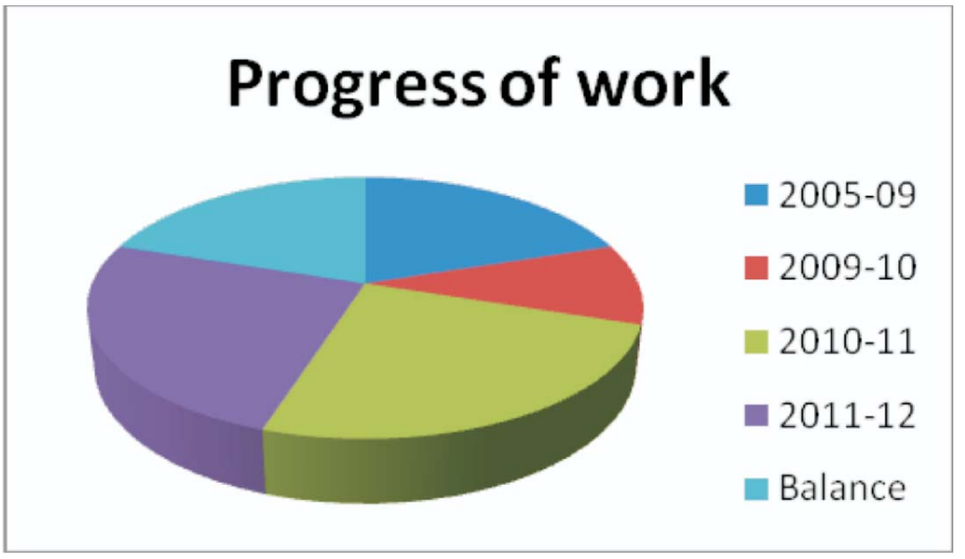


Fig. 6.7

B) DISTRICT PLANNING MAP SERIES (DPMS)

Initiative:

As per the decision of DCUSPC, NATMO has been assigned this project by DST in the year 1992 and work on the same had been initiated in the year 2002 after formulating the detailed specification. Though this project was shared between NATMO and Survey of India initially, but later on NATMO has been assigned this project solely.

Objective:

To provide a ready-reckoner to the planners, researchers, students in respect of complete geographical, geological, geomorphological, demographic, cultural information and features along with administrative boundary, blocks, speciality, etc. of a particular district both in paper format and in digitized format both in Hindi and English.

Achievement:

NATMO has almost completed the project and maps of 260 districts have been published for the users. Digital version of the maps are also going on in the final stage and will be published for the users very soon. However, revision and updation work on account of formation of new districts, are in progress along with the rest project. Year-wise achievement of the work, during the last four years, is shown below;

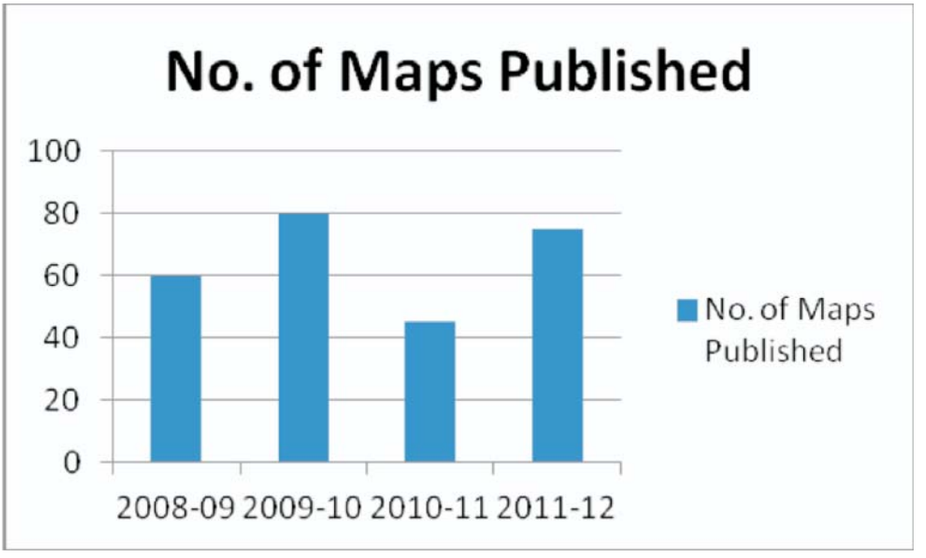


Fig. 6.8

C) NATIONAL ATLAS OF INDIA

Initiative:

In the year 1956, the then Prime Minister of India, Pundit Jawaharlal Nehru approved the formation of National Atlas & Thematic Mapping Organisation (then it was National Atlas Organisation) and

granted the **'National Atlas Project**' to NATMO. Hence, National Atlas is the flagship publication of NATMO. Accordingly '->0$ 0>7MM0@/2 8' first published in the year 1957 and its English Version, 'National Atlas of India' was published in the year 1986. Since, then this publication is being updated and revised keeping pace with the administrative changes in respect of states, districts etc.

Objective:

i) To have India's National Atlas like the other countries of the world.

ii) To depict the country in respect of its geology, geography, geomorphology, demography, culture, administration, etc. in thematic map form.

Achievement:

National Atlas of India, both in English and in Hindi version, has been appreciated by the users of every corner. It is for the vertical demand of the users, NATMO is still publishing the editions of the Atlas till today and regular updation and revision of the same is going on.

D) PUBLICATION OF ATLASES

Keeping in view the success, popularity and demand of the 'National Atlas of India', Govt. of India has assigned NATMO the task of preparing different atlases on various themes for various departments and purposes, they have also become the important publications of NATMO. Some of those Publications are :-

1. Tourist Atlas of India
2. Atlas of Forest Resources
3. Atlas of Agricultural Resources
4. National Atlas of India
5. Atlas of the City of Calcutta and its Environments
6. Water Resources Development Atlas
7. Land Resources Atlas
8. Students' Reference Atlas
9. Indian Ocean Atlas
10. National School Atlas
11. Atlas for the Visually Impaired (in English) Volume – I
12. Scoio-Economic Atlas
13. Uttaranchal Atlas
14. Science & Technology Atlas of India
15. Prathamik Manchitrabali (in Bengali) for Primary School Board, Govt. of West Bengal.
16. Atlas on Population Chages in India

17. Irrigation Atlas of India for CBIP;
18. Irrigation Atlas of India
19. Hydrogeological Atlases of different states for the Central Ground Water Board; (Bihar, West Bengal and Orissa)
20. Integrated Water Resources Development Atlas for the National Commission of Integrated Water Resources Development and Plan;
21. Atlases for Kheda and Anand Districts
22. Resource Profile for Bankura and Kolar Districts (jointly with the Centre for Studies in Resource Engineering, IIT, Mumbai) for the NRDMS Division, Department of Science & Technology;
23. Environmental Atlas of India and State-level maps on Environmentally Sensitive Zones and Siting of Industries for the Central Pollution Control Board;
24. Tribal Map of India (jointly with Anthropological Survey of india);
25. 341 Block Maps for the whole State of West Bengal for the Panchayat and Rural Development Department, Govt. of West Bengal and
26. Forest Atlas of India for the Department of Environment & Forest;
27. Digital Base for Koch Behar Division of West Bengal – A joint venture between the Chief Conservator of Forests, Government of West Bengal and NATMO
28. Block Maps of Shimla District on a scale of 1:50,000 – A project between the District Rural Development Agency, Shimla, Govt. of Himachal Pradesh and NATMO
29. National Cultural Heritage Atlas of India
30. Historical Atlas of India
31. District level communication and Infrastructure maps of Uttaranchal State.
32. A to Z of Kolkata City Map
33. Natural Resources Atlas of Sikkim **(As part of North-East Programme)**
34. Desertification Status Maps of Balia District (1:50,000 scale)
35. Disaster Management Maps of Maldah, East & West Medinipur Districts of West Bengal for the Relief Department, Govt. of West Bengal
36. State Atlas of Madhya Pradesh
37. State Atlas of Bihar
38. State Atlas of Uttar Pradesh
39. State Atlas of Uttaranchal (in Hindi)
40. National Atlas of India (Abridged Ed.) (in Hindi)
41. National Atlas of India (Abridged Ed.) (in Bengali)
42. State Atlas of Chhattisgarh

43. State Atlas of Jharkhand

44. Satellite Atlas of India

45. School Atlas for the Visually Impaired (in Eng. & Hindi) (in two volumes) – A TIFAC sponsored Programme of DST

46. Electronic Atlas of India (NRDMS Programme of DST)

Vision:

As there is a full-fledged Digital Mapping System along with necessary peripherals and application software in its own, NATMO is in the process of digitization of all the atlases and maps so that it can be reached electronically to the users in the near future. NATMO has also initiated to prepare Water Quality Atlas of West Bengal (to earmark the arsenic-affected region) and Geo-Touristic Atlas of India (to provide a handy guide to the tourists) during this year.

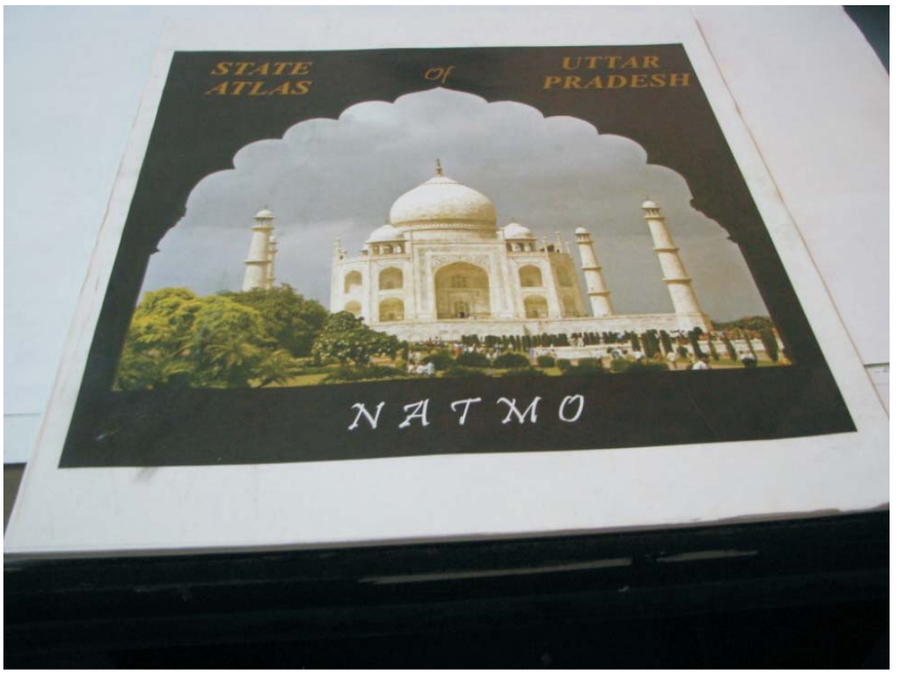


Fig. 6.9: Cover-page of Uttar Pradesh State Atlas

E) LARGE-SCALE MAPPIING:

In this cyber age, availability and accessibility of accurate and reliable information (both micro and macro level) with geospatial solutions, plays a pivotal role in planning and implementation of national policies in respect of natural resources and management. Effective use of geospatial information and technology has become the platform of solution for different environmental and developmental challenges. But due to absence of high-resolution map data in appropriate forms, many planning and development programme are lagging behind in our country. NATMO has taken initiative for preparation of large-scale maps (1:10,000 scale) on various themes to facilitate micro-level planning like irrigation, agriculture etc. using its own database and technical methodology.

TRAINING AND DEVELOPMENT FOR S&T ADVANCEMENT OF THE COUNTRY

NATMO also provides training on Thematic Cartography, Digital Cartography, Photogrammetry, Remote Sensing and GIS, Aerial Photography, Colour Cartography to the officers and staff of various govt. and private departments, university and college teachers, scholars and students of the country.

Training courses of NATMO are held in high esteem by scientific departments and organizations all over the country as well as abroad. During the year 2011-12, 450 persons were trained in NATMO.

There is also a Documentation Centre, Library and Remote-Sensing data archive in NATMO to provide a vast source of knowledge and information to the users.

Vision

NATMO is also in the process of commencing full-fledged degree and diploma courses on thematic cartography, digital cartography, photogrammetry. Collaboration from various universities in this regard has been requested through Department of Science & Technology, Govt. of India. We are hoping that the courses will be commenced very soon.

Fig. 6.10: Trainees are trained on Satellite Imagery Interpretation

SCIENTIFIC RESEARCH

NATMO employs a large number of highly qualified professional geographers, qualified statisticians, geologists and cartographers who are engaged in research for the technological advancement in the field of cartography in the geo-spatial arena. A good number of monographs, papers has been published in this regard which were highly held by the scholars and different departments of the country. NATMO has generated a revenue of Rs.1,235,530 by selling maps, atlases and monographs during the year 2011-2012.

INTERNATIONAL SCIENCE AND TECHNOLOGY COOPERATION

NATMO represents in various international seminars/conferences to promote the use of geospatial information and technology in cartography and has also earned honour and fame in that field.

Geo-informatics and Space Technology Development Agency (GISTDA), Government of Thailand has sought NATMO's cooperation in developing technologies for creation of data-base, preparation of large-scale maps, technological support for using THEOS data for mapping and also in providing training to GISTDA staff on mapping related issues. A MOU has been signed between DST and Govt. of Thailand in this regard and delegates from the Govt. of Thailand visited NATMO to finalise the areas of cooperation.

NATMO has also received the proposal from Sri Lankan Govt. for cooperation in respect of training and technology transfer on digital cartography and urban mapping.

INFRASTRUCTURE DEVELOPMENT

During the year, NATMO has almost completed the construction of **Rashtriya Atlas Bhavan** to get a wholly dedicated place for its research activities which will house a complete Digital Laboratory and Printing & Camera Unit.

TECHNOLOGY INFORMATION, FORECASTING AND ASSESSMENT COUNCIL (TIFAC), NEW DELHI

Technology Information, Forecasting and Assessment Council (TIFAC) was established in 1988. The Institute has a total of 81 regular employees, out of which 33 are scientists/faculty.

Areas of Focus is Technology Foresight, Special Reports and Technology Support Programmes

Foresight and Assessment Activities/Studies

Technology Vision 2035

The nation-wide Technology Vision 2035 exercise which was started in January, 2011, is progressing towards the Technology Vision 2035 document. Identified authors have started writing chapters for sectoral roadmaps in the 12 thematic areas. Questionnaires were evolved to make the exercise inclusive in widest sense.

Technology Refinement & Marketing Programme (TREMAP)

ARFD based electronic device for prevention of vehicle theft was commercialized. The device shuts off the vehicle ignition system when a vehicle is moved away from a RFD remote holding owner.

TIFAC-SIDBI Revolving Fund for Technology Innovation Programme (SRIJAN)

This joint programme of TIFAC and SIDBI sarted in 2010 to synergize strengths and capabilities of each organization initiated two new projects on 'Pouchable Grade Hi Sep PG battery separator with ribs and discrete dot configuration' at M/s Raman Fibre Science Pvt. Ltd., Bangalore and 'Manufacturing of

multi leaf collimator for SIDHARTH LINAC for cancer therapy' at M/s. Panacea Medical Technologies Pvt. Ltd. Bangalore. Two ongoing Projects include 'Development and Commercialization of Biodegradable Soluble cutting / Coolant Oil (BSCO)' at M/s. Ecocare Bio Lube India Pvt. Ltd., Coimbatore with technology know-how support from IIP, Dehradun and 'RFID tags for Solar PV module tracking' at M/s. IAITO InfoTech Pvt. Ltd., Kanpur.

Bioprocess & Bioproducts Programme

The ligno-cellulosic (LC) ethanol pilot plant with a capacity of processing 80 kgs of biomass per day has been completed under the Centre for Bio-fuels being set up by TIFAC at National Institute for Interdisciplinary Science & Technology (NIIST), Trivandrum. The pilot plant was inaugurated by in April, 2012.

Fig. 6.11

Technology Up gradation of select MSME clusters

As a capacity building intervention for the Baruipur Surgical Instruments cluster, training was carried out in advanced methods of operation for 100 entrepreneurs from different cluster industries. The final DPR for 'Setting up an aseptic pulp processing cum packaging plant at food park, Malda' was successfully completed for the Malda Food Processing Cluster. Of the **12** Technology Gap Analysis studies commissioned earlier for **11** clusters, five studies concerning the Sewing Machine and Bicycle Parts clusters of Ludhiana, Mini Gas Cylinder and Voltage Stabilizer clusters of Meerut, and the Electronics cluster of Mohali were finalized with recommendations towards implementation of further action for building capacity and upgrading the technology in these clusters.

Collaborative Automotive R & D (CAR)

A project entitled 'Process development in Semisolid Forming and Squeeze Casting of Aluminum Components for automobile components' was completed. Two consortium projects earlier nucleated by TIFAC were supported by DHI.

Special Linkages

Under the IIASA Programme with the International Institute for Applied Systems Analysis (IIASA), an independent non-governmental interdisciplinary research institution in Laxenburg, Austria, three Indian researchers participated in the Young Scientist Summer Program (YSSP) during July-September 2012 at IIASA. A study on Indian Perspectives on Global Energy Scenarios Till 2050 has been completed with Integrated Research and Action for Development (IRADe), New Delhi**.**

Major and Unique National Facilities created :

Important collaborations (national and global) established:

TIFAC has been involved with the national Mission on Electric Mobility (NMEM) initiative which was participation with six stakeholder ministries of the Govt. of India.

Important Output Indicators for 2011-12

S.No.	Parameters	Output
1	Papers in refereed journals	**C Collaborative Automotive R & D (CAR)** 1. Suresh Babu Muttana, Sajid Mubashir, 'Design Strategy for lightweight vehicles', Auto Tech Review (Springer India), Volume 1, Issue 4, April, 2012. 2. Arghya Sardar, Sajid Mubashir, 'Evolution of EV Battery: Role of materials availability', Volume 1, Issue 5, May, 2012. 3. Sajid Mubashir, Suresh Babu Muttana, 'Carbon Fibre Composites: Outlook for the Automotive Sector', Auto Tech Review (Springer India), Volume 1, Issue 6, June, 2012. 4. Sajid Mubashir, KSS Murthy, Suresh Babu Muttana, Pradip Dutta, 'High strength Aluminium Castings through Semisoild Forming, AutoTech Review(Springer India), Volume 1, Issue 7, July, 2012. 5. Sajid Mubashir, Arghya Sardar 'Natural gas-run vehicles : The near term potential in India, Volume1, Issue 9, September, 2012 6. Arghya Sardar, Sajid Mubashir, ' Prospects of Solar Energy for Electric Mobility', Volume 1, Issue 10, October, 2012**Bioprocess & Bioproducts Programme** 7. 'Industrial Enzymes: Technology Trends and Opportunities', in the Chemical Business in its special issue on industrial enzymes (vol. 26, no.7, July 2012).
2	Papers in Conferences	**Technology Vision 2035**Paper presented at '7th Indo-Japan Symposium held during September 20, 2012 organized by Biyani Group of Institutes at Jaipur.**TIFAC-SIDBI (SRIJAN)** Paper entitled 'Innovative, integrated, multi-disciplinary approach in commercialization of technologies developed through research and development – case study' at the Senior Management Programme on Managing Research Technological Organizations (RTOs) held at SIRIM Berhad, Malaysia during June 17-24, 2012
3	Number of Technologies/ Designs and other intellectual products commercialized	One under TREMAP programme and
4	Number of Technology leads awaiting transfer	Two process/product under CAR Programme.

PATENT FACILITATION PROGRAMME

Department of Science & Technology have established Patent Facilitation Cell (PFC) in TIFAC in the year 1995 and subsequently 24 Patent Information Centres (PICs) in various states under Patent Facilitation Cell (PFC) programme of the Department , for creating awareness and extend assistance on protecting Intellectual Property Rights (IPR) including patent, copyright, geographical indication etc. at state level. These PICs are also creating Intellectual Property Cells in Universities (IPCU) of their respective states. As of now 71 IPCU's have been created in different universities of the states. In addition they are also liable to provide assistance to the inventors from Govt. organizations , State Universities, Govt. industries for patent searches to find out the potential and assessment of the invention . Some of the PICs have also appointed the patent attorney to guide the inventor to file application with patent office in India and abroad.

During this financial year Department received 60 IP filing requests from the national and international from various universities, educational & research institutions and government agencies. These were evaluated and reviewed through PFC for patentability , out of which, twenty two (22) cases were recommended for patent filing and two for other IP registrations as per the details given below :

Table 6.1 List of Twenty two cases were recommended for patent filing and Two for other IP registrations facilitation provided

Sl. No.	Institute	Subject Area (No. of Applications)
1.	Malaviya National Institute of Technology (MNIT), Jaipur	Mechanical
2.	University of Petroleum and Energy Studies (UPES), Dehradun	Mechanical
3.	Forest Research Institute (FRI), Dehradun	Chemistry (Herbal Products)
4.	Kendriya Vidyalaya Sangathan	Electrical
5.	Dayalbagh Educational Institute (Deemed University), Agra	Mechanical/Operations
6.	Presidency College, Kolkata	Electronics
7.	Dronacharya College of Engineering, Gurgaon	Mechanical
8.	College of Engineering, Perumon	Electronics
9.	IIT Kharagpur	Chemistry (2 applications)
10.	Khalsa College, Patiala	Chemistry
11.	Choudhary Devi Lal University, Sirsa	Biotech (2 Applications)
12.	Tezpur University, Tezpur	Chemistry
13.	Indian Institute of Science (IISc), Bangalore	Physics
14.	Cashew Export Promotion Council of India, Kollam	Mechanical
15.	Guru Nanak Dev Engineering College, Ludhiana	Materials/Production (2 Applications)
16.	National Institute of Technology (NIT), Durgapur	Mechanical/Operations
17.	Panjab University	Chemistry
18.	Delhi University	Chemistry
19.	SGPIMS, Lucknow	Pharma
20.	Jawaharlal Nehru University, New Delhi	**Plant Variety registration**
21.	IIT Guwahati	**Design Registration**

The following graphs show the institute wise and subject wise distribution of the patent filing and other IP requests received:

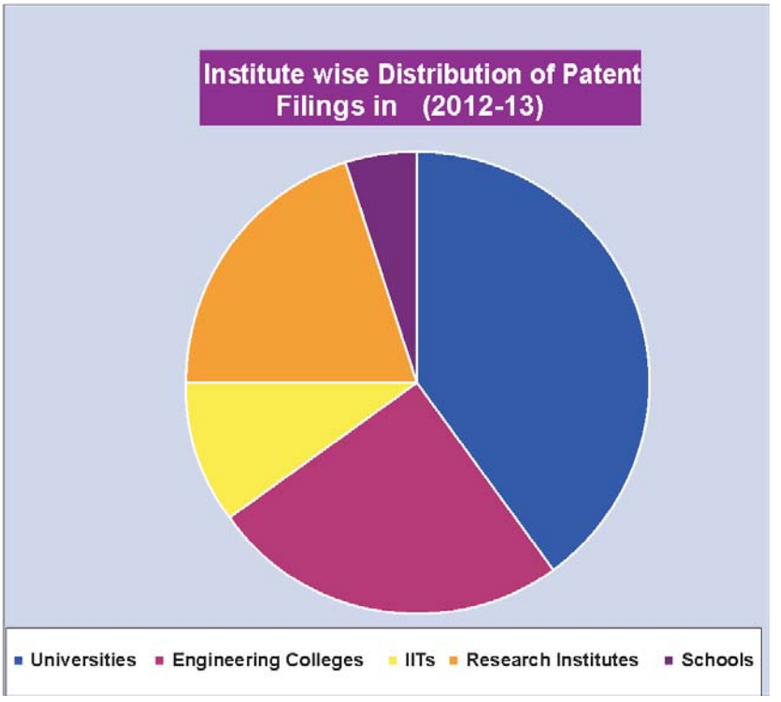


Fig. 6.12

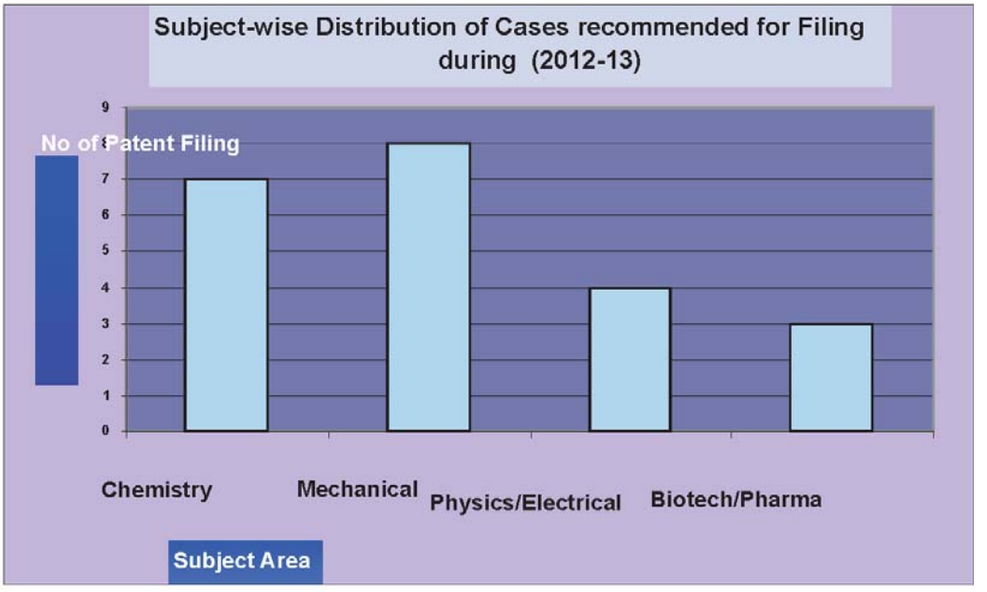


Fig. 6.13

Table 6.2 The list given below shows the Five (5) Indian patents and one US patent was granted to inventions for which facilitation provided :

Sl No	Title	Applicant:	Patent No/Country
1	An improved Tandoor	Indian Institute of Technology, Kanpur	251576 (Indian)
2	A manual fabric drying device	M L V Textile Institute	251753(Indian)
3	A methods of preparing novel organic thermal stabilizer	Chaudhary Charan Sing University, Meerut	251416 (Indian)
4	A method for the preparation of plasticizer	Chaudhary Charan Sing University, Meerut	251753(Indian)
5	Remote functionalised diaminodicyanoquinodimethanes having enhanced fluorescence in the solid state	Department of Science and technology and University of Hyderabad	252287/ (Indian)
6	Synergistic herbal ophthalmic formulation for lowering intraocular pressure in case of glaucoma	DIPSAR	8178134(US)

Supporting IP Facilitation of INSPIRE Projects

Around 500 cases for possible patentability of project exhibits under INSPIRE Programme of DST, where students from different schools from almost all states participated during INSPIRE Exhibition organized by DST in August 2011 at New Delhi. Out of these, 86 concepts/ideas were evaluated further for scope of protecting of IP. This protection is possible due to INSPIRE being a govt. approved exhibition and provision of grace period of one year in such cases is allowed. Now 85 patent applications (provisional specifications) have been filed on August 13, 2012.

Constitution of Expert Groups for guidance:

DST has constituted a Think Tank Committee(TTC) for Patent Facilitation Cell Programme to actively play constructive & progressive roles to foster activities and programmes of Patent Facilitation. The TTC is providing guidance for the implementation of the programme.

In addition to the above, Department has also constituted a Expert Group on Patent Information Centres (EGPIC) involving eminent scientists from different fields of science and technology to guide the Department for the implementation of the programme, assessment of the activities of Patent Information Centres created in the country. First meeting of the group was organized by Patent Information Centre situated at Karnataka State Council of Science & Technology, Indian Institute of Science Campus, Bangalore during 7-8th June, 2012. Around 20 coordinator Patent Information Centres participated in the meeting. A review on the activities of the patent information centre during 11th Plan was carried out which is depicted below in the table :

Table: 6.3 Contribution of PIC's towards implementation of patent regime in the country

PIC's	No of IPCU established	Workshop	IPR camps	Patent		GI	
				Filed	Granted	Filed	Registered
Punjab	7	10	16	14	5	1	1
West Bengal	5	24	—	20	7	6	4
Uttarakhand	8	6	—	2	——	—	—
Assam	3	21	60	26	2	1	1
UP	6	62	24	21	1	2	1
Kerala	5	103	50	12	—	5	5
Karnataka	3	27		47	—	—	—
Madhya Pradesh	3	27	—	47	—	—	—
Himachal Pradesh	4	11	4	6	—	2	2
Gujarat	5	11	—	—	—	—	—
Chattisgarh	3	—	2	2	—	—	—
Andhara Pradesh	5	1	—	—	—	—	—
Tamilnadu	4	17	7	6	—	1	—
Haryana	4	8					
Sikkim	5	2	5	—	—	4	—
Manipur	1	8	—	2	—	1	—
Mizoram	—	1	—	—	—	—	—

Important Training programme organized :

- National workshop on Introduction to Intellectual Property Rights was organized at Mewar University Camp Office , Sector -4C , Vasundhara , Ghaziabad on 2nd April'2012 – around 150 participants include PG science students , Engineers , Academician and Scientists from various nearby institutions participated

- One patent awareness workshop organized at NIT Agartala on August 10, 2012 in association with MHRD IPR Chair, Tezpur University and Patent Information Centre, Tripura.

- Two "Refresher course on update of IPR" were organized in association with Gujarat Council on Science Technology, Dept. of Science & Technology, Govt. of Gujarat, Block: B ,7th Floor , MS building , Nr. Pathikashram , Sector -11 , Gandhinagar -382 011 :

  1. Institute of Seismological Research, Gandhinagar during 23rd to 25th May 2012

  2. Gujarat Science City, Ahmedabad from 16th to 18th November 2012

The course was designed organized specifically for the SC/ST faculties of science, engineering and pharmacy subjects with an aim to inspire and inform about recent developments in Intellectual Property Right (IPR) activities. About 50 delegates from different scientific organisations of Gujarat are being invited to participate in the three-days programme.

VIGYAN PRASAR

Vigyan Prasar was established in 1989. The Institute has a total of 31 regular employees, out of which 15 are scientists/faculty.

Research Profile of the Organization

Areas of Research Focus

Vigyan Prasar is a National Institute for capacity building in science communication, development of science communication materials, and a national node for knowledge resource networks for dissemination and popularization of science. This focus is aligned with India's developmental initiatives and pathways wherein appropriate information delivered in a timely manner will enable well informed action. This is also in response to emerging calls for concerted action in the regional and global contexts.

Major Research Accomplishments (from calendar year 2009 to 2012) :

VP has been engaged in extensive in-house research in conceptualizing different programmes on and through science communication. All programmes are evolved by understanding the needs and requirements of the users at different levels and are designed and developed with an objective to enhance scientific awareness and embellish scientific temper among the targeted stakeholders. VP has developed itself as a resource - cum - facility centre in science communication.

i) **Publication Programme**

The institute has commissioned interesting books by renowned authors and has a programme for reprinting popular science classics. VP has brought out over 200 titles in English, Hindi and regional languages. Vigyan Prasar has also brought out a number of science kits, interactive CD/DVDs and posters on different aspects of S&T.

ii) **Audio – Visual**

Production of Radio and Television Science Serials and broadcast through National Channels. Every week about 5 programmes are being telecast in the national channel and about 180 programmes are produced every year. Further every week 19 programes are being broadcast from 117 radio station all over the country.

iii) Dream 2047

It is a bilingual monthly newsletter – cum – popular science publication. Its print run is fifty thousand. It is sent to schools, colleges, research institutes and individuals interested in science and technology communication.

iv) **Science Clubs**

Establishment of Network of Science Clubs throughout the country. The present strength of VIPNET Club is around 13,000.

v) Vigyan Prasar Information Systems

It is a repository of resource materials on science and technology. Most of the resource materials are available online in VP website www.vigyanprasar.gov.in

A Digital Library has been established. Presently there are over 10000 registered users. Over 2 lakhs visitors have benefited form the digital library. It has been listed in "Scholarly Literature and Digital Library Initiatives" – brought out by UNESCO.

vi) Outreach programmes

Outreach and Training Programmes through EduSat Network, VIPNET Clubs, State S&T Council and other organizations.

Celebrating International Years as the International Year of Planet Earth – 2008, International Year of Astronomy – 2009 and National campaigns on Total Solar Eclipse – 2009 and Annular Solar Eclipse – 2010, International Year of Biodiversity – 2010, International Year of Chemistry – 2011, National Mathematical Year 2012 through outreach, training & dissemination using resource materials developed by Vigyan Prasar.

Important Highlights of 5 Major Research Programmes (from calendar year 2008 to 2012):

Mathematics popularization & sensitization workshop for journalists

VP has organized more than 15 programmes around the country to popularize mathematics and sensitize journalists and media people with the aim to smother math-phobia.

Ramanujam- Chandrasekar – Legacy of Indian Science

More than 30 workshops and programmes have been held around the country to sensitize college level students and highlight the legacy of Indian science as part of centenary celebrations of Srinivasa Ramanujam and Subramanian Chandrasekar.

National Mathematical Year 2012

To create interest in mathematics among students VP plans to develop such programmes as Television serials, Radio serials, handbook, special outreach through EduSAT, Publications (Books, CDs, Posters), Workshops, etc. A desk calendar on the theme 'Mathematics' has been published and distributed by Vigyan Prasar.

International Year of Chemistry – 2011

Vigyan Prasar undertook a series of activities during IYC- 2011. A series of sensitization workshops were conducted at different parts of the country for the school chemistry teachers.

Vigyan Prasar developed an activity kit, an interactive CD on innovative activities on chemistry, activity Book on Chemistry behind Miracles and published a number of articles, books and a desk calendar – 2011 on the theme 'molecules'.

A 26 episode radio serial on chemistry, produced by VP was broadcast from 117 radio stations of All India Radio in 19 major Indian Languages. A 13 part video serial on the theme of Chemistry is being produced.

Dream 2047

Vigyan Prasar is bringing out the monthly bi-lingual science magazine Dream 2047 for the last thirteen years. Present circulation of the magazine is fifty thousand. It is sent to schools, colleges, research institutes and individuals interested in science and technology communication. VP is encouraging e-version of Dream 2047 to subscribers. At present 5000 readers have subscribed for the e-version of the magazine.

LSTV and VP - Films and news in Hindi and English

VP has undertaken a special programme in collaboration with LSTV to telecast weekly news and current affairs bulletin in Hindi and English showcasing developments in Indian S&T covering events, developments, research and activities in India. An innovative 'India Science this Week' a weekly news round-up with in-depths representation of Indian Science is on LSTV.

Gender and Technology Communication Initiative

Capacity building related activities for gender & equity programmes are designed to improve

a. Understanding of health field workers on problems of nutrition of rural women;

b. Skills of extension workers on problems of occupational health of women in unorganized sectors &

c. Awareness on opportunities for social workers for urban poor women.

Major and Unique National Facilities created (from calendar year 2007 to 2011):

- A country – wide network of Science Clubs has been established for popularizing science and creating scientific temper among the masses.
- Countrywide network using satellite communication – EduSat Network.
- Dream 2047 reaches 50000 subscribers every month.
- MoU entered for Science broadcast through DD, AIR, LSTV
- Vigyan Prasar Digital Library, Discussion Forum.
- Online availability of science and technology communication content (publications, audio, video programmes) developed by VP.
- Workshops and training programmes are organized throughout the country to train and motivate science teachers in doing innovative activities during classroom teaching to make science interesting to the students.
- Network of Resource Persons on astronomy, science activities, andscience Communication etc.

Important collaborations (national and global) established (from calendar year 2007 to 2011):

VP collaborated with many National institutions and agencies for training & dissemination & development of software. These institutions include State S&T Councils, NCSTC(DST), NCERT, Kendriya Vidyalaya, National Institute of Open Schooling, National Council for Science Museum, autonomous bodies under DST, Universities and several NGOs.

Important Output Indicators

S.No.	Output parameters	Calendar Year 2008	Calendar Year 2009	Calendar Year 2010	Calendar Year 2011	Calendar Year 2012	Total
1.	Papers in refereed journals	02	02	01	02	14	21
2.	Books	02	02	02	02	01	09
3.	Chapters in Books	01	02	03	08	06	20
4.	Papers in Conferences	11	14	20	25	32	102
	Indian Patents granted	01	NIL	NIL	NIL	NIL	01
5.	Technical Manpower trained*	600	700	850	1000	1800	4950
6.	B.Tech/ UG projects guided	05	04	03	02	01	15
7.	M.Tech/M.Sc./M.Phil projects guided	NIL	03	NIL	02	0	05
8.	Other products (during calendar year 2008 to 2012 to be specified):						
	Article published in magazines and journals	30	32	35	40	84	221
	Books published including reprints	37	27	19	42	13	138
	Science films made	52	52	78	180	273	635
	Radio serials on science and technology	988	988	988	988	754	4706

* Manpower trained through workshops conducted by Vigyan Prasar

Eminence Indicators: Science Popularisation Programmes:

1. Popular Science Magazines: 02 Science Magazines per month are published.
2. Comprehensive website on science popularisation
3. Maintaining digital library
4. Producing Radio and Television programmes on S & T
5. Science Clubs - Maintaining a network of 13000 science clubs all over the country
6. Science kits and toys
7. Astronomy and HAM radio popularization

8. Organising seminars and workshops
9. Training programmes for science communicators
10. Science Film Festivals
11. EduSat Network &
12. Technical inputs on science and science communication needs in national initiatives including those supported by the Planning Commission, Government of India.

Visual Outputs (if any, from calendar year 2008 to 2012)

273 videos produced / television programmes for popularizing science and educational videos produced.

Special Items of Expenditure

Financial Year	Expenditure on regular SC employees and other SC-specific projects/ programmes	Expenditure on regular ST employees and other ST-specific projects/ Programmes (Rs. lakh)	Expenditure on regular women employees and other women-specific projects/Programmes (Rs. lakh)
FY 2012-13	NIL	41.25	31.34

10th and 11th Plan Comparison

S.No.	Output parameters	10th Plan (from 01.04.2002 to 31.03.2007)	11th Plan (from 01.04.2007 to 31.12.2012)
1.	Papers in refereed journals	07	09
2.	Books	06	11
3.	Chapters in Books	10	15
4.	Papers in Conferences	70	82
5.	Indian Patents filed	01	NIL
1.	Indian Patents granted	NIL	01
6.	Technical Manpower trained*	2500	3650
7.	B.Tech/ UG projects guided	12	19
8.	M.Tech/M.Sc./M.Phil projects guided	03	05
9.	Other products (to be specified):	550	673

* Manpower trained through workshops conducted by Vigyan Prasar.

NATIONAL SCIENCE AND TECHNOLOGY MANAGEMENT INFORMATION SYSTEM (NSTMIS)

The National Science & Technology Management Information System (NSTMIS) division continued its efforts of generating and making available information on resources both manpower as well as financial devoted to scientific and technological (S&T) activi-ties by conducting national surveys both through in-house as well as sponsored studies.

(i) S&T Resources Studies

The national survey for the year 2009-10 for collection of data on resources devoted to research and development activities has been completed. Filled-in questionnaires have been scrutinized for their completeness and consistency. Data has been entered, validated and standardised. Generation of statistical tables based on the survey data is under progress. The report based on this survey titled **'Research and Development Statistics 2009-10'** seventeenth in the series, is being prepared. In this report, the scope and the coverage of the R&D activities has been enlarged substantially by including the expenditure of major multinational companies performing R&D activities in addition to (i) Higher Education Sector (ii) Small Scale Industry (SSI) Sector; (iii) Industries other than those recognized by the Department of Scientific and Industrial Research (DSIR), (iv) Central Sector and (v) State sector.

The national level report based on the above mentioned survey ***'Research and Development Statistics'*** will pro-vide information and analysis in forms and variety like financial and human resources deployed by research institutions/laborato-ries of major scientific agencies, central ministries/depart-ments, State Government institutions/ departments, research stations and in-house R&D units of public and private sector industries. It includes S&T indicators and their trends such as R&D expendi-ture per capita and as percentage of gross national product, Plan/Non-Plan allocation for S&T, researchers per million population, stock of S&T person-nel, stock of scientists, engineers, technicians for selected countries, enrolment, out-turn, patents, etc. for evidence based S&T policy planning.

The new initiative, ***'Science,Technology, Innovation and Creation of Knowledge (STICK)'*** Programme is aimed at the development of Science, Technology and Innovation (STI) Indicators in Indian context. The framework to measure the innovation and knowledge creation capabilities of industrial enterprises at the national level was evolved by the NSTMIS with various stakeholders including international domain experts.

The National Innovation Survey targeting a population of more than 2 lakh enterprises in various industrial sectors spread across all the States/ Union territories (except Arunachal Pradesh, Manipur, Mizoram and Lakshadweep) in the country through a statistical valid sampling design has been completed. Several issues of the bulletin entitled '**Understanding Innovation - The Indian Context'** based on the analysis of sample of innovative firms in various states were brought out by the Division (for details see www.nationalinnovationsurvey.in) and the work is in progress for the preparation of **National Innovation Indicators** Report. Some reflections of the status of the innovation activities for industrial firms spread across the country as a part of the National Innovation Survey are as below:

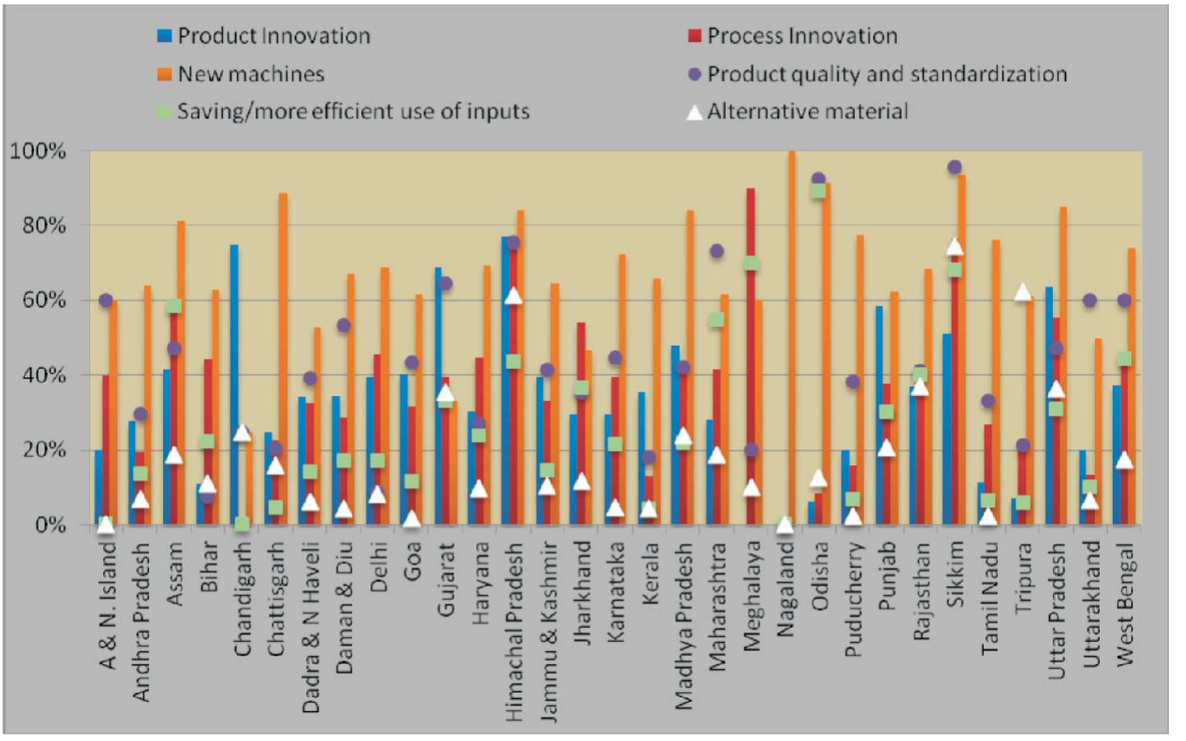


Fig. 6.14: State-wise distribution of Innovative firms for Type of Innovation

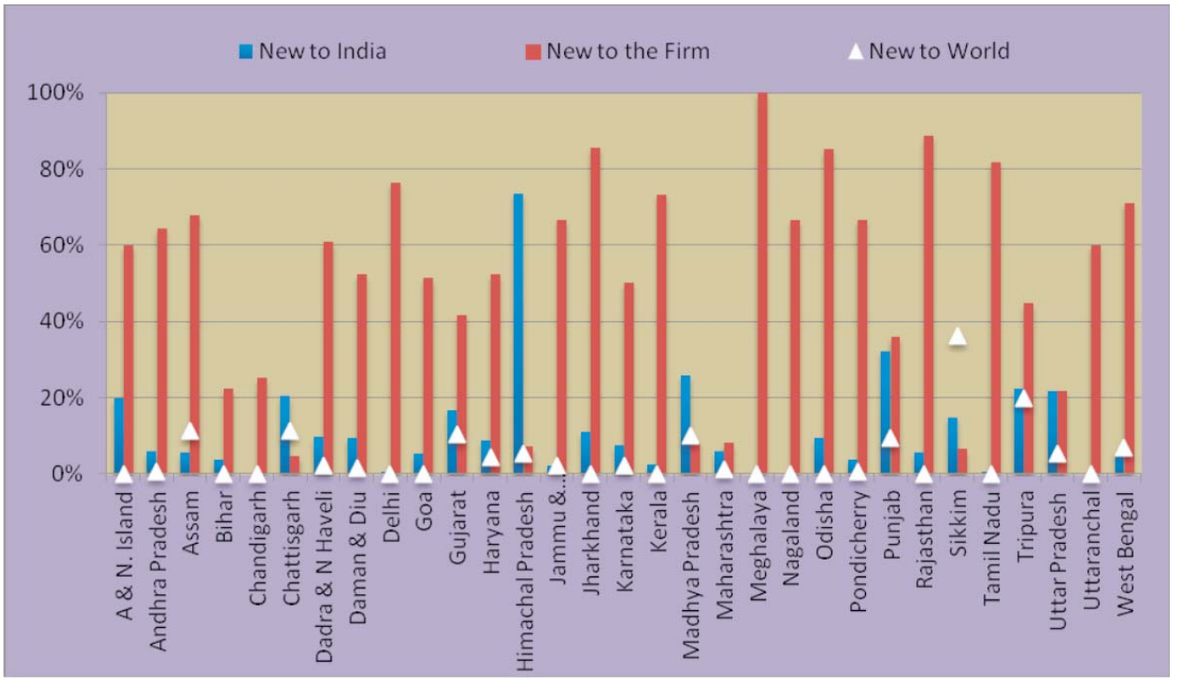


Fig 6.15: State-wise Distribution of Innovative firms with Novelty of Innovation

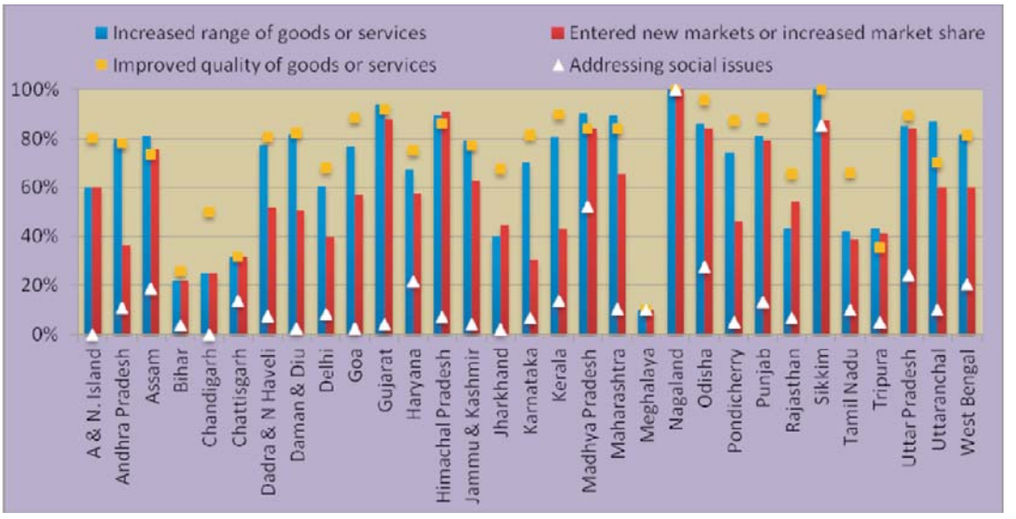


Fig 6.16: State-wise Distribution of Innovative firms with Gains from Innovation (Product Outcomes)

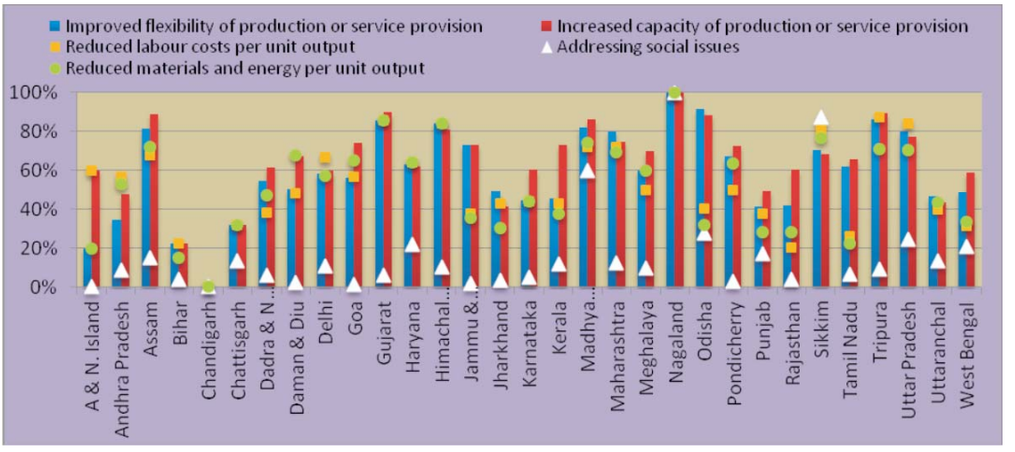


Fig 6.17: State-wise Distribution of Innovative firms with Gains from Innovation (Process Outcomes)

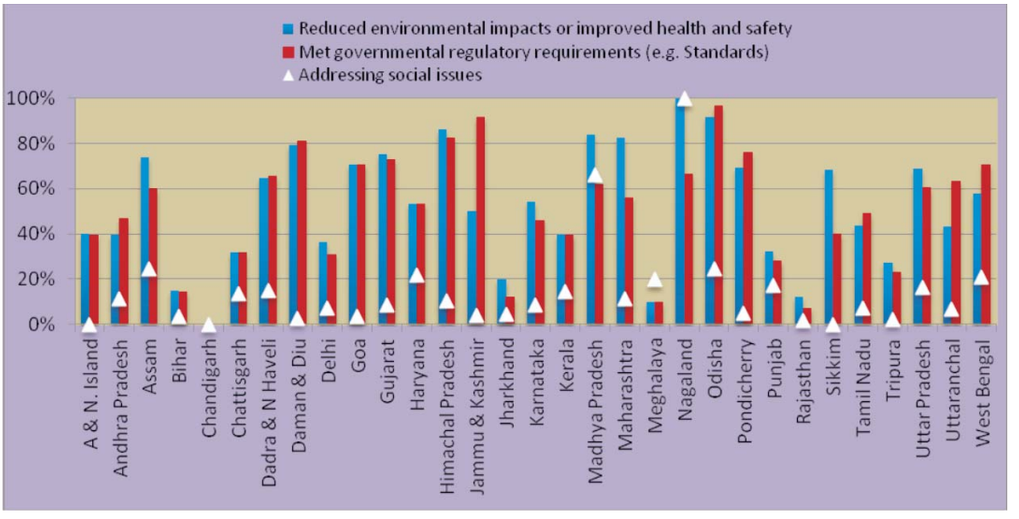


Fig 6.18: State-wise Distribution of Innovative firms with Gains from Innovation (Other Outcomes)

Studies commissioned for the development of ***Bibliometric Indicators*** in Indian context (phase-I) based on the two globally popular databases namely SCI, Thomson Reuters and SCOPUS, Elsevier were completed. The studies have provided analysis and trends of India and select comparative countries in terms of research papers published, their share in total world output including the impact factor, highly cited publications, collaboration analysis etc. This would provide the basis for evidence based evaluation and monitoring of scientific research for policy planning.

(ii) Information System/Database Activities

With a view to disseminate information on research and development (R&D) projects for the benefit of different interest groups, the National Science and Technology Management Information System (NSTMIS) division of the Department of Science and Technology (DST) continued its effort to compile information on extramural R&D projects funded by different central S&T agencies. Besides maintaining a computerised database on extramural R&D projects, the Department publishes annually a ***Directory of Extramural Research and Devel-opment Projects*** funded during the year since 1990-91. The work relating to the preparation of **Directory of Extramural R&D projects for the year 2010-11** is under progress.

The NSTMIS division of DST has also been analyzing the outcome of the Extramural R&D projects supported by the central government S&T agencies. Report on the analysis of outcome of the extramural R&D projects entitled **"Analysis of Outcome of Extramural R&D (EMR) Projects during 2000-05"** has been brought out. Comparative analyses of sponsored research projects during the two five year periods 1995-2000 and 2000-05 provides us interesting results as given below:

OUTCOME AT A GLANCE

1995-2000	**2000-2005**
Total number of EMR Projects	
9134	12523
Total EMR Projects Funding	
Rs. 1341.79 crore	Rs. 2198.47 crore
Number of scientists reached out	
8484	9231
Coverage of Institutions	
1491 located in 426 cities	1773 located in 408 cities
Responses received from EMR Projects	
3907 (42.77%)	6024 (48.10%)
Main sponsors of EMR Projects by number and responses received (in brackets)	
DST 2237 (1559), AICTE 1419 (440) UGC 1058 (391), CSIR 1010 (324) and ICAR 713 (320)	DST 3466 (2199), UGC 2276 (1305) CSIR 1091 (795), DBT 949 (252) and ICMR 917 (664)

Number of research papers published	
Total papers 21390	Total papers 31372
Indian journals 7148, foreign journals 5544	Indian journals 6680, foreign journals 13687
Indian conferences 6232	Indian conferences 6232
Foreign conferences 2466	Foreign conferences 3900
Number of Patents sealed	
Patents filed 332, patents sealed 102	Patents filed 318, patents sealed 49
New Products, Instruments and Prototypes developed	
Products 1155, Instruments 194	Products 2596, Instruments 298
Prototypes 335	Prototypes 368
New Processes and Principles/theories developed	
Processes 1061, Principles/theories 1031	Processes 1062, Principles/theories 534
Specialised Manpower generated	
PhDs 2546, DScs 23, MPhils 249	PhDs 3707, DScs 12, MPhils 304
MDs 34 and MTechs 1218	MDs 23 and MTechs 1216
Manpower employed	
JRFs 1471, SRFs 558, RAs 772	JRFs 2634, SRFs 1342, RAs 1139
Engineers/Doctors 567, Technicians 754	Engineers/Doctors 472, Technicians 883
Supporting Staff 983	Supporting Staff 883

Research papers constitute an important outcome of extramural R&D projects. The research papers emanating from extramural R&D projects supported during 2000-05 have increased relatively. Despite an increase in number of papers during 2000-05 over 1995-2000 period, the number of papers per project has remained almost the same. But, it is interesting to note that there has been a shift in the pattern of research papers publication in journals over the two periods. The publication in the foreign journals has enhanced significantly to 67% in 2000-05 as compared to 44% in 1995-2000 period.

(iii) Sponsored Studies

Apart from the in-house efforts in bringing out the R&D statistics at national level, the NSTMIS division sponsored a number of studies to build databases on S&T investment, S&T manpower availability/ deployment/gap and S&T indicators.

The following studies were completed during the year:

i) Preparation of data bank on general health status of the population in the open cast mining areas of Assam vis-à-vis their exposure to dust in ambient air.

ii) Accessing science & technology research output on the basis of major global secondary services.

iii) Key output indicators for performance evaluation of scientific research and development activities in India-A pre-feasibility study

iv) A study of the gap in management education vis-à-vis industry requirements in the context of Madhya Pradesh.

v) Commercialization of inventions from public funded research in India

vi) Knowledge creation and innovation in Nanotechnology: Contemporary and future scenario in India

vii) Mapping S&T innovations: A cross country study of patenting

(iv) International Collaboration

The Department has actively participated and contributed in the UNESCO Institutes of Statistics (UIS) and Organization for Economic Cooperation and Development (OECD) meetings for the development and revision of standards/concepts/definitions used for collection of Science Statistics and development of Science, Technology and Innovation Indicators. The department also provided information for the country on Science & Technology Indicators to UNESCO Institute for Statistics for their publication titled "UIS Statistical Year Book".

NATIONAL ACCREDITATION BOARD FOR TESTING & CALIBRATION LABORATORIES (NABL)

The National Accrediation Board for testing and caliberation Laboratories was established in the year 1998.The total number of employees in the organization is 58 Organization.All the employees in NABL (including scientists/ technical staff) are engaged on contract basis extendable from time to time.

Areas of Focus

To strengthen the accreditation system accepted across the globe by providing high quality, value driven services, fostering APLAC/ILAC MRA, empanelling competent assessors, creating awareness among the stake holders, initiating new programs supporting accreditation activities and pursuing organisational excellence.

Major accomplishments of NABL during 2012-13

NABL Accreditation / Final Assessment, Surveillances, and Re-assessments

NABL carried out 262 final assessments, 192 surveillance assessments, 314 desktop surveillances, 620 re-assessments and 118 verification visits. The total assessments carried out by NABL during this period was 1506

Important Highlights of 5 Major Research Programmes:

(i) Accreditation of laboratories -

During the F.Y. 2012-13 (from 01.04.2012 to 31.10.2012) 332 laboratories in the field of Testing Calibration and Medical laboratories were accredited. Total laboratories having valid accreditation as on 31-10-2012 is 1770 in 2529 disciplines / fields.

(ii) Peer Evaluation of NABL:-

NABL's peer evaluation was conducted during 10-14.09.2012 by a team of 4 International Evaluators. Evaluation was successful as there was no Non-Conformity raised. There were 3 minor concerns which have been addressed.

(iii) Assessor' Training Programmes

One Assessors' Training Programmes were conducted in which 17 Assessors were trained.

Major and Unique National facilities created:-

NABL initiated construction of its own building at Plot No. 45, Sector-44, Gurgaon at an estimated cost of Rs.9.34 Crores. The total floor area of building is around 21,000 sq.ft. Construction of building has been completed. Building has been registered in NABL's name. NABL is awaiting completion certificate from HUDA authorities. NABL is expected to shift to its new building in the month of November, 2012.

Important collaborations (national and global) established :

Implements Accreditation System for Laboratories

- NABL grants accreditation to Testing & Calibration Laboratories as per ISO/IEC 17025 and Medical Laboratories as per ISO 15189.
- NABL operates its own system as per ISO/IEC 17011.

International recognition of NABL

- NABL is signatory to Asia Pacific Laboratory Accreditation Co-operation (APLAC) Mutual Recognition Arrangements (MRA) and International Laboratory Accreditation Co-operations (ILAC) MRA since 2000.

NATIONAL GOOD LABORATORY PRACTICE (GLP) PROGRAMME

Governments and industries all over the world are concerned about safety of humans, animals and the environment through use of chemicals (industrial chemicals, pharmaceuticals, veterinary drugs, pesticides, cosmetic products, food additives, feed additives, etc.). Regulatory authorities, the world-over, are continuously engaged in determining the level of risks acceptable to the society and elaborate on scientific inputs and technical data to ensure that risks posed by these chemicals do not exceed the contemplated level of risks.

Good Laboratory Practice (GLP) is a quality system, which has been evolved by the member countries of **Organization for Economic Co-operation and Development (OECD),** concerned with the organizational process and conditions under which non-clinical health and environmental safety studies on the above-said chemicals are planned, performed, monitored, recorded, reported and archived. This system helps to ensure the quality and integrity of safety data (on chemicals) produced by test facilities. The OECD Principles of GLP are internationally accepted.

A **National Good Laboratory Practice (GLP) Compliance Monitoring Authority** was set up in April 2002, under the administrative control of Department of Science and Technology, with the approval

of the Cabinet to help Indian industries to obtain GLP-compliance status for their test facilities, so that data generated by these test facilities is acceptable in the countries of OECD. The Government of India has in principle agreed to follow the OECD principles of GLP for environmental and health monitoring of chemical substances. India was invited to be an Observer in the Working Group of GLP in 2003. Since then, a representative of NGCMA has been attending the meeting of the Working Group of OECD on GLP as an Observer. For getting a full adherent status to OECD's Mutual Acceptance of Data (MAD), India was rigorously evaluated by the OECD Working Group on GLP through on-site Mutual Joint Visits in 2008 and 2010. On March 3, 2011, the Minister for Science and Technology on behalf of Government of India accepted the invitation of OECD Council to become a full adherent to OECD Council Acts related to Mutual Acceptance of Data (MAD) in assessment of chemicals and to join that part of chemicals programme related to MAD, with all of the rights and obligations of OECD member countries.

Some of the major achievements of the Indian GLP programme are given below:

- Six **new test facilities were granted the GLP-compliance status**. These include:

  a) Bioneeds Laboratories, Bangalore Rural District, Karnataka.

  b) UPASI Tea Research Foundation, Valparai, Distt. Coimbatore, Tamil Nadu

  c) GLP Testing Facility, Syngenta Biosciences Pvt. Ltd., Goa.

  d) Sun Pharma Advanced Research Company Ltd., Vadodara, Gujarat

  e) Vanta Bioscience, Tamil Nadu.

  f) Vimta Labs Limited, Hyderabad, Andhra Pradesh.

- Three new test facilities were **re-certified**. These include:

  a) Zydus Research Centre, Ahmedabad, Gujarat

  b) The National Toxicology Centre, National Institute of Pharmaceutical Education and Research (NIPER), Mohali), Punjab

  c) GLP test facility, The Himalaya Drug Company, Makali, Bangalore, Karnataka

- **Annual Surveillance inspection** of following test facilities was done and their GLP-compliance status was continued for a period of another one year :

  a) Jai Research Foundation, Vapi, Gujarat

  b) Aurigene Discovery Technologies Limited, Hyderabad, Andhra Pradesh

  c) Gharda Chemicals Limited, Dombivili, Maharashtra

  d) LARS, Reliance Life Sciences Private Limited, Navi Mumbai, Maharashtra

  e) Intox Pvt. Ltd., Pune

  f) Indian Institute of Toxicology, Pune

g) PI Industries, Udaipur

h) RCC, Hyderabad, Andhra Pradesh

i) Sa-Ford, Raigad, Maharashtra

j) Orchid Research Laboratories Limited, Chennai, Tamil Nadu

k) Advinus Therapeutics Limited, Bangalore, Karnataka

l) Torrent Research Centre, Ahmedabad, Gujarat

m) Syngene International Limited, Bangalore, Karnataka

n) Ranbaxy Research Laboratories, Gurgaon, Haryana

- The following training courses/workshops/symposiums were organized:

  a) Three Day "**Training Course for Quality Assurance Professionals of GLP Test Facilities**" at INSA, New Delhi on February 6-8, 2012.

  b) Three Day "**Refresher Training-cum-Brainstorming Meeting of NGCMA with GLP Inspectors along with USFDA"** at INSA, New Delhi on July 18-20, 2012.

  c) Two Day **"Sensitization Workshop on GLP**" at INSA, New Delhi on August 29-30, 2012.

  d) Three Day "**Training Course for Study Directors of GLP Test Facilities"** at NASC Complex, Pusa, New Delhi on December 17-19, 2012.

- The website of National GLP Programme **"www.indiaglp.gov.in"** has been re-designed and is continuously being updated.

The National GLP Compliance monitoring authority since 2009 is signatory to the OECD working group on GLP with respect to Mutual Acceptance of Data this implies that health and safety data for pharmaceuticals, industrial chemicals, agrochemicals food and feed additives and cosmetics emerging from GLP certified facilities in India would now be accepted in all 38 OECD working group countries.

CHAPTER 7

MISSION PROGRAMMES

The mission mode programmes of the Department of Science and Technology includes Climate Change, Water Mission, Solar energy Mission, Nano Mission and Bamboo Mission. All these area supported in under the mission mode programmes are highly important and are aimed towards the preparing the country for the future issues.

In the current year two new thematic units of excellence on Computational Materials Science and one major project on Computational Materials Science were supported under the nano mission program for the development of R&D infrastructure.

Under the Climate Change programme more than 20 conferences and workshops has been supported to create awareness among the scientists and academicians regarding the changing climate and the mitigation methodology.

The National Mission on Bamboo Applications continues to focus upon value addition to bamboo materials through applications of technologies. 276 bamboo structures handed over to the Sarva Shiksha Abhiyan in Chattisgarh and 54 structures handed over in Maharashtra.

CLIMATE CHANGE PROGRAMME (CCP)

Two of the eight national missions on climate change launched under NAPCC are being coordinated by Department of Science & Technology through its Climate Change Programme (CCP) division. These missions are ; National Mission on Strategic Knowledge for Climate Change (NMSKCC) and National Mission for Sustaining Himalayan Ecosystem (NMSHE) with the main focus to generate strategic knowledge through various S&T interventions , thereby, enabling the formulation of appropriate policy measures for the sustainable development . There are several long and short term objectives to be undertaken in both the missions. Some of the major initiatives taken up and progress made by CCP during 2012-13 as given below:

(a) NMSKCC

1. Implementation of 14 R&D projects including two Centres of Excellence in climate Change (details given below at the Table).
2. Action for the formation of Five Knowledge Networks initiated. A preliminary meeting was held at JNU, N.Delhi in which several research groups participated.
3. Formulation of two major Knowledge network programmes on “Climate Change Science & Modeling” and “CC Impact on Health” comprising of 17 projects involving 15 partnering institutions .
4. Approval and launch of 22 new R&D projects including two major Knowledge Network Programmes.
5. Initiation of action for the establishment of Global Technology Watch Groups (GTWG) in the key areas of Climate Change. Organised Braimstorming session in July, 2012 at IIT Bombay to

identify the key partners for technology watch group. Expressions of interests from sixteen groups / technology institutions have been received so far. It is proposed to launch at least Three Technology Watch Groups from this identified team.

6. Initiation of programmes under Public-Private-Partnerships in key socio-economic sectors relating to climate change. In adaptation and Mitigation Technologies, a roundtable discussion was held in October, 2012 with private sectors to identify key partners for PPP initiative in climate change areas.

(b) NMSHE

7. Human and Institutional Capacity Building in Himalayan Ecosystem
   - Mapping of all R&D Institutions in the Himalayan Region has been carried out
   - A programme on Building Human and Institutional capacities been launched.
   - Over 100 institutions working in Himalayan ecosystem areas have been invited to submit pre-proposals
   - Over 60 pre-proposals have been received which are being processed.

8. A meeting of Stakeholders has been organized in IHBT, Palampur on 6th and 7th October,2012 to discuss the NMSHE programme with the State Government and the participating institutions from various institutions from IHR.
9. Action for obtaining administrative and financial approval of the Mission document. A draft EFC circulated and working on new format provided by Planning Commission.
10. Establishment of bi-lateral mechanism for addressing capacity building in Glaciology through a Indo-Swiss Joint Working Group . A three-phase training programme on glaciology and related areas is being planned to be launched under this bilateral cooperation.
11. The climate Change Programme has supported more than 20 conferences and workshops to create awareness and promote the climate change related activities to various institutes and academia.

Table: 7.1 (R & D proposals being implemented under CCP)

S. No	**Title of the project and total cost**
1.	Long Term Changes in Extreme Sea Level and Mean Sea Level Along the Indian Coast by National Institute of Oceanography (CSIR), , Goa
2.	Strategic Knowledge for Climate Change on Agriculture and Forest Ecosystem in Indo-Gangetic Plains (IGP) of UP by National Botanical Research Institute (NBRI) Lucknow
3.	Adaptation of Indian Agriculture to Climate Change, IARI New Delhi
4.	Devise a Grassroots' level Geospatial Climate Capacity Building Information System (GGCCBIS) for Climate-Stress resource management in Bhilangana Basin by University of Delhi, Delhi
5.	*Climate Studies Centre by* Indian Institute of Technology Bombay
6.	Analysis of Climatic Changes During the Quaternary From Glacial Sites in India Based on Multi-Proxy Data by The Birbal Sahni Institute of Palaeobotany (BSIP), Lucknow
7.	Climate Change : Impacts, Adaptation and Mitigation Strategies for Agriculture in Tamil Nadu by Tamilnadu Agricultural University, Coimbtore

8.	Laboratory Culture Experiments to Understand Response of Foraminifera to Ocean Acidification by National Institute of Oceanography (CSIR), Dona Paula, Goa
9.	Creation of a Centre of Excellence on Climate Change Studies and Collaborative Action Research on Promoting Climate Change Adaptive Behaviour for Sustainable Livelihoods by Indian Institute of Rural Management, Anand
10.	DST-ICRISAT Center of Excellence (CoE) on Climate Change research for Plant Production (CCRPP) by International Crops research Institute for the Semi-Arid Tropics (ICRISAT)Hyderabad
11.	Modeling Regional Climate Change : Addressing Scientific uncertainties and capacity building needs by Indian Institute of Technology, Delhi
12.	Local Scale Assessment of Tropical Cyclone Induced Coastal Storm Surge Inundation over the Coastal Zones of India a probabilistic Climate Risk Assessment Scenario by Indian Institute of Technology, Delhi
13,	Socio Economic Vulnerability of Himachal Pradesh to Climate Change by IRADe, New Delhi
14.	Study of Extreme Rainfall Events over India in the Context of Climate Change by University of Allahabad.

FLY ASH UNIT

Fly Ash Mission, a Technology Project in Mission Mode of Government of India commissioned during 1994 as a joint activity of Department of Science & Technology (DST), Ministry of Power (MOP) and Ministry of Environment & Forests (MOEF), with Department of Science & Technology as the nodal agency, after its approved period i.e. 31st March 2002 was named as "Fly Ash Utilization Programme" (FAUP) and thereafter since May 2007 is providing new focus & thrust under Fly Ash Unit (FAU), Department of Science and Technology (DST).

In India, large quantity of fly ash is being generated, as most of our energy demand is met through coal based thermal power stations. It's generation in the country has increased from 40 Mn T/yr. in 1994 to about 220 Mn T/yr in 2012. It is projected to be 350 Mn T/yr in 2017, 500 Mn T/yr in 2022 and 1000 Mn T/yr in 2032. The fly ash generation is expected to grow further as coal would continue to remain as major source of energy. The fly ash, which is a resource material, if not managed well, may pose environmental challenges.

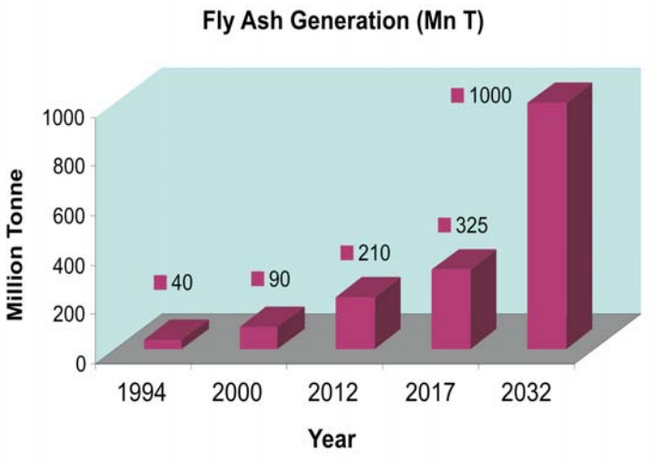


Fig. 7.1

It has been proved to be a useful material and collective efforts initiated under Fly Ash Mission of Govt. of India (1994) have lead to utilization of 120 Mn T/yr in 2012 as against 1 Mn T/yr in 1994.

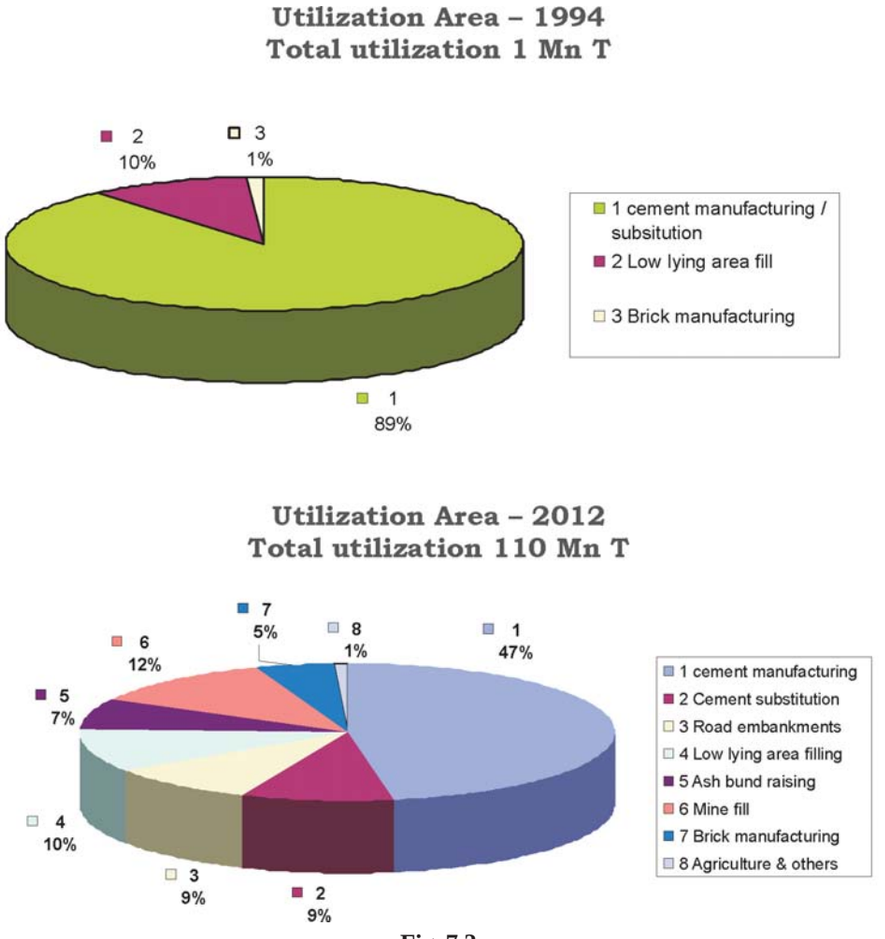


Fig. 7.2

Large number of projects/activities have been undertaken including 10 R&D and 15 facilitation projects during the reported year. Increased impetus and thrust is being provided for technology development/ demonstration activities including up gradation / preparations of new standards / specifications, dissemination of information and knowledge, awareness creation, facilitation of multiplier effects, providing inputs for policy interventions etc. in the area of safe management & gainful utilization of fly ash. In addition, fly ash technology / know how transfer and facilitation mechanisms are also to be developed and facilitated which would *inter-alia* catalyze capacity building at all levels of stakeholder agencies.

CURRENT FOCUS

Following are the new focus areas:

- Use of fly ash in concrete for critical structures such as building and foundation for rolling mills, turbo-generators in power plants, chimneys and cooling towers etc.
- Construction of railway embankments with fly ash.

- Induction of fly ash in academic curriculum.
- Preparation of Base Line Documents for each area of fly ash utilization and management to work as road map for future activities and to aid the policy and strategy planning.

IMPACT MADE

"Fly Ash Mission – India", now known as Fly Ash Unit-DST, through development & application of technologies has turned around the image of fly ash from a "WASTE MATERIAL" to a "RESOURCE MATERIAL", *inter alia,* increased it's utilization in the country from 1 million tonne (1994) to 120 million tonne (2011-12) reducing annual CO_2 generation by 65 Million Tonne, reduction in consumption of a number of mineral resources, generation of employment for more than 1 Million and added economic returns worth more than US $ 3 Billion.

Indian expertise of S&T and management / utilization of fly ash has been requisitioned by the Republic of Russia. Fly Ash Unit, DST, under a Protocol signed between the two countries is facilitating setting up of "Fly Ash Mission – Russia" including import of technologies from India.

It also envisages:

i. Exchange of experience and expertise

ii. Development, proving and application of technologies

iii. Development and implementation of investment projects of companies/government organizations to establish enterprises

iv. Enhancing cooperation between Russian and Indian scientists

Fig. 7.3: Fly ash Protocol Signing Ceremony with Russia on 16th December, 2011 at The Kremlin, Russia

NATIONAL MISSION ON BAMBOO APPLICATIONS (NMBA)

The National Mission on Bamboo Applications (NMBA), a mission mode project under the Department of Science and Technology (DST), has been tasked to develop and commercialize technologies for enhanced

value addition, employment generation and socio-economic up-liftment based on bamboo, and also to create the basis for enlargement of bamboo sector in the country by augmenting economic opportunity, income and employment.

Development of new innovative products in various segments of bamboo applications include areas of:

- **Green Building**

  - **Nandurbar Project**

    NMBA has been mandated by the Department of Primary Education, Govt of Maharashtra for construction of 111 engineered bamboo school units including kitchen, toilets etc at Nandurbar District. This is a remote, inaccessible area having no road connections. The project is under the Sarva Shiksha Abhiyan scheme. Work has already commenced for 54 units in Phase I with a total cost of Rs 489 lakhs.

Fig. 7.4

  - **Engineered Bamboo Structures in Manipur**

    One of the major programmes of the Central Govt. is to improve the infrastructure services of the primary schools in the States. On the request of Manipur Govt., Construction of 1174 prefabricated structure of size 10 ft X 10 ft to be used as Kitchen cum store under Mid day Meal at various locations of Manipur, have been supported by NMBA.300 structures has been handed over to Manipur education department and another 100 structures would be handed over in the next 20 days.

Fig. 7.5

- **Bamboo thermoplastics application in auto sector.**

  Bamboo thermoplastics are being used in the non critical components of vehicles (i.e. three wheeler and two wheeler).It is also being used in the interiors of the vehicle.

- **Bamboo Timber**

  India has the second largest bamboo resource after china & a long term sustainable alternative to wood timber can be found by setting up Bamboo timber unit. Bamboo timber can be used in the form of Reinforced compressed Bamboo Beam and Board. It is a 100% substitute of wood timber as it can be cut sawn, sanded and polished in any direction. Bamboo timber is a revolutionary type of board that has seen a growing demand in the market.The raw material of the board would be bamboo waste bundle, which then be dried and glued and formed into board and lumber in hot press.

- **Nano Cellulose**

  NMBA has taken the initiative of looking at the possibility of obtaining nano materials from bamboo by using various techniques and also establish procedures of compatibilizing nano cellulosic whiskers with polymers like methyl methacrylate, polylactic acid and poly capolactum.These procedures open up new opportunities to develop completely bio degradable nano composites. The cellulose nano whiskers are believed to enhance the mechanical properties like strength and stiffness of the composites.

  This nano whisker finds application in areas like polymer composite, reinforced materials, food additives and medicine.

  To look at the objective of obtaining nano materials from bamboo study has been carried out with IWST(Institute of Wood science and Technology) for studying the techno-economic feasibility of extracting cellulose nano whiskers from bamboo fiber by different methods, characterization of nano cellulose from bamboo fibers and preparation of polymer composites using nano cellulose whiskers as reinforcements followed by evaluating properties of polymer composite prepared with nano cellulosic filler from bamboo fibers.

■ **Skill Up gradation**

NMBA as part of its activities generates bamboo based livelihood in rural/ bamboo growing areas. To ensure supply of sustained and cost effective raw material,skill development training and induction of fixtures and primary processing machinery's is supported for manufacturing bamboo sticks at village and community locations. NMBA has provided trainings for cluster level processing of bamboo shoots, mat weaving, use of natural dyes, processing of bamboo shoots, agarbati sticks and incense-cone making. Trainings are provided at Nagaland, Chhatisgarh, Karnataka, Kudal, Tamenglong,Assam, Meghalaya, Bihar, Orissa and Tripura.

■ **Bamboo Vinegar Oil**

NMBA has explored various avenues for development of various applications of bamboo being highly versatile. Processed bamboo is an excellent source for high grade charcoal and activated carbon. The byproduct produced during the processing of bamboo into charcoal as a result of condensation is **bamboo vinegar**.

Fig. 7.6

■ **Activated Carbon based on bamboo**

Activated Carbon is produced in two steps by Production of charcoal where bamboo will be converted into carbonaceous material by burning it without flame at inert temperature. There are different methods i.e. closed dome batteries, Open pit and closed pit for producing charcoal. Charcoal from above process will be activated at very high temperature (800 to 950° C) in brick lined rotator kiln. It is useful in the purification process like water purifiers etc.

■ **Value Addition**

Bamboo carries the potential of value added economic activity and provisioning of income through technologies.NMBA has developed technologies to convert bamboo into products such as bamboo flooring, sticks, shoots, boards etc. Square sticks carry a higher value, especially if polished and sized. Conversion of waste into the bamboo charcoal is a viable alternative and provides value addition. During the preparation of bamboo shoots for canned bamboo shoots, the uneven pieces are mixed together and in turn are used to produce bamboo shoot pickle.

■ **Jointings Projects**

NMBA has supported technology for development of bamboo jointing with whole bamboo and using local material for construction of multi-storey houses. This is based on German Technology and the project is being implemented in Arunachal Pradesh.

Fig. 7.7

■ **DDA venture**

Using the above mentioned Jointings technology, DDA has given a project mandate to NMBA for the construction of an eco-friendly park on the banks of Yamuna river.

MISSION ON NANO SCIENCE AND TECHNOLOGY

The Mission on Nano Science and Technology (Nano Mission) — an umbrella programme - was launched in the year 2007 to promote R&D in this emerging area of research in a comprehensive fashion. The main objectives of the Nano Mission are — basic research promotion, infrastructure development for carrying out front-ranking research, development of nano technologies and their applications, human resource development and international collaborations. During the year 2012-13, Nano Mission continued to record expansion in its activities and break new grounds in promotion of R&D and human resource development in the field of nanotechnology.

Basic Research Promotion

25 new individual scientist-centric R&D projects were funded this year which focused on fundamental scientific studies on nano-scale systems. Some of these projects were on –

Study of catalytic activity of nano size metals and metal oxides prepared by novel or conventional routes; experimental and first-principles theoretical studies of metal oxide nanostructures for photo-electrochemical splitting of water; studies on magneto-transport in magnetic tunnel junctions; studies on bone targeted nano drug delivery systems for treatment of osteo-degenerative disease in improvement of women health; studies on superferromagnetism in magnetic nanoparticle systems; development of nano fibrous membrane polymer electrolytes and nano structured electrode materials for lithium rechargeable batteries; development of hybrid nanomaterials for energy production from renewable sources; development of titania aerogel photoanode for desensitized solar cell application; computational studies of bare and zeolite-supported metal nanoclusters and their application in catalysis; mechanistic studies on extra cellular biosynthesis of metal nanoparticles; development of protein nanoparticles delivery system for targeting anti-retroviral drugs to HIV infected cells; multifunctional materials for electrochemical energy conversion and storage devices; synthesis and characterization of novel nanoparticles and study of their interactions with stem cells; development of parenteral sustained release dosage forms and colon targeted drug delivery systems for low molecular weight heparin.

The ongoing R&D projects continued to receive support during the year. Some important achievements reported from the ongoing projects are —

Different dipeptides with high purity and good yields were synthesized successfully. It was also showed that dipeptides could be self-assembled to form nanostructures of various morphologies and dipeptide nanoparticles could load a wide array of drug molecules and showed enhanced cellular uptake. Dipeptide nanoparticles could also be generated in an organic-aqueous mixture to load highly hydrophobic drug molecules such as curcumin. Anti-cancer drug loaded nanostructures also showed enhanced efficacy in cancer cells.

Polymeric nanoparticles were prepared which are capable of crossing blood brain barrier and can deliver the curcumin there and these have been found to be stable for 3 months.

The *Jasad bhasma*, was characterized for physicochemical properties by XRD, TEM etc. It was found out that the *bhasma* preparation contains polycrystalline particles of irregular shapes with defects in crystal structure. These are important findings as the irregularities in shape and stresses in crystallites will play significant role in defining and enhancing the therapeutic effect (s) of the *bhasma*.

The formation of continuous thin films on a topographically patterned substrate with the undulations 180°out of phase with respect to the substrate patterns was carried out which is a completely new

observation. The influence of substrate feature height on dewetting was observed for the first time. The identification of four distinct morphological regime was also reported for the first time. The experiments involving dewetting of a thin bilayer on a topographically patterned substrate is also novel and reported for the first time.

It was found that there is a complete morphological transition in the Au nanostructures prepared with tyrosine-based amphiphiles from multipod to spherical upon transfer to nonpolar organics and the catalytic activities of NiCo alloy nanostructures are excellent towards different organic coupling reactions. Gold nanoparticles thin film functionalized with different ligands can be used as supported catalyst in organic reactions. CoNi alloy and monometallic Ni nanostructures can be used for catalyzing various organic reactions.

Folic Acid Super Paramagnetic Iron Oxide Nanoparticles (FA-SPIONs) were developed which are highly stable, biocompatible, with prolong and better biodistribution profile as compared to commercially available SPIONs. It was also found out that developed FA-SPIONs have high selectivity and specificity to cancer cells. Also, Folic acid conjugated Quantum Dots were synthesized which are stable, biocompatible with good fluorescence properties.

Preparation of bioceramics using synthesized mullite and colloidal silica together was done.

Au-Ni, Cu-Co, Cu-Ni multilayer nanowires have been synthesized using potentiostatic electro-deposition. Nanochannels of anodic alumina membrane were used as template. Morphology of the wires has been studied, structural characterization has been done, Superconducting Quantum Interference Device (SQUID) was done to measure the magnetic properties. Impedance measurements were also made.

Metal phosphide (M_xP_y) electrodes were prepared by direct electro-deposition, reporting the synthesis of high temperature materials at low temperature using aqueous electrolyte. The nanoarchitectured electrode assembly demonstrated high energy capacity as well as high power density as compared to traditional flat lithium battery electrode using any electroactive materials.

Coiled carbon nanotubes (CCNT) have been synthesized on the carbon fiber substrate. The necessary conditions for coiled nanostructure growth have been investigated. Catalyst coated and CCNT coated substrates have been characterized. CCNTs, carbon microcoils (CMCs) and CNCs of varying length, diameter and coil pitch have been synthesized. Carbon nanocoil coated carbon fiber reinforced composites shall be useful for structural applications.

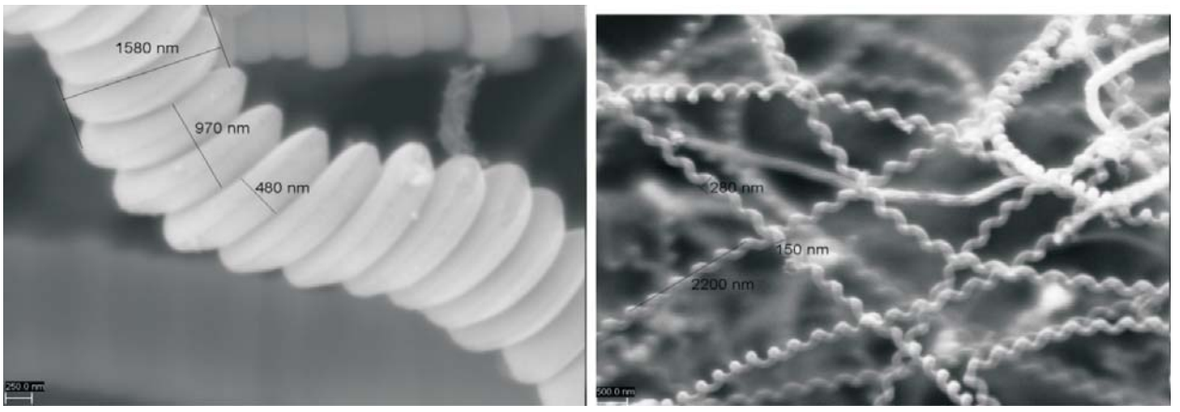


Fig. 7.8 Carbon Nanocoil/microcoil coated carbon fiber

CNTs synthesized by catalytic decomposition of a carbon source (acetylene) on a nickel catalyst coated carbon fiber substrate. Iron nanoparticles, formed by the thermal decomposition of ferrocene, were encapsulated during the CNT growth. Further, iron encapsulated carbon nanotubes were characterized. Iron encapsulated CNTs are clearly observed through the SEM micrographs.

Nanostructured metal borides with controlled shape and size were obtained by microemulsion/ hydrothermal methods. The methodology leads to efficient properties like microhardness, acid resistance and field emission properties.

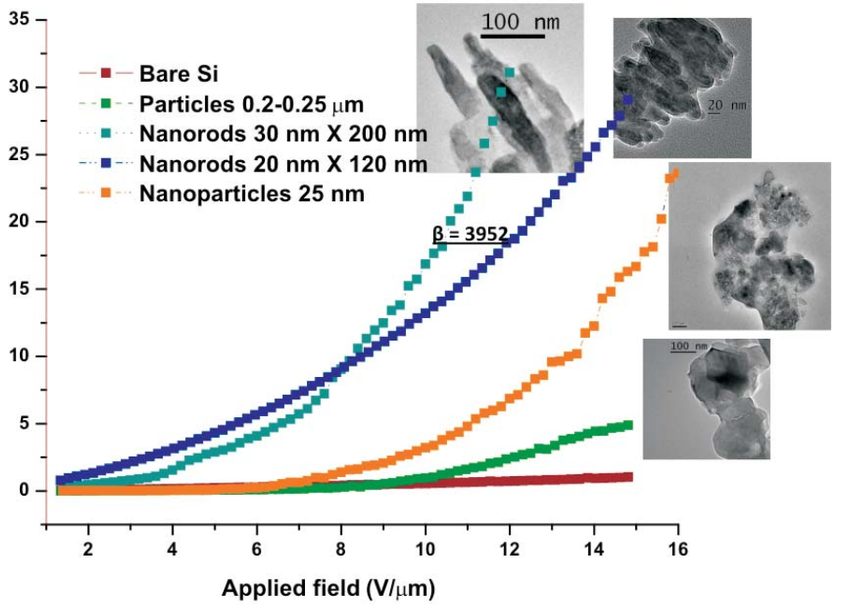


Fig. 7.9: Enhancement of field emission properties of vertically aligned nanorods of lanthanum hexaboride

A good number of scientific achievements were reported from University of Hyderabad project, a few are indicated below:

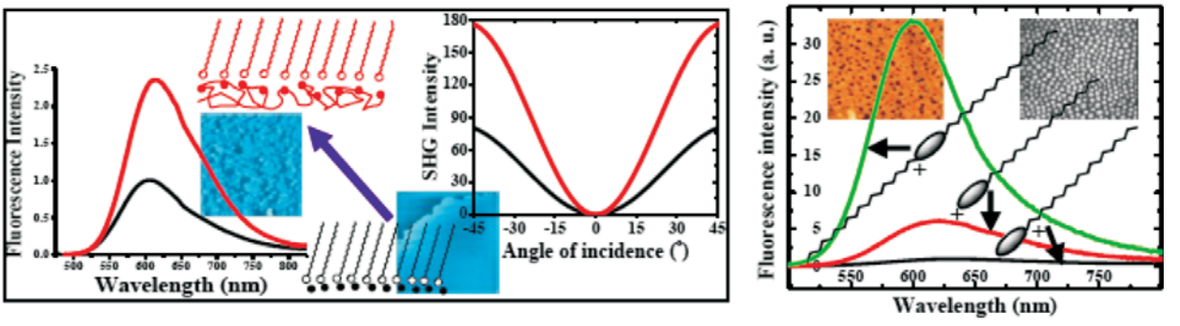


Fig. 7.10: Polyelectrolyte templating of Langmuir-Blodgett films

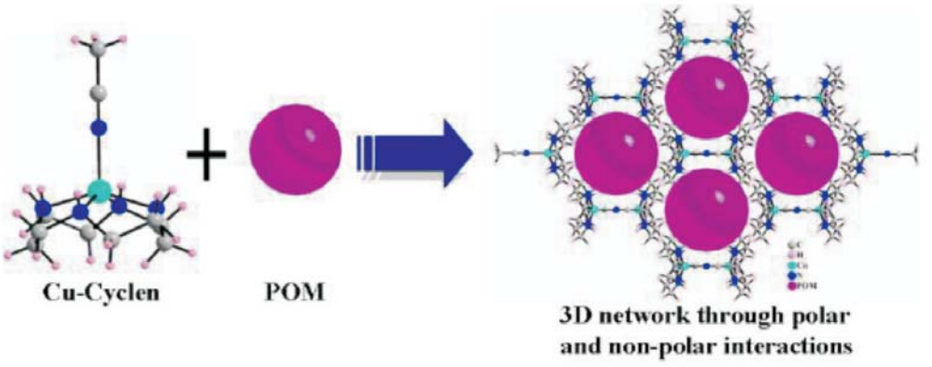


Fig. 7.11: Crystallographic evidence for coexistence of a transition metal–aza crown ether complex with a polyoxoanion.

Dual drug release data was reported using coated poly lactic-*co*-glycolic acid **(**PLGA) nanoparticles. Magnetic nanoparticles co-encapsulated within drug loaded PLGA nanoparticles.

The progress/outcome of about 80 individual scientist-centric R&D projects and 14 Units/Centres projects was also reviewed during the year.

Development of R&D Infrastructure

2 new Thematic Units of Excellence on Computational Materials Science and 1 Major project on Computational Materials Science were supported during the year.

The process for establishment of low-energy ion-beam facilities at Kurukshetra University and Allahabad University continued during the year.

The appointment of Director, INST Mohali was made during the year. Now, the activities of INST-Mohali are expected to gain momentum which shall focus on agri- and bio-nanotechnologies.

The High Performance Computing (HPC) facility set up at IUAC continued stable operation this year, and the Kalki cluster continued to run at sustained full loads with moderate wait queues. The data centre housing the cluster, the first large-scale installation in the country using water-based rack cooling for very high server densities and high energy efficiency, functioned stably as well, and an enhanced home-grown monitoring and alarm system was put in place. The number of users grew this year from 42 to 60, and the number of participating institutes from 24 to 42.

The Centre for Knowledge Management of Nano Technology (CKMNT) created at ARCI, Hyderabad continued giving valuable analyses of the Indian research scene and prepared important reports and guidelines. The publication of quarterly newsletter dedicated to Nano Science and Technology 'Nanotech Insights' continued during the year.

Support to the existing Units/Centres continued. Interesting results were reported from these Units & Centres, some of which are summarized below –

Work on purification of water using reduced graphene oxide-based composites continued during the year.

Work on nanoparticle based solar energy devices, nanomedicine and targeted drug delivery, nano catalysis, nanomaterials for opto-electronic and photonic applications, nano electronics and nano ionics devices, nanoporous materials for hydrogen storage continued during the year.

Human Resource Development

Support to ongoing Post Graduate programmes [M.Sc./M.Tech in Nano Science & Technology] continued during the year.

Post-doctoral fellowships to attract talented young researchers towards advanced research in Nano Science & Technology continued to be offered through Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR), Bangalore. 8 Post-doctoral fellows are continuing their research at present.

Nano India Meet, an important event of the Nano Mission organized at Trivandrum. Support to a number of International /National Conferences, Seminars, Workshops etc. was also provided.

International Collaborations

The India-Japan beamline established at the Photon Factory, KEK, Tsukuba, Japan became a useful and sought-after facility. Indian Scientists and researchers from all over the country continued carrying out experiments using this facility.

The project for gaining assured access to all the beamlines of the PETRA III synchrotron radiation facility and the FLASH facility at DESY, Hamburg, Germany gained momentum during the year. PETRA III, being a high energy and nano-size radiation source, opened up newer areas of research for the Indian scientific community. 20 experiments were carried out by Indian scientists using this facility and 32 proposals were forwarded to DESY.

Using funding through SN Bose National Centre for Basic Sciences, Kolkata, Indian Scientists and researchers continued experiments at different synchrotron radiation and neutron facilities abroad.

Under the Indo-Canada collaborative programme, 1 Faculty-to-Faculty collaboration completed while 8 such new collaborations were initiated during the year.

Development of Nano Technologies and their Applications

Support to Nanotechnology Business Incubator (NBI) at NCL, Pune continued during the year. This NBI has nurtured activities by 7 start-up companies on items like- computational modelling of flow and chemical processes, therapeutic potential of biotechnologically engineered antibodies, ocular and maxillofacial implants, and 12 start-up companies are under incubation presently as Resident Incubates on items like-maxillo-facial surgery, organic chemical synthesis etc.

Support to other ongoing projects in this category continued during the year. Significant progress has been made in these projects.

Orchestrating National Dialogues

The Nano Mission continued to forge linkages with other government agencies and industry organizations in promoting NS & NT in the country and also orchestrate national dialogues on issues which

are manifestly multi-agency issues. Nano Mission has made special efforts in this direction. Special mention may be made of the following –

For development of Standards for Nanotechnology, Nano Mission supported a project to National Physical Laboratory (NPL), New Delhi.

The Task Force doe developing Regulatory Framework on Nanotechnology completed two important things–(i) "Appeal for responsible development of nanotechnology"; and (ii) "Guidelines and best practices for safe handling of nanomaterials in research laboratories and industries" during the year.

A fully-audited, open source web-based on-line project submission system continued in operation during the year.

Output Indicators

The cumulative output from various projects/programmes supported under the earlier Nano Science & Technology Initiative (NSTI) and the Nano Mission are summarized below:

Research papers in cited Journals	4667
Research papers in Conferences	1391
Ph.Ds produced/undergoing	800
M.Tech. produced	546
M.Sc. produced	92

CHAPTER 8

S & T PARTNERSHIP BUILDING AND INTERAGENCY PLATFORMS FOR S & T OUT-REACH

The International Division of the Department of Science and Technology plays a key role in fostering international bilateral cooperation and partnerships. The responsibility is carried out by the Division in close consultation with the Ministry of External Affairs and other concerned agencies. The Department has nurtured joint research project under active bilateral S&T programs of cooperation with more than 40 countries, facilitated bilateral advanced schools training programs and bilateral programs on Innovation and Entrepreneurship development using PPP model with Finland, France, South Korea and USA. In the year 2012-13 the Department has launched New Africa S&T Initiative Program which includes fellowships, trainings and strengthening of R&D institutions through twinning.

INTERNATIONAL S&T COOPERATION 2012-13

International Division of DST has the mandated responsibility of (i) negotiating, concluding and implementing S&T Agreements between India and other countries; (ii) providing interventions on S&T aspects in international forums. This responsibility is carried out by the Division in close consultation on the Indian side with the Ministry of External Affairs, Indian Missions Abroad, stakeholders in scientific, technological & academic institutions, concerned governmental agencies and with various industry associations in India.

Guiding Principles for International S&T Cooperation

DST is able to strategically leverage 'international collaborative advantage' by building chosen international alliances and partnerships with selected countries that can have perceptible yields, such as:

(i) R&D outputs through international alliances which can contribute directly to national R&D priorities and outcomes;

(ii) Accelerating institutional and human capacity building through international exposure and linkages;

(iii) Enable new paradigms being practiced by other emerging economies for sustainable adoption by Indian R&D and innovation systems;

(iv) Evolve modalities and mechanisms for seamlessly connecting Indian research with global efforts particularly in the frontier areas of S&T and in areas addressing global challenges;

(v) Absorbing experience of existing global research facilities in fine-tuning and/or coupling with upcoming or existing Indian research facilities;

(vi) India's contribution in international mega-science projects;

(vii) Empowering developing countries in S&T; and

(viii) Promoting innovation and techno-entrepreneurship through Global Innovation & Technology Alliance (GITA).

Spectrum of Cooperative Activities undertaken

During the year, DST undertook a spectrum of bilateral cooperative activities such as: (i) Scientific and ministerial missions; (ii) Joint workshops; (iii) Joint research projects; (iv) Support to and creation of Bi-national S&T bodies, (v) Joint R&D centers, (vi) Virtual Networked centers; (vii) Utilization of large scale research facilities abroad; (viii) Advanced training programs; (ix) Participation in international mega-science projects; (x) Contributions to international non-governmental scientific bodies; (xi) Technology summit, industrial fairs, S&T exhibitions; (xii) Fellowships and Visitation programs for both Indian and foreign researchers and (xiii) Promoting institutional partnerships etc.

SALIENT ACTIVITIES CARRIED OUT DURING THE YEAR

New/ Renewal of Inter-Governmental S&T Cooperation Agreements /MoU/ Programs of Cooperation were concluded by India with Argentina, Austria, Brazil, Bulgaria, Chile, Czech Republic, El Salvador, Germany, Italy, Norway, Russia, Singapore, Sweden Switzerland, Ukraine and Vietnam.

Fig. 8.1: Indo-Russian MoU on S&T Cooperation signed during the 2012 Summit Meeting in New Delhi

Joint S&T Committee/ Council meetings were held with Belarus, Botswana, Brazil, Bulgaria, Chile, Czech Republic, Finland, Germany, Italy (Trento programme), Mauritius, Mexico, Norway, Pakistan, Russia, Singapore, South Korea, Sweden, Switzerland, Taiwan, United Kingdom, USA and Vietnam. Governing Body meeting of the Indo- French Centre for Promotion of Advance Research (IFCPAR), Indo-German Science & Technology Centre (IGSTC), and Indo-US S&T Forum (IUSSTF) were held during this year.

About 400 Joint R&D projects and over 40 Joint workshops/ seminars were supported. More than 600 exchange visits took place under various bilateral programs for joint research, information exchange and joint use of facilities and seminars/ training schools supported.

New programs of cooperation were initiated with US National Science Foundation (Virtual Centre on Mathematics and Computer Sciences & East Asia-Pacific Internship Program); Indo-US Endowment Fund for Innovation & Entrepreneurship; Indo-US Joint Clean Energy R&D Centre; Finnish Innovation Council; UKIERI of UK; Indo-UK Science Networking Program; Indo-Hungarian S&T Fund; India-South Korea Joint R&D Fund, ILTP- Phase II with Russia; re-energisation of programme with Czech Republic, Fellowship programs with Australia and Korea; Grand Challenges Awards with Australia; Indo-French Centre for Allied Mathematics with CNRS France; Glaciology and Energy Technology programs with Switzerland; Glaciology Program with Norway; Joint Research Projects with Austrian Science Fund; Solar Energy and Civil Security with Germany, and Joint R&D Projects with Sri Lanka.

New Africa S&T Initiative: Department in partnership with MEA hosted a Summit meeting of African S&T Ministers at New Delhi in 2012 which had participation from 37 African nations. Sir CV Raman Fellowship for African Researchers to work in Indian laboratories under the New Africa S&T Initiative was also provided.

Fig. 8.2: India-Africa S&T Ministers Meeting held at Vigyan Bhawan, New Delhi.

This initiative is aimed towards capacity building and developing research linkages with African countries through fellowships, training and twinning with African R&D institutions. A training course on "Technological Innovation for Capacity Building in Data Analysis" was conducted during October 15- November 2, 2012

at Indian Institute of Information Technology Allahabad in which 25 participants from 14 African countries successfully completed the course.

Fig. 8.3: African researchers undergoing training course at IIIT, Allahabad

Bilateral Research Projects

International interactions through joint collaborative projects with countries mentioned below have been instrumental in accelerating outcome and adding value to national science, technology and innovation enterprises at large. Spectrum of impact can be gauged from illustrations such as (i) creation of new knowledge and research tools captured in co-authored papers with foreign scientists published in world class scientific journals; (ii) joint patents have been filed with foreign scientists; (iii) project based mobility has provided opportunities to Indian scientists for joining international R&D projects; (iv) absorbing experience of existing global research facilities in fine-tuning and/or coupling with upcoming or existing Indian research facilities; (v) building extended and stable institutional tie-ups with foreign partners to incubate feasibility of and/or scaling up of research, pilot scale production and high tech competence in India; etc.

- **Argentina:** 5 new bilateral R&D projects have been approved for implementation. In addition 10 projects in the areas of structural chemistry, bio-pesticide, health, and food industry were continued to be supported under the ongoing program of cooperation.

- **Australia:** Indo-Australia Joint Science and Technology Committee (JSTC) Meeting was organized through video conferencing in April, 2011 in New Delhi. The joint committee reviewed ongoing activities and recommended to support 7 new projects and 6 workshops.

  Under the Australia–India Strategic Research Fund (AISRF) ongoing program in 'Competitive Category', 49 Indo-Australian research projects were supported in the areas of agricultural research, astronomy & astrophysics, microelectronic devices & materials, nanotechnology, renewable energy and marine sciences. 130 exchange visits of scientists were taken place under these projects. 2 Indo-

Australian Joint Symposium on "Preparing for climate change on marine systems in Australia and India" were organized in Central Marine Fisheries Research Institute, Cochin and Tasmanian Aquaculture and Fisheries Institute (TAFI), University of Tasmania.

Under the Indo-Australia Strategic Grand Challenge Research Fund, 121 Expression of Interest (EOI) were received in the areas of Health and Energy against the new call. 16 EOI's have been recommended to submit full detailed project. Support was continued to 3 on-going major joint projects in the areas of food sciences and water security.

20 Fellowships to **Early Career Researchers (3-12 months)** and 10 Fellowships to **Senior Professional Scientists (1-2 weeks)** were awarded in frontline areas in all fields of Science & Technology including Medical and Agriculture to visit Australia during the year 2013 under the Indo-Australia Fellowship Programme.

- **Austria:** Support to 13 joint research projects was continued. DST and Federal Ministry of Education & Research (BMWF) received about 35 new collaborative proposals against the last joint call for proposals launched by both sides. These proposals are under technical evaluation process by both sides for joint consideration.

  DST and Austrian Research Fund (FWF) have launched call for proposals under for consideration support under DST-FWF MoU. The deadline for receipt of the proposals is 15th March 2013.

- **Brazil:** 1st meeting of the India-Brazil Joint Commission on S&T was held at New Delhi on 22nd March 2012. The Joint Commission discussed various ways of cooperation and identified several areas of cooperation in S&T such as Biotechnology; Computer sciences and ICT; Earth Systems Sciences including Ocean sciences and Climate change; Engineering, Material sciences and Nanotechnology; Health & Biomedical sciences; Mathematics; Natural sciences; and Renewable energy, Energy efficient and Low Carbon technologies. A Programme of Cooperation in Science and Technology for the period of 2012-14 with the Federative Republic of Brazil was also signed.

  During the Eighth Joint India - Brazil Science Council (IBSC) meeting held on September 14, 2012 at Bangalore IBSC took stock of the developments and status of on-going activities and future cooperation in the priority areas such as biomedical sciences, computer sciences, material sciences, mathematical sciences, physical sciences, ocean and marine sciences and renewable energy. The two sides also agreed to organize joint workshops in Computer Sciences (March 2013) in Brazil, Material Sciences- one in conjunction with the Next Council Meeting in Brazil and the second one in 2014 in Chandigarh, India; Nanomaterials for Energy (October 2012) in Brazil; Mathematical Sciences (February 2014) in Goa; Physical Sciences (2013) in Brazil; and a training programme in India in ocean and marine sciences. The Council also decided to open these workshops for participation of students and young faculty wherever possible.

- **Bulgaria:** 7th meeting of the Joint S&T Committee was held at Sofia in December 2012 which reviewed activities under bilateral cooperation programme. The Committee considered 58 joint R&D proposals and approved 10 new joint R&D projects in areas of Biomedical research, biotechnology, high energy physics, and food technology.

- **Finland:** Second Joint S&T Committee meeting was held at Helsinki, Finland on 6th September 2012. Support was continued to 11 Joint projects in the areas of Green Chemistry and Nanomaterials. Indo-Finish Working Group meeting on Innovation was also held at Helsinki on5th September 2012.

- **France:** Targeted programmes enabling research funding agencies of both the nations in focused areas have been launched viz. a) Indo-French Centre for Applied Mathematics (IFCAM), between DST and Centre National de la Recherche Scientifique (CNRS), b) DST-INRA project on "Adaptation of Irrigated Agriculture to Climate Change" c) DST-ANR call for proposals in the areas of Infectious diseases and Engineering Sciences.

- **Germany:**

  DST-DAAD project based personnel exchange program**:** Support to 20 on-going joint research projects was continued and 10 new projects were approved in the various areas of basic research which includes areas of advance-materials, physical and chemical sciences; Biotechnology, Earth and atmospheric sciences. .

  DST-DFG Program: Support continued for 25 on-going projects was continued. A joint call for proposals in the thematic area of applied chemistry is currently under way with deadline as 30th March 2013. .

  DST-AvH Program: The 4th Indo-German (DST-AvH) Frontiers of Engineering symposium was held in Germany in June 2012. This symposium was attended by 35 young engineers from each side to deliberate upon the ongoing cutting edge research across engineering disciplines with the aim to develop new collaborations in promising areas of engineering sciences. The next such symposium is planned to be held in Hyderabad in March 2013.

  DST-MPG Partner group program: Four partner groups and 5 DST-MPG Fellowships were sanctioned during the tear in addition to the already supported PG's in the areas of atmospheric chemistry, plant-insect interaction, tumor specific drug delivery system, cosmology & gravity, mass black holes in gravitational wave window, human genetic diversity, health sciences and evolutionary biology and structure-function relationship in protein machinery.

  DST-Leibnitz Association MoU: The 2nd Indo-German (DST-Leibnitz Association) symposium on New vistas in cutting edge science was organized in ICT Mumbai during October 2012. About 35 Indian and 15 German experts participated in this 4 days symposium and deliberated on the topic of "Sustainable and Green Chemistry" .

- **Israel:** Support continued to 8 on-going joint projects in the areas of information technology (imaging sensor and robotics) and solar energy (solar thermal & photovoltaic).

- **Italy:** Support to 16 joint projects was continued. Third phase of India Trento Program for Advanced Research (ITPAR) was initiated. Under the ITPAR, 4 new projects in the areas of nano-photonics, computer sciences, material sciences and MEMS were approved. In addition, about 25 Indian scientists visited Trieste to perform experiments on Elettra Synchrotron Beam-line.

- **Japan:** Under India-Japan Science Cooperative Programme 21 new projects, 3 workshops, 20 exploratory visits were supported in the areas of molecular structure, spectroscopy & dynamics; advanced materials including nano-materials; surface and interface sciences including catalysis; modern biology and biotechnology including biomedical sciences; manufacturing; and space science. Support continued to 42 on-going joint projects. About 150 exchange visits of scientists were taken place under the joint projects. A Mizushima-Raman Lecture was delivered by eminent Indian scientist in Japan under this program. 4 Indian scientists were deputed for participation in the ASIAHORC Symposium on Biomedical Research including infection, immunity and vaccine. A DST-JSPS Asian Academic Seminar and Winter School on "Manufacturing Science" were organized at IIT, Bombay during December, 2012. About 55 students and 50 scientists from Asian Countries were participated in the Seminar and Winter School.

  Support continued to 22 ongoing projects the area of information and communication technology under DST-JST S&T Cooperation Programme.

- **Mexico:** The Fourth Meeting of India-Mexico Indo-Mexican Joint Committee on S&T (JCST) was held on July 17, 2012 in New Delhi. *The JCST approved 15 joint projects* in areas of seismicity, physics, and water, statistics, chemistry, and health sciences *for support.* Decision on 4 projects was deferred. In addition, JCST also decided to organise 5 joint workshop on *i)* Water*; ii)* Biotechnology*; iii)* Health*; iv)* Seismology and *v)* Nanotechnology*; announce* Joint Call for proposals in 2013 and encourage exchange visits of young faculty and researches (upto three months to work in each other's laboratories) under the approved projects.

- **Netherlands:** 5 joint projects in the area of bio-medical devices are being supported. Bilateral workshops in the areas of Smart Materials and Smart Grid (energy) were held. Call for new proposals in thematic areas of functional materials have been made and 22 proposals have been received. These are being assessed. A new programme DIWALI (Dutch India Water Led Initiative) has been launched and an interaction meeting with Indian and Dutch water scientists and industry were organized. Details of the collaboration in this sector are to be worked out.

- **Norway:** Support to 3 on-going projects was continued. 2 new collaborative projects in the area of Changes in Mass Balance of Glaciers/Rivers etc were also sanctioned during the year.

- **Portugal:** 10 new projects in areas such as new materials, smart textiles, microelectronics, mechanical engineering, health and biotechnology were approved for implementation. In addition, 30 on-going projects were continued to be supported.

- **Republic of Korea (South Korea):** 5th Joint S&T Committee was held on 11th December 2012. Support to 20 on-going joint research projects was continued and 6 new projects were approved in the areas of Energy and Environment.

- **Russia:** Cooperative activities continued under ILTP Phase II and the DST-RFBR program, under which over 100 joint R&D projects were supported this year in areas covering basic and applied sciences. Fresh call for proposals was made this year and new proposals are being received. 6th meeting of the Indo-Russian Working Group on Science & Technology was held at New Delhi in

October 2012. A new memorandum of cooperation with Russian Ministry of Education & Science for cooperation in Science, technology and Innovation was concluded.

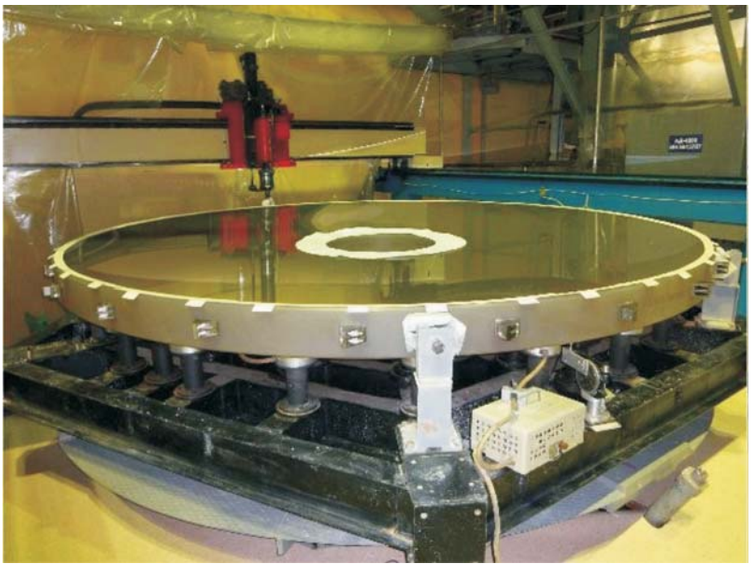


Fig. 8.4 : The primary mirror of 3.6m optical telescope at LZOS workshop in Russia.

- **Slovenia:** 13 joint R&D projects in areas of health & biomedical sciences, metallurgy & new materials, polymer chemistry, mathematics, electronics, and alternate energy sources were continued to be supported.

- **South Africa:** Support to 3 mega networked project in the area of HIV/AIDS and Tuberculosis with involvement of multiple institutions on both sides was continued. In support continued to 29 ongoing joint research projects. Two joint workshops in the areas of Astronomy and indigenous knowledge systems were organized.

- **Spain:** Under Indo-Spain S&T Programme of Cooperation, 18 new projects were supported in the areas of Renewable Energy, Nanotechnology, Information Technology and Health and Medical Research and support continued to 25 ongoing joint research projects in the areas covering renewable energy, information technology (including computer science), health and medical research, life science and biotechnology (including pharmaceuticals), agriculture technology & food processing, nanotechnology continued. About 100 exchange visits of scientists taken place under these projects.

- **Sweden:** Continuation of support to 5 ongoing projects in the area of embedded systems was provided. The next meeting of the Indo-Swedish joint committee on Science & Technology is planned in January 2013 to finalise the programme of cooperation for next 3 years.

- **Switzerland:** 11 new projects were sanctioned for support by both sides in the areas of of medical health (including Infectious diseases) and nanotechnology. Another 10 new joint research projects in basic research with participation of Ph.D students were also sanctioned jointly covering all areas of science & technology.

- **Taiwan: Su**pport to 30 on-going projects was continued and 10 new projects were approved in the areas of seismology& disaster management, nano-technology, tropical and infectious diseases, natural

product chemistry, structural biology; functional genomics & development biology, ICT, renewable energy including storage devices, micro/nano-electronics and embedded systems.

- **Thailand:** Under the Indo-Thai Programme of Cooperation with Thai Ministry of Science & Technology, the first joint call for proposals was launched. Seven joint proposals were approved against this call.

- **Tunisia:** 5 ongoing projects were supported in the areas of medical sciences, materials and biotechnology. A fresh joint call for proposals was launched.

- **UK:** Two new major initiatives were launched between DST-RCUK for supporting joint projects on 'Bridging the rural/urban divide' for providing technological solutions to improve the quality of life of rural inhabitants in both countries; and 'Next generation fuel cell technologies' for application towards renewable and clean energy source and "solar Energy Research" aimed towards development of solar photo-voltaic systems. Three workshops were supported to develop future collaborative programmes on Advanced Manufacturing, Applied Mathematics and Smart grids. Proposals have been invited for joint collaborative research in the fields of smart grid, materials and mathematics. These are being assessed.

The program on India UK Science Networking between DST and Royal Society was renewed under which joint workshops, seminars and meetings would be supported in either country. Under this program, 15 bilateral events have been already supported.

Under DST-UKIERI program, 25 ongoing projects were continued in the areas of nano-science & technology and advanced materials, biotechnology including stem cell research, telecommunications, climate change and weather forecasting, new energy sources including hydrogen. 70 exchange visits of scientists from both sides have taken place under these projects. DST-UKIERI program was renewed and the new call for proposals has been launched.

- **Ukraine:** New inter-governmental agreement for cooperation in Science & Technology was concluded at New Delhi on 17th November 2012. 10 new joint R&D projects are being implemented in the areas of Astrophysics, Biology, Chemistry and Medical Sciences.

- **USA:** Second Meeting of Indo-US Joint Commission on Science & Technology was held at Washington, DC during 8-13 June, 2012. The joint commission reviewed he on-going activities and identified action plan for 2012-14. The action plan includes the supporting of joint projects, joint workshops, exchange visits of scientists, and establishment of virtual networking centers in the areas of Basic and Applied Sciences, Atmospheric, Environmental and Earth Sciences, Health and Medical Sciences, Data sharing, Science, Technology, Engineering and Mathematics (STEM) Education, Innovation, Women in Science

Support continued to two ongoing projects under the International Materials Network Program of NSF. India also became a Governing Board member country of the Global Research Forum established at the behest of NSF and hosted the Asia chapter of the meeting in New Delhi.

- **Vietnam:** Support to on –going five new joint research projects was continued in the areas of smart antennas for mobile communications; power source converter for AC photovoltaic' s; etc.

Bilateral Workshops

Nearly 40 joint S&T workshops/ symposia and training programs were supported in India and abroad in partnership with Australia, Brazil, Bulgaria, Finland, Germany, Japan, Myanmar, New Zealand, Russia, South Korea, South Africa, Spain, Switzerland, Taiwan, and UK. These activities were aimed towards information dissemination, networking and human capacity building and also helped to define the common areas of mutual interest for initiating cooperation with these countries.

Industrial R&D Programs

For ensuring that R&D output is translated beyond the realms of the laboratories and the outcome reaches the market, bilateral initiatives directed towards scaling and commercialization of R&D outputs by providing financial assistance as well as networking with appropriate R&D organizations and industry partners on bilateral level have been initiated with chosen partner countries like Israel, Canada, Germany, Sweden, Switzerland Taiwan, and United States.

Department had signed an MOU with the Confederation of Indian Industries (CII) for setting up of the Global Innovation and Technological Alliance (GITA) as a not for profit society in public-private partnership mode as a vehicle for implementing bilateral Industrial R&D programs with various partner countries. GITA was been registered as Section 25 not for profit company in December 2011 for the above purposes.

Fig. 8.5 : Inauguration of the GITA logo at Vigyan Bhawan in New Delhi on the Technology Day, 11 May 2012

Joint R&D Centers

Thirteen joint virtual R&D centers with networking between Indian and institutions abroad were continued to be supported. These Centers have been built on complementarity around existing capabilities, strengths and infrastructure towards optimal utilization of resources and also build human capital through seamless networking and mobility. These centers are basically meant for facilitating focused and integrated interaction and collaboration through networking of capabilities and infra-structure between Indian and partner country (Russia, France and Germany) institutions in identified fields of mutual interest so as to leverage each other's strength to address research problems in quick and holistic manner.

Fellowships/Internships

Outgoing Fellowships for Indians:

- 8 students in the area of Life Sciences have been deputed to Japan to meet Japanese Nobel Laureates under the HOPE meeting.
- Lindau Nobel Laureates Meeting: 18 students and young researchers in the areas of Physics were deputed to Germany for participation in the Meeting of Nobel Laureates and students, during June/ July 2012.

Fig. 8.6 : Indian students with Nobel laureates – at Lindau Nobel Laureates Meeting 2012.

- 10 Indian PhD students were awarded fellowships to work in Swiss R&D institutes for up to 12 months duration under Indo-Swiss Research Fellowship program.
- 4 Indian young scientists were supported under DST-MPG Fellowship program to conduct research in Germany.
- 10 Indian Ph. D students have been selected under the India-Korea Research Internship Programme. These students would be working in the Korean Institutes / Universities for about 3 to 12 months.

- 29 bright and meritorious undergraduate students from across the country along with three supervisors in the 6th Asian Science Camp 2012, held at Hebrew University of Jerusalem, Israel, during August 25-30, 2012. It was a 6 days inspiring / life changing moment for around 270 selected bright students, supervisors and leaders from 21 Asian countries, who were engaged in the discussion, interaction and learning and sharing the thoughts and ideas with 6 Nobel Laureates and 10 world class scientists in the fields of Physics, chemistry, mathematics, biology and medicine.

Incoming Fellowships for Foreign Scientists to India:

- CV Raman International Fellowship: Third call for CV Raman International fellowship for African researchers was made this year. Over 600 applications from 37 African nations were received and assessed. About 125 candidates would be recommended to avail this fellowship in three different categories: Post- Doctoral Fellowship, Visiting Fellowship and Senior Fellowship during 2013-14.

- 10 Swiss PhD students were awarded fellowships to work in Indian research.

- 2 Korean students have been selected under the India-Korea Research Internship Programme. These students would be spending about 3 months in the Indian institute / laboratory.

International Advanced Research Facilities

Facility for Anti Proton Research (FAIR): India became participating member with share- holding at the Facility for Antiproton and Ion Research (FAIR) at Germany. India would be contributing around 3 % of the total construction cost of the FAIR. The FAIR Convention and other documents are being finalized outlining the scientific role of India.

Indian beam-line at KEK Japan: **The "Indian beam line" at KEK Tsukuba** has started working with simple experiments and Indian scientists from SINP, Kolkata; Institute of Technology (BHU), Varanasi; SNBNCBS, Kolkata; UGC-DAE Consortium for Scientific Research, Indore and BARC, Mumbai have been doing experiments using the facility at the KEK. An average, 30-40 experiments is being carried out be Indian scientists every year on this facility.

Bilateral Joint Centres

- **Indo-French Centre for Promotion of Advanced Research:**

  IFCPAR, India's first bilateral International S&T organization has completed its 25 years of existence in 2012. This year Centre has supported 18 new collaborative projects in the areas of Computer Science, Life and Health Sciences, Pure and Applied Physics, Pure and Applied Chemistry, Earth and Planetary Sciences, Material Sciences and Information Technology. Academia-Industry linkage has been strengthened by supporting two new projects for finding solutions for the development of diagnostics tool for Colorectal Cancer and improving the shelf-life of Indian muskmelon. Six seminars supported in the areas of Information Communication Technology, Material Science, Micro Nano Technology, Atmospheric Sciences and Water Management by the Centre have brought together around 200 scientists from India and France to share the knowledge in the advanced areas, relevant to both the countries.

  To commemorate 25 years of the Centre, two seminars were held in India and France for showcasing the successful projects of IFCPAR. Two seminars in advanced Mathematics and Energies for the

future have been supported to identify future research areas of bilateral interest. Prof. Jules Hoffmann, Nobel Laureate 2011 in Medicine/Physiology was invited to deliver lecture on innate immunology of Drosophila in the cities of Delhi, Pune, Hyderabad, Chennai and Bangalore. On this occasion, a Special Publication on "CEFIPRA at 25" has been brought out.

Fig. 8.7

- **Indo-German S&T Centre (IGSTC): Indo-German Science & Technology Centre:** Indo-German Science and Technology Centre (IGSTC) , inaugurated in December 2010 with an aim towards Indo-German Strategic partnership for joint research projects of industrial relevance through substantive interactions among Government, academia and industry. In last one year, IGSTC has launched eleven (11) major projects on PPP mode with 44 partners in the areas of Biotechnology, Solar-Thermal, Advanced Materials & Nanotechnology, Energy & Environmental Research and Information Technology with commitment of funding to the tune of Rs.30crore by both sides. All the projects with well defined deliverables are being partnered by R&D intensive companies from India and Germany jointly with academia and research institutions.

IGSTC has also launched its call for joint scientific workshop/ brain storming meetings alongwith the call for 2+2 projects to be taken up in the near future.

- **Indo-Russian S&T Centre:** The Delhi NCR unit of the Indo-Russian S&T Centre (IRSTC) was inaugurated in April 2012. Indian side visited few Russian scientific and production centres in Sep 2012 to make assessment and prepare detailed feasibility report on select technology products. Russian unit of the Centre hosted Indo-Russian Round Table meeting at New Delhi in October 2012 to showcase some of their technologies.

- **Indo- US S&T Forum: 25 bilateral workshops and 3 training schools** were supported on thematic areas of interest. These include topical areas such as Technology commercialization through public-private sector partnerships; Advanced modeling and data assimilation for tropical cyclone predictions with special reference to the hurricane weather research and forecasting (HWRF) system;

"Triple trouble": malnutrition, tuberculosis and HIV in India; Space situational awareness, space weather and debris research; Cloud computing and web services; Systems architectures for big data; Women engineers leading global innovation; Nutrition practice guidelines for type-2 diabetes mellitus: sharing evidence and best practices to improve patient outcomes; Disorders of the developing brain; Frontiers in cancer biology and therapeutics; Industry-academia interaction in advanced biotechnology and drug discovery; Internet-driven computer vision; Chromosome stability; Fostering synergistic collaborations to accelerate big data applications, etc.

25 **Fellowships** were awarded to Indian scientists in the areas of atmospheric and earth sciences; chemical sciences; engineering sciences; life sciences; medical sciences; mathematical and computational sciences; and, physical sciences. Researchers chosen from academia and laboratories hail from a variety of backgrounds such as Cancer biology and target-based drug discovery, Probabilistic structural mechanics, Hydrological modeling for snow and glacier covered area under climate change scenario, Soft matter physics and nanotechnology, Organic photovoltaic, etc.

About 8 **R&D Knowledge Networked Centers** were established towards promoting collaborative research activities. Support continued to the 4 ongoing Indo-US joint Centers of Research Excellence (CRESE).

3 projects were awarded in the areas of 'Healthy Individuals' and 'Empowered Citizens' under the **Indo-US S&T Endowment Fund.**

- **Indo- US S&T Forum: Indo- US S&T Forum: 25 bilateral workshops and 3 training schools** were supported on thematic areas of interest. These include topical areas such as Technology commercialization through public-private sector partnerships; Advanced modeling and data assimilation for tropical cyclone predictions with special reference to the hurricane weather research and forecasting (HWRF) system; "Triple trouble": malnutrition, tuberculosis and HIV in India; Space situational awareness, space weather and debris research; Cloud computing and web services; Systems architectures for big data; Women engineers leading global innovation; Nutrition practice guidelines for type-2 diabetes mellitus: sharing evidence and best practices to improve patient outcomes; Disorders of the developing brain; Frontiers in cancer biology and therapeutics; Industry-academia interaction in advanced biotechnology and drug discovery; Internet-driven computer vision; Chromosome stability; Fostering synergistic collaborations to accelerate big data applications, etc.

  28 Research **Fellowships** were awarded to Indian scientists to get exposure in US S&T institutions for a period of 3 to 12 months. **30 biotechnology students were also supported under the Khorana scholarships** for summer internships at Univ. of Wisconsin, Madison and 6 other CIC US universities and **10 computer science/ engineering students** were supported for internships at Viterbi Colleg of Engineering, University of Southern California. A new program on technology transfer training was initiated with first batch of 12 biotechnologists trained at University of Wisconsin, Madison. **15 US students** were also supported for internship in Indian S&T institutions. 4 Fellowships were awarded under the Stanford India Biodesign program.

  Exchange visits of 24 faculty and students were supported under IUSSTF's collaboration with American Physics Society and American Society for Microbiologists.

  About 8 R&D Knowledge Networked Centers were established towards promoting collaborative research activities. Support continued to the 4 ongoing Indo-US joint Centers of Research Excellence (CRESE) and 20 R&D knowledge networked centres.

Strategic Programs:

3 joint projects were awarded in the areas of 'Healthy Individuals' and 'Empowered Citizens' under the **Indo-US S&T Endowment Fund** for S&T innovations leading to commercialization for societal benefit.

The IUSSTF has been entrusted by the Ministry of Science & Technology to administer the Indo-U.S. **Joint Clean Energy Research and Development Center** (JCERDC), a joint initiative of the DST, DBT and the U.S. Department of Energy to facilitate joint research and development on clean energy needed to deploy these technologies rapidly with the greatest impact. For this program, both governments have pledged $5,000,000 (about Rs. 26 crore) per year for five years, with matching commitment by the private sector.

After an intensive multi-level review and evaluation process, three consortia (one each in the three priority areas: Solar Energy, Second Generation Biofuels and Energy Efficiency of Buildings) were selected for award in April 2012. This first-of-its-kind initiative has brought together more than 90 Indian and US institutional and industrial partners to work jointly in the space of clean energy research.

Fig. 8.8 : US Secretary Clinton meets Rustom Irani and Sorin Grama, winners of the first U.S. India Science and Technology Endowment award for their cold-storage technology to reduce agricultural produce spoilage.

INTERNATIONAL MULTILATERAL REGIONAL S&T COOPERATION

International Multilateral Regional Cooperation Division (IMRCD) of Department of Science and Technology (DST) continued to play its mandated role in fostering India's regional and multilateral science and technology cooperation frameworks at inter-governmental level with a view to make a positive contributions, gainful consequences and spin offs in : (i) Enlarging India's pursuit of influence in global arena/platforms and mainstreaming Science, Technology and Innovation (STI) into international science diplomacy and foreign relations; (ii) Moving up the ranks for India's scientific excellence in the global research landscape; (iii) Leveraging foreign alliances and partnerships to accelerate key priorities and

programs devoted to strengthening India's national science and technology (S&T)/Research and Development (R&D) competencies-capabilities-access to technologies.

India's regional and multilateral S&T cooperation related functions performed during the year included the following:

- Coordination of negotiation, conclusion,implementation and monitoring of India's international regional and multilateral S&T cooperation agreements/frameworks and related S&T Program of Cooperation's **(India's S&T Cooperation with EU,ASEAN, IBSA, BRICS, BIMSTEC, SAARC, ACD);**
- India's engagements vis-à-vis S&T aspects of UN and other international organizations **(India's S&T engagements with NAM S&T Centre, UNESCO-TWAS-ICTP,UNCSTD, OECD, IOR-ARC);**
- Indian perspectives at S & T Ministerial Multilateral Platforms and its spin offs **(Carnegie Group Meetings and its spin offs like GSO-GRI) ;** and
- Strategies, opportunities for India's engagements with Indian S&T Diaspora (STIOs abroad) and related collaborative R&D activities/projects **(DST's CP-STIO Program, MOIA Global INK Platform, PM Global Advisory Council-Overseas Indians Steering Committee's HRD-KBE component).**

These functions in sync with India's overall foreign policy were carried out by IMRCD, DST in close consultation with Ministry of External Affairs, Ministry of Commerce and Industry, Ministry of Human Resources Development (MHRD), Scientific Ministries/Agencies, National Scientific Expert Committee on the Indian side and with DST (IMRCD) counterparts abroad for regional-multilateral entities-UN and international organizations dealing in S&T.

Salient Achievements during 2012-13

India-European Union S&T Cooperation

i. India-EU signed Joint *Declaration on Research and Innovation* Cooperation

Science and Technology Cooperation plays an important role in the India-EU Strategic Partnership. India-EU S&T Cooperation has reached the new height when the European Commission and the Indian Government signed Joint *Declaration on Research & Innovation Cooperation* during 12th India-EU Summit on 10 February, 2012.

Fig. 8.7: Exchange of document signed by Dr. Ashwani Kumar and Mr.Karel De Gucht Those witnessing are : Dr.Manmohan Singh, Prime Minister of India & Mr. Jose Manuel Durao Barroso, President of European Commission

The *Declaration* was signed by Karel De Gucht the Commissioner

for Trade and by Dr. Ashwani Kumar, Minister of State for Science and Technology. The *Declaration* reflect commitment of Indian and EU Governments to step up the S&T cooperation towards building an 'Indo-European Research and Innovation Partnership' by: (i) enhancing the scale, scope and impact of cooperation actions (ii) focusing on common societal challenges and (iii) building on the synergies between India, the EU and its Member States. This Joint Declaration will further strengthen the existing cooperation under the umbrella of the EU-India S&T Cooperation Agreement signed in 2001.

ii. India-EU/Member States adopted *Brussels Communiqué* to deepen science and business links during 2nd India-EU Ministerial Meeting at Brussels on June 1, 2012

The 2nd India-EU/MS S&T Ministerial Meeting was hosted by the Danish Presidency of the European Union with the participation of Ms Máire Geoghegan-Quinn Commissioner, DG Research and Innovation; Morten Østergaard, Danish Science and Innovation Minister; Shri Vilasrao Deshmukh, Indian Minister of Science and Technology and Earth Sciences; and representing the past and future EU Presidencies - Barbara Kudrycka**,** Polish Minister of Science and Higher Education representing and Stavros Malas, Cypriot Minister of Health.

A 'Brussels' Communiqué' was adopted on the occasion wherein Ministers agreed to:

- Jointly develop a *Strategic Research & Innovation Agenda(SRIA)* for medium to long term India-EU/Member States Partnership for addressing societal challenges of common interest such affordable healthcare, sustainable environment and water, bio-economy, agriculture, energy

Fig. 8.8:From left to right: Mr Stavros MALAS, Cypriot Minister for Health; Ms. Barbara KUDRYCKA, Polish Minister for Science and Higher Education; Mr Morten OSTERGAARD, Danish Minister for Science, Innovation and Higher Education; Mr Vilasrao DESHMUK'H, Indian Minister for Science and Technology and Earth Sciences; Ms. Maire GEOGHEGAN-QUINN, Member of the European Commission; Mr R.A. MASHELKAR, President of Global Research Alliance and Advisor to Indian Prime Minister.

and transport, ,ICT as well as covering the whole innovation chain from research to development and the deployment of innovative and affordable solutions.

- Establish a Group of Senior Officials (GSO): a three tier structure for streamlining governance of Indo-European S&T cooperation at bilateral-multi-country-multilateral levels especially in addressing STI based solutions for tackling major societal challenges of common interest.

- *Support setting up an industry-driven India-Europe stakeholder group for research and innovation.* This group could ensure effective involvement of industry and other research actors in defining and implementing the *Strategic Agenda.* Particular attention may be given to promote cooperation between European and Indian SMEs notably for the co-development and for deployment of affordable and innovative products and services.

Further, both sides agreed for the next India-EU S&T *Ministerial Meeting* to be will be organized in India in 2014.

iii. India-EU/Member States Stakeholders' Conference for Indo- European Research and Innovation Partnership

In parallel with India-EU S&T Ministerial Meeting, India-EU/MS Stakeholders' Conference on Research and Innovation Partnership was organized jointly by DST and DG Research and Innovation, EC at Brussels during May 31- June 1, 2012. The main objectives of the stakeholder's conference was to identify research and innovation priorities where future Indo-European cooperation should focus on in the next 3 to 5 years and to devise new pathways/ instruments/ toolbox for implementation of future Europe-India collaboration, beyond 2012.

The conference was inaugurated by Indian S&T Minister Shri Vilasrao Deshmukh. In his key note address he said, there is political will for stepping of India-EU/MS cooperation in Research and

Fig. 8.9: Shri.Vilasrao Deshmukh Hon'ble Minister for Science and Technology and Earth Sciences, delivering Keynote Address at India-EU/MS Stakeholders conference

Innovation sector. Both EU and India recognize the value and opportunities offered by innovations. Small and Medium Enterprises are eager to cooperate. EU, Member States and India rely on Small and Medium Enterprises as drivers of manufacturing and economy. SME are ideally positioned to create demands for innovations and supply products at affordable prices to the consumers.

Over 200 European and Indian stakeholders (policymakers, scientists, students, industry representatives) from Government, academia, research institutions, industry gathered in this two day's Conference and extensively deliberated upon various issues of India-EU STI collaboration. The discussion and deliberation during the conference resulted in identification of common priority areas for future collaboration including roadmap with potential actions and delivery mechanisms to enhance Europe-India cooperation in research and innovation based on mutual interest and mutual trust,as given below:

In **health sector** ,infectious and non-communicable diseases, cardiovascular diseases, cancer, diabetes, hypertension, neurodegenerative etc.; **in Energy and Transport**: Smart cities, Photovoltaïcs, Bioenergy, Smart grid, Off-grids energy production, Hydrogen generation, Automotive (including for international standards), Energy storage (including batteries), Energy Efficiency; **in ICT**: Technologies for societal challenges such as use of ICT for delivering health services, especially to the elderly and rural population, Health information systems for increasing efficiency of health services, tele-education, ICT based solutions for efficient transportation & storage of food grains, Increase efficiency of food processing establishments and distribution systems, ICT based solutions for environmental monitoring and state of the environment assessment using advanced networked mobile sensor systems (air, land, and sea applications). A detailed Conference Report is available at EC and DST website.

iv. 8th EU-India S&T Steering Committee Meeting, was held at New Delhi on October 11, 2012

The 8th EU-India S&T Steering Committee meeting took place in New Delhi on October 11, 2012 under the co-chairmanship of Dr. T. Ramasami, Secretary DST from Indian side and Dr. Wolfgang Burtscher, DDG Research and Innovation, European Commission(EC) from the EU side.

Both sides agreed to build India-EU/MS Strategic STI collaboration based on principles of reciprocity and parity with co-investment of resources including funds for co-generation of values, knowledge, products and services through coordinated Joint Call joint Workshops/scientific Meetings/, Research Training; Sharing/ accessing large scale research facilities; Innovation Prizes etc. In this regard, the meeting among others agreed for:

i) creation of India-EU/MS Group of Senior Official; a three tier structure(GSO, GSO Working Group and Thematic Group) for streamlining governance of bilateral/multilateral India-EU/ Member State Research & Innovation Partnership at policy-framework-thematic expert's dialogue levels to provide solutions for tackling major societal challenges. It also subsumes participation of Industry at all three horizontal levels.

ii) development of India-EU Flagship Project on Affordable Healthcare with co-investment of resources with focus on diabetes, cancer, neurodegenerative and infectious diseases

iii) launch of New INDIGO –India DST Call on Energy & Transport;

iv) Endorsement of Expression Of Interest(EOI) for collaboration in imaging infrastructure in life sciences between Indian Bio imaging Consortium & EU Bio imaging Consortium;

v) building a monitoring mechanism for Indo-European water research & deployment projects that began in 2012;

Fig. 8.10

v. Kick-off Meeting for Launching India-EU Water Research and Innovation Projects

Kick-off Meeting for EU-India Water Research and Innovation Projects, was held in Bangalore on October 10, 2012. Four India-EU water research/deployment projects acronym as NAWATECH, SWINGS, ECO-INDIA and SARASWATI were launched during the meeting steered by DST designated Indian Scientific Expert Committee and EU Directorate of Research & Innovation (Environmental Research Unit). These projects aim at development of appropriate technologies for waste water treatment, recycling and reuse; and water purification. These technologies will be deployed at select Indian locations for its testing at pilot scale. Thus the collaboration seeks co-development / deployment of holistic, durable, most effective affordable, sustainable, socially viable, technology-based solutions to resolving societal challenges related to water. This unique opportunity, first of its kind, was attempted to connect India-EU S&T Cooperation with DSTs national mission on water technology, *WAR* [Winning, Augmentation and Renovation].

vi. India-EU Joint Projects in Solar Energy launched

In response to 2nd EU-India joint Call, two India-EU Solar Projects were co-funded to the tune of 3 million Euro equivalents from each side (DST & DGResearch,EC);

- ESCORT focusing advancement of *Dye Sensitized Solar Cell* technology for development of efficient Solar cell based organic and hybrid technology; and

- OISC/LARGECELLS- conjugated polymer & hybrid system for polymer based solar cells with enhanced efficiency,aiming at enhancing India participation in roll in roll manufacturing process testing and validation of materials and solar cells.

These multi partner projects would help in networking Indian and EU scientific institutions such as:

- IICT Hyderabad, IIT Delhi, SOPL Hyderabad, CEL Delhi; CNR Italy, EPFL Switzerland, IIT-IT, DSL UK from Indian and EU side respectively [under ESCORT] and
- NIIST Trivandrum, IISER Trivandrum, University of Madras, IISc, Bangalore, JNCASR Bangalore; UBT Germany, UOT Netherlands, Technical University of Denmark, Negev University Israel, Graphic-Electronic Denmark[under OISC/LARGECELLS] from Indian and EU side respectively.

vii. India-EU Collaboration in Imaging Infrastructures in Life Sciences

An India-EU Workshop on 'International Collaboration in Imaging Infrastructures in Life Sciences' was jointly organized by National Centre for Biological Sciences (NCBS) Bangalore and 'Euro-Bioimaging' in Bangalore on September 21, 2012, to identify and discuss synergies and potential collaborations in imaging facility resources (sharing,user access, services, training, facility operation-management at the national level and together with Euro-Bioimaging, operation.

DST participated in the workshop . This India-EU Workshop culminated in formation of an (a)'India Bio-imaging Consortium' coordinated by NCBS; (b) A joint Expression of Interest (EOI) by 'India-Bioimaging' and 'Euro-Bioimaging' for India-EU Bio-imaging resource sharing/collaboration with thrust amongst others on (i) training of Indian Bio-imaging facilities managers and users (ii) strengthening new techniques in Indian Bio-imaging facilities by leveraging Euro-Bio imaging expertise and (iii) accessing Euro-Bio-imaging facilities by Indian experts. The initiative was later endorsed by the 8th India-EU S&T Steering Committee.

viii. India-EU Seminar/information Campaign was organized

India-EU Seminars/Information Campaigns within India have been jointly organised, in an effort to step up outreach and dissemination of India-EU S&T collaboration opportunities that are co-funded or supported under FP7 within the ambit of India-EU S&T Agreement. These campaigns have found its impact whereby the India-EU S&T Agreement has:

- Directly influenced implementation/ approval of 16 India-EU research projects (out of ' 100 applications received) in solar energy, waste water management and reuse with co-funding of Euro 34 M (50:50 shared by EC and DST) based on India-EU Coordinated Joint Calls;
- Indirectly created favorable condition for participation of Indian scientists in FP7 Research Projects which resulted in India becoming the 4th largest country from outside Europe in FP7 (after Russia, USA, China) in key research areas of health, environment, energy, food agriculture and biotechnology .

ix. Mid-term Review of 5 India-EU projects in Computational Materials Science

The first EU-India Joint Call was launched in 2009 in the areas of Computational Materials Science. Total 6 projects were implemented with co-investment of 5 million Euro equivalents from each side.

The mid-term review of these projects was carried out in 2011 with the broad view of developing S&T output-input correlation and to receive feedback from scientist on how this new type of call has been received by the scientific community and how in their opinion DG RTD and DST have handled the call, in order to improve future potential calls and handling of the projects. Key ***achievements/ findings for these 5 India-EU research projects on computational materials science*** (at the mid term stage with evaluation criteria and joint evaluation procedure very clear up front.) being as follows:

- These projects are helping in generating critical mass of trained young researchers (-71 PhD/ Postdoc in niche areas of computational modeling for design and development of new micro and nano scale materials for industrial use such as hydrogen storage, GHG absorption materials, transition metal oxide based material for microelectronic devices;
- These projects are resulting in 105 publications in peer reviewed journals, with 10 joint publications involving at least one European & Indian scientist/author;
- Patents have been filed from Indian side under two of the India-EU projects (AMCOS, MONAMI);
- Two-way mobility trends revealed that relatively more of Indian research students visited Europe (25/14) while relatively more of European senior scientists visited India (36/21).

The specific added value of EU-Indian collaboration projects was summed up as: Better exchange of and access to bright students; Complementary expertise; Promotion of research ambassadors; Nucleation points for other research collaborations between EU and India; Overall the call was perceived to have been well focused and transparent;

ASEAN-India S&T Cooperation

i. 1st ASEAN-India Science and Technology Senior Official Meeting (S&T SOM)-cum-9th ASEAN-India Working Group on Science and Technology (AIWGST-9) held at New Delhi on September 11,2012

In run up to the ASEAN-India Commemorative Summit to celebrate 20th anniversary of ASEAN-India dialogue relations at New Delhi during Dec 20-21, 2012, the 1st ASEAN-India Science and Technology Senior Official Meeting (S&T SOM)-cum-9th ASEAN-India Working Group on Science and Technology (AIWGST-9) and 3rd Meeting of Governing Council of ASEAN-India Science and Technology Development Fund (AISTDF) was held at New Delhi on September 11-12,2012. The Meeting was co-chaired by Dr. T. Ramasami, Secretary, DSTon behalf of GOI and Dr. Mai Ha, Director General, DIC, Minister of Science & Technology, Vietnam on behalf of ASEAN .

The meeting envisioned development of ASEAN-India enhanced S&T partnership that focused on STI collaboration, sustainable and inclusive development ; thematic tracks for STI cooperation that appeal to and offer desirable impact on citizens of the two regions. The meeting also encouraged trans-national variable geometry approach for collaboration besides India's proactive initiatives to empower CLMV (Cambodia, Lao PDR, Myanmar and Vietnam) nations within ASEAN region. It also suggested hosting of ASEAN-India S&T Ministerial Meeting at Brunei Darussalam on Dec 1-

2,2012 on the margin of ASEAN Informal Ministerial Meeting on Science & Technology (AIMMST) to adopt joint vision and pathways on ASEAN-India Enhanced STI Cooperation beyond 2012.

The meeting approved 5 new ASEAN-India S&T collaboration activities viz (i) Participation of ASEAN Member States students in 20th Indian National Children Science Congress at BHU, Varanasi, Dec 27-31,2012(AIF); (ii) ASEAN-India Program on Quality Systems in Manufacturing to be implemented by NABL, India involving USD 153,000 for 3 years(AISTDF). (iii) ASEAN-India Workshop on Marine Biotechnology at NIO, Goa in 2013 with the support of USD 119,217 (AIF); (iv) Two ASEAN-India Flagship Programs under AISTDF framework in the field of Health (Malaria) & Disaster Management (Multi-hazard Early Warning Systems) (v) Maintaining USD 1 Million in AISTDF at any given time out of which ~USD 600,000 to be exclusively supplemented by DST in the FY (2012-13). The 3rd Governing Council of AISTDF which met on September 12, 2012, approved the proposed new ASEAN-India S&T activities for funding. Meeting noted that two ASEAN-India portals on Technology, Information & Commercialization and Intellectual Property and ASEAN-India S&T Digital Library may be co-launched around the ASEAN-India Commemorative Summit Meeting in India.

ii. ASEAN-India Technology Mission cum Expert Meeting on Functional Food

Thailand (Thailand Institute of Science & Technology Research) hosted the ASEAN-India Technology Mission cum Expert Meeting on Functional Food at Bangkok under the framework of AISTDF (ASEAN-India Science & Technology Development Fund). Representatives from India (CSIR-CFTRI, MoFPI, ICAR-CIPET) and 10 ASEAN Member States participated in this event. The meeting identified the research topics for 2012 ASEAN-India call for proposals such as : i) Enrichment of rice that has desirable nutrients ii) Tropical fruit and vegetable processing technology improvement and value added product development-diversification. iii) Alternatives for sugar-fat for combating growing incidence of diabetes and other related consequences (obesity, inflammation). It also agreed to the representation of Indian Scientific team in the 13th Biennial ASEAN Food Conference on Nutrition & Food Science at Singapore on Sep12-13, 2013 and organization of ASEAN-India Workshop on Functional Food Policy and Regulations.

iii. ASEAN -India Technology Mission/Workshop on Renewable Energy

The Workshop on Renewable Energy organized jointly by MNRE-DST- MEA-GITA-ASEAN Secretariat in New Delhi, India on 5-6 November 2012. The Workshop included a specific session on "2012 ASEAN-India Call for Proposals in Renewable Energy R&D"for identification of research topics of common interest.

Based on the deliberations at the session, the strategies proposed for strengthening India-ASEAN cooperation include:

- Organizing Study Missions from India to ASEAN region for exploring synergies and complementarities in various renewable energy areas
- Organizing ASEAN-India Joint Interaction Meeting for sharing experiences arising from new concepts such as: (a) renewable purchase obligation under electricity act, (b) feed-in-tariff system for renewable electricity being fed into national electricity grids, and (c) off-grid decentralized renewable options.

- Mapping of technology needs of India and ASEAN countries by GITA related to various renewable energy areas (such as solar, bio-fuels, hydrogen and wind energy).

Developing and implementing India-ASEAN joint programs and projects in renewable energy .

iv. ASEAN-India Commemorative Summit

ASEAN- India Commemorative Summit was hosted by India in New Delhi, India, on 20 December 2012, to commemorate the 20th Anniversary of the ASEAN-India Dialogue Relations under the theme of "ASEAN-India Partnership for Peace and Shared Prosperity". ASEAN Leaders welcomed India's consistent support for ASEAN integration, the ASEAN Community building process and ASEAN-India cooperation through contributions via ASEAN-India Fund (AIF), ASEAN-India Green Fund (AIGF), ASEAN-India Science & Technology Development Fund (**AISTDF)** as also through direct financial assistance to various research and development initiatives.

On this occasion, a ASEAN-India Vision Statement was issued wherein the Leaders adopted the following

- declare that ASEAN-India Partnership stands elevated to a strategic partnership ;
- will strengthen socio-cultural cooperation and promote greater people-to-people interaction through increasing exchanges in culture, education, youth, sports, creative industries**, science and technology**, information and communication technology and software, human resource development and scholarly exchanges;
- appreciated India's commitment to continue the special focus on the CLMV countries that represent a bridge between ASEAN and India by intensifying focus on human resource development and capacity building e-initiatives, particularly in the fields of information technology, **science and technology,** English language training, among others, efforts under the Mekong-Ganga Cooperation from the USD 1 million annual India-CLMV Fund.
- call for the formulation of specific initiatives to achieve the objectives of this Vision Statement, which would be funded through the AIF, AIGF, and AISTDF.

S&T Cooperation under BRICS Framework

i. BRICS Sherpa Meeting hosted by India on March 27, 2012

India is the current chair of BRICS (Brazil, Russia, India, China, and South Africa) Group. DST(IMRCD) participated in the BRICS Sherpa Meeting at New Delhi on March 27,2012 and contributed to finalizing the Para on BRICS STI Cooperation & Action Plan 2012-13 in the 'Delhi Declaration" during the 4th BRICS Summit hosted by India in New Delhi on 29 March 2012 and attended by the Heads of States of respective BRICS countries. The Joint Statement *Delhi Declaration* took note of the meeting of S&T Senior Officials in Dalian, China in September 2011, and, in particular, the growing capacities for research and development and innovation in BRICS countries. The leaders of the BRICS countries reiterated that BRICS countries must encourage this process both in priority areas of food, pharma, health and energy as well as basic research in the emerging inter-disciplinary fields of nanotechnology, biotechnology, advanced materials science, etc.,

and flow of knowledge amongst our research institutions through joint projects, workshops and exchange of young scientists. *Delhi Declaration* also approved Second BRICS Senior Officials' Meeting (SOM) on S&T to be hosted by South Africa.

ii. 2nd BRICS S&T Senior Official Meeting (SOM)

Pursuant to Joint Declaration of 4th BRICS Summit held in Delhi on March 29, 2012, the 2nd Meeting of BRICS Science and Technology Senior Official Meeting (SOM) was held at South Africa at Pretoria during November 7-8, 2012 and India participated in this meeting. Pentalateral BRICS S&T alliance and partnership was better perceived in the context of BRICS significance and identity in global affairs. Hurrying slowly for cohesive-coherent S&T projects approved involving all the 5 member nations was the consensus.

The 2nd BRICS S&T SOM discussed, amongst other things, Establishment of Framework of Cooperation (Operational Mechanism, MoU/ POC for 3-5 years,); Identification and prioritization of converging S&T thematic areas of cooperation (for Joint Workshops/Training /Joint Projects);Funding instruments/mechanism (that ensures co-investment of resources, including funds to undertake joint R&D projects). In this regard, the meeting among others agreed for:

i) Building upon the elements of and concluding BRICS Penta-lateral Memorandum of Understanding (MoU) on STI Cooperation which shall serve as a formal cooperative framework for BRICS S&T initiatives and consisting of articles devoted to scientific objectives, key principles guiding principles, thematic S&T priority areas , modes of cooperation, governance structure, financial and administrative norms etc ;

ii) Undertaking BRICS Thematic Meetings/Workshop during 2012-2013,with identification of lead country on the basis of their relative areas of strength, competence, importance for forging BRICS STI collaboration. In this regards the respective BRICS countries has indicated their willingness to take lead role in the specific areas as indicated below

Brazil: Climate change – Natural Disaster Mitigation;

Russia: Advanced Materials, Nanotechnology, Innovation

China : Renewable Energy – Solid State Lighting, New Energy Vehicle;

South Africa: Astronomy , Health -HIV, AIDS

iii) India hosting the 3rd BRICS S&T SOM in India around Nov.2013 and taking a lead role in working towards the conclusion of BRICS MOU on STI Cooperation as one of the key deliverable besides feedback from the 4 BRICS Thematic Workshops/Meetings scheduled during 2012-2013.

iii. BRICS Agricultural Expert Working Group Meeting

DST participated in the 2nd BRICS 'Agricultural Expert Working Group' meeting organized by the Department of Agricultural Research and Education (DARE), (ICAR) on 28th August 2012, at New Delhi. The Group deliberated on identified themes viz.(i) Creation of agricultural information base

system; (ii) Development of general strategy for ensuring access to food for the most vulnerable population ; (iii) Reduction of negative impact of climate on food security and adaptation of agriculture to climate change; (iv) Enhanced agricultural technology cooperation and innovation.

India tabled action points on 'Agricultural technology cooperation and innovation' which include inter-alia, establishing a strategic co-operative alliance; an agricultural technological cooperation forum; conferences and seminars and cooperation in the area of fisheries; development of biomass energy, crop residue recycling; conducting collaborative research on low carbon fishery technology, emission reduction of fission vessels, carbon sink function of aquaculture and recycling of aquaculture system etc.

DST proposed synergistic action by the two Departments in view of potential common actions points of Agricultural Expert Working Group and that of the Working Group on 'Science Technology and Innovation' which has identified STI co-operation in priority areas such as : Exchange in information on STI policies; food security and sustainable agriculture; climate change renewable energy; nanotechnology; basic research, technology transfer etc. through activities such as personnel exchange, joint training programs, sharing of mega research facilities and data, thematic workshops and collaborative research.

S&T Cooperation under IBSA

i. IBSA Nanotechnology Initiative Technical Review Workshop & back to back IBSA Meeting on Funding

Technical Review cum Workshop of "IBSA Nanotechnology Initiative Project (2009-2012)"supported under the IBSA S&T Cooperation framework, that had received funding from DST,CNPq & NRF on behalf of IBSA countries was organised at Pretoria. The salient feature which emerged during the meeting was scientific progress was made despite the heterogeneities in the financial systems and grants accessible to flagship project's scientific teams in IBSA Countries for the spectrum of collaborative activities under 5 thematic area Advanced Materials, Energy, Health, Water and Human Resource Development. All the IBSA countries had played an active role and co-funded human resource capacity building in nano science and technology through organization of 3 IBSA Nano-schools (Brazil in Energy; S. Africa in Health, India-in Advanced Materials) with 70—100 participants /nano school consisting of young researchers, faculty from all the relevant academia-research laboratories of IBSA countries. With regard to the way forward on the implementation of the IBSA Nanotechnology Initiative, the meeting agreed on the following:

- It was decided that IBSA Nanotechnology Initiative's Project Coordinators may redefine and realign the project proposal (clearly defined deliverables, milestones, project partners) through mutual consultations and submit the revised proposal within two months. South Africa indicated that from their side, a number of workshops have been conducted to re-define the project proposals. It was recommended that both India and Brazil then redefine and align the projects and this will be followed by a meeting between the respective countries on each area before submitting.

- It was agreed that the IBSA nanotechnology project would restart from 1 June 2012 with the initial duration of the project two years in order to match with Brazil project duration.

- To keep parity with Brazil, India and South Africa will cover all costs (domestic and international) of students when sending them to Brazil under the IBSA nanotechnology project. On the other hand, Brazil will cover all domestic and international costs when sending students to South Africa and India.

ii. IBSA Satellite Technical Meeting

India conducted IBSA Satellite Technical Meeting (hosted by ISRO, Bangalore on 23rd Oct, 2012), pursuant to the decision agreed in the 8th Meeting of IBSA Joint Working Group on S&T (at Pretoria in Oct 15, 2011). Participants from Brazil- S. Africa-India dwelt on the merits of developing IBSA Satellite and preliminary details of developing 100 kg IBSA Satellite for space weather applications and sharing technical responsibilities by each participating nation. All the three sides agreed to finalize the scientific objective of the proposed IBSA satellite for space weather studies, Prioritized list of instruments would be drawn based on the reliability and also its relevance to meet the scientific objective, to define the following through subsequent technical interactions: Orbits; Launch requirements; Satellite-launcher interfaces; Mechanical separation system; Mission-specific ground segment set up in three nations; Mission operation scenario; and Data policy and sharing and finally preparation of a Project Document adopting the template of IBSA Joint Working Group (JWG) on Science and Technology for exploring the feasibility for realization.

iii. Two IBSA Trilateral Workshops organized

Pursuant to the decision agreed in the 8th Meeting of IBSA Joint Working Group on S&T (held at Pretoria in Oct 15, 2011), India participated in two IBSA Workshops in the areas of Oceanography & Antarctic Research (in Brazil), Health Sciences (in South Africa).

INDIAN OCEAN RIM ASSOCIATION OF REGIONAL COOPERATION (IOR-ARC)

i. IOR-Academic Group (IORAG) Meeting

DST (IMRCD) participated in 18th IOR-AG Meeting at Gurgaon on Oct 29, 2012 and made interventions on behalf of India on 'IOR Regional Centre for Science, Technology and Transfer (RCSTT)' relevance, consultation with National Focal Point for developing regional scientific cooperation projects/action plans, and funding systems available for RCSTT driven initiations. The IORAG Action Plan for 2012-13 took on board DST's interventions viz., i) utilization of RTF-DCS Fellowship program by developing countries amongst IOR-ARC Member countries and ii) participation of IOR-ARC Member Country delegates in 100th Indian Science Congress at Kolkata during Jan 3-7,2013.

INDIA-CARNEGIE GROUP ENGAGEMENTS

i. India's Ministerial interventions in the 40th Meeting of the Carnegie Group

India participated in the 40th meeting of the Carnegie Group of Science Advisers to the Heads of the States/Government of G-8, O-5 nations (Brazil-India-China-South Africa-Mexico) and EU on June 29-July 1, 2012 at Constance, Germany. Secretary DST along with Head (IMRCD) as Souse Sherpa provided India's Ministerial interventions on three thematic issues during the course of the informal discussions , as given below:

(a) '**Research for addressing demographic changes'**-The Carnegie Group Meeting suggested making of an **inventory of policies of various countries** for responding to ageing & gender specific differentiated response to ageing, as well as enhanced international cooperation on disease prevention, biomedical devices for elderly, orthopedic- locomotor disabilities and neurodegenerative diseases. An **international frameworks to define and deal with international migrations and mobility** was also proposed by the Group. However, India favored bilateral and multilateral R&D partnerships on research areas relating to health care for ageing population. biomedical devices and implants required especially for the ageing population at affordable costs. India also proposed to have "Observer Status" to the European programme on "More Years, Better Lives". India also offered sharing its lessons and data on "Research for Enabling Elderly in Healthy Living". The change in paradigm of "Disease and Cure" to "Health, Prevention and Behavior" was proposed as a proactive societal response to demographical alterations.

(b) '**S&T Policies for Fostering Disaster Anticipation and Resilience'-** India, being one of the most vulnerable nation in the world to natural hazards, sought international cooperation in precursor studies, vulnerability assessment, improving reliability and spatial accuracy of prediction and flood modeling. India however was recognized for its competencies in Tsunami Warning Systems at INCOIS Hyderabad that has been issuing reliable and well time in advance advisories on tsunamis over Indian Ocean region. Recognizing that nations from region to region are vulnerable to different natural hazards and that integration of data from various sources for reliable monitoring-forewarning to vulnerable populations pose major challenge, the Carnegie Group meeting agreed for an **international meeting on disaster scenarios for different regions** that can be best addressed through international cooperation. India agreed and subsequently participated in the meeting jointly organized by EC, UN, and World Bank on 6th Dec.2012 at Brussels.

(c) '**Promoting International STI Cooperation for Transition to Green Economy'**.

India provided its view on major impediments in international cooperation on research and development of green technologies which could be grouped into issues of (i) global funding; (ii) right type of manpower and human capacity; (iii) institutional capacities for R&D on green technologies;(iv) essentiality of contextual referencing of green technologies to applications and (v) sharing / access to technologies. It also flagged the green technologies being in the private domains and governed by IPR regime and lack of 'special and differential treatment' provision to developing countries in the multilateral agreements as other issues. Innovations in policy paradigms to "include the excluded" by developing knowledge commons through public investments was suggested. India also shared its initiatives in the area and further suggested (i) creation of Global Green Economy Fund and (ii) Promoting North-South and Triangular North-South-South Cooperation in Green Technologies. The Carnegie Group meeting suggested setting up a '**Global Forum on Green Energy Technology"** under the aegis of German Academy of Sciences, for monitoring the programs in development of green economy; building more robust regulatory frameworks; putting in place effective communication strategies; and factoring innovation-reward relationship.

ii. Meeting of the Senior Officials of Carnegie Group, the United Nations and the World Bank on Disaster Anticipation and Resilience

DST (IMRCD) participated in the Senior Officials' Meeting of the Carnegie Group, the United Nations and the World Bank, organised by the Joint Research Centre of the European Commission on 6 December 2012 in Brussels. The meeting deliberated on need for identification of key areas of cooperation and good practices on disaster anticipation and resilience. Recognising that disaster anticipation and resilience is a global challenge requiring an increasing level of international cooperation, the meeting concluded that (i) More science is needed for developing expertise in disaster management; (ii) More robust data and modelling are needed; (iii) The links between science and policy and science and society are of utmost importance. It also suggested that cooperation could take the form of a Global Multi-Hazard Partnership (with focus on disaster risk reduction and climate change adaptation). It should create a framework allowing to build on already existing networks at regional level to tackle vulnerabilities that countries have in common.

iii. World-wide development and operation of Global Research Infrastructure (GRIs)

DST participated in the 3rd meeting of the Group of Senior Officials for Global Research Infrastructures (GSO-GRI), on 3-4 April 2012 at Hamburg, Germany and articulated key amendments to the "Draft International Framework for Coherent and Coordinated World-wide Development and Operation of GRIs" which inter-alia, included that aspects relating to development of GRIs such as funding; governance; remote control; monitoring; immigration policy of manpower have to be consistent with national laws-policies existing from time to time and that the national laws and strategies would take precedence over the international framework. India also insisted on option for both in-cash and in-kind contributions to the development of new GRIs, instead of the in-cash contribution only. Application of the framework initially on pilot cases of single sited, distributed and national facilities was proposed. India also identified and proposed globalization of two of its national infrastructures in astronomy viz. Indian Neutrino Observatory(INO) and 3rd station of Laser Interferometer Gravitational Wave Observatory (LIGO). The 40th Carnegie Group on June 29-July 1, 2012 at Constance, Germany, endorsed the draft framework as mature for finalization and circulation as 'suggestive guidelines' to national Governments/ Agencies.

INDIA-NAM S&T CENTRE ENGAGEMENT

i. 2nd Bureau Meeting of 12th Governing Council of NAM S&T Centre

The Second Meeting of the Bureau of the 12th Governing Council of the NAM S&T Centre was hosted by the Nepal Academy of Science & Technology (NAST) on behalf of the Government of Nepal at Kathmandu during 18th-19th March 2012. The meeting was chaired by Prof. Dr. Mahmoud M.A. Sakr, Vice President, Academy of Scientific Research and Technology (ASRT) of Egypt; Head (IMRCD) on behalf of Secretary DST as ex-officio Vice President of the Bureau ; and Ms. Mmampei Chaba, Chief Director, Department of Science & Technology (DST) of South Africa. In the Bureau meeting, DST offered support for three new international scientific programmes of interest to India to be implemented by the NAM S&T Centre during 2012-2015, viz. (i) An International Training Programme on Intellectual Property Rights (IPR) for Developing Countries; (ii) A Research Training Fellowship Programme for Developing Country Scientists (RTF-DCS) with India as the

Destination; and (iii) An International Workshop / Training Course on Science Diplomacy for Developing Countries. Further DST announced Govt. of India's decision for increasing its annual membership subscription to NAM S&T Centre from US$ 10,000 to US$ 20,000 to be paid by DST from 2012-13 onwards. This has led to around 10 other member countries taking up similar measures.

ii. Enhancement of India's annual membership contribution to NAM S&T Centre

Pursuant to decision taken by 2nd Bureau Meeting of the 12th Governing Council of NAM S&T Centre at Kathmandu in March, 2012. GOI doubled the annual membership contribution to NAM S&T Centre from USD 10,000 to USD 20,000 from FY 2012-13 onwards. The increase has been effected as India is convinced about an important role is being played by the NAM S&T Centre in South-South Cooperation through a wide range of international scientific activities for self-reliance, human resource development and finding tangible solutions to the issues where S&T may make a meaningful difference. India is also cognizant of more and more countries taking membership of NAM S&T Centre and sustained enthusiasm of its member countries to send their nominees to various international scientific activities being implemented by NAM S&T. With this proactive step, other member countries are taking similar steps in raising their current level of annual subscription in view of the tangible and intangible gains accruing to member countries of NAM S&T Centre.

Acknowledgement of NAM S&T Centre's contributions during 16th NAM Summit at Tehran
The 16th Non-Aligned Movement **(**NAM**)** Summit at Tehran, Iran on Aug 26-31,2012 adopted a declaration and, under the South-South cooperation, vide para 482.7, recognised the positive contribution of the Centre for Science and Technology of the Non-aligned and Other Developing Countries, located in India, and expressed support for its strengthening cooperation in the field of science and technology.

iii. "International Advanced Training Program on Contemporary Strategies on IPRs for Developing Countries"

DST sponsored an "International Advanced Training Program on Contemporary Strategies on IPRs for Developing Countries" organized in India by NAM S&T Centre at Manesar , Gurgaon, on July 16-20, 2012. The training programme was attended by 36 trainees from 25 countries of Asian-African-Latin American region. Secretary DST inaugurated the programme and remarked that India in its lead role focused on sharing experience amongst the participating countries during this training program.

Indian experts dwelt upon elements including (i) the changing grammar of IPR and new formations outside WTO & WIPO (ACTA,IP5 etc.,), that are impacting developing countries differently than the rest ; (ii) nature of asymmetries in access to IP in crucial domains of health, agriculture, traditional knowledge and practices, ICT; (iv) instances such as 'Doha Declaration on Public Health' that represented a collective stand of several developing countries in playing with the flexibility provisions within TRIPS for the broader concerns of affordable healthcare to masses. The participants from various countries also provided useful feedback facilitated by DST, GOI and NAM S&T Centre for added coverage in future IPR Training Programs

iv. Research Training Fellowship for Developing Country Scientists (RTF-DCS)

As a follow up of the offer made in the 2nd Bureau Meeting of 12th Governing Council of NAM S&T Centre Bureau meeting as indicated above, DST has assigned the responsibility of implementing the second phase of its programme on 'Research Training Fellowship for Developing Country Scientists (RTF-DCS)' for the five year period (2012–2017) upon the NAM S&T Centre; DST awarded a grant of Rs.5.03 crores for Phase II RTF-DCS Program. This scheme aims at capacity building of developing countries in S&T by giving opportunities of affiliation of incoming 20 deserving young scientists and researchers from NAM member countries and other developing countries each year with premier academic and research institutions in India for a period of six months with full financial support including their international travel ,local hospitality, consolidated fellowship,research contingent grant etc. .

The NAM Centre initiated action towards implementation of this new flagship scheme. Detailed guidelines for the fellowship programme were prepared in consultation with the International Multilateral & Regional Cooperation Division (IMRCD) of DST and about 150 leading Indian research and academic institutions were contacted seeking partnership in RTF-DCS, out of which **63** institutions consented for affiliation of some Fellows with them. In response to the announcement for 2012-13 circulated in September 2012, more than **300** applications were received out of which **181** applications from **40** developing countries were short-listed for further consideration of the Indian institutions and final selection by an International Selection Committee.

INDIA-OECD ENGAGEMENT

i. India-OECD S&T Engagement and Policy review

In order to recalibrate Department's S&T engagement with the Organization for Economic Co-operation and Development (OECD) - an inter-governmental organization consisting of 34 member countries, DST assessed its interactions and participation in various activities of OECD. It was decided that while DST may continue with its ongoing S&T engagements with OECD, areas for future cooperation/engagements should be crystallized. Accordingly, in view of DST's mandate and in conformation of India's current policy of sectoral engagements with OECD, subsequently endorsed by MEA, it was decided that DST should participate as regular Observer in the Committee for Scientific and Technological Policy (CSTP). Observership will facilitate association with Working Groups on Experts in Science and Technology Indicators (NESTI); OECD Global Science Forum (GSF); Working Party on Technology and Innovation Policy(TIP); Working Party on Research Institutions and Human Resources(IRHR); Working Party on Nanotechnology (WPN); Steering Group on Governance of International Cooperation on Science, Technology, and innovation for Global challenges(STIG) and OECD Global Forum on the Knowledge Economy. Such engagement will enable India/DST influence the work agenda of CSTP / OECD by making them appreciate and learn from India's knowledge, understanding and experience and incorporate its perspective in the OECD's policy recommendations.

INDIA-UNESCO S&T COOPERATION

ii. Participation in the Meeting of Indian National Commission (INC) for Cooperation with UNESCO and Natural Sciences Sub- Commission deliberations

On behalf of Secretary DST as the Chair of INC Natural Sciences Sub-Commission, DST (IMRCD) officers participated in the July 31,2012 Meeting of Indian National Commission (INC) for Cooperation with UNESCO, chaired by Hon'ble Minister for Human Resource Development, and its constituent, INC's Natural Sciences Sub- Commission deliberations.

Current and new engagements for UNESCO-India S&T Cooperation were discussed by Natural Sciences Sub-Commission members (DST, DBT, MoEs, MoE&F, ICAR, ICMR Reps, & Prof. Sibajit Raha, Bose Institute as an individual member). DST tabled the following proposals for new engagements with UNESCO:

- India may support UNESCO declaring 2014 as International Year of Crystallography. It would allow India to showcase its competencies by hosting regional & international events besides its engagements in regional and multilateral collaborative projects in this field.
- Indian expert scientists to be nominated on UNESCO Panel for Comprehensive Evaluation of its UNESCO Category-II Centres.
- UNESCO Study on International Migration and Mobility of Scientific and Technical Professionals. This could be gainfully used as an input for national policies on knowledge based economy and offer a basis for building international frameworks and collaborations.

  UNESCO may facilitate short-term visiting attachments of internationally distinguished scientists at Indian science education and research establishments (such as IISER, Universities etc.).

INDIA- TWAS ENGAGEMENTS

12th General Conference, 23rd General Meeting & Ministerial Session of The World Academy of Sciences (TWAS)

The 12th General Conference and 23rd General Meeting of TWAS was co-hosted by the Chinese Academy of Sciences (CAS), Tianjin Municipal People's Government, Ministry of Finance and Ministry of Science & Technology, Peoples Republic of China during18 -21 September, 2012. The meetings were attended by 9 Ministers of Science & Technology from Brazil-Argentina/South Africa -Kenya-Nigeria-Rwanda-Zimbabwe/China and India along with the Presidents of Research Councils and scientific agencies, distinguished scientists and international organizations across the world.

The Then Hon'ble Minister for S&T and ES Shri Vayalar Ravi made India's intervention in the Ministerial Session: STI for Economic Growth & Poverty. This statement included an inclination in favour of PAN- Africa doctoral fellowship program to be hosted in India to promote India as an S&T destination.

ENGAGING INDIAN S&T DIASPORA

i. Engaging Scientists and Technologists of Indian Origin (STIOs)

DST continued to engage Indian S&T Diaspora (STIOs) by facilitating visits of about 20 STIOs to Indian academic institutions and research labs to leverage their expertise in areas of national relevance under the Collaborative Projects with Scientists & Technologists of Indian Origin Abroad (CP-STIO) Program.

ii. Participation in the Steering Group of Prime Minister's Global Advisory Council of Overseas Indians (PMGAC- OI)

Prime Minister's Global Advisory Council of Overseas Indians (PMGAC- OI) has been functioning since 2009 with the objective to draw upon the experience, knowledge and skills of eminent people of Indian Origin in diverse fields. DST(IMRCD) participated in the 3rd Meeting of the Steering Group of PMGAC-OI convened by Ministry of Overseas Indian Affairs in New Delhi on July 30, 2012. The Steering Group dwelt upon Indian diaspora's engagements with home country on "Knowledge Transfer, Science & Technology and Higher Education Collaboration". DST apprised the Group about the S&T fields, that have attracted greater response for partnership of home country peers with STIOs viz. Biomedical Science & Technology, Materials Science & Engineering; Information and Communication Technologies and Environmental Sciences.

STATE SCIENCE AND TECHNOLOGY PROGRAMME (SSTP)

State Science & Technology Programme (SSTP) formerly known as *"Scheme for Assistance for development of State Councils for Science & Technology"* is the only scheme of the Central Government focussed on the specific objective of promotion of Science & Technology at state level. The scheme, formulated at the instance of Planning Commission, is being implemented by Department of Science & Technology (DST), Government of India since VI plan. The core support and programme support provided under the programme has played an important catalytic role and has encouraged and facilitated State Science & Technology Councils to act as nodal organization for planning, formulating, evaluating and implementing Science & Technology activities at State level. The core support provided by the department has enabled State S & T Councils to equip themselves with requisite S & T manpower and office infrastructure which has contributed to their effective functioning. The programmatic support, on the other hand, aims to demonstrate, through carefully chosen projects, the contributions science & technology interventions can make in development process of the State.

In order to give focussed attention to identification and demonstration of S&T projects including field trials, a special mechanism in the form of Core Group on State S&T Demonstration projects is present. The mandate of this Core Group is to facilitate identification of technologies developed in the S&T institutions and to facilitate their field trials and demonstration at a sizeable scale so that benefit of intervention are quite visible in various States. This group, in its two meetings considered 33 new projects in diverse areas of Socio-economic importance and also monitored 33 ongoing projects. The group recommended demonstration of specific indigenous technologies in the fields of bio-fuel, waste management, environment protection, energy efficiency, decentralized energy generation, organic farming concepts, mangrove protection and water purification at appropriate locations.

Some of the important achievements during the year under various activity heads of the programme are enumerated below:

1. Core Support to State S&T Councils

- Core support was continued to the State S&T Councils of 26 States/Union Territories. The support was oriented to S&T manpower to strengthen S&T capabilities of the State S&T Councils to undertake programmes in newer and emerging areas. An amount of ₹ 14.71 crores was provided under this during the year.

2. Demonstration Projects including Replication of Success Models :

Under this programme, technologies developed by national laboratories as well as by State S&T Councils were encouraged for field trials, demonstration and replication. Some of the major achievements were in the following areas:

- **Water Management:** Project initiated on, mitigating Water Crisis by Roof top rain water Harvesting structures for SC/ST households in drought prone region of Southern Andhra Pradesh. It is proposed to construct 400 Roof Top Rain Water Harvesting Structures for ST/SC population. Awareness would be created among masses for judicial use of safe drinking water.

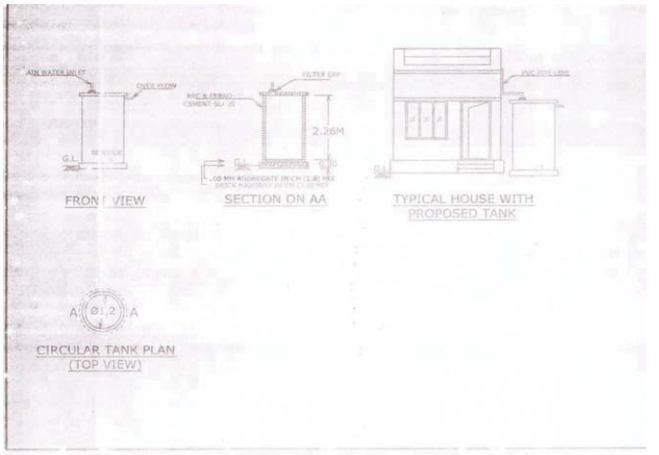


Fig. 8.11: Proposed drawing for Roof Top Rainwater Harvesting Structure

- **Mangrove Protection**: Project initiated on "Integrated Mangrove-Aquaculture for the Environmental Management and Socio-Economic Upliftment of Rural People in Kerala". Aquaculture is an important activity in the coastal zone of Kerala. But mangrove denundation for aquaculture is a major issue in this area. Rapid development of aquaculture in coastal areas has raised worldwide concern on its potential role in mangrove habitat loss. This is likely to cause serious hazards including vulnerability to cyclones, tsunami etc. Efforts to control mangrove deforestation and promote community based management of remaining mangrove forests as well as replanting would help to mitigate some of the worst impacts on coastal villages. Scientific and mangrove friendly type of aquaculture is the only alternative to boost up fish/crimp production. The present project proposes to introduce integrated mangrove aquaculture(silvofishery) model in selected coastal brackish water area covering nine districts in Kerala, as an attempt to make brackish water aquaculture more environmentally sustainable.

Fig. 8.12

Mangrove plantation in coastal area of Kerala

- **Waste Management :** A project on Demonstration of Waste Heat Recovery System (Recuperator) in Pulverized Coal Fired Steel Re-rolling Mills initiated in Punjab. The steel re-rolling mills operating in Punjab function at a thermal efficiency of 20-30% resulting in wastage of huge volumes of heat energy. Major heat loss (approx. 30-40%) is in the form of flue gases. Under the present project improved recuperators would be installed to recover waste heat from these gases, thereby enhancing the efficiency of industrial processes.

Recuperator at M/s. Lakshmi Steel Rolling Mills, Khanna, Punjab

- **Environment Awareness:** A project on Up-scaling of mass production of patented technology of organic endo-mycorrhiza and liquid formulation of a bio-pesticide was initiated in the state of Karnataka. The project involves standardization of up-scaling technology for mass production of organic endo-mycorrhiza *Glomus mosseae* and liquid formulation of *Trichoderma Viride. Glomus mosseae* is a very effective bio-fertilizer and *Trichoderma Viride* is an effective bio-pesticide. Under the project data on the shelf-life, toxicity which are required for the commercialization of the technology would be generated and technology would be disseminated for mass production of the products (OF-AMF-GM) among innovative farmers.

- **Environment Protection**: A project initiated on Promotion of environmental friendly plasma nitriding/nitrocarburizing process for wear and corrosion resistance of industrial components . This project aims at setting a plasma nitriding/ nitrocarburizing system at Central Tool Room(CTR), Ludhiana to cater to all the industries in Punjab for improving wear and corrosion resistance of industrial components. A survey indicated that most of the indutries get their components surface hardened by conventional surface hardening methods like gas nitriding and carburizing. this system will promote the use of eco-friendly plasma nitriding/ nitrocarburizing process, and increase awareness on this new technology to the local industries in Punjab. It is a collaborative project between CTR, Ludhiana and FCIPT, Gujarat routed through Punjab State Council for Science & Technology (PSCST).

- **Micro Hydel System:** A 3 X 100Kw MH system was commissioned at perennial river Sakthang Rong near Sange, Nyakmagongy, Dundri & Mohan Camp village in West Kameng district of Arunachal Pradesh. The project has been commissioned in a decentralized mode and completed in record time.

Fig. 8.13

Micro-hydel turbines with control Panel at Sakthang Rong, Arunachal Pradesh

- **SC/ST Upliftment :** A series of projects related to upliftment of SC/ST population involving integrated traditional livelihood sustaining activities initiated, in socially and economically backward areas of **Chhattisgarh**, **Karnataka, West Bengal and Tamilnadu**. These projects involve scientific interventions for sustenance of traditional livelihood skills like livestock rearing ,agriculture and vocational training in traditional crafts with people participation.

Fig. 8.14: Livestock rearing, nutritional garden & Vermiculture program in progress in tribal areas of West Bengal

3. Information Exchange

The fifteenth Regional Meeting for the North-Eastern Region State S&T Councils and Departments, was held at Nagaland Science & Technology Council(NASTEC), KOHIMA during 19-20th November, 2012. This meeting was organised in collaboration with Nagaland Science & Technology Council. The meeting was presided over and inaugurated by Sh. Neiphiu Rio, Chief Minister of Nagaland and Dr T. Ramasami, Secretary(DST), GOI . It was attended by S&T Secretaries of State

and State S&T Council Heads from North-Eastern region. In addition resource persons from different academic institutions, Universities, labs, central agencies, local NGOs and local central agencies were also present to share their experiences and help in mobilization of location specific projects and problem shooting. The theme of the meeting was "**Driving sustainable growth through Science & Technology".** The platform was used to review and discuss the status of the existing State level S&T structures as well as for identification of areas of mutual cooperation between State S&T Councils and Departments in their respective regions.

Fig. 8.15

4. Location Specific R&D and Technology Development

The programmes aimed to provide scientific intervention to local specific problem through development of new technologies / process for benefit of the society.

The following new projects /programme initiated :

"Establishment of a Rural Training Facility at Hyderabad to Provide Comprehensive Diagnostic Services for Common Genetic Disorders to Rural Populations has been initiated at Genome Foundation, Banjara Hills , Hyderabad ; "Scientific Technology and Research Inputs for the Upliftment of People from Weaker Section in Pithoragarh District of Uttarakhand " has been initiated at People's Association of Hill Area Launchers (PAHAL) , Manas Mandir , Cant Road , Pithoragarh , Uttarakhand Pin: 262501 ; Study of bio-degumming and chemical deposition on muga silk (Antheraea assamensis Helfer) fibers of Assam has been initiated at , Institute of Advanced Study in Science and Technology, Paschim Boragaon, Guwahati-781035, Assam **;** Effect of Parental Education, Ethics of Research Participation and Array Comparative Genomic Hybridization in Subjects with Mental Retardation (MR) and/or Autism initiated at Centre for Tobacco Control, RML Hospital, New Delhi in collaboration with Centre for DNA Fingerprinting and Diagnostics (CDFD) , Hyderabad ; **Biodiversity and Management of Aphids in Temperate Zone of India was initiated at Sher-e-Kashmir University of Agricultural, Sciences & Technology of Kashmir, Shalimar Campus, Srinagar-191121 ; "Identification modification evaluation & knowledge transfer of novel rodent traps and other eco friendly rodent control methods in Tamil Nadu" was initiated at , Arul Anandar College, Karumathur, Madurai- 625514, Tamil Nadu** ; **" Development of low cost technologies**

for increasing agricultural productivity and livelihood in some selected villages in Chittoor Dt., Andhra Pradesh was initiated at Centre for Natural Biological Resources and Community Development (CNBRCD) , No. 41, RBI Colony , Anand Nagar , Bangalore – 560 024 ; **"***Efficient e-waste management through co-ordinated web service using WS-dependent space has been initiated at* Dept of Computer Science and Engineering., Vellamal college of Engineering and technology, Viraganoor, Madurai-625009, Tamil Nadu. *;* **"**Delineation of Cadmium contaminated soil and exploration of bioremediation strategies for removal and for environmental sustenance by harnessing Arbuscular Mycorrhizal fungi and PGPR *has been initiated at* Dept. of Agricultural Microbiology, TNAU, Coimbatore *;* **"**Conductive Concrete Blocks from Industrial Waste as Electromagnetic Shielding material *has been initiated at* Dept. of Civil Engineering, , Velammal College of Engineering and Technology , Madurai-625009 **"Creation of Digital Repository of the reports of student projects Programme : A flagship programme of Karanataka State Council for Science & Technology , Indian Institute of Bangalore Campus , Bangalore**; "*Plus tree selection and development of Ailanthus excelesa based agroforestry system for south-west Haryana". has been initiated* at CCS Haryana Agricultural university regional research station Bawal (Rewari)-123501*;* "Study on Wild Edible Plants and Documentation of Ethnobotanical Knowledge of Utilization Practices associated with different Tribes of Arunachal Pradesh" has been initiated at Arunachal Pradesh State council for Science and Technology, Itanagar, Arunachal Pradesh **; "Assessment of copepods as Bio-control agents of mosquito larvae in standing water bodies of Punjab" has been initiated at** Punjab Agriculture University(PAU), Ludhiana-141004 ; **"Wild Silk Moths: Genetic diversity based on Morpho-molecular markers in North-Eastern Region of India" has been initiated at Nowgong College , Nagaon, Assam-782001**

Important meeting/workshop supported :

- **"**National Science Mela 2012 : Science Exhibition in a hamlet school in Usilampatti Educational District for Promotion of Science, Co-Operation and Health" was supported at Arul Anandar College (Autonomous) , Madurai and organized during March'2012 **:** To provide an opportunity for students to enhance their scientific and technical knowledge by conducting their own research studies.
- **The Brain Storming session** on " Development of proposals on SSTP – LSR &TD and DP " has been organized /supported at Jammu University , Jammu on 25th Sept'2012 –. Around 50 Participants participated from J&K region , a skill development session for writing of the proposal was also organized to create enthusiasm in the participants to formulate scientific proposal on day to day need of the society.
- **The workshop on the " Soil Testing Kit – Ferticheck" attended at the SRL college , Dhimishri , Sadabad , Agra on 28th Sept'2012 -** Around 150 farmer participants were participated in the programme , 50 kits were delivered to the farmers to getting the feedback on the developed technology of soil testing.

Some of the ongoing /completed activities :

1. Establishment of a rural centre at Kalwari Village, Jaunpur, UP to Provide Comprehensive Diagnostic Services for Common Genetic Disorders to Rural Populations by CCMB , Hyderabad & Genome Foundation , Banjara Hills, Hyderabad-500007

A pilot epidemiological study was supported to CCMB, Hyderabad / Genome Foundation for establishment of the rural centre at Kalwari Village, Jaunpur, UP. The Centre has been functioning for the

last two years. They have covered 20363 samples of population and being analyzed for providing genetic counseling .

Coverage of epidemiological survey conducted

Village	Number of families as per Census	Number of families covered	%coverage	Number of individuals as per Census	Number of individuals covered	% coverage
35	3090	2869	92.8	21661	20363	94.0

Currently, Entry of demographic, anthropometric data finished , Analysis of lipid profile on 2000 individuals is underway.

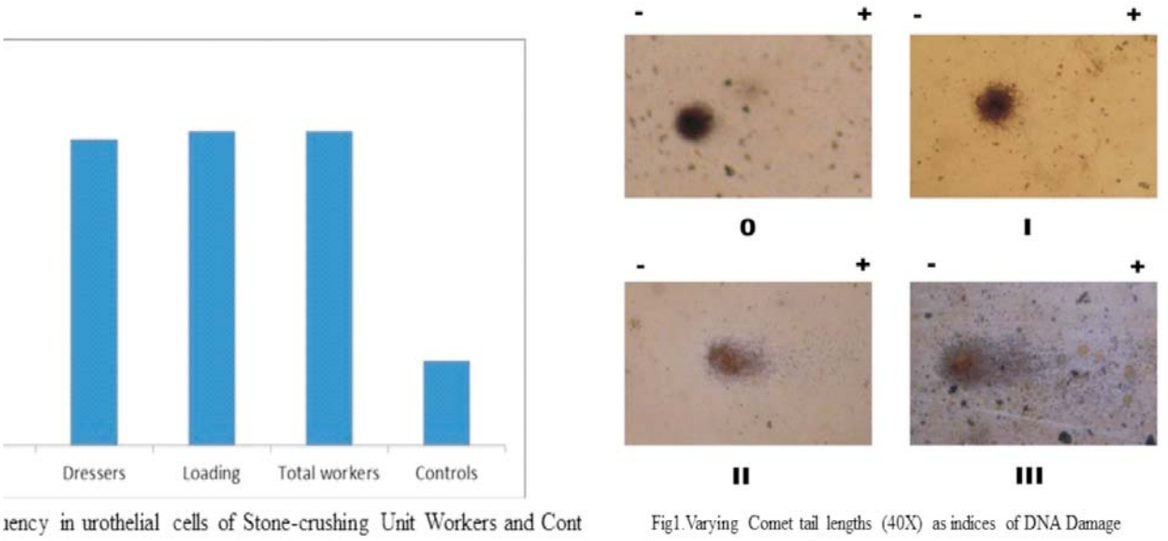
The some of the analysis represent that there is instances in the population of the villages of Jaunpur Dist. that female members of several families over four generations do not have fingers and toes; families having several members affected with muscular dystrophies; and many families having disabled children born generation after generation. Therefore for providing preventive measure, their genetic basis needs to be established by which it might soon be possible to use biomarkers of genetic susceptibility to identify individuals with their enhanced or reduced risk of disease, and to create clinically useful diagnostic as well as therapeutic methods. The centre is addressing this problem in rural sector and strongly felt that fruits of Science & Technology as visualized in this project is very relevant for the population of the country to reduce disease burden and there by saving the revenue of Govt. of India .

2. Estimation of Pesticides and Heavy Metals in People of Bihar and Linkage with Cancer at Mahavir Cancer Sansthan, Patna – 801 505.

The present study was conducted to provide a first report on the prevalence of familial cancers in Bihar with the risk assessment of carcinogenic pesticides and heavy metals. Carcinogenic pesticides such as aldrin, ppDDT, ppDDE, ppDDA, á endosulfan, â endosulfan, chlorpyriphos, malathion and monocrotophos, and arsenic heavy metal was selected and evaluated in the study by HPLC and AAS instruments. Among the 38 districts of Bihar, high prevalence of prostate, testis, breast, ovary and gallbladder cancer was recorded in the following districts; Begusarai, Bhojpur, Buxar, Chapra, Gaya, Gopalganj, Khagaria, Madhepura, Muzaffarpur, Patna, Samstipur, Siwan, Saupal and Vaishali. Prostate, ovary and gall baldder cancer incidences are remarkably linking to Gangetic zone of Bihar with a high risk of arsenic persistence in ground water and drinking water. Elevated level (>100 ppb) of arsenic over the WHO permissible limit (10 ppb) was recorded in the drinking water sources of different blocks of Patna as well as different Gangetic region of the state. Nearly, 20 ppb and 4000 ppb level of DDT residue was accumulated in blood and tissues respectively of diagnosed breast, ovary, gall bladder and prostate cancer patients. Among studied pesticides, DDT and endosulfan are detected in the blood and tissue of most of the breast and ovarian cancer cases. Maximum 4,307 ppb level of DDT and 324 ppb level of endosulfan was recorded in the malignant tissue of breast cancers. Among the studied pesticides residue, DDT and endosulfan was found as maximum in cow milk and water samples. High concentrations of DDT (maximum 22 ppb in cow milk and 13 ppb in water samples) and endosulfan (maximum 48 ppb in cow milk and 49 ppb in water samples) were observed in the most of the samples collected from different blocks of Patna district.

3. Metabolic genotypes as modulators of DNA and Chromosomal damage in persons engaged in quarrying/ stone crushing at Guru Nanak Dev University , Amritsar 143 005

In the present study, the genetic health of individuals working in stone-crushing operations has been assessed by studying chromosomal and DNA damage in their blood, buccal mucosa and urothelial cells and genotyping for GSTT1 ,GSTM1 and GSTP1(Ile/Val) genes was done from blood genomic DNA samples. Workers had mild and moderate forms of Chronic Pulmonary Disease on the basis of spirometric measurements. Self-reported health effects included frequent coughing (50.00%), shortness of breath (50.00%), muscle and/or joint pains (33.33%), redness and itching of eyes (66.66%). Reproductive performance revealed miscarriages (1.45%), abortion (9.45%), still births (4.72%), low birth weight babies (4.72%) and infertility (1.11%) from pedigree analysis. Genetic damage, oxidative stress levels and the pulmonary function test revealed highly significant elevated (pd"0.001) DNA (Fig.1) and chromosomal (Fig. 2) damage in peripheral blood leukocytes, buccal mucosa cells and the urothelial cells. Also the lipid peroxidation ($p<0.001$), total oxidant status ($p<0.05$) and the oxidative stress index ($p<0.01$) were significantly elevated in workers. The genotypic frequency of the respective recessive genotypes in workers was higher (32%, 43%, 7%) than in the controls (19%, 39%,6%). The workplace exposure at the stone-crushing units has probably caused the significant genomic instability, oxidative stress in the workers besides the accompanying respiratory distress. Therefore workers at stone-crushing units need to be sensitized about their genetic health as genomicl damage can lead to malignancy.



ıency in urothelial cells of Stone-crushing Unit Workers and Cont

Fig1.Varying Comet tail lengths (40X) as indices of DNA Damage

Fig. 8.15

4. Biological control of two lepidopteran pests by two assassin bugs at St. Xavier's College, Palayankottai 627 002, Tamil Nadu.

1. Evaluation of biocontrol potential of *Rhynocoris fuscipes* (Fabricius) and *R. longifrons* (Stål) in terms of mortality factor, functional and numerical responses and stage and host preferences continued with different prey species exhibited positive biocontrol potential.

2. Crowding of predators reduced the survival rate. Natural substrates with plant materials and stones as substrates enhanced the survival rates of *R. longifrons and R. fuscipes.*

3. The life stages of *R. longifrons* and *R. fuscipes* significantly (P<0.05) affected the population of larvae of *Spodoptera litura* F. and *Helicoverpa armigera* (Hubner) without affecting the predatory arthropods. The yield of seed cotton was not significantly increased by the release.

4. The chemical ecology prey-predator interaction by analysing the body secretions of prey suggest that the predators prefer lepidopteran prey.

8.16 : Rhynocoris fuscipes predating upon Helicoverpa armigera

8.17 : Rhynocoris longifrons predating upon Dysdercus cingulatus

8.18 : A cotton agroecosystem where reduviids were mass released

8.19 : Mass rearing of Rhynocoris fuscipes and R.longifrons

CHAPTER 9

ADMINISTRATION & FINANCE

RECRUITMENT CELL

Recruitment Cell in this Department is vested with the responsibility of making recruitment to Group 'A' and Group 'B' (Gazetted) scientific and technical posts as recruitment to these posts is exempted from the purview of UPSC. The recruitment to these posts is made by the method of direct recruitment or deputation (including short-term contract) or absorption as prescribed in the Recruitment Rules for the relevant posts.

Recruitment Cell is also vested with the responsibility of in-situ promotion of departmental Scientists under the Flexible Complementing Schemes (FCS) as contained in the Department of Science and Technology Group 'A' Gazetted posts (non-ministerial, scientific and technical) Rules, 2004.

Besides, Recruitment Cell also deals with the proposals regarding recognition of Institutions / Organizations under various Ministries / Departments as scientific and technical for the purpose of introduction of FCS.

During the year, recruitment has been made to two posts of Hardware Engineer on deputation (including short-term contract) basis and two posts of System Analyst on deputation basis in NSDI, Department of Science & Technology and one post of Scientific Attaché in Indian Missions at Washington on deputation (including short-term contract) basis. Recruitment for eight posts of Scientist 'C', four posts of Scientist 'D', One post of Scientist 'F' on direct recruitment basis is under process. Recruitment for two posts of Scientist 'C', one post of Scientist 'D' on deputation basis and one post of Junior Documentation Officer on deputation (including short-term contracts) basis is also under process.

Proposals for extension of FCS in the National Sugar Institute (NSI), Kanpur, a subordinate office of Department of Food and Public Distribution, under the Ministry of Consumer Affairs, Food & Public Distribution and Implementation of modified FCS as circulated vide DoP&T O.M. No. AB-14017/37/2008-Estt. (RR) dated 10.9.2010 for R&D professionals in S&T organizations of CSMRS, New Delhi; CWPRS, Pune and NIH, Roorkee are under process.

The Assessment of eligible departmental Scientists (From Grade 'E' to 'F') for in-situ promotion under FCS for review as on 01.07.2010 has also been done.

STAFF POSITION

DST has a total number of 228 Group 'A' and Group 'B' (Gazetted) Officer. A detailed break up is given below :-

Group	General	SC	ST	OBC	PH	Total
Group 'A'						
Scientific	106	08	02	-	04	120
Non-Scientific	30	01	02	-	-	33
Group 'B'						
Scientific	05	02	01			08
Non-Scientific	52	11	04	-	-	67
Total	193	22	09	-	04	228

TRAINING

Department of Science & Technology, in consultation with DOPT, other Scientific Departments and various organizations initiated an ambitious project of Human Resource Development namely "National Programme for Training of Scientists and Technologists working in the Government sector" for scientific and technical personnel during the X Plan to meet the challenges of national development and international competitiveness in S&T area. Considering the efficacy of the Scheme, the Department has decided to continue it in XI Plan.

2. During the year 2012-13, 41 training programmes were planned to be held. A total of about 1000 scientists will be benefited from these programmes. The training programmes are being held on various topics as per following table:

S. No.	Name of the training programme	Institute
1.	Knowledge Management & Knowledge Sharing in Organizations	IIPA, New Delhi
2.	Science and Technology for Rural Societies	CDM, NIAR, LBSNAA, Mussorie
3.	General Management Programme	ASCI, Hyderabad
4.	Advance Techno Management Programme G level scientist	ASCI, Hyderabad
5.	Agro Biodiversity Conservation and Sustainable Livelihoods	M S Swaminathan Research Foundation
6.	General Management Programme	ASCI, Hyderabad
7.	Multidisciplinary Perspective on Science, Technology and Society	NIAS, Bangalore
8.	Capacity Building Programme for Technical Assistants of the Science & Technology Department	IIPA, New Delhi
9.	Ethics and Values for Scientists & Technologists	CDM, NIAR, LBSNAA, Mussorie
10.	Soft Computing Techniques for Optimization	Atal Bihari Vajpayee Indian Institute of Information Technology and Management, Gwalior

S. No.	Name of the training programme	Institute
11.	Workshop on "Research Methodologies For Scientists"	AIIMS, New Delhi
12.	IPR & WTO issues	TIFAC, New Delhi
13.	Green and Sustainable Technology	The Energy and Resources Institute (TERI), New Delhi
14.	Science Policy and General Management	Management Development Institute, Gurgaon
15.	Science, Administration and Research Management	ASCI, Hyderabad
16.	Communication and Presentation Skill	IMTR, Goa
17.	Climate Change and Carbon Mitigation Research & Education, Dehradun	Indian Council of Forestry
18.	12th Foundation Training Programme for Scientists and Technologists of S&T Department GOI	IIPA, New Delhi
19.	Entrepreneurship Development & Management for Scientists & Technologists	Entrepreneurship Development Institute of India, Ahmedabad
20.	Essentials of Finance and Research Methodology	Amity Institute of Training and Development, Amity University, Noida
21.	Accountability and Responsiveness in Scientific Organization	Academy of Human Excellence, Baroda
22.	Climate Change, Forest Ecosystems and Biodiversity, Vulnerabilities and Adaptation Strategies.	Indian Council of Forestry Research & Education, Dehradun
23.	Technology Forecasting, Assessment and Technology Management	NIAS, Bangalore
24.	Technology Diplomacy	CUTS, Jaipur
25.	Science and Technology for Rural Societies	CDM, NIAR, LBSNAA, Mussorie
26.	Managing Technology Value Chains for Directors & Division Heads	ASCI, Hyderabad
27.	A Primer in Administration and Management	CDM, NIAR, LBSNAA, Mussorie
28.	Financial Management in Scientific Organisation	Indian Institute of Public Administration (IIPA), New Delhi
29.	Research Methodology and Data Analysis	Indian School of Mines, Dhanbad
30.	Natural Resources and Environment Management for Scientist	Indian Institute of Forest Management (IIFM), Bhopal
31.	Managerial Effectiveness Enhancement Programme for Science	IMTR, Goa
32.	Emotional Intelligence at Work Place	Center for Organisation Development, Hyderabad

S. No.	Name of the training programme	Institute
33.	Creativity and Innovation Management in Research	Engineering Staff College of India, Hyderabad
34.	Managing Innovation and Technology Competitiveness	ASCI, Hyderabad
35.	Science, Administration and Research Management	ASCI, Hyderabad
36.	Management of R&D Projects	Indian School of Mines, Dhanbad
37.	Science, Technology and Emerging Trends in Governance for Scientist and Technologists	IIPA, New Delhi
38.	Capacity Building Programme for Technical Assistants of the DST	IIPA, New Delhi
39.	Decision Support Systems and Technologies	Indian Institute of Foreign Trade, New Delhi
40.	Advance Techno Management Programme C, D, & E level scientist	ASCI, Hyderabad
41.	Managing Innovation and Technology Competitiveness	ASCI, Hyderabad

3. Under the Foreign Component of the Training Programme, 23 Junior Scientists were deputed for five day exposure visit to Japan and 22 Senior Scientists were deputed for five day exposure visit to South Africa during the financial year 2012-13.

4. Women Component Plan - Under women component plan of the Training Programme '14' programmes were planned to be conducted exclusively for women scientists in which about 350 Women Scientists are likely to avail the opportunity. The training programmes are being held on various topics as per following table:

S. No.	Name of the training programme	Institute
1.	Integrated Scientific Project Management	Center for Organization Development, Hyderabad
2.	Finance Management and Audit Sensitization	Xavier Institute of Management (XIM) Bhubaneswar
3.	MDI, Gurgoan	Advance Techno-Management Programme for Scientists
4.	Communication and Presentation Skill	IMTR, Goa
5.	IPR and WTO issues	Technology Information, Forecasting and Assessment Council (TIFAC) Delhi
6.	Science & Technology for Rural Societies	Indian Institute of Public Administration (IIPA), New Delhi
7.	Technology Diplomacy	Consumer Unity and Trust Society (CUTS), Jaipur
8.	Future Challenges to Society	National Institute of Advanced Studies (NIAS), Bangalore
9.	Role of Scientists in Community Resource Management for Women Scientists	Indian Institute of Forest Management (IIFM) Bhopal

S. No.	Name of the training programme	Institute
10.	Managing Change in Government Organizations	IMTR, Goa
11.	National Training Programme on Entrepreneurship Development & Management for Women Scientists & Technologists	Entrepreneurship Development Institute of India, Ahmedabad
12.	Biodiversity Conservation	Wildlife Institute of India (WII) Dehradun
13.	General Management Programme for Women Scientists	ASCI, Hyderabad
14.	The Science of Living	Academy of Human Excellence, Baroda

5. A workshop for the evaluation of training programme and finalization of training programme for the next financial year was organized during the year. Nodal officers of all the training institutes along with a number of scientists participated in the workshop.

EXHIBITION

1. The Exhibition Cell was assigned a number of responsibilities of organization of exhibition, participation in the national and international exhibitions. In addition it has also responsibility of coordinating the work related to participation of Department of Science & Technology along with its organizations in the exhibition.

2. The Exhibition Cell has participated and put up DST Pavilion in IITF -2012 and will put up DST Pavilion in Science Congress 2013. The Cell has also played an active roll in Inspire Exhibition during October 2012. The Exhibition Cell also participated in a number of other exhibitions in various states during the year 2012-13.

HINDI SECTION

The Department of Science and Technology continued to make concerted efforts to promote the use of Hindi in official work and to ensure compliance with the provisions of the Official Language Act, 1963 as amended in 1967 and Rules 1976 framed there under as also the various orders / instructions issued by the Department of Official Language from time to time with a view to ensure proper implementation of the Official Language Policy of the Government.

DST has a full – fledged Hindi Section consisting of a Joint Director (O.L.) assisted by an Assistant Director (O.L.) and other supporting staff which caters to the need of the Department of Science & Technology and also its Subordinate offices / Autonomous Institutions. Besides monitoring the implementation of the Official Language Policy and the Annual Programme, Hindi Section arranges for in - service training of the staff in Hindi Language, Hindi Typewriting and Hindi Stenography. It also undertakes translation of the material received from various Sections / Desks of the Department from English into Hindi and vice – versa.

For promotion of use of Hindi in this Department and to create conducive environment for the officials to work more in Hindi, various programmes are being undertaken:

- All documents coming under Section 3(3) of the official language Act, 1963 like general orders, notification, cabinet note, annual report and any paper which is to be laid in the parliament were

issued bilingually in both Hindi and English. Letters received in Hindi were invariably replied to in Hindi.

- With a view to encourage original scientific writing in Hindi, DST introduced "Dr. Meghnad Saha Award Scheme". Under the scheme, books written in the year 2006 to 2008 were invited. Another advertisement was published for inviting the entries for Dr. Meghnad Saha awards for the year 2007 and 2008.
- The officers of Hindi Section conducted inspections of Subordinate offices / Autonomous Institutions and 6 sections of the department regarding progressive use of Hindi.
- During the year, quarterly meetings of Departmental Official Language Implementation Committee were organized regularly. Likewise, Hindi workshops were organized to encourage the officers / staff of the department to do their maximum work in Hindi.
- The Hindi Advisory committee has been reconstituted.

Hindi Pakhwara was organized from 14 to 28 September, 2012 in the Ministry of Science and Technology. Various Hindi competitions were organized and the successful participants were given cash awards and certificates.

PARLIAMENT UNIT

The Parliament Unit is assigned with the responsibility of handling entire parliamentary work of the Department. It ensures that the parliamentary work pertaining to the Ministry of Science & Technology is accomplished as per the prescribed schedule and procedures. The Unit maintains liaison with the Ministry of Parliamentary Affairs, Secretariats of Lok Sabha/Rajya Sabha, and other Ministries/Departments (including Scientific Departments) with a view to fully discharge the parliamentary obligations of the Ministry of Science & Technology. The Unit also coordinates the visits of the Parliamentary Committees to various scientific institutions which are under the administrative control of this Department.

RTI

A total of 400 RTI applications including 80 Appeals were received for the period of 01-01-2012 to 15.12.2012. All applications have been replied in time by the CPIOs. Appeals have been disposed as per provisions of RTI Act.

PUBLIC GRIEVANCES

A total of 512 grievances were received during the year 2012 till 15.12.2012. Out of which, 334 grievances were disposed of by the different sections/divisions.

CITIZEN CHARTER

Department has drafted Citizen Charter in consultation of Performance Management Division of Cabinet Secretariat and uploaded on DST website.

CHAPTER 10

AUTONOMOUS S&T INSTITUTIONS AND PROFESSIONAL BODIES

The Department of Science is supporting 24 Autonomous Institutions which includes 15 research institutions, 5 professional bodies and 4 specialized knowledge institutions and S&T service organizations covering a varied range of research and science and technology areas. These autonomous institutions have published more than 1500 papers in refereed journals and over 80 books/chapters in books. No of patents filed by these institutions are more than 150. This year Prof. K. Sengupta from IACS has been selected for the prestigeous Skati Swarup Bhatnagar (SSB) prize in the area of Physical Science while Dr. Kaushik Sen of WIHG has been conferred with K. Naha Award by the "Geological Society of India". Elaborated specific accomplishments of these institutions can be seen in this chapter.

MACS AGHARKAR RESEARCH INSTITUTE, PUNE

MACS AGHARKAR RESEARCH INSTITUTE (ARI) was established in the year 1946. The Institute has a total of 143 regular employees, out of which 39 are scientists/faculty& 5 are post-doctoral research staff.

Report on Activities during 2012-13

Important Output Indicators for 2012-2013

S.No.	Parameters	Output
1.	Papers in refereed journals	96
2.	Chapters in Books	44
3.	Papers in Conferences	41
4.	Number of Ph.D. produced	15
5.	Indian Patents filed	8
6.	Number of Technologies/Designs and other intellectual products commercialized	14
7.	Number of Technology leads awaiting transfer	4
8.	Research Manpowertrained (other than Ph.Ds)	40
9.	Technical Manpower trained	10
10.	B.Tech./ UG projects guided	2
11.	M.Tech./ M.Sc./ M.Phil projects guided	35

Report on Activities during 2012-13

Major Accomplishments

Nanobioscience Anti-diabetic potential of Zinc oxide nanoparticles was validated in Type 1 and Type 2 diabetic rat models

Genetics 1) Durum wheat entry MACS 3828 was tested in final year of AVT for timely sown irrigated conditions in North Western Plain Zone and Central Zone, 2) Under coordinated program, a bread wheat entry MACS 6478 has been promoted to final year of testing in AVT for timely sown irrigated conditions in PZ, 3) One hundred forty synthetic hexaploid wheat in the background of MACS-6222, NIAW-302 and GW-322 are in F_6 generation and ready for comparative evaluation, 4) Soybean variety MACS 1281 has been identified for Southern Zone by Varietal Identification Committee

Mycology 1) Fungal species like *Auxarthronopsis bandhavgarhensis, Manoharachariella indica, Pseudocercospora kamalii, and Volvariella sathei* were described in detail, 2) Cardiovascular-protective, antioxidative, and antimicrobial properties of natural lichen *Usnea complanata* were studied, 3) á- and â-glucosidase inhibitory property of lichen metabolites salazinic acid, sekikaic acid, usnic acid from *R. celastri, R. nervulosa* and *R. pacifica* were investigated, 4) Fungi *Arthrinium rasikravindrii, Ellisembia karadkensis* and *Lentinus* sp.nov. were discovered, 5) First time report of the lichens occurring on mangrove plants in Andaman Islands were published giving an account of 29 lichen species including 14 species new records to Andaman Islands, and 5 new records to India.

Chemistry 1) Eleven monographs were published in Quality Standards of Indian Medicinal Plants, Volume-8, ICMR, New Delhi, 2) 21 monographs were published in Phytochemical Reference Standards of selected Indian Medicinal plants, Volume 2, ICMR, New Delhi

Zoology 1) Initiated a part of DBT Centre of Excellence in Epigenetics, 2) Establishment of a *Drosophila* facility

Important Highlights of 5 Major Programmes

Microbial Sciences 1) An enzymatic process for the synthesis of optically pure carbamoyl amnio acids using recombinant hydantoinase enzyme functionally overexpressed in *E. coli*, 2) Two novel species of thermophilic oil degrading bacteria isolated and characterized for taxonomic novelty and applications in petroleum industry, 3) A microbial process developed for the bioremediation of waste water containing nitro explosives, 4) A microbial process for the bioremediation of combined industrial effluent from Ankleshwar Industrial estate.

Nanobioscience 1) The prototype kit for rapid identification and antibiotic susceptibility of pathogens has been tested with ~100 clinical samples, 2) Multiplexed detection of food borne pathogens was demonstrated using quqntum dot based immunosensor

Genetics 1) New Soybean variety MACS 1188 identified, 2) New Soybean variety MACS 1281 identified

Mycology 1) Research: Biodiversity and Bio-prospecting of fungi and lichens, 2)

Repository: *Ex situ* germplasm Bank-about 2700 fungal strains in NFCCI, 3)

Service: Fungal Identification Service to Academia and Industries- more than 100

Biometry 1) Curry leaf extract showed islets protective property in diabetic rats, 2) Dairy calcium supplementation to dams throughout pregnancy showed greater efficacy in lowering blood pressure and body fat of rat pups compared to mineral calcium supplementation, 3) A novel method in 96-well plate format for the determination of serum iron using ferrozine method was standardized, 4) Mass spectrometric studies revealed that copper binds amyloid beta peptide in ATCUN-like structure which was published in ACS Journal Inorganic Chemistry, 5) Insulin mimetic protein was purified from *Costus species*.

Chemistry 1) Phytochemical Reference Standards of 21 Indian medicinal plants isolated characterized, 2) Quality standard of 11 Indian medicinal plants were optimized, 3) Field trials of honeybee attractants on 8 commercially important crops were completed. About 25% yield improvement was seen, 4) Antioxidant activity of Indian propolis was demonstrated, 5) Essential oil of *Tinospora cordifolia* leaf was isolated and charaterized its antioxidant property was determined.

Zoology 1) Phylogeny of Indian hydra established using morphological and molecular markers, 2) Emergence and divergence of RTK homologues in hydra studied by genome-wide screening

Major and Unique National Facilities created

Botany Plant Authentication Service AHMA and crude drug repository

Genetics Extension of 'Accredited Test Laboratory' (ATL) under National Certification System for Tissue Culture Raised Plants (NCS-TCP)

Mycology National Fungal Culture Collection of Fungi –DST sponsored

Chemistry Repository of Phytochemical Reference Standards was created and handed over to ICMR

Zoology Establishment of a large scale hydra facility in progress

Important collaborations (national and global) established

Nanobioscience 1) Collaboration with ICAR, New Delhi, 2) PGIMER, Chandigarh

Genetics 1) Exploitation of Interspecific Biodiversity for Wheat Improvement, In collaboration with Nottingham University, PBI Sydney, Australia and DWR, Karnal, 2) Biofortification of wheat for micronutrients through conventional and molecular approaches-Phase II, in collaboration with IARI New Delhi, PAU Ludhiana, IU Baru Sahib, GBPUA&T Pantnagar, IARI Indore, 3) Early Heat Tolerance in Wheat, BMZ project funded by CIMMYT, 4) Testing of Organic Agri-Bio-Inputs in Wheat, funded by Kan Biosys Pvt. Ltd.

Mycology DBT sponsored National Network program on Lichens collaborating with various Institutes being initiated.

Biometry KEM hospital, Pune

Chemistry 1) University of Agricultural Sciences, Dharwad, 2) National Research Centre for Grapes, Pune

Zoology National - University of Pune, National Center for Cell Science, Pune, IISER, Pune; Global - University of Tokyo, Japan, University of Kiel, Germany

ARYABHATTA RESEARCH INSTITUTE OF OBSERVATIONAL SCIENCES (ARIES), NAINITAL

Aryabhatta Research Institute of Observational Sciences (ARIES) was established in the year 2004. The Institute has a total of 113 regular employees, out of which 38 are scientists/faculty& 4 are post-doctoral research staff.

Report on Activities during 2012-13

Areas of Focus: The main research interests of Astronomy & Astrophysics division are in solar, planetary, stellar, galactic and extra-galactic astronomy including stellar & quasar variabilities, X-ray binaries, star clusters, nearby galaxies, quasars absorption and emission line studies and inherently transient events like supernovae and highly energetic gamma-ray bursts. Moreover, to strengthen the scientific contribution, the Institute has extended its horizon to theoretical and numerical studies in Relativistic Astrophysics. Research focus in Atmospheric Sciences division is mainly in the lower part of the atmosphere and covers the studies on trace gases, aerosols and dynamics.

Major Accomplishments:

(i) Factory acceptance of 3.6-m Devasthal Optical Telescope has been successfully completed. The telescope is being shipped from Belgium to India.

(ii) Technical specification of the near infrared spectrometer instrument for 3.6 –m Devasthal Optical Telescope has been finalized.

(iii) Successful testing of mini ST Radar (array of 49) at the ECIL.

(iv) Successful setup of WRF-Chem model and it operation for the tropospheric chemistry for the first time in India.

(v) Extremely impulsive X1.8 class major flare observed in Há on 23 October, 2012 from active region NOAA 11598 with 15-cm Coude Solar Tower Telescope at Manora Peak, Nainital.

(vi) The advanced research is being pursued on the study of solar transients/eruptions and magneto hydrodynamic (MHD) waves, and the results are being published in the peer-reviewed international journals (e.g., ApJ, A&A, MNRAS, Solar Physics etc).

Important Highlights of 5 Major Programmes:

(i) A 3.6 meter aperture optical telescope is being established at Devasthal, Nainital. The Devasthal is located at an altitude of 2.5 km in the Central Himalayas. The telescope will have active optics technology and it will be largest optical telescope in Asia. The telescope will have a number of

instruments providing high resolution spectral and imaging capabilities at visible and near-infrared bands. The telescope will be ready for observations by 2013.

(ii) The Faint Object Spectrograph and Camera (FOSC) is planned as the first light instrument at the axial port of the Cassegrain focus on the 3.6-m Devasthal Optical Telescope. The FOSC is being developed in-house at ARIES. The instrument will cover the wavelength range of 350-1000 nm. The instrument will have two distinct observing modes: (i) direct broad- and narrow-band imaging capabilities with one pixel resolution of less than 0.2 arcsecond and (ii) low-to-medium resolution spectroscopy with spectral resolution (250-2000) using set of normal grisms covering optical wavelength band 350-1000 nm.

(iii) ISRO Environmental Observatory: Observations of ozone, CO, NO-NOy, SO2, BC, aerosols number concentrations, AOD and meteorological parameters show contribution of regional pollution over the Central Himalayas. This is confirmed from space based observations and model results. Balloon borne observation provided evidences influences of bio-mass burning at higher altitudes also.

(iv) Lidar: A high energy pulse Lidar (Nd:YAG) system has been developed and operational for the measurement of aerosols. It has two modes of operations i.e. Mie and Raleigh covering altitude up to about 80 km.

(v) ST Radar: A miniature ST Radar (49 array) was operated at ECIL for few months and it provided data up to 7 km. Now, installation of TRM and Antennae are in progress at ARIES site.

Major and Unique National Facilities created:

The 130-cm telescope and 80-cm Schmidt telescope has been installed.

Important collaborations (national and global) established:

(i) Research collaboration is made with Dr. Mary Barth (NCAR, USA) and Prof. G. P.Brasseur (CSC, Germany) for modeling activities.

(ii) Multi-wavelength studies of star forming regions to study the global view of star formation in these regions, in collaboration with Prof. K. Ogura (Japan), Prof. W. P. Chen (Taiwan), Prof. S. K. Ghosh, Dr. D. K. Ojha (TIFR, Mumbai) are being carried out.

(iii) To search and study the pulsational variability in chemically peculiar stars, a program in collaboration with D. L. Mary of Labratoire Universitaire d'Astrophysique de Nice, France, Dr. Peter Martinez of South African Astronomical Observatory (SAAO), South Africa, Dr. T. Ryabchikova, M. Sachkov of Institute of Astronomy, Russian Academy of Science (INASAN), Russia and N. K. Chakradhari of School of Studies in Physics and Astrophysics, Pt. Ravishankar Shukla University, Raipur, India is being carried out.

(iv) To study the morphology of extragalactic objects, a collaboration with Dr. Joydeep Bagchi of IUCAA, Pune and Prof. Gopal Krishna of NCRA, Pune, is being pursued.

(v) Studies of complex properties of Giant Radio Galaxies are being carried out in collaboration with Prof. D. J. Saikia of NCRA-TIFR, Pune, India and Prof. Oleg V. Verkhodanov of Special Astrophysical Observatory, Russian Academy of Sciences, Russia.

(vi) The bilateral international projects (e.g., Indo-Russian, Indo-US) have been implemented. While, the collaborations and research cooperations are extending over the globe, e.g., with Warwick and Sheffield Universities in U.K.; UMCS, Poland; IZMIRAN and SAI (MSU) in Russia; SRI, Graz in Austria, LMSAL, NASA, and California State University in U.S.A etc. Inspite of various international research cooperations, the national collaborations and projects are also going on with various national institutes as well as universities.

Important Output Indicators for 2012-13

S.No.	Parameters	Output
1.	Papers in refereed journals	49
2.	Papers in Conferences	05
3.	Number of Ph.Ds. produced	Awarded – 02
4.	Research Manpower trained (other than Ph.Ds)	04
5.	Technical Manpower trained	50
6.	B.Tech/ UG projects guided	10
7.	M.Tech/M.Sc./M.Phil projects guided	5

BIRBAL SAHNI INSTITUTE OF PALAEOBOTANY, LUCKNOW

Birbal Sahni Institute of Palaeobotany (BSIP) was established in the year 1946.The institute has 158 regular employees out of which 61 are scientists and 5 post doctoral research staff.

Report on Activities during 2012-13

Areas of Focus:

I. Early life, atmosphere and oceans: Evidences from Indian Craton.

II. Fossil land plant communities: Morpho-structure, Evolution, Systematics with applications to Biostratigraphy and Palaeoecology.

III. Integrative Micropalaeontology, Organic Petrology and Organic facies: Relevance to fossil fuel characterization and exploration.

IV. Multi-proxy parameters for Quaternary palaeoclimate reconstructions, vegetation dynamics, relative sea level changes and anthropogenic influence.

V. Polar and Major Planetary Events.

Major Accomplishments:

Institute is carrying out researches with a commitment to ensure growth in fundamental and applied aspects of Palaeobotany and allied Earth System Sciences, especially focusing on past plant life and palaeoclimate. The palaeobotanical researches are being conducted right from Archaean to Recent geological sequences ranging from 3200 Ma to 400 AD in age, which includes the Archaeobotany and Dendrochronology (tree-ring analysis) for the interpretation of climate change. Emphasis has been laid on deriving knowledge about the diversification of Precambrian life, diversity, distribution and inter- and intra-

basinal correlation of Gondwana and Tertiary floras, terrestrial and marine microfossils and their application in solving geologic problems and hydrocarbon exploration, coal/lignite quality and to understand the interaction between the climate and vegetational changes during Quaternary Period.

Important Highlights of 5 Major Programmes:

Precambrian Palaeobiology— Records of casts/ impressions of large sized discs, laminated filamentous and algal forms from the Sonia Sandstone of Jodhpur Group, Marwar Supergroup (MSG) possibly suggest a new line of evidence of Ediacaran life forms and their diversity on the earth during 635-541 Ma. Study of the Nagaur trace fossils assemblage suggests that the Nagaur Sandstone belongs to the Cambrian Series-2 making the MSG a most comprehensive Ediacaran Period -Precambrian-Cambrian boundary section of the peninsular India.

Gondwana Flora— Plant fossils studied from various Gondwana successions of Son-Mahanadi, Satpura, Pranhita-Krishna-Godavari, Kashmir and Kachchh basins have helped in interpreting floristic evolution and palaeoecology of the regions. An attempt has been made to place all Indian records earlier described as equisetaceous/ equisetalean stems/axes under the genus *Paracalamites*. Established 3 different varieties of *Noeggerathiopsis hislopii* based on their morphotypes. In addition, analysed spores-pollen assemblages from various coal-bearing Gondwana sequences of Damodar, Wardha-Godavari, Son-Mahanadi valley's coalfields for biostratigraphic dating and correlations. For the first time, recovered microfossil assemblages and carbonized cuticular forms from the Permo-Triassic type section exposed in Kashmir.

Tertiary Flora— Generated additional data on plant megafossils (from western, central & north-east India, and Himalayan Foreland Basin), and micro-remains (from Kachchh, Saurashtra, Rajasthan, north-east and central India, Lesser Himalaya) from certain terrestrial and marine Cretaceous-Palaeogene horizons in terms of their palaeogeographic, biostratigraphic and palaeoenvironmental significance. It is evident that Deccan Intertrappean flora was considered as the ancestral flora for angiosperm evolution in India. Occurrence of family Dipterocarpaceae plant remains from the Neogene sediments of Rajasthan and Gujarat indicates warm and humid conditions during the Cenozoic period in contrast to the arid to semi-arid climate at present; causing ultimate extinction of the family in the region. Climate Leaf Analysis Multivariate Programme was initiated in India for the quantitative estimation of palaeoclimate.

Micropalaeontology & Organic Petrology— Continued studies on calcareous nannofossil forms from western Indian Jurassic continental shelves, and dinocyst/ palynofacies assemblages from late Cretaceous-early Palaeocene sequences of South Shillong Plateau. Studied facies characterization and palaeoenvironmental significance of reef-forming Coralline algae dominated sediments from the Guitar Formation (Middle Pliocene) of Car Nicobar Island. Analysed phase shifts from coral-dominated to algal-dominated reefs in the Andaman Islands. Diatoms have been recovered for the first time from the Inglis Formation of Havelock Island. Certain Permian coals from Godavari Valley, Mesozoic coals from Saurashtra Basin, and Tertiary lignites from Cambay Basin have been evaluated for their categorization in relation to economic suitability, besides depositional settings.

Quaternary Palaeoclimate— Studies have been carried out to understand the climates through palynological/palaeobotanical proxies (pollen, phytoliths, phytoplankton, tree-rings, Archaeobotany, etc). The data generated from Indo-Gangetic plain, southern MP, Mahanadi Delta, Darjeeling, flood plain of Assam, Meghalaya, Trans & Tethyan Himalaya, Arabian Sea, etc. has been utilized for the interpretation of spatio-temporal climatic changes covering major time span of the Quaternary Period. It is evident that the climate induced vegetational evolution and relative sea level changes have left an impact on evergreen to

semi-evergreen vegetation including mangroves in the peninsular region including coastal areas. A gradual replacement by dry deciduous forest is evident, that is enhanced by anthropogenic pressure during Late Holocene. The study of fresh water thecamoebians has been taken up for the first time in India as new proxy for understanding palaeoecology and palaeoclimate. Based on tree-ring data of *Cedrus deodara* growing within the river basin (Kullu Valley) in western Himalaya, reconstructed summer month's (March-April) discharge data of Beas River back to AD 1834. Palaeo-ethnobotanical finds from ancient Ghorakatora (District Nalanda, Bihar), and Harappan site Khirsara (Kachchh, Gujarat) revealed advanced agricultural practices in these regions during Chalcolithic and Early Historic times.

Polar Palaeoclimate Research— Initiated preparation of modern analog of biotic components and assemblages along the river Ganga, coastal areas and Polar fjord / lakes to be utilized to assess response variables against abiotic components acting as forcing functions**.** In addition, Institute participated in India's Arctic and Antarctic Programmes for field related and Quaternary palaeoclimatic studies.

Major and Unique National Facilities created:

The calibration for C-14 dates is being carried out as per available latest softwares extending the calibration to about 50,000 yrs BP. A new Liquid Scintillation Counter (ultra-low level), and CHNO Analyser have been installed.

Important collaborations (national and global) established:

Multidisciplinary and multi-institutional research activities with Institutions in India and abroad have been continued in several spheres. Institute is working in close unison with abroad institutions like Institute of Botany, CAS Beijing; Institute of Geosciences, University of Sao Paulo and Guarulhos, Brazil; University of Texas, USA; Institute of Geosciences, RAS Moscow; and with Indian institutions like WIHG (Dehradun), GSI (Kolkata), DSI (Visakhapatnam), NIO & NCAOR (Goa), University of Jammu, etc. In addition, an international programme is continued with the aim assimilate the valuable palaeobotanical data available at BSIP with international experts.

Important Output Indicators for 2012-13

S.No.	Parameters	Output
1.	Papers in refereed journals	60
2.	Books	2
3.	Chapters in Books	6
4.	Papers in Conferences	24
5.	Number of Ph.Ds. produced	5
6.	Research Manpower trained (other than Ph.Ds)	19
7.	Technical Manpower trained	2
8.	B.Tech/ UG projects guided	10
9.	M.Tech/M.Sc./M.Phil projects guided	4
10.	Other Products/ Indicators	
	Help to Industry	1
	Collaborative Research	25
	Consultancy Services (in Carbon dating, SEM, Palynology & Coal Petrology)	34

BOSE INSTITUTE, KOLKATA

Bose Institute was established in the year 1917.The institute has 298 regular employees out of which 64 are scientists and 34 post doctoral research staff.

Report on Activities during 2012-13

Areas of Focus

At the time of founding Bose Institute, the illustrious founder, Sir J. C. Bose had unequivocally declared that the objective of Bose Institute would be to practice seamless science, without compartmentalisation on the basis of specialisation. Bose Institute strives to achieve this ideal, encouraging inter-disciplinary research to the fullest.

Major Accomplishments :

Broadly, the current research activities of our scientists cover the following areas:

Institutional 11th Plan :

I. Improvement of Plants: Biotechnological, Genomic and Proteomic Approaches
II. Protein Structure, Function and Engineering :
III. Bioinformatics and Computational Biology :
IV. Molecular Medicine :
V. Microbial Genomics and Infection Biology :
VI. Development of Systems Biology
VII. Basic and Applied Problems in Physical and Environmental Sciences

Important Highlights of 7 Major Programmes :

I. Improvement of Plants: Biotechnological, Genomic and Proteomic Approaches:

This group is working on different fundamental problems of plant biology and emphasis has also been given to identify the key proteins and genomic components coding for desirable phenotypes through genetical and molecular approaches. Recently initiatives have also been undertaken to understand epigenetic, transcriptional and post transcriptional regulations of selected key genes. The effective use of these novel genes and the regulatory elements in crop improvement programme by functional genomic approach has been undertaken with a view to improve the plant performance.

II. Protein Structure, Function and Engineering :

Resolution of Protein structure is the key criteria to determine functional organization of a protein. Study on the structure–function relation coupled with expression analyses have been undertaken to design therapeutically and other economically important protein molecules.

III. Bioinformatics and Computational Biology :

Bioinformatics Centre was incepted in 1988 as one of the nine nodal centres under the programme, Biotechnology Information System (BTIS) of the Department of Biotechnology, Government of India,

with genetic engineering and molecular modelling as the two major thrust areas. Since then the centre is functioning as a repertoire of information related to bioinformatics and its dissemination in Eastern India. It provides computational facilities to carry out research in genome analysis, molecular modelling, plant genomics and proteomics, biomolecular structure determination (through NMR and X-ray crystallography), protein structure analysis, protein-protein interaction, docking and molecular recognition, protein folding and threading etc. The Bioinformatics Centre has the distinction of being designated as Centre of Excellence of the Department of Biotechnology, Government of India.

IV. Molecular Medicine :

One of the important focuses of the Division is to develop drug(s) against cancer based on the information obtainded about the mexchanism of intiation and/or propagation of cancer. Participants have taken initiatives in identifying and characterizing the active principles of biomolecules useful in pathophysiology. Development of novel peptides/ bio-molecules against specific disease(s) is also another target.

V. Microbial Genomics and Infection Biology :

Genomic approaches have been taken to study the basic biology of microbes leading to useful insights into the mechanisms of their growth, proliferation and cell-cycle regulation. Molecular mechanisms underlying the processes by which some of these microbes cause infectious diseases are being elucidated. Identification of microorganisms with a potential for bioremediation is also under study.

VI. Development of Systems Biology :

Scientists have taken system level approaches combining mathematical modeling with cell biological experiments to dissect the functional organization of various genes, proteins and transcription factors in relation to development of cancer, tuberculosis and other diseases; and the biology of pathogens**.**

VII. Basic and Applied Problems in Physical and Environmental Sciences :

The Department of Physics contributes both to fundamental knowledge as well as applications relevant to industry and society in general. The Department's current research activities are in the areas of Radiation Physics; Statistical Mechanics; Foundations of Quantum Mechanics and Quantum Entanglement; Astrophysics of Strongly Interacting Matter; Characterization of Detector Materials for Heady Ions; Preparation and Characterization of Dielectric Materials, Condensed Matter Physics, Nuclear and High Energy Physics, Astroparticle Physics and Cosmology. Recently, intense activities have also been initiated in Millimeter Wave and Microwaves as well as atmospheric sciences.

Major and Unique National Facilities created :

The institute hosts support and service centres like the Central Instruments Facility (CIF), the Distributed Information Centre (DIC). The wide-ranging and comprehensive base of available scientific infrastructure at Bose Institute also comprises the Acharya J.C. Bose High Altitude Research Centre at Darjeeling and the experimental field stations at Falta, Madhyamgram and Shyamnagar. Recent augmentations include the establishment of a National Facility on Proteomics and Genomics, a National Facility on Astroparticle Physics and Space Sciences, a Centre of Excellence in Bioinformatics, a Rural Biotechnology Training Centre at Falta and the J.C.Bose Biotechnology Innovation Centre based at the Madhyamgram campus.

The facilities available in the institute for scientific enquiry and its applications also cater regularly to the scientists from several universities and research centres in the country.

Important collaborations (national and global) established :

Bose Institute has recently started a new chapter in the realm of manpower development in collaboration with the University of Calcutta. Based on the success of the integrated M.Sc.-Ph.D. course in Plant Molecular Biology & Bio-technology that had been running since 2007, the scope of the course was broadened during the year 2012-13 to include all areas of Biological Sciences. Thus the Institute now runs an integrated M.Sc. Ph.D. course in Life Sciences in collaboration with University of Calcutta.

Bose Institute has become a partner and collaborating Institute in the ALICE collaboration of the Large Hadron Collider (LHC) at CERN.

Bose Institute has been functioning as the nodal centre for India's participation in the Facilities of Antiproton and Ion Research (FAIR) at Darmstadt, Germany. The Director of Bose Institute, Prof. Sibaji Raha, has been unanimously elected the Vice-Chairman of the International Council of FAIR for a period of two years since November 2011.

C. Important Output Indicators

S.No.	Parameters	Output
1.	Papers in refereed journals	163
2.	Books	2
3.	Chapters in Books	7
4.	Papers in Conferences	6
5.	Number of Ph.D.s produced	18
6.	Foreign Patents filed	-
	Foreign Patents granted	-
7.	Indian Patents filed	3
	Indian Patents granted	-
8.	Number of Technologies/Designs and other intellectual products commercialized	-
9.	Number of Technology leads awaiting transfer	-
10.	Research Manpower trained (other than Ph.Ds)	198
11.	Technical Manpower trained	15
12.	B.Tech/UG projects guided	3
13.	M.Tech/M.Sc./M.Phil projects guided	21

CENTRE FOR SOFT MATTER RESEARCH, BANGALORE

Centre for Soft Matter Research (Formerly Centre for Liquid Crystal Research). The Centre was established in 1991 as a scientific society and was taken over in 1995 by the Department of Information Technology. The Centre was transferred as an autonomous institute to the Department of Science and Technology (DST) in 2003. It was renamed as Centre for Soft Matter Research (CSMR) with effect from 1.9.2010.The Institute has 43 regular employees out of which 13 are scientists (1 Scientist of Eminence, 1 Emeritus Scientist, 2 Visiting Professors, 1 Research Associate) and 14 Post doctoral staff.

Report on Activities during 2012-13

Areas of Focus: The Centre was established to focus on basic and applied research in liquid crystals. Now, Centre has broadened its scope in Soft Matter to include polymers, gels, membranes and so on.

Major Accomplishments :

I. Investigations to significantly improve the parameters in twisted nematic (TN) display devices: In a TN liquid crystal driven by a low frequency square wave electric field, periodic director modulation is found to occur transiently over a few seconds at each polarity reversal. Significantly, the instability is polarity sensitive, with the maximum distortion localized in the vicinity of negative electrode, rather than in the midplane of the layer. Besides the Carr-Helfrich mechanism, quadrupolar flexoelectric polarization arising under electric field gradient is strongly indicated as involved in transient periodic order.

II. Major influence of quenched disorder created by nanosilica network on rotator phases in orientationally disordered systems : Calorimetric studies on composites of a long chain n-alkane, tetracosane, doped with nanosilica aerosil particles decorated with a corona of hydrophobic/hydrophilic nature exhibit weakly perturbing random field created by the addition of the aerosil particles influencing many interesting features governed by the nature of the corona of the particles.

III. Ultra-thin films of chemically modified graphene (CMG): We have devised a simple and elegant method to obtain ultra-thin films of CMG based hybrids with noble metal nanoparticles. These films are free-standing and extend to large area and produced in a single step synthesis. A constrained environment provided by the interface of two immiscible liquids is chosen for the formation of ultra-thin films. CMG-Au, CMG-Ag and CMG-Pd nanoparticles have been synthesized in this manner and are also demonstrated as suitable solid phase catalysts.

IV. Cost-effective chemical solution deposition to fabricate ZnO: We have utilized simple and cost-effective chemical solution deposition to fabricate ZnO and transition metal doped ZnO films on Si substrates and found an appreciable increase in photo current with transition metal doping compared to undoped ZnO. We have synthesized the polycrystalline La0.67Ca0.33MnO3 by standard solid state reaction method and find for small applied magnetic field, a large magnetoresistance and anisotropic magnetoresistance.

V. Investigations on the dynamics of spreading of a liquid over a liquid subphase : We have studied the liquid crystalline molecule, octyl cyano biphenyl (8CB) with a fluorescent dye. Under epifluorescence microscope, the layers within the domain gets sheared and the domain spreads to a larger area. Under reflection microscope, the domain retracts. We found an exponential behavior with different time constants for spreading and retraction. We attribute these dynamics to surface and interfacial tension components due to photo bleaching of the dye.

Important Highlights of 5 Major Programmes :

I. Anisotropic nematic electro convection: It is a bulk phenomenon usually originating in the midregion of the sample, away from bounding surfaces. Its occurrence close to the substrates under low frequency electrical excitation is, therefore, an important finding. Ongoing extension of this work has shown a similar behaviour even in the underlying smectic C state. As very little is known in literature of polarity sensitive phenomena in non-chiral tilted smectics, the results are likely to be of wide interest.

II. Simple synthesis routes for producing large area, CMG-metal nanoparticle hybrid materials: In this programme we plan to utilize aqueous/air and liquid/liquid interface. Efficient transfer of these free-standing films to suitable substrates for Raman, IR and morphological characterizations will be performed. Applications of these hybrid materials in catalysis are being investigated by performing the model reaction involving reduction of aromatic nitro to aromatic amino group. Investigations of electrical characteristics of CMG-metal nanoparticle hybrids are also under progress using two-probe method and conducting atomic force microscopy.

III. Synthesis and characterization of dimer-like mesogens: We have observed reentrant nematic behaviour in such mesogens. Characterization of supramolecular hexacatenars: These compounds exhibit columnar phase well below and above room temperature. Circular dichroism and FTIR studies suggest the chiral (helical) organization of mesogens within the columns through inter-molecular hydrogen bonding. Liquid crystal behavior of cholesterol-based dimers: These compounds show technologically important chiral nematic (N*) phase as well as frustrated phase viz., twist gain boundary (TGB) phase.

IV. Synthesis, characterization and photoresponse studies of undoped and transition metal doped zinc oxide thin films: The films for photoresponse study were fabricated by Ag contacts on the top in metal-semiconductor-metal configuration. A high photocurrent density of ~ 0.7 mA/cm^2 and less response time of ~ 200 ms for Ni doped ZnO. We studied the structural, morphological, resistivity, magnetoresistance and anisotropic magnetoresistance properties of polycrystalline La0.67Ca0.33MnO3. We found high values of magnetoresistance and anisotropic magnetoresistance at low temperatures for small applied magnetic field.

V. Ionic interactions in mesogenic molecules for sensor and device applications: The binding of ions to the liquid crystal molecules lead to a macroscopic orientational response. However, in these studies the commanding role of interface where such response is triggered is not well understood. We have studied systematically the effect of ions on liquid crystalline molecule (octyl cyano biphenyl, 8CB) through surface manometry, Brewster angle microscopy and kinetic studies. Our studies show that the divalent and trivalent ions promote condensation in area while the monovalent ions lead to expansion in area.

Important collaborations (national and global) established :

National: Collaboration with Bharat Electronics Limited, Raman Research Institute, Indian Institute of Science, Jawaharlal Nehru Centre for Advanced Scientific Research and so on.

Research projects undertaken: Four SERB Projects.

S.No.	Parameters	Output
1)	Papers in refereed journals	24
2)	Papers in Conferences	2
3)	Research Manpower trained (other than Ph.Ds)	6 (from other institutions)
4)	Other Products/ Indicators (to be specified by adding rows to this Table) *** Lectures given at schools/colleges under popularization of science**	26 lectures * (till 12.11.2012)

Global: Collaboration with Wigner Research Centre for Physics of the Hungarian Academy of Sciences under INSA-Hungarian Bilateral Exchange Programme. Collaboration with Bulgarian Academy of Sciences under DST Indo-Bulgarian Joint Bilateral Programme. Other Collaborations with Kent State University, USA, Tokyo Institute of Technology, Japan, Max Plank Institute for Dynamics and Self-Organization, Germany and so on.

INDIAN ASSOCIATION FOR THE CULTIVATION OF SCIENCE JADAVPUR, KOLKATA

Indian Association for the **Cultivation** of Science was established in the year 1876.The total number of regular employees is 257.Their are 77 scientists and 17 post doctoral staff.

Report on Activities during 2012-13

Areas of Focus : Physics & Chemistry

Major Accomplishments : 2 faculty members received the prestigious DST J C Bose Fellowship, one became FNA.

Important Highlights of 5 Major Programmes:

The activities of the institute is carried out in four umbrella areas- Theoretical, Molecular, Biological and Materials science. The major achievements are the following:

Theoretical Sciences: New theoretical models are developed for non-equilibrium dynamics of cold atom systems and for junctions of grapheme and topological insulators. 5-d Randall-Sundrum model applied for Higgs boson in large Hadron collider (LHC). Classical Brownian dynamics of particles confined in a two dimensional studied. Computational genomics is applied to study oral cancer.

Materials Science: Nanoparticle based solar cells and light-emitting diodes based on doped nanocrystals developed. Novel glass nano-composites and polymer electrolytes embedded with ionic liquids have been made and dynamics of charge carriers in these matrials have been elucidated. Functionalized nano-particles and CNT-enzyme nano-conjugates are synthesized for nano-medicine, nano-photonics, and hydrogen storage. Grapheme like materials are synthesized using molecular beam epitaxy.

Molecular Science: Single molecule spectroscopy is applied to demonstrate that ionic liquids are heterogeneous and to unravel conformational dynamics, folding-unfolding and binding of fluorophore in a protein. Matrix isolation IR spectroscopy and Mass spectrometry was used to study weakly bound molecular complexes and low-energy electron impact spectroscopy. Valence tautomerism is detected in a Cu(II) compound involving a redox-active *N*-heterocyclic ligand. Cu(II) templated pseudorotaxanes are synthesized for OFF/ON switching via axle substitution reaction. Catalysts for O_2 activation/reduction and H_2 formation have been synthesized and characterized using Raman spectroscopy and electrochemistry. A general synthetic route has been developed for anti-malarial artemisinin and its analogues. Titanocene chloride has been used for asymmetric synthesis of *bis*-butyrolactone skeleton based natural products and extended towards the synthesis of bio-active deoxy aza-disaccharide.

Biological Science: Functionalized nano-particles and CNT-enzyme nano-conjugates are synthesized for nano-medicine. Role of heme and copper bound amyloid beta peptides in Alzheimer's disease and of amylin peptides in type 2 diabetes has been elucidated.

Major and Unique National Facilities created:

400 MHz NMR, Raman Spectrometer, PLD

Important collaborations (national and global) established:

IACS has been selected as a partner of the prestigious India-US solar energy project (SERIIUS)

Important Output Indicators for 2012-13

S.No.	Parameters	Output
i.	Papers in refereed journals	522
ii.	Chapters in Books	05
iii.	Papers in Conferences	101
iv.	Number of Ph.Ds. produced	38
v.	Foreign Patents filed	01
vi.	Indian Patents filed	04
i.	Indian Patents granted	01
vii.	Number of Technology leads awaiting transfer	01
viii.	M.Tech/M.Sc./M.Phil projects guided	11

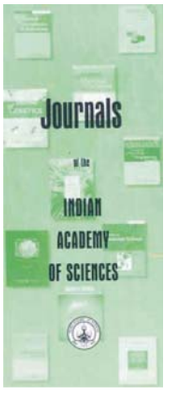
INDIAN ACADEMY OF SCIENCES, BANGALORE

Indian Academy of Sciences was established in the year 1934. The academy has 41 regular employees.

Report on Activities during 2012-13

Areas of Focus:

a) Publication of the following 11 scientific journals:



1. Journal of Chemical Sciences
2. Proceedings, Mathematical Sciences
3. Journal of Earth System Sciences
4. Sadhana(Proceedings in Engineering Sciences)
5. Pramana – Journal of Physics
6. Journal of Biosciences
7. Bulletin of Materials Science
8. Journal of Astrophysics & Astronomy
9. Journal of Genetics
10. Resonance – Journal of Science Education
11. Current Science (in collaboration with the Current Science Association)

Fig. 10.1

b) Recognition of excellence by conferring fellowships to scientists
c) Science Education Programme for students and teachers
d) Repository of Fellows' publications
e) Conducting Mid-Year and Annual Meetings of Fellows, Public Lectures by visiting scientists etc

Major Accomplishments: The academy has published over 1950 papers (14914 printed pages) in its 11 journals in the year 2011

Important Highlights of 5 Major Programmes:

There is a steady increase in the number of summer Fellowships offered to students and teachers over the years. Likewise, the number of Refresher Courses and Lecture Workshops conducted are also increasing.

The increasing impact factors of all its 11 Journals are evident to the fact that the journals are visible worldwide.

The number of downloads for full text of articles published by the Academy are on the rise.

The Repository of Fellows which was launched two years ago has a metadata of 89185 records with 20,289 full text files.

It has registered over 89000 hits.

Fig. 10.2

http://repository.ias.ac.in/information.html

Important collaborations (national and global) established: The Academy is collaborating with the other two National Science Academies INSA, New Delhi and NASI, Allahabad in its activities under the Science Education Programmes since 2007.

Fig. 10.3: The inaugural session of the 77th Annual Meeting of the Academy held at Ahmedabad during 18-20 November 2011

INSTITUTE OF ADVANCED STUDY IN SCIENCE & TECHNOLOGY (IASST), GUWAHATI

Institute of Advanced Study in Science & Technology (IASST) was established in the year 1979; The Institute was taken over by DST (GOI) in 2009.The Institute has 67 regular employees. The institute has 17 scientists and 6 post doctoral research staff.

Report on Activities during 2012-13

Areas of Focus: Nonlinear Phenomena of Plasmas, Waves and Instabilities in Dusty Plasma, Plasma Processing, Polymer Liquid Crystal, Synthesis of Nanomaterials, Plasma Polymerization, Stochastic Process, Distribution Theory, Fuzzy Mathematics, Summability Theory, Image Processing, Exploration of Biodiversity in N.E. region, Ecobiological Study of flora and fauna, Abatement of Hydrocarbon pollution in oil contaminated soil, Medicinal plant, Seri-biotechnology.

Major Accomplishments:

a. Investigation of collective processes in laboratory dusty plasma and Nonlinear Phenomena in Multicomponent Plasma and Development of RF Plasma polymerization process for deposition of hard transparent and corrosion resistant coating on Bell metal and surface modification of Muga silk fibres and possible applications.

b. Nanostructured alumina deposition at low temperature on bell metal by RF magnetron sputtering and Studies on the discharge characteristics of pulsed plasma system for synthesis of conducting polymer films and development of nanocomposite organic-inorganic based materials.

c. Development of Liquid Crystalline Polymers. Surface self-assembly and constructive nanolithography enroute to polyaniline based nano devices.

d. A new notion of generalized difference for sequence spaces have been introduced and applied for the investigation of different classes of sequences.

e. Fuzzy C-means for image processing of PAP Smear image of cervical cancer.

f. Different types of Bernoulli vacation models have been studied for different situations.

g. Phyto assisted bioremediation of oil contaminated soil for abatement of hydrocarbon pollution in soil. Significant reduction of hydrocarbon (TPH) has been achieved in experimental and field conditions.

h. Aquatic biodiversity recorded and reported in high altitude watershades of Arunachal Pradeshn & Assam.

i. Exploration and study of faunal biodiversity in Assam.

j. A skin ointment developed from medicinal plants against fungal infection and a base material for ointments from plants has been filed for patent.

k. Hypolipidaemic / antioxidant activities of some medicinal plants of this area have been established.

Important Highlights of 5 Major Programmes:

a. Investigation of collective processes in laboratory dusty and multi-component plasma

b. Production of (i) Low temperature and low density plasma, (ii) Positive ion –negative ion plasma. RF plasma polymerization process on bell metal and Muga fibre, Fabrics. Synthesis of Organic-Inorganic Nanocomposite thin films by plasma based technique.

c. Fabrication of Nanopatterns, Monolayer assembly. Investigation of metal coated polymer nanowire as chemical sensing material.

d. Development and Synthesis of Liquid Crystalline Polymers.

(e) Computational Image Processing:Studies on some pattern recognition and machine learning methods related to cancer data and development of algorithm based on Pearsonian system of curves.

(f) Metagenomic DNA Bank has been created for long term storage of genomes of microbes inhabiting diverse ecosystems of NE India.

(g) Hydrocarbon remediation related studies include efficient biosurfactant producing bacteria for recovery of hydrocarbon from sludge, oxidative degradation of contamination in soil and efficient hydrocarbon degrading phytoremediation technology has been developed for oil fields of Assam.

Major and Unique National Facilities created :

Physical Sciences Division is aiming to create a National Centre for Basic Plasma Research at IASST. The CCNS is carrying out investigations on application of functional analysis in summability theory and applied stochastic process. Automation of PAP Smear image of cervix cancer for detection and staging of cancer. The life sciences division is carrying out research on medicinal plants, quality testing for muga silk, phytoremidiation from oil fields, creation of DNA bank and hydrocarbon remediation.

Important collaborations (national and global) established:

National: BARC, Mumbai; ISI Kolkata; IISc, Banglore; SINP, Kolkata; TERI, New Delhi; IIT (Kharagpur, Bombay, Guwahati); Gauhati University, Manipur University, National Institute of Nutrition, Hyderabad; JSS University, Mysore; AIIMS, New Delhi, CAT, Indore; IMTECH, Chandigarh; IBSD, Imphal; Asian Institute of Gastroenterology, Hyderabad; IICT, Hyderabad; ICSIT, Kolkata; IITR, Lucknow; B. Barooah Cancer Research Institute, Guwahati; Annamalai University, Tamilnadu; DRL Tezpur.

Global: Yokohama University, Institute of Space, High Energy Accelerator Research Organization and Astronautical Science, Japan; University of Ulster, School of Biomedical Sciences, Northern Ireland, Padova University, Italy; Stazione spermente la seta, Milano, Italy; Shanghai Second Medical University, China; University of Maryland, USA; Museum national d'Histoire naturelle, Department Evolution et Syatematique, France; Deakin University, Australia; Firat University & Adiyaman University, Turkey; Dalhousie University, Canada; National taichung Institute of Technology, Taiwan; University of Missouri-Kansas City, USA; Michigan Tech. University & Chicago University, USA; Shanghai Second Medical University, China; University of Greece.

Important Output Indicators for 2012-13

S.No.	Parameters	Output
1.	Papers in refereed journals	36
2.	Chapters in Books	01
3.	Papers in Conferences	12
4.	Number of Ph.Ds. produced	07
5.	Number of Technologies/Designs and other intellectual products commercialized	01
6.	Research Manpower trained (other than Ph.Ds)	45
7.	Technical Manpower trained	01
8.	B.Tech/ UG projects guided	12
9.	M.Tech/M.Sc./M.Phil projects guided	07

INDIAN INSTITUTE OF GEOMAGNETISM, NAVI MUMBAI

Indian Institute of Geomagnetism was established in the year 1971. The institute has 38 full time working scientists/faculty.

Report on Activities during 2012-13

Areas of Focus : Geomagnetism and allied fields

Major Accomplishments :

IIG has the mandate to carry out basic and applied research in Geomagnetism and allied fields. IIG has established observational facilities to measure the geomagnetic field and several atmospheric and ionospheric parameters at its two regional centres at Tirunelveli and Allahabad, its twelve magnetic observatories located in different parts of our country right from the geomagnetic dip equator to the northern focus of ionospheric Sq current system and at the Indian Antarctic stations, namely, Maitri and Bharati. A significant achievement during this period has been the near-real time transmission of geomagnetic data from 11 of the observatories to IIG Headquarters at Navi Mumbai.

High resolution satellite derived free air gravity anomaly, its transformations and 2D crustal models were used to build an evolutionary model of the Western Continental Margin of India, with special emphasis on Laccadive Ridge (LR). Deviatoric stress fields are computed from the inversion of Gravitational Potential Energy for the Indo-Eurasian plate collision region. Another effort has led to the construction of self-consistent velocity and strain rate field model for the northeast Indian region and Indo-Burmese Arc.

Magnetovariational fields recorded by an array of magnetometers in Saurashtra and the surrounding regions have been analyzed and the electrical conductivity distribution in the region has been inferred.

Records of magnetic properties of 96 samples of a 4.7 m long gravity core comprising of late quaternary sediments collected from the central part of the western Indian margin (off Goa) at 840 m water depth indicate major variations during three time slices between 30 ka and 5.5 ka with distinct palaeoclimate links.

Using Sagdeev pseudopotential technique, the existence of large-amplitude ion-acoustic solitons was investigated for a plasma composed of ions and hot and cold electrons. The spatial and temporal structures of field line oscillations have been studied using ground as well as satellite data for the outer regions of Earth's magnetosphere.

The corotating interaction region (CIR) induced magnetic storms which occurred during solar minimum were investigated to study their effects on equatorial and low latitude ionosphere and geomagnetic field in the Indian sector.

Important Highlights of 5 Major Programmes:

Studies of magnetic properties of sediment core samples from Lonar Lake have yielded a continuous pre-anthropogenic 10 ka palaeoclimate and palaeoenvironmental records. Further, a multidisciplinary approach to the Lonar Impact Crater had led to estimation of post-impact effects on magnetic properties and palaeomagnetic directions and development of spectral models delineating mineralogical changes in basaltic rocks.

Vertical electrical resistivity soundings were carried out over Western and Northern Maharashtra in order to identify aquifers and estimate salinity of water bodies and their association with dyke patterns. Longitudinal geo-electrical sections along these dykes demonstrated carrier as well as barrier stretches which identified potential aquifers up to depths of 25-30 m.

Broadband magneto-telluric data collected along Indore-Jhalawad profile were analyzed and modeled using 2D inversion. The results have yielded valuable information about the thickness of traps, the overlying Vindhyan sediments and a broad high conductivity structure at the centre of the profile bounded at both ends by Dhar and Asmara lineaments.

A novel study on altitudinal variation of ionospheric zonal electric fields has been carried out using ground-based magnetometers, ionosondes and space-borne in-situ observations from low-Earth orbiting satellites. An interesting possibility that emerged from this study has been that the ionospheric zonal electric field can be reversed, exhibiting opposite zonal electric fields in equatorial E- and F-region altitudes during geomagnetic storms.

Study of low-frequency electromagnetic waves in the solar wind and magnetosheath using linear theory for a multi-species plasma is undertaken. The growth rates and dispersion properties of mirror and proton cyclotron anisotropy instabilities for the field and plasma parameters observed by the Cluster satellite have been obtained by solving the linear kinetic dispersion relation.

Major and Unique National Facilities created :

The Environmental Magnetism Laboratory was augmented to carry out spectroscopic studies. SEM and MicroMag instruments were added to the existing facilities in this lab.

Important collaborations (national and global) established:

(i) National Atmospheric Research Laboratory, Gadanki, (ii) Center of Exploration Geophysics, Osmania University, (iii) Geology Department, Allahabad University, (iv) BHU, Varanasi, (v) GFZ, (vi) Tuebingen University, Germany, (vii) National Space Institute, Technical University of Denmark, (viii)

Research Institute for Sustainable Humanosphere (Kyoto University), Kyotom, (ix) School of Environmental and Earth Sciences, North Maharashtra University, Jalgaon, (x) Department of Environmental Sciences, Shivaji University, Kolhapur, (xi) National Geophysical Research Institute, Hyderabad, (xii) Space Physics Laboratory, Vikram Sarabhai Space Centre, Thiruvananthapuram, (xiii) University of Western Cape, Bellville and SANSA, Hermanus, South Africa through an Indo-South Africa Bilateral project, (xiv) Nevada Bureau of Mines and Geology, University of Nevada, USA, (xv) University of Kwazulu-Natal, Durban, South Africa, (xvi) Andhra University, (xvii) Pondicherry University, (xviii) M.S. University, Vadodara, (xix) GSI, (xx) NCAOR, Goa

Important Output Indicators for 2012-13

S.No.	Parameters	Output
1	Papers in refereed journals	45
2	Chapters in Books	2
3	Papers in Conferences	54
4	Number of Ph.Ds. produced	4
5	Research Manpower trained (other than Ph.Ds)	7
6	Technical Manpower trained	2
7	B.Tech/ UG projects guided	1
8	M.Tech/M.Sc./M.Phil projects guided	24
9	Other Products/Indicators	
10	Workshop conducted	1
11	Survey conducted for other organizations	1
12	Public Outreach (talks, articles, awareness workshops, science day, open house etc)	Yes, several of them

INDIAN NATIONAL ACADEMY OF ENGINEERING, NEW DELHI

Organization Particulars

The Indian National Academy of Engineering (INAE), founded in 1987, comprises India's most distinguished engineers, engineer-scientists and technologists covering the entire spectrum of engineering disciplines. INAE functions as an apex body and promotes the practice of engineering & technology and the related sciences for their application to solving problems of national importance. The Academy provides a forum for futuristic planning for country's development requiring engineering and technological inputs and brings together specialists from such fields as may be necessary for comprehensive solutions to the needs of the country. It is the only engineering Academy in India. INAE is a Member of the International Council of Academies of Engineering and Technological Sciences (CAETS).

Report on Activities during 2012-13

INAE Silver Jubilee Inaugural Function on April 20, 2012 at New Delhi

INAE Silver Jubilee Inaugural Function was organized on April 20, 2012, at Indian National Science Academy (INSA) Auditorium, Bahadur Shah Zafar Marg, New Delhi. Dr. R Chidambaram, Principal Scientific Adviser to the Government of India was the Chief Guest. The function commenced with the address by Dr Baldev Raj, President, INAE. This was followed by the address by Dr. T Ramasami, Secretary, Department of Science & Technology, Government of India. Prof. René Dändliker, President, International Council of Academies of Engineering and Technological Sciences, Inc. (CAETS) and Past – President, Swiss Academy of Engineering Sciences (SATW), also delivered his address. The INAE Coffee Table Book on "Glimpses of Indian Engineering Achievements" was released by Dr R Chidambaram. The research study reports on Technologies for Healthcare Sector in India, Assessment of Civil Engineering Inputs for Infrastructural Development and Water Resources Management were released by Dr T Ramasami. A video film to commemorate the INAE Silver Jubilee Celebrations was released by Prof. René Dändliker. A Special Postal Cover to commemorate the Silver Jubilee Year of INAE was released by Sh. L. N. Sharma, Postmaster General, Department of Posts.

The INAE Silver Jubilee Young Engineers Awards were presented by Dr R Chidambaram to four young engineers below 45 years of age. The awardees were Dr Avinash Kumar Agarwal, Associate Professor, Department of Mechanical Engineering, IIT Kanpur; Prof Sanghamitra Bandhopadhyay of Machine Intelligence Unit, Indian Statistical Institute, Kolkata Prof Sirshendu De of Department of Chemical Engineering, IIT Kharagpur and Dr Sukumar Mishra, Associate Professor, Department of Electrical Engineering, IIT Delhi. The Silver Jubilee Distinguished Lectures were delivered Prof. P Rama Rao, Chairman, Governing Council, ARCI Hyderabad and former Secretary, Dept of Science & Technology, Govt. of India; Dr. Anil Kakodkar, DAE Homi Bhabha Chair, former Chairman, AEC and Secretary, DAE, Govt. of India and Dr. Baba N Kalyani, CMD, Bharat Forge Ltd., Pune. One of the highlights of the function was participation by Presidents/representatives of the member-academies of CAETS from Australian Academy of Technological Sciences and Engineering (ATSE), Chinese Academy of Engineering, Technology Academy Finland, Swiss Academy of Engineering Sciences (SATW) and Netherlands Academy of Technology and Innovation

(a) Seminars/Conferences - The Academy organizes Symposia/Seminars/ Workshop/ Conferences at national/international levels on topics of national importance. Based on the deliberations, INAE invariably brings out policy recommendations for suitable follow-up action by the concerned Ministry/ Department/agency(ies).

The following Seminars/Workshops/Conferences/Lectures were organized by INAE during the year 2012-13.

(i) INAE Silver Jubilee Distinguished Lecture by Prof. Paulo B. Lourenco

INAE Silver Jubilee Distinguished Lecture was delivered by Prof. Paulo B. Lourenco Head, Structures Group, Dept. of Civil Engineering, University of Minho, Portugal and Coordinator of the European Erasmus Mundus Advanced Master's in Structural Analysis of Monuments and Historical Constructions on August 23, 2012 at IIT Madras, Chennai.

(ii) International Conference on "Towards a Better Innovation Ecosystem" held on Sep 20-21, 2012 at New Delhi

Fig. 10.4

The International conference on "Towards a Better Innovation Ecosystem" was held on September 20-21, 2012 at India International Centre, New Delhi. The conference was organized in collaboration with National Innovation Council (NIC), India; International Council of Academies of Engineering and Technological Sciences (CAETS) and Confederation of Indian Industry (CII). The conference was held in seven Technical Sessions followed by a Discussion in each session. The themes of the sessions were Innovation Ecosystem: An Assessment; Creating and Nurturing Innovation Mindsets; Fostering International; Collaboration for Innovation; Restructuring R&D; Inclusive Innovation; Funding Innovation & Building Innovative India. Special Keynote address on "On Building an Inclusive Innovation Ecosystem" was delivered by Dr. RA Mashelkar, National Research Professor & President, Global Research Alliance National Chemical Laboratory. The Inaugural Address was delivered by Mr. Sam Pitroda, Chairman, National Innovation Council & Adviser to the Prime Minister on Public Information Infrastructure & Innovations. In addition, two Special Keynote addresses were delivered on "Improving the Research & Innovation Ecosystem" by Dr. R Chidambaram, Principal Scientific Adviser to the Govt. of India & DAE Homi Bhabha Chair Professor and on "Innovation and Measurement" by Mr. Arun Maira, Member, Planning Commission, Govt. of India.

(iii) INAE – ATSE Workshop on Solar Thermal and Solar Photovoltaic Technologies

This workshop was held in Australia during October 15-19, 2012; where leading experts from India and Australia joined together and conducted detailed deliberations on the complete spectrum of Solar Energy with the aim of building a roadmap for faster penetration of these technologies in India and Australia. Dr RR Sonde was the Convenor of the workshop. Eminent experts

representing Academia, Research, Policy and Industry segment participated in this event. The Workshop was enhanced by technical visits to appropriate Research Institutions and Demonstration Centres in Australia in order to further develop India-Australia Science & Technology linkages.

(iv) Symposium on National Frontiers of Engineering (NatFOE-7)

The Seventh Symposium on National Frontiers of Engineering (NatFOE-7) which is an annual flagship event of INAE, was organized during October 12-14, 2012 at Indian Institute of Technology, Guwahati. Prof. CVR Murty was the Coordinator of this event. Dr. Hemant B. Kaushik, Assistant Professor, IIT Guwahati was the convener of the event who is also an INAE Young Engineer Awardee. The symposium had four broad themes - Engineering Education in India, Engineers in technical policy making of India, Urban Infrastructure (e.g., Power, water, transportation) and Automation in daily life (e.g., Laptops, Cell phones, TVs).

(b) Academia-Industry Interaction - AICTE-INAE Distinguished Visiting

Professorship Scheme - The Indian National Academy of Engineering (INAE) launched a Distinguished Visiting Professorship (DVP) Scheme jointly with All India Council for Technical Education (AICTE) in 1999. As per the objectives of the scheme; the Distinguished Visiting Professor is required to deliver lectures on the state-of-art of Industry, industrial ambience and R&D needs of the industry to the students and faculty of technical institutions; guide student projects/ theses of interest to industry. The Scheme has received very enthusiastic response from industry and engineering institutions over the years. Twelve industry experts were selected under the subject scheme in this year.

(c) International Affairs - 20th CAETS Convocation and Annual Meeting - The CAETS (International Council of Academies of Engineering and Technological Sciences) Council Meeting and Symposium on "Urban Development and Public Transportation – Improved Understanding of the Interdependencies" hosted by Swiss Academy of Engineering Sciences (SATW) was held during August 29-31, 2012 at Zurich, Switzerland. INAE delegation participated in this event.

(d) Promoting Excellence in the Field of Engineering

(i) Life Time Contribution Award in Engineering 2012 - This award is given to an eminent Indian citizen who has made most distinguished contributions in the field of Engineering / Engineering Research / Technology, which have brought prestige to the nation and regarded as landmarks of technological development of the country. Prof P Rama Rao and Dr RA Mashelkar were selected for the year 2012.

(ii) Prof. Jai Krishna and Prof. SN Mitra Memorial Award 2012 - These awards are given to an eminent engineer, engineer-scientist or a technologist for Academic and scholarly achievements in any discipline of technology/outstanding research. Prof Amitabha Ghosh and Prof N Viswanadham were selected for Prof. Jai Krishna and Prof. SN Mitra Memorial Award the year 2012.

(iii) INAE Young Engineer Award 2012 - Instituted in 1996, INAE Young Engineer Award is given for excellence in design and technology transfer, innovative development and engineering research. Ten candidates were selected for INAE Young Engineer Award 2012.

(iv) Innovative Student Projects Award 2012 - The Academy has instituted 'Innovative Student Projects Award' since 1998 to identify innovative and creative research projects undertaken by the students at three levels, B.E./ B.Tech, ME/ M.Tech and Ph.D in Engineering Colleges. Five theses at Doctoral level, five at Master's level and six projects at bachelor level were selected for conferment of Innovative Students Project Award 2012.

(e) Research Studies - The Academy undertakes studies on important/topical national issues each year. The objective of such study is to prepare a comprehensive/exhaustive document covering review of existing international and national technological and commercial aspects, analysis of options, future trends and specific implementable policy/recommendations and methodology for execution.

(f) INAE e-Newsletter - This monthly electronic newsletter contains engineering and technology updates and aspects of frontiers of engineering as well as the news regarding INAE activities.

(g) INAE Forums - One of the important objectives of the Academy is to assist the Government from time to time in formulating policies on critical technical issues. For this purpose, three forums were constituted – INAE Forum on Engineering Education, INAE Forum on Microelectronics and INAE Forum on Energy. These forums enable giving inputs to policy makers, institutes of higher learning & research, industries, etc.

(h) The Fellowship – Thirty six Fellows and four Foreign Fellows were elected during the year.

Important Output Indicators for 2012-13

The following important publications have been brought out during the year 2012-13

a) Annals of INAE - The Annals of the INAE contains the text of the lectures delivered by Life Time Contribution Awardees; Professor Jai Krishna and Prof. SN Mitra Memorial Awardees, newly elected Fellows of the Academy and INAE Young Engineer Awardees.

b) Research Study Report on "Technologies for Healthcare Sector in India "

c) Research Study Report on "Impact of R&D on Indian Mining Industry Performance – Identifying the new priorities and strategic initiatives"

d) Research Study Report on "Water Resources Management"

e) Research Study Report on "Assessment of Civil Engineering Inputs for Infrastructural Development"

f) The Third report on Indian Engineering Heritage (Railways). This report covers Rails based Urban Transport Systems, Heritage Railway Buildings, Tunneling and River Training and Bridge protection Works.

THE INDIAN SCIENCE CONGRESS ASSOCIATION

The Indian Science Congress Association was established in the year 1914.The total number of employees is 31.

Report on Activities during 2012-2013

Areas of focus

The Indian Science Congress Association was established in 1914 with the following objectives:

(a) To advance and promote the cause of Science in India;

(b) To hold an Annual Congress at a suitable place in India;

(c) To publish such proceedings, journals, transactions and other publications as may be considered or desirable;

(d) To secure and manage funds and endowments for the promotion of Science including the rights of disposing of, or selling all or any portion of the properties of the Association;

(e) To do perform any or all other acts, matters and things as are conducive to, or incidental to, or necessary for, the above objects.

Major Accomplishments (2012-13) :

1. Holding of 100th Indian Science Congress Session at Calcutta University, Kolkata
2. Publications including ISCA's bi-monthly journal Everyman's Science
3. Augmentation of ISCA Chapter Activities
4. Subscription of Journal for ISCA Library
5. Organising Seminars, Symposia, Discussions, Workshop etc.
6. Young Scientists' Programme
7. Science Awareness Programme for Popularisation of Science
8. Advancement and Promotion of Science and Technology through
9. National/International Symposia, Follow-up of Recommendation(s)
10. Involving Young Scientists
11. International Collaboration on Exchange Programme
12. Microfilming of ISCA Old Publications
13. Software Development in different departments
14. Construction of additional floor including renovationa/alteration in existing buildings
15. Infrastructure Development

Important Highlights of 5 Major Programmes (2012-13)

The 100th Indian Science Congress under Presidentship of Dr. Manmohan Singh, Hon'ble Prime Minister of India was held at Kolkata under the auspices of the Calcutta University (from January 03 to 07, 2013. The 100th Session of the Science Congress was presided over by Dr. Manmohan Singh , Prime Minister of India, on January 03, 2012. The Focal Theme of the Congress is "Science for Shaping the Future of India"

The Indian Science Congress Association (ISCA) has instituted several Awards to honour and encourage scientists in India – mainly through special endowments received from individuals and groups and also from its own funds.

The Association envisaged constructive work for the popularisation and advancement of science by organising seminars, symposia, discussions, popular lectures, quiz contest, etc. thought out the year under twenty nine ISCA Chapters. The Association also observed the science day, environment day, doctor's day, engineer's day, technology day, and also organize joint collaborative programme with other organizations at its Headquarters.

Important collaborations (national and global) established (2011-12) : At National Level ISCA through its chapters is holding science popularization activities with various Institutes / Universities. The Indian Science Congress Association also has exchange programme with British Association of Science, Sri Lanka Association of Advancement of Science, Ameican Association of Advance of Science, Chinese Academy of Science, etc.

JAWAHARLAL NEHRU CENTRE FOR ADVANCED SCIENTIFIC RESEARCH, BANGALORE

Jawaharlal Nehru Centre for Advanced Scientific Research was established in the year 1989. The Institute has a total of 72 regular employees, out of which 47 are scientists/faculty and 80 are research associates.

The Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR), Bangalore, is a premier research institute in the country, and was established in the year 1989 in the birth centenary year of Pandit Jawaharlal Nehru, by the Department of Science and Technology (DST) with objectives to pursue and promote scientific research and training at the highest level in the frontier and interdisciplinary areas of science and engineering. The Centre is a deemed to be university. The Centre, which is just twenty three years old, is creating news regularly in the scientific world with its breakthrough discoveries and has research collaborations with several national and international institutions. The faculty members of the Centre have received several national and international recognitions. Several faculty members are Fellows of National and International science and engineering academies.

Prof. C N R Rao was the founder of the Centre. Prof. V Krishnan succeeded him. Prof. M R S Rao is presently the President.

Report on Activities during 2012-13

The focus of research in ***the*** **Chemistry and Physics of Materials Unit** : Force fields for supramolecular polymers have been developed and MD simulations using such force fields are being carried out. *Mesostructure group* carried out research on Synthesis and characterization of new nanomaterials for brain cell delivery applications. Screening new catalysts for the conversion of carbondioxide to methane have been carried out. Identifying new catalysts for oxidative dehydrogenation of alkanes. *Epitaxy group* has set up nanofab-lab and fabricated high performance GaN LED and HEMT structures using nanocolumns for charge carrier and photon transport. *Magnetism group* thin films of nonmagnetic materials have be grown by RF sputtering and their surface magnetism have been studied by Magnetic Force Microscopy and X-ray magnetic circular dichroism to establish the intrinsic nature of ferromagnetism.

Metal-organic framework group has been engaged on synthesis of multifunctional materials, i.e. materials which combine a set of well-defined properties (e.g. porosity and magnetism, porosity and optical), by a rational strategy to assemble a 2D magnetic layers of M_A -$[M_B(CN)_6]^{3-}$ (M_A = MnII, Co(II), Ni(II); M_B = Fe(III), Cr(III)) into a 3D rigid porous framework by linking organic pillars that exhibits permanent porosity as well as ferro / ferrimagnetic ordering at low temperatures. In addition, new nanomaterials particularly graphene analogues, nanocomposites, etc have been synthesized with emphasis on large scale synthesis. Multicomponent patterning has been a routine activity in the years to come. With such developments, new material interfaces with well defined defect profiles will be realized. This will lead to device fabrication based on the functionalities of the nanomaterials. Polymer based electronics will be a continued activity.

In ***New Chemistry Unit***, research has been pursued in several aspects of the chemistry of materials. These include Exciting new chemistry, Functional organic and supramolecular materials, Organic synthesis, molecular probes, peptide and protein chemistry, nucleic acid chemistry, bionanotechnology, Bio-organic and medicinal chemistry, Designing new ways to small molecule heterocyclic scaffolds, Inorganic and solid state chemistry, Nanomaterials and renewable energy, Solid state inorganic chemistry.

In the ***Evolutionary and Organismal Biology Unit,*** the faculty continued their ongoing integrative researches in the broad areas of Evolutionary Genetics and Population Ecology, Chronobiology and Behavioural neurobiology, Animal Behaviour and Phylogeography. Most of these studies are long-term in nature, being based on either selection experiments or long-term observations on social behaviour and demography in wild populations.

Education Technology Unit (ETU): The Unit continue to develop and produce multimedia CDROMs and books especially for school students and teachers in various disciplines of science. CNR Rao Hall of Science and Education Technology Unit will be organizing teachers/students workshops/ programs in different subjects like Physics, Chemistry, Biology, Nanoscience. The Kannada Book 'NANOPRAPANCHA' authored by Prof. C.N.R. Rao and translated by Mrs. Indumati Rao of ETU, has bagged the *'Awards for Excellence in Publishing'* from the Federation of Indian Publishers.

The Summer 2012 Science Outreach Programme sponsored by the CNR Rao Hall of Science, JNCASR was conducted in association with Himalayan Gram Vikas Samiti, Gangolihat by Prof. K.S. Valdiya on May 6-9, 2012. 148 Participants from 24 Govt. intermediate colleges attended the program which had lectures on topics in Science & Engineering from Eminent Scientists.

SCIENCE POPULARIZATION PROGRAMME : This year significant progress has been made in all spheres of academic activities at the Centre. A series of programmes were organized by Education Technology Unit (ETU) and Hall of Science toward the promotion of science education. C.N.R. Rao Hall of Science and ETU organized and conducted the program to award the Prizes for Outstanding Science Teachers for the year 2011 donated by the C. N. R. Rao Education Foundation. Shri S V Burli and Smt. M.S. Rekha were awarded the prizes. C. N. R. Rao Hall of Science and Education Technology Unit along with SOP-ETU took up a project of conducting four Workshops for 100 Pre-University Teachers from different places in Karnataka in using the College Chemistry Kit. The Science Outreach Program has become an important academic component of the Centre. Many school children and teachers were exposed to the excitement of Science through various programmes at the Centre. The C N R Hall of Science and Education Technology Unit conducted various programmes for children in their endeavour in popularizing science among the young students.

The Faculty of ***Engineering Mechanics Unit (EMU)*** conducted studies on Granular matter and other complex fluids, Mesoscale simulations and high performance computing, Instabilities and interfacial flows, Aerospace and atmospheric fluid mechanics, Fluid mechanics and heat transfer, Rheology of complex fluids, vortex dynamics, transport processes in the nocturnal boundary layer. One part of the group's studies have been on turbulence, so the computational needs will increase manifold. Consequences of the above findings in real applications (atmospheric boundary flows, clouds and others) have been investigated.

In ***Geodynamics Unit*** studies were carried out on Neotectonics and environmental geology.

International Centre for Materials Science established the major scientific user facilities to serve both in-house researchers and researchers from other institutions. It has further expanded its infrastructure by installing sophisticated equipments like Superconducting Quantum Interference Device (SQUID), Inductively Coupled Plasma Optical Emission Spectrometry (ICP-OES), UV Spectrometer, Photoluminescence Spectrometer (PL), etc.

The ***Centre for Computational Materials Science (CCMS)*** (renamed as Thematic Unit of Excellence on Computational Materials Science) of ICMS has established a High Performance Computing Facility, an instructional computing laboratory with 30 computers for hands-on training of the students.

In the ***Molecular Biology and Genetics Unit*** the biological function of the mrhl non-coding RNA encoded in the mouse genome has been studied in greater detail particularly in relation to its involvement in the regulation of the wnt signaling pathway. The biological functions of the human homologue of mrhl that has been recently discovered in the laboratory, has been explored with reference to its role in development, differentiation and cancer. Studies on the role of transcription factors: AEBP1 and ASCL1, in gliomagenesis has been expanded to understand the molecular mechanisms involved in the pathogenesis of glioma.

The dynamics of centromere and neocentromere formation in Candida albicans have been studied. Genetic and epigenetic factors that control centromere formation in Candida albicans are major emphasis of the studies.

Studies have been undertaken to elucidate the role of purine nucleoside and nucleotide cycles in regulating levels of various metabolites in P. falciparum. Genes of the two cycles have been knocked out and the metabolome has been profiled in the mutant strains using NMR and mass spectrometry. Aspects of malaria pathogenesis have been examined using a systems biology approach.

Further pathogenic characterization of the Indian HIV strains. Understanding aspects of gene expression from the viral promoters. Strategies for controlling chronic immune activation in HIV-AIDS by use of effective immune-modulatory agents.

Establishment of a new laboratory emphasizing yeast biochemical and fluorescence microscopy assays for peroxisome degradation and analysis for autophagy related pathways is on anvil.

Analysis of the role of asrij gene function in maintaining stem cell pluripotency. Elucidating mechanisms of cardiovascular development using transgenic and knockout mice that the group has generated.

Using concepts and technologies of human genetics and genomics, the group explored molecular basis of certain neurological disorders (epilepsy and non-PD movement disorders), sensorineural disorders (congenital deafness, and pain asymbolia) and certain speech-language disorders.

The animal facility currently established at the Centre has been upgraded, both in terms of infrastructure and personnel to meet the requirements of the researchers.

In ***Theoretical Sciences Unit,*** while many of the current activities will continue to determine the research activities of the unit, some general themes are expected to emerge in the next few years as thematic foci. One is the development of computational methods to address that phenomena which span many length and time scales, and may involve multiple levels of description. Multiscale modeling, QM/MM, and coarse-grained modeling methods for complex soft molecular systems belong to this theme. The other theme is the application of research on condensed matter to energy applications, ranging from photovoltaics to materials for gas storage. A third theme is the application of methods described above, in particular statistical mechanical methods to study biological systems. This will involve the use of concepts developed for studying soft matter to study biological matter, and also mathematical modeling to describe time dependent phenomena, information flow etc, in the organization of biological processes. Finally, the application of the expertise in the unit to address questions related to climatic processes and the environment may emerge as another significant theme of interest.

Computer Laboratory

High-Performance Computing (HPC)

To cater to the needs of researchers working in areas of bio-informatics, engineering mechanics, physics and chemistry of materials, we plan to set up a cluster with four-CPU nodes based on 12 AMD Core (OmniCore architecture) CPUs (or equivalent of other types) in a 2U Rack.

Major Accomplishments

This has been an another year of significant scientific discoveries made by our faculty and students; to name a few, Prof C N R Rao and Prof Umesh Waghmare have shown that an inorganic compound containing boron, carbon and nitrogen could absorb carbon dioxide (CO2) and methane (CH4) — two greenhouse gases (GHGs) that contribute to global warming.

The study offers a way of creating spatially confined graphene-like structures, which could form the foundation of functional devices; Prof. Srikanth Sastry, Mr Vishwas V Vasisht, Mr Shibu Saw, Theoretical Sciences Unit, have reported that liquid silicon can actually transform between two different 'phases' — one at low temperature and pressure and one at high temperature and pressure. The finding may suggest novel avenues for making silicon in the crystal phase as well as different forms of amorphous silicon.

Important Highlights of Major programmes:

In TSU a novel and practicable way of changing the morphology of gold nanoparticles deposited on a metal oxide substrate, by doping the oxide with atoms has been found which will increase catalytic efficiency by changing the particle shape from three- to two-dimensional.

A group in Materials Science and Theoretical Science have shown that an inorganic compound containing boron, carbon and nitrogen could absorb carbon dioxide (CO_2) and methane (CH_4).

An invention in MBGU reports anti squamous cancer (cervical and oral) specific compounds having tremendous potential to be used as lead molecules.

Work carried out at EMU simulates, for the first time, cumulus cloud form, evolution and entrainment in the laboratory. It shows that diabatic heating provides the long- sought missing link between cloud microphysics and macrodynamics making cumulus models more effective.

The research group from CPMU shown that the electronic properties of grapheme can be tuned from semi-metallic to semiconducting if the lateral dimensions are reduced to a few tens of nanometers. A method to fabricate granting structures on bulk graphite has been invented from which multi-or few layer grapheme ribbons can be sourced repeatedly by lift-off.

Major and Unique National Facilities created:

Agilent 8453 UV visible spectrometer with accessories & softwares, Laben Inverted Darkfield Microscope with accessories, IVC Ventilator Model V-3, IVC Cage Rack, IVC Cage Assembly, Animal Change Station/Workstation, Oriel Sol3 A Class AAA Solar Simulator, I-V Tester, Glove Box Work Station Code : 1500001, Semiconductor Characterization System, JASCO Circular Dichroism Spectrometer with accessories, Bruker Model Tensor 27 FTIR Spectrometer with accessories, Lambda 650 UV / VIS Spectrometer with accessories, Optima 7000 Dual View ICP Spectrometer with accessories, Mini Arc Melting System with accessories, Leica S6 D Trinocular Stereo Zoom Microscope, Leica High Speed Digital Color Fire Wire Camera, 200AMU Residual Gas Analyzer with RS232, Electron Multiplier (EM), built-in Power Module for AC Line Operation.

Important collaborations (national and global) established:

The interactions with academic institutions and universities globally have continued and the Centre is expanding its formal ties in respect of collaborative research, exchange of graduate students and consultancy projects. A few MOU's were signed with Defense Food Research Laboratory (DFRL, Mysore), Queensland University of Technology, and UKIERI -UK –US India Trilateral Research in Partnership for academic interactions.

Important Output Indicators

PUBLICATIONS : The Centre has registered a very good progress in its publications records. Total **279** publications have been reported during the year in around 136 peer-reviewed high-ranked journals. Average impact factor was **4.44**. 7 Books and book chapters were also credited by the faculty members along with 3 international conference papers.

ACADEMIC AND EXTENSION ACTIVITIES : There is a steady increase in the number of research students in the Centre pursuing various academic programmes. The present student strength is 283. 42 students joined the Centre during August session of 2012. 16 students were awarded Ph D, 7 with M S (Eng.) degree, 4 with M S – Ph D and 4 with M S (Materials Science) degrees. In order to provide opportunities to teachers and others to obtain training and for carrying out science education projects, the Centre is offering a Postgraduate Diploma Programme in Science Education.

Summer Research Fellowships, Project Oriented Chemical Education Programme, Project Oriented Biological Education Programme, Visiting Fellowships, Extension Programmes and Academic Exchange Programmes have attracted wide attention and have been highly successful.

For the Summer Research Fellowships programme, out of the 48 candidates selected, 36 candidates were placed under JNC faculty and 12 under non-JNC faculty. In addition, 15 SRFP candidates were

awarded Rajiv Gandhi Fellowship. For POCE, 11 meritorious students were offered the fellowship. Nine students of POCE-2009-11 were awarded Diploma in Chemistry. One students of POCE-2010 batch has been selected for the Integrated M.S/Ph D programme of JNCASR. Under POBE, 9 candidates have joined the programme. Eight students of POBE 2009 batch received their Diploma in Biology certificates this summer on successful completion of their 3 year project training. One student from POBE batch of 2010 has joined JNCASR under the MS-Ph D programme.

Nine candidates from R&D institutions have been offered Visiting Fellowships. JNCASR-CCSTDS has been renamed as JNCASR-CICS Fellowship. It is jointly instituted by the Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR) Bangalore and the Centre for International Co-operation in Science (CICS), Chennai. Two Fellows selected for the year 2009-10 have been given certificates on successful completion of their 3 month training programme in India. 4 Fellows have been given JNCASR-CICS certificates for the year 2010-11. In 2011-12, 7 scholars have been selected for the fellowship.

INTELLECTUAL PROPERTY : During the current year, 24 patent applications (Indian Provisional Applications–8, Indian Complete Applications–2, PCT–3, USA-5, EPO-2, Brazil-1, China-1, Japan-1, Korea-1) have been filed. 3 patents (USA-1, EPO-2) were obtained and 7 inventions were licensed.

The Centre maintains its vibrant academic activities through conferences, seminars, colloquia and discussion meetings.

The infrastructure is being constantly upgraded to meet the academic requirements and for scientific and student activities. All these developments would not have been possible without the continuous support from the Department of Science and Technology.

AWARDS/DISTINCTIONS

The Centre's faculty members have received number of national and international recognitions. Prof. C N R Rao, Chairman, Scientific Advisory Council to the Prime Minister and National Research Professor, has been awarded with H K Firodia Lifetime Achievement Award, 2011 and Einstein Professorship of Chinese Academy of Sciences. He has also been felicitated with Ernesto Illy Trieste Science Prize (2011) for materials research;Dhirubhai Ambani Life-Time Achievement Award for Innovation(2011); EDGE Award for leadership in education (2011); D.Litt. by Karnataka State Open Univeristy (2011); D.Sc. (honoris causa) Universite Joseph Fourier; D.Sc.(honoris causa) SRM University, Tumkur University. Prof. Roddam Narasimha has been awarded with the prestigious H K Firodia Award 2011 for Excellence in Science & Technology and Distinguished Alumnus Award, University Visvesvaraya College of Engineering. Prof. P. Rama Rao has been elected as Foreign Associate of the US National Academy of Engineering, 2012. Prof. S. Balasubramanian has been awarded with the Shanti Swarup Bhatnagar prize. Prof. Shobhana Narasimhan has received Stree Shakti Science Samman Award and Kalpana Chawla Award of the Government of Karnataka. She has also been elected as Fellow, National Academy of Sciences of India. Prof. Vijay Kumar Sharma has been elected as Fellow, Indian Academy of Sciences, Bangalore, 2012. Prof. Ganesh Subramanian has received Indo-US Senior Fullbright Fellowship. Prof. Tapas Kumar Maji has been selected as an "Emerging Investigator" in Chemical Science by Journal of Chemical Communications in 2011. Dr. T. Govindaraju has received INSA Medal for Young Scientist (2011), Indian National Science Academy, New Delhi, India. Dr. Subi J. George has been chosen as a Young Investigator in the field of Chemical Sciences by the Journal Chemical Communications, 2012, published by the Royal Society of

Chemistry. Prof. Amitabha Chattopadhyay has received Darshan Ranganathan Memorial Lecture Award (CRSI), 2011. Prof. Satyajit Mayor has been the recipient of TWAS Biology Prize, 2011. Prof. Partha P. Majumder has been elected as Fellow, TWAS: The Academy of Sciences for the Developing World, Trieste – 2011.

INDIAN INSTITUTE OF ASTROPHYSICS, BANGALORE

Indian Institute of Astrophysics, Bangalore was established in the year 1971. The Institute has a total of 303 regular employees, out of which 64 are scientists/faculty and 06 are post-doctoral research associates.

Report on Activities during 2012-13

Areas of Focus : Astronomy and Astrophysics, Atomic and Molecular Physics

Important Output Indicators for 2012-13

S.No.	Parameters	Output
•	Papers in refereed journals	123
•	Chapters in Books	4
•	Papers in Conferences	43
•	Number of Ph.Ds. produced	8
•	Research Manpower trained (other than Ph.Ds)	50
•	Technical Manpower trained	10
•	B.Tech/ UG projects guided	20
•	M.Tech/M.Sc./M.Phil projects guided	25

1. The engineering model of the Ultraviolet Imaging Telescope (UVIT), a payload on India's first dedicated astronomy satellite ASTROSAT, was assembled and tested extensively. The Critical design review of UVIT was completed and assembly of the flight model commenced in the Class 100 area of the MGK Menon Laboratory.

2. The digitization of over 100 years of solar data on photographic plates from Kodaikanal has made excellent progress. The full series of digitized Ca-K images of the Sun is now available to the scientific community to carry out synoptic studies spanning over 9 solar cycles.

3. IIA has played a lead role in co-ordinating India's participation in the the international Thirty Meter Telescope (TMT) Project, to build and operate the next generation of a ground based mega optical and IR telescope facility. NLST and TMT have been recommended by a national committee for implementation in the 12th five year plan.

4. The 2-m National Large Solar Telescope (NLST) project, a unique facility proposed by the Institute for observingthe Sun at high resolution, was endorsed by the IIA Governing Council and is awaiting approval for implementation in the 12th five year plan.

5. Integrated tests of the optical system of the 1.3-m telescope and the integrated telescope were carried out. The telescope pier as well as concrete support structure for the steel building and dome was completed. The telescope is ready and will be installed as soon as the building is ready.

6. The fabrication of a Visible Emission Line Coronagraph payload on Aditya I to study the solar corona is progressing well.

7. A new broadband radio antenna system, designed and fabricated in house, was commissioned at the Gauribidanur observatory.

8. The Hanle Echelle Spectrograph (HESP), a high resolution spectrograph for the 2-m Himalayan Chandra Telescope, is under fabrication.

9. Avijeet Prasad, an IIA graduate student, received the prestigeous Shyama Prasad Mukherjee Fellowship from the DST.

10. 8 students completed PhD on topics ranging from optics to extra-galactic astronomy. Six students compelted the MTech part of the MTech-PhD program and one student completed the MSc part of the MSc-PhD program.

Section B: Item 5:

1. BARC, Mumbai is collaborating with IIA in the development of a new gamma ray facility, the Major Atmospheric Cerenkov Experiment.

2. TMT consortium (USA, Canada, Japan, China) collaborating with TMT – India to build prototypes of various systems and sub-systems for the Thirty Meter telescope (TMT) project.

3. A high resolution spectrometer (HESP) for the Himalayan Chandra Telescope (HCT) is currently under construction. It is being developed in technical collaboration with Industrial Research Limited, New Zealand.

4. About 25 international collaborative projects on scientific projects across various countries.

THE NATIONAL ACADEMY OF SCIENCES, INDIA

The National Academy of Sciences, India (NASI) was established in 1930. The academy has 17 regular employees. 35 NASI Senior scientists are associated as scientists/faculty and 5 of them are NASI –Chair Professors.

Report on Activities during 2012-13

Areas of Focus : Promotion & Popularization of Science & Technology; to aid & advise in Policy Making

Major Accomplishments : The major accomplishments were the following-

The Year of Science Programmes

As per decision taken last year in the Science Congress Association, the NASI is organizing several programmes to celebrate the Year of Science; books on History of science are to be released.

Publications

- Apart from regular publications (the Academy published a vast data of research as its regular publication in collaboration with the Springer India Pvt. Ltd.); also published three volumes on **Nematode Infestations**. The **reviews** published in the Proceedings and Science Letters of the Academy covered the most discussed areas of research from **Nanotechnology to Biotechnology; and Material Science to Transformational Technologies.**
- A book on **Malaria (in Hindi**) of about **600 pages** has also been published in collaboration with the ICMR, N Delhi: A first of its kind in India.
- Two Special Issues (one on **Nanotechnology** & the other on **Biodiversity**) were also published this year, having celebrated articles.

Science Communication Activities

- The highlights of activities were **Children Science Meet, Summer & Winter Schools, Vacation Training Programmes, Workshops, Vigyan & Health Chaupals, Seminars, National Technology Day, National Science Day and World Environment Day** etc.
- NASI-HQ and its 17 Chapters organized hundreds of science communication activities, in and around their region throughout the period of the report of the year 2012-13.
- Not only that, a **first of its kind activity** was started by the Academy for the young researchers, when a series of **workshops on Scientific Paper Writing** was organized by the Academy to train them for expressing their views and research findings in an appropriate manner. So far, such five workshops have been organized at BHU, Varanasi, SGPGI, Lucknow, CIFE, Mumbai and the NASI.

An Establishment of a Magnificent Ganga-gallery

The river Ganga occupies an unique position in the cultural ethos of India. But the holy river Ganga's existence is under threat, due to enormously increasing load of pollution year by year. Therefore, the Council of the Academy decided to adopt ways to make the people aware for the conservation and restoration of the holy river Ganga by establishing a Ganga Gallery with well defined objectives in order to highlight the religious, cultural, socio-economic and scientific aspects of the holy river. The gallery was inaugurated last year by **Hon'ble Shri Pawan Kumar Bansal**, Science & Tech. Minister, Govt. of India. The highlights are given on-**www.nasi.nic.in**.

Science Education Programmes in joint collaboration of other National Science Academies

The NASI together with other two Science Academies - Indian National Science Academy, New Delhi and Indian Academy of Sciences, Bangalore is jointly sponsoring the Summer Research Fellowship under the joint Science Education Panel to provide opportunities to bright under-and post-graduate students and teachers to usefully spend their summer/winter vacations.

Annual Session/Symposia/Seminars & Scientific Discussions

The Academy organized a National Symposium on **"Sustainable Management of Biodiversity using Science & Technology" on Nov. 24-26, 2011 at Trivandrum**; with an aim to take concrete

steps for conserving the biodiversity for Sustainable Development. The convener of this symposium was Prof Manju Sharma; who has **also published an edited Special Issue on Biodiversity** this year. **Now, another Symposium on Nano-science & Technology is also to be held this year in November.**

Fellowship / Membership

The ICMR, New Delhi, posing full faith in the scientific capability of the Fellows of the Academy, has instituted the **ICMR Fellowship in the area of Public Health Research; and** a**nother Fellowship-*Distinguished Woman Scientist Chair*** has also been instituted with the financial support of the DST, N Delhi. **The Academy instituted NASI-Honorary Scientists Positions also this year.**

Singhania Library

Library services were enriched through digitization of the library, subscribing more books and by providing facilities of storage, reading room, microfilming, citation index etc. Internet facility for educational purpose is also being provided to the students free-of-cost. **The library has been connected to National Knowledge Network (NKN).**

Recognition and Awards

Several Fellowships and Awards were given during the year; a few are mentioned for example:

- NASI-Reliance Industries Platinum Jubilee Awards (2012) for the Application Oriented Innovations covering both Physical and Biological Sciences.
- NASI-Young Scientist Platinum Jubilee Awards (2012) in the fields of Biological/Physical/ Chemical Sciences.
- NASI-Senior Scientist Platinum Jubilee Fellowships (2013)- Awarded.
- NASI Scopus Awards (2011) - Announced
- NASI – Science and Maths Teacher Awards (2011) by NASI HQ and some of its Chapters in their respective region

Local Chapters

The 17 Chapters of the Academy have undertaken **a hundreds of activities** for the furtherance of the Academy's objectives.

1. Important Highlights of 5 Major Programmes: **The highlights are –**

   a) The Year of Science Programmes – going on.

   b) The Ganga-gallery has been well established; and plan for its further extension as a Science Museum is being finalised.

   c) A book on **Malaria (in Hindi**) of about **600 pages** has been published, a first of its kind in India; another two special publications are on **Nanotechnology** and **Biodiversity**.

d) ***Science Communication Activities :*** The highlights of activities were **Children Science Meet, Summer & Winter Schools, Vacation Training Programmes, Workshops, Vigyan & Health Chaupals, Seminars, National Technology Day, National Science Day and World Environment Day** etc. Not only that, a **first of its kind activity** is being organized regularly by the Academy for the young researchers, i.e. a series of **workshops on Research Paper Writing.**

e) Apart from conferring Fellowship/Membership of the Academy, Several awards were also given **in recognition of the significant scientific contributions of the young scientists, such as** –

NASI-Reliance Industries Platinum Jubilee Awards (2012) for the Application Oriented Innovations covering both Physical and Biological Sciences.

NASI-Young Scientist Platinum Jubilee Awards (2012) in the fields of Biological/Physical/ Chemical Sciences.

NASI – Swarna Jayanti Puruskars (2012) for Best Paper Presentation in the Annual Session; and the NASI Scopus Awards (2011)-are to be given.

2. **Major and Unique National Facilities created** : **The Ganga-gallery** (**IGNOU, New Delhi** has included the gallery in its syllabus/project to make the students learn the aspects of conservation of a river; as well as **UP Tourism** and **Consortium of IITs** have also included the gallery on its official website). The Science Museum is to be established soon.

3. **Important collaborations (national and global) established**:

a) **The NASI together with other two Science Academies - Indian National Science Academy, New Delhi and Indian Academy of Sciences, Bangalore** is jointly sponsoring the Summer Research Fellowship under the joint Science Education Panel

b) **Also continuing its established collaboration with the Reliance Industries** for recognizing the scientific research.

c) **The Academy has established collaboration with the SCOPUS** for recognizing the scientific talents.

d) **It has also established an association with the Springer** for publishing its journals.

e) **Also organized many science communication activities in collaboration with the Indian Universities/Institutes/CSIR Laboratories/ NCSM and other prestigious institutions.**

NATIONAL INNOVATION FOUNDATION – INDIA, AHMEDABAD, GUJARAT

National Innovation Foundation – India was established in 2000. Number of scientists/faculty is 7 and post doctoral staff is 4.

Report on Activities during 2012-13

1. Areas of Focus: Contemporary technological grassroots ideas, innovations and traditional knowledge

2. Major Accomplishments:

   (a) Hermes Innovation Award on 10th May 2012 in Paris by European Institute for Creative Strategies and Innovation to Honey Bee Network/NIF;

   (b) 5th EMPI-The Indian Express Indian Innovation Star Award;

   (c) Patent granted to a grassroots innovation viz. Multi crop thresher of Shri Madan Lal Kumawat of Rajasthan.

   (d) Two farmer developed plant varieties (HMT and Kudrat) registered under the PPV&FR Act 2001.

   (e) The following four grassroots technologies were transferred to different entrepreneurs - household sugarcane juice extractor, bicycle plough cum weeder, mitticool clay creations, and clay water pot.

Important Highlights of 5 Major Programmes:

(a) NIF was able to scout and document 18, 000 ideas, innovations and traditional knowledge practices from 32 States and Union Territories

Over 250 grassroots technologies taken up for validation of innovators' claim at different research/ technological institutions

b) 125 applications for Intellectual Property protection filed nationally and internationally, which include 116 patent applications in India and 2 PCT applications.

c) IGNITE 12 National Award ceremony to honour student (class 12 and under) ideators and innovators. The prizes given by Dr. APJ Abdul Kalam on Nov. 10, 2012 at IIM Ahmedabad. Close to 15, 000 ideas/innovations documented from 282 districts of the country in the same.

d) company named "Idea India ka Innovations Pvt. Ltd." registered in collaboration with Future Group for commercialization of grassroots technologies

Major and Unique National Facilities created : Nation's first multimedia mobile lab-cum-exhibition van for scouting, documentation, processing and dissemination of Grassroots innovations built.

Important collaborations (national and global) established:

a) With WWF – India for Climate Solvers Program to take forward green grassroots innovations

b) Wisdom Tree, New Delhi and Ameya Prakashan, Pune for publishing books on Children's creativity and Marathi India Innovates respectively.

Important Output Indicators for 2012-13

S.No.	Parameters	Output
1	Books	2
2	Papers in Conferences	6
3	Foreign Patents filed	2
	Foreign Patents granted	-
4	Indian Patents filed	116
	Indian Patents granted	1
5	Trademark Applications	7
6	Plant Varieties registered under PPV&FRA (certificates issued)	2
7	New applications filed under PPV&FRA	6
8	Number of Technologies/Designs and other intellectual products commercialized	4
9	Number of Technology leads awaiting transfer	15
10	B.Tech/ UG projects guided	21
11	M.Tech/M.Sc./M.Phil projects guided	17
12	Improved Prototypes developed of various ideas/innovations	20
13	New grassroots technologies validated	60
14	Projects supported under Micro Venture Innovation Fund (MVIF)	7

RAMAN RESEARCH INSTITUTE, BANGALORE

Raman Research Institute was established in 1848. The total number of regular employees 190.The institute has 51 scientists and 7 post doctoral research staff.

Report on Activities during 2012-13

Areas of Focus: Astronomy and Astrophysics, Light and Matter Physics, Soft Condensed Matter and Theoretical Physics

Major Accomplishments :

The on-going research programmes of the Astronomy and Astrophysics, Soft Condensed Matter, Light and Matter Physics and Theoretical Physics groups were continued with members formulating and solving problems on their own and in collaborations with PhD and other visiting students.

Major experimental developmental activities, as reported last year, were continued: they included (a) design and development of high-speed ADC-FPGA unit as a part of the RRI Aperture Array, (b) analysing pulsar data collected from the E-W wing of the Decameter Wave Radio Telescope at Gauribidanur, (c) the Murchison Wide-field Array (MWA) which is now moving from building to commissioning to do science with it (d) designing and constructing new broadband receivers for the Ooty Radio Telescope, (e) development of an X-ray polarimeter in collaboration with the Indian Space Research Organisation (ISRO) and (f) participation in the Large Area X-ray proportional counter (LAXPC) for the ASTROSAT – a satellite mission of ISRO for multi-wavelength astronomy. Planning for a Quantum Information and Computing as well as brain computer interface was initiated.

Important Highlights of 5 Major Programmes:

The Institute's participation in the Murchison Wide-Field Array (MWA), an international project between the US, Australia, New Zealand and India. This array is now moving from building to commissioning to do science with it.

The Institute's participation in the design, development, construction of SKA-Low systems; field-testing and commissioning – towards an aperture array of antennas on the ground continued. This is, as was reported earlier, also an international project in partnership with UK, Netherlands, France, Italy & Australia forming an SKA-Low consortium.

The Institute's project on X-ray polarimeter in collaboration and cooperation with the Indian Space Research Organization is progressing well and several developmental works relating to design, fabrication and preliminary work were carried out. Development of Cosmological Models to describe the radiation from the Epoch of Reionisation (EOR).

Exploitation of research potential using the recently acquired High Resolution Micro Raman Spectrometer, NMR Spectrometer, Field Emission Scanning Electron Microscope and other equipment by Soft Condensed Matter Physics group. Planning for continued productive experiments exploiting the five quantum optics laboratories

Important collaborations (national and global) established:

In addition to seven important collaborations that the Institute had established and reported during the last year, the following new collaborations have been entered into:

a) A project on 'Gravitational Wave Astronomy' under the Indo-Australian Science and Technology Cooperation, between the Institute and the University of Western Australia and the University of Adelaide.

b) Collaborative Exchange Programme between the Institute and the Kyushu Institute of Technology, Japan.

c) Collaborative project on 'Effect of the Correlations in the statics and dynamics of extended systems' under 'CEFIPRA' between the Institute and Lab. de Physique Theororique et Modeles Statistiques, France.

d) Collaborative programme on 'Quantum Computing' between the Institute and the University of Waterloo, Canada.

e) Collaborative programme on 'all weather imaging systems using polarization contrasts and/or intensity modulation' between the Institute and the University of Rennes and the Centre National de la Reserche Technique, France.

Important Output Indicators for 2012-13

Papers in refereed journals	133
Papers in Conferences	13
Number of Ph.Ds. produced	11
Foreign Patents filed	7
Foreign Patents granted (total)	3
Indian Patents filed – under process	9
Research Manpower trained (other than Ph.Ds)	4
Technical Manpower trained	2
B.Tech/ UG projects guided	65
M.Tech/M.Sc./M.Phil projects guided	48

S. N. BOSE NATIONAL CENTRE FOR BASIC SCIENCES

S. N. Bose National Centre for Basic Sciences was established in 1986. The Institute has a total of 55 regular employees, out of which 32 are scientists/faculty& 22 are post-doctoral research staff.

Report on Activities during 2011-12

Areas of Focus:

(a) Synthesis and characterization of nanomaterials, including nanofabrication, nanolithography, opto-electrical and transport properties, microscopy.

(b) Ultrafast timescale magnetization dynamics using time resolved magneto optic Kerr effect, related theory and simulation.

(c) Theoretical and simulation studies of electronic band structure, magnetic properties etc. of various materials.

(d) Ultrafast and high frequency spectroscopy of various systems including biomolecules, bio-mimicking systems, nano materials etc.; energy transfer.

(e) Black hole astrophysics, cosmology, the effect of event horizon, experimental astrochemistry and astrobiology.

(f) Quantum field theory, quantum information, gravity and black holes, statistical physics, nonlinear physics.

Major Accomplishments:

(a) Time and Space resolved Kerr Effect Measurements.

(b) Clean room with nanofabrication facility using ion beam and e-beam lithography.

(c) Atomic Force Microscopy (AFM) with lithography facility upgraded with Innova model of Bruker

(d) High Resolution Transmission Electron Microscope (HRTEM) upgraded with Electron Energy Loss Spectroscopy (EELS)

(e) Pulsed Laser Deposition (PLD) unit upgraded with high pressure RHEED system

Important Highlights of 5 Major Programmes:

(a) Physics of nanomaterials including application-specific materials development.

(b) Advanced computational materials science including soft condensed matter.

(c) Interface of biology and condensed matter physics including fluctuation and stability of biomolecules, DNA-protein interactions and biomolecular recognition in physiological conditions, biology of extreme conditions, and application of ultra fast spectroscopy in biomolecules and quantum effects in fast molecular and non-adiabatic process.

(d) Collective behavior in quantum and classical condensed state including driven systems, ultra cold quantum gases and spin transport through Quantum wires.

(e) Theoretical work on black holes and its cosmological consequences and astro-chemistry. Selected problems in Quantum field theory.

Major and Unique National Facilities created :

(a) Time and Space resolved Kerr Effect Measurements.

(b) Clean room with nanofabrication facility using ion beam and e-beam lithography.

(c) Atomic Force Microscopy (AFM) with lithography facility upgraded with Innova model of Bruker

(d) High Resolution Transmission Electron Microscope (HRTEM) upgraded with Electron Energy Loss Spectroscopy (EELS)

(e) Pulsed Laser Deposition (PLD) unit upgraded with high pressure RHEED system

Important collaborations (national and global) established:

Project Title Project	PI / Co – PI	Funding Agency	Duration of the
" Understanding Physics and Chemistry of novel material using NMTO Wannier Functions "	Dr. T. Saha Dasgupta	Indo-GermanFP/2004(40)	15-12-2004 to 14-12-2011
"INAE (Emeritus Scheme)	Prof. B.B. Bhattacharya	INAEINAE/405/NS	1-7-2006 to 30-6-2011
DST/BC/08-09/10 -"Astrophysical and cosmological implication of noncumulative space time"	Dr. Biswajit Chakraborty	DST (Indo SA Jt. Proj) INT/SAFR/P3(11)/2009	11-9-2009 to 10-9-2012
DST/AB/09-10/18 –"DYNAMAG: Advanced Computational Studies of Dynamic Phenomena in Magnetic Nano-Materials"	Dr. Anjan Barman	DST & European Commission INT/EC/CMS(24/233552)/ 2008(i)	11-9-2009 to 10-9-2012
DST/PM/09-10/22 – "ATHENA – Advanced Theories for Functional Oxides: New Routes to Handle the Devices of the Future" (India European Union Research Project)	Dr. Priya Mahadevan	DSTINT/EC/ATHENA (3) / 233553/2008 (i)	8-9-2009 to 7-9-2012
DRDO/KM/09-10/24 -"Study of magneto caloric effect"	Dr. Kalyan Mandal	DRDOERIPR/ER/ 0902182/M/01/1296	24-3-2011 to 31-3-2012
DST/AB/09-10/27 -"Spin wave and domain wall dynamics in vertical magnetic nanowires (DST-UKIERI)"	Dr. Anjan Barman	DSTDST/UKIERI/SA/ P-2 /2008	15-6-2008 to 14-6-2011
CSIR/KM/09-10/29"Preparation and study of nanostructured dilute magnetic semiconductors"	Dr. Kalyan Mandal	CSIR03(1178)/10/EMR-II	1-10-10 to 30-9-2013
DST/AB/09-10/31 -"Magnonic Crystals: New paradigm towards microwave communications"	Dr. Anjan Barman	DST (DST-JST Prog) INT/JP/JST/P.23/2009	26-7-2010 to 25-7-2013
BRNS(DAE)/KM/09-10/36 - "Preparation and study of magnetic nanowires"	Dr. Kalyan Mandal	BRNS (DAE)2009/37/ 16/BRNS	21-12-2009 to 20-12- 2012
DST/TSD/09-10/37 -"MONAMI – Modeling of NANO – Scaled Advanced Materials Intelligently"	Dr. Tanusri Saha Dasgupta	DST (Int Div)INT/EC/ MONAMI (25/233513)/ 2008 (i)	11-9-2009 to 10-9-2012
SRC/TSD/09-10/38 - "Magnetism in organic materials"	Dr. Tanusri Saha Dasgupta	Swedish Research Council(SRC)	24-3-2010 to 23-3-2013
" Design and Fabrication of Nanomachined Thermal Sensors using FIB (DST – UKIERI)"	Prof. A.K. Raychaudhuri	DSTDST/UKIERI/SA/ P-29/09	23-9-2009 to 22-9-2011

" Contacting 3D electrodeposited nanowires: new opportunities for sprintonics technology (DST – UKIERI)"	Dr. Kalyan Mandal P-13/09	DSTDST/UKIERI/SA/	18-8-2009 to 17-8-2011
"Neutron diffraction studies of collapse of charge ordering in narrow band half-doped manganite $Y_{0.5}Ca_{0.5}MnO_3$ nanoparticles "	Prof. A.K. Raychaudhuri	UGC DAE CSRCSR/AO/ MUM/CRS-M-154	Till 31-12-2012
EICOON – Euro Indo forum for nano materials research coordination & cooperation of researchers in sustainable energy technologies	Prof. A.K. Raychaudhuri Dr. Sugata Mukherjee	University of Twente 10-3-2013	11-3-2010 to
DIT/AB/10-11/52 –"Development of GHz Frequency Filters and Attenuators using Nanoscale Magnonic Crystals"	Dr. Anjan Barman	DIT1(7)/2010/M&C	18-3-2011 to 17-3-2014
DST/AKR/10-11/53 –"Investigation of strain-dependent magnetization dynamics and electronic transport in magnetic oxides for spintronics and signal processing applications"	Prof. A.K. Raychaudhuri	DST-DAAD (Indo-German)INT/FRG/ DAAD/P-210/2011	dated 9-7-2011 5-9-2011 to 4-9-2013
DST/AKR/10-11/55 –"Electroresistance in single crystals and thin films of mixed valence manganites"	Prof. A.K. Raychaudhuri	DST (DST-RFBR) (RUSP-1183)INT/ RFBR/P-110	8-11-2011 to 7-11-2013
UKIERI/AKR/11-12/70 – "Nano Breath App"	Prof. A.K. Raychaudhuri	IND/CONT/E/11-12/086	5-3-2012 to 4-3-2014

Important Output Indicators for 2011-12

S.No.	Parameters	Output
1.	Papers in refereed journals	147
2.	Books	1
3.	Chapters in Books	3
4.	Papers in Conferences	38
5.	Number of Ph.Ds. produced	19
6.	Indian Patents filed	5
7.	Research Manpower trained (other than Ph.Ds)	21
8.	Technical Manpower trained	2
9.	M.Tech/M.Sc./M.Phil projects guided	4

SREE CHITRA TIRUNAL INSTITUTE FOR MEDICAL SCIENCES & TECHNOLOGY., TRIVANDRUM

Sree Chitra Tirunal Institute for Medical Sciences & Technology., Trivandrum was established in 1980. The Institute has a total of 1053 regular employees, out of which 138 are scientists/faculty& 107 are post-doctoral research staff.

Report on Activities during 2012-13

Areas of Focus : Biomaterials Research and Development Product Development, Technology Transfer and Industrial Linkages; Quality Management Systems, Testing and Technical services; Patient care and Public Health

Major Accomplishments :

Patient care- The Institute successfully conducted the first Homograft valve transplant implantation in the State of Kerala. This is the second Institute in the country in public sector to undertake Homograft valve surgery

Technology Transfer Agreements

The division co-ordinated the following technology transfers during the year:

(i) Technology Transfer agreement was executed on 10th May 2011 with M/s IFGL Refractories Ltd, Kolkota for

a. Injectable calcium phosphate cement for dental applications

b. Bioactive composite ceramics for orthopedic applications

(ii) Technology transfer agreement was signed on 30th March 2012 with M/s HLL Lifecare Ltd, Trivandrum for hormone releasing intrauterine device. The technology transfer documents were also handed over to M/s HLL Lifecare Ltd.

Research & Development: The large number of research projects made good progress. While the product development projects moved towards clinical evaluation stage or towards technology transfer phase, the research projects contributed substantially to produce better outputs through patents and publications.

Quality: The quality management system was continued with the COFRAC Surveillance audit taking place during January 27th & 28th 2012 and the NABL audit being held during 17th & 18th January, 2012.

Patents & Publications: A healthy growth of patents & publication during the year:

Important Highlights of 5 Major Programmes:

i) Technology Transfer & Industrial Linkages: The technology transfer of 3 new products were made to the industry and also industry linkages continued in the form of various collaborations for projects and technology transfer.

ii) **Product Development:** Many of the product development projects like Coronary Stent System, Centrifugal blood pump, SCTIMST-VSSC Left Ventricular Assist Device (LVAD), PVDF coated and gel sealed vascular graft, bioactive bone cements based on organically modified ceramic resin, Calcium sulfate based injectable bone substitute, IUD etc made considerable progress.

iii) **Biomaterials research & development**: Developing nanomaterial based drug delivery systems, sensing applications, molecular imprinting, quantum dots, polymers, ceramics and polymer-ceramic composites for medical applications, development of coatings, tissue engineering approaches for small vascular grafts, orthopedic, cornea, liver, cartilage, lung applications, novel dental materials, growth factors, blood material & tissue material interactions, decellularised tissues etc

iv) **Testing services:** A steady increase in the tests enquired and offered. About 672 work orders were executed from external customers during the year.

Major and Unique National Facilities created :

Ceramic Coating Facility consisting of Titanium Nitride coating unit and new generation Diamond-like Carbon (DLC) Coating Unit for coating on devices and materials for biomedical applications

Important collaborations (national and global) established:

Memorandum of Understanding (MoU)

During the year, the following Memorandum of Understanding (MOU) were signed:

(i) MOU with M/s Lifecare Innovations Pvt Ltd on 11th Nov 2011 for collaboration in oral heparin

(ii) MOU with Indian Institute for Information Technology and Management-Kerala, Trivandrum (IIITM-K) on 12th Dec 2011 for cooperation in the area of medical informatics

(iii) Extension of MOU was signed in January 2012 with Agharkar Research Institute, Pune for evaluation of Actinokinase molecule

(iv) MOU with M/s SIDD Life Sciences Pvt Ltd, Chennai on 6th March 2012 to set up a Hub for development of cardiopulmonary devices.

Non disclosure/Confidentiality agreements/Material Transfer Agreements

Different instruments such as NDAs, MTAs etc were entered into with the following organizations for various projects:

- NTU, Singapore
- International Stem Cell Services Ltd, Bangalore
- Vins Bioproducts Ltd, Hyderabad

Important Output Indicators for 2012-13

S.No.	Parameters	Output
1.	Papers in refereed journals	189
2.	Books/Chapters in Books	6
3.	Papers in Conferences	72
4.	Number of Ph.Ds. produced	8
5.	Foreign Patents filed	Nil
	Foreign Patents granted	Nil
6.	Indian Patents filed	19
	Indian Patents granted	Nil
7.	Number of Technologies/Designs and other intellectual products commercialized	3
8	Number of Technology leads awaiting transfer	3
9	Research Manpower trained (other than Ph.Ds)	35
10.	Technical Manpower trained	38
11.	M.Tech/M.Sc./M.Phil projects guided	15
12.	MPH /DPH projects guided	18

WADIA INSTITUTE OF HIMALAYAN GEOLOGY, DEHRA DUN

Wadia Institute of Himalayan Geology was established in June' 29, 1968. The Institute has a total of 208 regular employees, out of which 63 are scientists/faculty& 06 are post-doctoral research staff.

Areas of Research Focus :

The Institute has been given the mandate to carry out geological and geophysical investigations of the Himalaya – the youngest and loftiest mountain system on Earth which plays a critical role in climate modulations. The research activities of the Institute have been grouped into five mission mode projects that are implemented through long term and short term projects. The main emphasis is to study Himalayan river systems, glaciers, earthquake precursors and landslides.

Major Research Accomplishments (2012-13) :

- The alluviation and the incision history of Late Quaternary terraces between HFT and MBT suggest the linkage between tectonic and climate
- The continuous retreat of glaciers in the Central Himalaya and the advancement of glaciers in the Northwestern Himalaya have been noted during the last ~50 years
- The mammalian dispersal patterns across the width of the Himalaya suggest a significant uplift of the Himalaya during 10 - 8 Ma

Important Highlights of 5 Major Research Programmes (2012-13) :

1. The migration of Ganga River near Varanasi during ~40 ka following a tectonic event has been depicted. Since then, it meandered freely within its valley until 7 ka when another tectonic event took place

2. Multiple wavelength geoid anomalies indicate that the Delhi-Haridwar Ridge system is a part of the North-South deep seated (lithospheric depth) transverse fault that abuts the Himalayan frontal plate boundary and plays a distinct role in diffusing the stress accumulated as a result of the ongoing present day frontal crustal shortening

3. Mid Oceanic Ridge (MOR)- type mafic intrusives emplaced within the mélange zone of the Manipur Ophiolitic Complex (Northeast India) indicate that these are dismembered fragments of oceanic crust generated at the mid-ocean spreading ridge system and support the hypothesis that the Naga-Manipur ophiolites was initially formed at the divergent plate margin

4. The systematic orienttaion in the Mesoscopic and magnetic fabric within the Ladakh batholith suggests the changing angle of Indo-Eurasia convergence besides, the presence of a major strike-slip component during Eocene.

5. Soft-sediment deformation structures, interpreted as 'seismites' are reported for the first time from the Middle Siwalik Subgroup, Arunachal Pradesh. These are probably generated during the Late Miocene by a moderate earthquake associated with re-activation of the Bomdila Thrust or Main Central Thrust

6. The pre-Himalayan granulite facies metamorphism has been observed in the mafic and pelitic xenoliths arrested in the Kinnaur Kailash Granite

Major and Unique National Facilities created (2012-13)

1. Ground Penetrating Radar, High precision robotics Total Station with GPS and Engineering Seismographs have been added to the existing facility

2. National Geotechnical Facility for the creation of Geotechnical database in the Himalaya is being developed

3. Six Automatic Weather Stations (AWS) have been established in the Chorabari and Dokriani glaciers for the continuous round the year monitoring of meteorological data to infer the climate change in the Himalayan region

Important collaborations (national and global) established (2012-13) :

1. With ISTerre, Univ. of Savoie, France on the Neotectonic study

2. With the University of Iceland, University of Akureyri (North Iceland) and the Icelandic Meteorological Office on the Earthquake predictive and Hazard study

3. With NORSAR, Norway on the Earthquake and Landslide Hazard & Risk studies

4. With NGRI on the sub-surface structure of the Indian Lithosphere along Satluj river

Important Output Indicators (2012-13)

S.No.	Parameters	Output
1.	Papers in refereed journals	39
2.	Chapters in Books	1
3.	Papers in Conferences (and other non-SCI papers)	2
4.	Number of Ph.Ds. Produced (1 awarded and 3 submitted)	4
5.	M.Tech/M.Sc./M.Phil projects guided	10
6.	Research Manpower trained (other than Ph.Ds)	75
7.	Awards and Honours • Prof. Anil K. Gupta has been elected as Fellow of The Academy of Sciences for the Developing World (formerly the Third World Academy of Sciences) (TWAS), Trieste, Italy • Dr Koushik Sen has been conferred with 'K Naha Award' by the Geological Society of India"	2
8.	Workshops/Seminars organized • Organized 'Brain storming meeting' between the scientist of WIHG and NGRI during 27 - 29 August 2012 • Organized 'National Conference on Green Earth with focus on the Himalaya' during 18 - 20 October 2012 • Organized '78th Annual Meeting of the Indian Academy of Sciences, Bangalore' during 2 - 4 November 2012	3

INDIAN NATIONAL SCIENCE ACADEMY, NEW DELHI

Indian National Science Academy was established in 1935. The Institute has a total of 67 regular employees

Report on Activities during 2011-12:

Areas of Focus:	Science Promotion & Recognition of Scientists
Major Accomplishments:	Election to Fellowship of eminent Indian & Foreign Scientists, Bilateral Relationship with Foreign Science Academies, Summer Research Fellowship for Science Students, Research Projects under History of Science Programme, INSPIRE project of DST, Publications.
Important Collaborations:	Since inception, the Academy has fostered scientific relationships with prominent scientific academies and organizations of the world to develop and promote the internationalization of science. The Academy has established linkages with Science Academies / Organizations in 42 countries in Europe, Asia, North America, South America and Latin America. During the year 2011-2012, MOU / Agreements were signed / renewed with 7 Foreign Academies.

Important output Indicators for 2012-13

The Academy during the period 2011-2012, nurtured and promoted scientists and scientific institutes to achieve excellence in research through various programmes detailed under:

1. SCIENCE PROMOTION

Supported Research Professorships (5) named after distinguished Indian Scientists, Senior Scientists (58), Honorary Scientists (67), Visiting Fellowships (7). Associated / sponsored (78) scientific meetings i.e. seminars / Symposia / Conference / Workshops within the country under the Science Promotion programme.

YOUNG SCIENTIST RESEARCH PROGRAMME

7 Research projects of Young Scientist Medal awardees (below 35 years of age) were supported .

2. RESEARCH IN HISTORY OF SCIENCE

During the year the Commission recommended 6 new projects and renewed 24 on-going projects covering various topics like history of cannons, metals and metallurgy, mathematics and astronomy, ecology and forestry, art and architecture, etc.

3. INTERNATIONAL COUNCIL OF SCIENCE (ICSU) AND OTHER IMPORTANT SCIENTFIC MEETINGS

As an adhering organization in India and on behalf of the nation, Academy discharged its responsibilities of adherence to ICSU. The Academy facilitated participation of Indian scientists at the following Congresses / General Assemblies held abroad.

IUGG XXC General Assembly Earth on the Edge: Science for a Sustainable Planet, Melbourne, Australia; INQUA Congress 2011, Bern Switzerland; 46th IUPAC General Assembly, San Juan, Puerto Rico; XXX URSI General Assembly, Istanbul, Turkey; 22nd Congress and General Assembly of IUCr, Madrid, Spain; 30th ICSU General Assembly, Rome, Italy; 17TH International Congress in Beijing at China Convention Centre; 27th IUPAP General Assembly at Institute of Physics, London, UK.

During 2011-2012, the Academy supported about 89 Scientists for such ICSU programme.

4. INTER-ACADEMY EXCHANGE PROGRAMME

During the year 2011-2012, 65 Indian scientists and 30 Indian Distinguished Fellows visited abroad to work in academic and R&D institutions and hosted 81 overseas scientists to work in Indian Institutions under various bilateral exchange programmes.

5. PUBLICATIONS

INSA brought out following publications during the year :

IJPAM (*Indian Journal of Pure and Applied Mathematics);* Proceedings INSA; IJHS *(Indian*

Journal of History of Science) ; INSA News; Annual Report in English & Hindi; Biographical Memoir; Year Book; Fellowship Nomination Books.

The back volumes as well as the latest issues of all journals published by the Academy are also made available online at the official website of the Academy.

6. LOCAL CHAPTER / POPULARISATION OF SCIENCE

16 Local Chapters of INSA deliberates on various issues relating to Scientific policy, social impact of science, and planning in science and technology, besides various services i.e. lectures, seminars for the benefit of Scientists and school children.

7. INFORMATICS

The Informatics Centre encompasses (i) Library – the information resource center supporting scholarly information resources and information needs, (ii) Computer facility for facilitating a whole range of IT-related services of the Academy.

Academy receives about 450 scientific and technical journals under exchange arrangements and has collection of about 13210 books covering History and Philosophy of Science, Science Management and Science Policy.

The Informatics Centre provides information services to its users both on-site and remotely, using IT communications channels. During the year, High Definition Video Conferencing Equipment has been procured to facilitate the scientific community to interact in real time basis. National Informatics Centre (NIC) provided the NKN (National knowledge Network) which facilitates the Academy's Video Conferencing System.

8. CENTRE FOR INTERNATIONAL CO-OPERATION IN SCIENCE (CICS), CHENNAI.

CICS (earlier known as CCSTDS), Chennai's is mandated to spread the spirit of science and technology co-operation among developing societies. The center functions under the auspices of the Indian National Science Academy (INSA) with grant obtained from the Department of Science & Technology, Government of India. During the period 2011-2012, grant of Rs.62.00 lakhs was released. The activities pursued during the period ranged from providing support to scientists from developing countries to work in research institution in India, partial travel fellowship to Indian Scientists to attend International Conferences abroad, organized series of lectures, etc.

9. SCIENCE & SOCIETY

Under the science & society programme, the Academy endeavours to address issues pertaining to science and technology that are of relevance to the society. Some of the initiatives are :

- Science education programme
- Study group for preparation of evidence-based well-considered documents and topical seminars of social relevance to initiate enthusiasm and positive discussion amongst the scientific community and influence science policy.

- Some of the recent activities of Science and Society are :

  Release of position paper on '*Hazardous Metals and Minerals and pollution in India: Soruces, Toxicity, and Management'*, Panel Discussion on *'Strategies for Augmenting and Conserving Water – India's Options'; Brain Storming Meting on Man, Animal and Science;* Symposium on *"Challenges in Nuclear Safety';* and many lectures were organized.

10. INTER ACADEMY PROGRAMME ON SCIENCE EDUCATION

The Indian National Science Academy, in August 2006 established the Science Education Panel to initiate and oversee the Science Education Programmes undertaken by the Academy for School and College students. The panel, jointly in association with Indian Academy of Sciences, Bangalore and the National Academy of Sciences of India, Allahabad sponsored a variety of activities that are aimed at strengthening for Higher Education in Science and encouraging the young students to take science as a career. The activities undertaken are:

- **Summer Research fellowships for students and teachers :**
- During the year 2011-2012, 1030 students and 118 teachers availed the fellowships.
- **2-week All India Refresher Courses for teachers :**
- 18 Refresher courses were held during April 2011 to March 2012.

1. Lecture workshops for students and teachers :

48 workshops were held during the year ended 31st March 2012.

Fig. 10.5: Dr.Krishan Lal, President INSA during the signing Ceremony of Agreement on Scientific Co-operation in Sri Lanka

Fig. 10.6: Releasing the position paper on 'Hazardous Metals and minerals Pollution in India: Sources, Toxicity, and Management"

INTERNATIONAL ADVANCED RESEARCH CENTRE FOR POWDER METALLURGY AND NEW MATERIALS (ARCI), BALAPUR, HYDERABAD, AP

A. Organization Particulars

Name of the Institute: International Advanced Research Centre for Powder Metallurgy and New Applications (ARCI) was established in April 01, 1997. The institute has a total of 163 regular employees out of which 74 are scientists.

B. Report on Activities during 2011-12

Areas of Focus: Nanomaterials, engineered coatings, ceramic processing, laser processing of materials, sol-gel coatings, fuel cell technology, carbon materials, solar energy materials and automotive energy materials

Major Accomplishments:

a) Demonstrated large scale production of 18-Cr ferritic steel powder by Inert gas atomization

b) Development of solar selective coatings on stainless steel absorber tubes with an optical efficiency for solar thermal energy conversion of 60% for solar thermal power plant applications. The know-how is found to be up-scalable

c) As a part of project on establishment of solar thermal power technologies at ARCI, the processing and joining of Silicon Carbide(SiC) tubes which is an outstanding central solar absorber in Concentrated Solar Power System has been completed. Thermo-mechanical property evaluation and Integration of the tubes with a test loop system are in progress.

d) Detonation spray coating for improved performance of propeller shaft seals used for special applications

e) Hardfaced plates by laser cladding were successfully field tested in thermal power plant boiler. The plate wear performance was found to be substantially better than present technology

f) Developed a 5 kW PEM fuel cell power pack with thermal management suitable for transportation applications. Integration of this unit in the electric vehicle and field trials are in progress

g) Laser –MIG hybrid weldability studies have been carried out on Reduced Activation Ferritic Martensitic Steels (RAFMS), a recently developed indigenous material for ITER test blanket module applications. Process optimized for welding 12 mm thick plates in single pass

h) Developed process know-how for making bipolar plates from exfoliated graphite (EFG) that has been successfully demonstrated in large number of PEM fuel cell stacks in capacity range upto 10kW. Application of bipolar plates made from EFG has also been demonstrated in hydrogen production units

i) Aluminum-Steel joints with very thin intermetallic layer interface have been successfully produced by Cold Metal Transfer Process. These joints had a load bearing capacity of 200 N/mm which could be a useful mechanical property for application in automotive body assembly. Further optimization of strength by improving the interface and reducing the porosity in the weld bead is underway

j) Developed nylon-based polyamide-6 nanofibre coating on commercial air filtration medium using continuous electro-spinning equipment and demonstrated the suitability for commercial automotive filters

k) Fe-P soft magnetic alloy for stator component in motor for automotive applications has been developed and a stator assembly for a prototype motor was fabricated and assembled into a motor in collaboration with an automotive company. The performance was found to be relatively better than the motor with stator component made of conventional Si-steel

l) Synthesized nanocrystalline inorganic fullerene-like (IF) as well as nanosheets of tungsten disulfide (WS_2) by a novel route

m) Developed portable cold spray coating technology that is now ready for application development and transfer

n) Micro Arc Oxidation (MAO) technology has been successfully adapted to continuous coating with necessary controls. A novel process modification developed to enhance fatigue life by MAO coating, by 10-15 times that of bare substrate. Demonstrated continuous coating on 100m long foil

Important Highlights of 5 Major Programmes:

a) ***Solar Energy Materials:*** A pilot facility to fabricate CIGS PV panels of size 30 x 30 cm is being established and various equipments are being procured as part of this programme. An economical, easy to scale-up, less time consuming flash light & laser treatment process for the preparation of CIGS thin films for solar applications has been developed.

b) ***Automotive Energy Materials:*** A full-fledged pilot facility capable of manufacturing Li-ion batteries of all sizes and capacities relevant to varied applications, ranging from electric bike to heavy duty bus is under establishment. Simultaneously research on new and novel materials for the anode, cathode and electrolyte is taken up. A large scale synthesis route for producing $LiFePO_4$ in kilogram quantities has been developed. Work initiated on development of next generation of hard and soft magnetic materials for motors for electric/hybrid vehicle.

c) ***Oxide Dispersion Strengthened (ODS) Steels*****:** Successfully completed the Phase -1 of IGCAR sponsored project for th**e** development of a technology for the production of ODS clad tubes for fast breeder reactors.

d) ***Fuel cell technology:*** Developed 20 kW Polymer Electrolyte Membrane (PEM) Fuel Cell System for stationary applications by a modular approach where in two modules of 10kW are connected in series electrically with two parallel air supply modules.

e) ***Cathodic arc PVD technology:*** Cutting tools have been coated with super hard nanocomposites coatings and 5 axis high speed CNC has been commissioned for performance evaluation. The technique has been tried for multilayer coatings for solar thermal application as well.

f) ***Iron based cerametallic cookies for heavy duty clutch applications: (***NMITLI, CSIR sponsored project): Developed process for making iron based cerametallic cookies on actual component from both blue dust and iron powder using an indigenously designed and fabricated prototype special purpose hot press. Dynamometer testing is in progress.

Major and Unique Facilities Created:

Aerogel Synthesis Facility, Pressure Slip Casting Facility, Horizontal high energy ball mill capable of producing 4 kg of nanostructured material, Induction plasma facility for synthesizing nanopowders

Important Collaborations (National and Global) established: New Collaborations with the following organizations have been established in material processing and related areas

National: NAL, BDL, BHEL, CIPET, CSIO, Ceradecor India Ltd, Clutch Auto Ltd, DRDO, HAL, Hoganas India Pvt Ltd, ISRO, IGCAR, L&T, NEI, Redson Engineers Pvt Ltd, Tata Motors, Tata Steel, Thermax, Ultratech Cement, University of Hyderabad, IIT-Hyderabad, Cummins Technologies India Ltd, Tata Chemicals, Walchandnagar Industries Ltd

Global: Fraunhofer-Germany, General Motors-USA, Grenoble INP-France, IMI-NRC Council-Canada, PACT-France, SUNY-Stony Brook USA, National Research, McGill Institute of Aerospace Engineering, Canada.

Important Output Indicators during 2011-12

S.No	Parameters	Output
1.	Papers in Refereed Journals (SCI)- Calendar year 2011	**79**
2.	Books	**—**
3.	Chapters in Books	**—**
4.	Papers in Conferences (with or without proceedings)	**80**
5.	Foreign Patents filed	**1**
1.	Foreign Patents granted	**2**
6.	Indian Patents filed	**8**
1.	Indian Patents granted	**1**
7.	No. of technologies transferred / applications developed / products supplied	**8**
8.	Number of Technology leads awaiting transfer	**13**
9.	Research Manpower trained (No. of SRF/ JRFs)	**20**
10.	Technical Manpower trained (Employees/Fellows deputed for training / participation in workshops etc)	**85**
11.	B.Tech/ UG projects guided (including ongoing)	**36**
12.	M.Tech. / M.Sc./M. Phil. projects guided (including ongoing)	**47**
13.	Invited presentations/lectures in Workshops, Symposia, other events etc	**126**
14.	Number of current Ph.D Scholars (excluding ARCI regular employees)	**18**

CHAPTER 11

RESULTS-FRAMEWORK DOCUMENT (RFD) OF DEPARTMENT OF SCIENCE AND TECHNOLOGY FOR THE YEAR 2011-12

The Government of India has approved the outline a "Performance Monitoring and Evaluation System (PMES)" for Government Departments to measure the performance of Government by preparing "Results-Framework Documents (RFD)" of all the Ministries/Departments every year which provides a summary of the most important results that a Department/Ministry expects to achieve during the financial year.

The RFD for the year 2011-12 of the Department of Science and Technology not only provides summary of the most important results that the Department expects to achieve during the financial year but also an objective and fair basis to evaluate Department's overall performance at the end of the year.

The year 2011-12 was a land mark year for the Department. It earmarked the completion of 40 years of service to the science sector since its establishment Accordingly, the Department of Science and Technology has prepared RFD for 2011-12 with a vision "to enable India becoming a global knowledge power by promoting basic research, development of cutting-edge technologies and innovation for globally competitive and inclusive growth to power technology-led economic progress of the society" with six core areas namely; (i) Formulation of policies relating to Science and Technology; (ii) Strengthening basic research and expanding R&D base: Human capacity; (iii) Strengthening basic research and expanding R&D base: Institutional capacity; (iv) Implementing Technology Development Programmes; (v) Societal Intervention of S&T; Science, and (vi) Technology Co-operation and Partnerships/Alliances. A total number of 14 new initiatives had been proposed under all the six objectives of the Department. Total of 40 success indicators for covering the six overall objectives had been selected with a blend of 37 non-financial and 3 financial targets.

The High Power Committee (HPC) on Government Performance reviewed the overall performance of Department and assigned a composite score of **91.64** out of 100 for 2011-12.

SECTION 1: VISION, MISSION, OBJECTIVES AND FUNCTIONS

VISION

To enable India becoming a global knowledge power by promoting basic research, development of cutting edge technologies and innovation for globally competitive and inclusive growth to power technology-led economic progress of the society.

MISSION

To strengthen the R&D base of the country through funding, development and utilization of technologies, building entrepreneurship and innovation, fostering international S & T cooperation, popularization and demonstration, generating S&T database, mounting mission mode initiatives, attracting talent to science and rejuvenating research in university and promotion of public-private partnerships.

OBJECTIVE

1 Formulation of policies relating to Science and Technology

2 Strengthening Basic research and Expanding R&D; base -Human Capacity

3 Strengthening Basic research and Expanding R&D; base -Institutional Capacity

4 Implementing Technology Development Programs

5 Societal interventions of S&T;

6 S&T; co-operation / Partnerships and Alliances

FUNCTIONS

1. Formulation of policies relating to Science and Technology. 2 .Support and Grants-in-aid to Scientific Research Institutions, Scientific Associations and Bodies. 3. Matters regarding Inter-Agency/Inter-Departmental coordination for evolving science and technology missions. 4. Matters relating to the Scientific Advisory Committee of the Cabinet (SACC). 5. Promotion of new areas of Science and Technology with special emphasis on emerging areas. (i) Research and Development through its research institutions or laboratories for development of indigenous technologies concerning bio-fuel production, processing, standardization and applications, in co-ordination with the concerned Ministry or Department; (ii) Research and Development activities to promote utilization of by-products to development value added chemicals.

All matters concerning: (a) Science and Engineering Research Council; (b) Technology Development Board and related Acts (c) National Council for Science and Technology Communication; (d) National Science and Technology

Entrepreneurship Development Board; (e) International Science and Technology Cooperation including appointment of scientific attaches abroad (in close cooperation with the Ministry of External Affairs); (f) Autonomous Science and Technology Institutions relating to the subject under the Department of Science and Technology including Institute of Astro-physics, and Institute of Geo-magnetism; (g) Professional Science Academies promoted and funded by Department of Science and Technology; (h) The Survey of India, and National Atlas and Thematic Mapping Organisation; (i) National Spatial Data Infrastructure and promotion of G.I.S (j) The National Innovation Foundation, Ahmadabad.

7 Matters relating to institutional Science and Technology capacity building including setting up of new institutions and institutional infrastructure.

8 Promotion of Science and Technology at the State, District, and Village levels for grass-roots development through State Science and Technology Councils and other mechanisms.

9 Application of Science and Technology for weaker sections, women and other disadvantaged sections of Society.

10 Matters commonly affecting Scientific and technological departments /organisations/institutions, e.g., financial, personnel, purchase and import policies and practices.

11 Management Information Systems for Science and Technology and coordination thereof.

12 Matters concerning domestic technology particularly the promotion of ventures involving the commercialization of such technology other than those under the Department of Scientific and Industrial Research.

13 All other measures needed for the promotion of science and technology and their application to the development and security of the nation.

14 Futurology.

15 Coordination and integration of areas of Science & Technology having cross sectoral linkages in which a number of institutions and departments have interest and capabilities.

16 Undertaking or financially sponsoring scientific and technological surveys, research design and development, where necessary.

Section 2:
Inter se Priorities Among Key Objectives, Success Indicators and Targets

Objective	Weight	Action	Success Indicator	Unit	Weight	Target / Criteria Value				
						Excellent	Very Good	Good	Fair	Poor
						100%	90%	80%	70%	60%
[1] Formulation of policies relating to Science and Technology	13.00	[1.1] Finalization of National Science, Technology and Innovation Policy	[1.1.1] Date of finalization of National Science, Technology and Innovation Policy	Date	4.00	27/02/2012	07/03/2012	14/03/2012	21/03/2012	31/03/2012
		[1.2] Finalization of National Data Sharing on Access Policy Framework Document	[1.2.1] Date of finalization of National Data Sharing on Access Policy Framework Document	Date	3.00	05/09/2011	12/09/2011	19/09/2011	25/09/2011	30/09/2011
		[1.3] To develop suitable measurement systems for the science, technology and innovation output indictors for India	[1.3.1] Date of development of the measurement system	Date	3.00	27/02/2012	07/03/2012	14/03/2012	21/03/2012	31/03/2012
		[1.4] To devise Performance related Incentive Systems for promoting basic research in the country	[1.4.1] Date of developing the System	Date	3.00	27/02/2012	07/03/2012	14/03/2012	21/03/2012	31/03/2012
[2] Strengthening Basic research and Expanding R&D base -Human Capacity	17.00	[2.1] Number of INSPIRE awards released	[2.1.1] Number of students covered as an indicator of penetration of INSPIRE	Number	3.00	200000	190000	180000	170000	160000
		[2.2] Number of INSPIRE internships covered through winter camps	[2.2.1] Realization of quantitative target for number of youth attracted to summer/winter camps	Number	3.00	50000	45000	40000	35000	30000
		[2.3] Number of scholarships for Higher	[2.3.1] Number of scholarships	Number	4.00	2000	1900	1800	1700	1600

Section 2:
Inter se Priorities Among Key Objectives, Success Indicators and Targets

Objective	Weight	Action	Success Indicator	Unit	Weight	Target / Criteria Value				
						Excellent	Very Good	Good	Fair	Poor
						100%	90%	80%	70%	60%
		Education awarded	released							
		[2.4] Institution of INSPIRE faculty position	[2.4.1] Number of INSPIRE faculty position	Number	4.00	50	45	40	35	30
		[2.5] To establish new alliances with the Ministry of Human Resources Development for strengthening institutional capacities in the area of Research and Development	[2.5.1] Date of establishing the alliance	Date	1.50	30/06/2011	07/07/2011	15/07/2011	25/07/2011	30/07/2011
		[2.6] Mapping of the publications/patents of the Indian researchers in Indexed Journals as an indicator of competitiveness of India	[2.6.1] Number of status reports prepared per year	Number	1.50	5	4	3	2	1
[3] Strengthening Basic research and Expanding R&D base -Institutional Capacity	13.00	[3.1] Capacity building through Fund for infrastructure strengthening S&T (FIST)	[3.1.1] Level of utilization of competitive grants	%	4.00	100	98	95	92	90
		[3.2] Development and proactive promotional programmes for strengthening institutional capacities through Promotion of University Research and Scientific Excellence (PURSE)	[3.2.1] Number of Universities supported	Number	4.00	30	25	20	15	10

Section 2:
Inter se Priorities among Key Objectives, Success indicators and Targets

Objective	Weight	Action	Success Indicator	Unit	Weight	Target / Criteria Value				
						Excellent	Very Good	Good	Fair	Poor
						100%	90%	80%	70%	60%
		[3.3] Development and proactive promotional programmes for strengthening Women Universities through Consolidation of University Research Innovation and Excellence (CURIE)	[3.3.1] Number of institutions supported	Number	2.00	6	5	4	3	2
		[3.4] Expanding S&T infrastructure through special pacakages like those presently available for J&K and NE states	[3.4.1] Date of delivery of the package	Date	3.00	31/12/2011	07/01/2012	15/01/2012	20/01/2012	27/01/2012
[4] Implementing Technology Development Programs	18.00	[4.1] Number of technologies assisted for application and absorption	[4.1.1] Number of technologies applied and promoted	Number	2.00	40	35	30	25	20
		[4.2] Implementation of Public-Private Partnership (PPP) programmes under Drug and Pharma Research Programme	[4.2.1] Level of fund utilization	%	2.00	100	98	95	92	90
		[4.3] Number of convergent technology solutions for water challenges identified and selected	[4.3.1] Number of technology solutions for water found out	Number	2.00	5	4	3	2	1
		[4.4] Initiation of Programmes envisaged in Detailed Project Report for indigenous Solar Energy Research initiative	[4.4.1] Number of research projects supported	Number	1.50	8	6	5	4	2

Section 2:
Inter se Priorities Among Key Objectives, Success Indicators and Targets

Objective	Weight	Action	Success Indicator	Unit	Weight	Target / Criteria Value				
						Excellent	Very Good	Good	Fair	Poor
						100%	90%	80%	70%	60%
		[4.5] R&D programmes under Security Technology initiative	[4.5.1] Number of research projects supported	Number	1.00	10	8	6	4	2
		[4.6] Implementation of application oriented nano S&T R&D projects in Public-Private Partnership (PPP) ventures under nano mission	[4.6.1] Number of PPP projects sanctioned under Nano Mission	Number	1.50	5	4	3	2	1
		[4.7] PhD/M.Tech. students trained in the area of nano science and technology in the country under nano mission	[4.7.1] Quantitative number of PhD/PG outputs	Number	2.00	130	120	100	90	80
		[4.8] Implementing new thrust areas: Cognitive science	[4.8.1] Number of researchers supported	Number	1.00	60	50	40	30	20
		[4.9] R&D programmes for establishing knowledge networks in the areas of climate change and clean energy	[4.9.1] Number of programmes taken up	Number	1.00	10	8	6	4	2
		[4.10] Programme initiation for promotion of Public Private Partnerships for R&D areas and increased engagement of Private sector in R&D	[4.10.1] Number of study reports generated	Number	1.00	5	4	3	2	1
		[4.11] To create a test bed for potash technology from sea water with a capacity of 0.75 TPD and provide inputs to evidence based policy	[4.11.1] Date of commissioning of the unit	Date	1.00	27/02/2012	07/03/2012	14/03/2012	21/03/2012	31/03/2012

Section 2:
Inter se Priorities Among Key Objectives, Success Indicators and Targets

Objective	Weight	Action	Success Indicator	Unit	Weight	Target / Criteria Value				
						Excellent	Very Good	Good	Fair	Poor
						100%	90%	80%	70%	60%
		inputs to Ministry of Chemicals and Fertilizers								
		[4.12] Strengthening and Promotion of Innovation clusters	[4.12.1] Level of fund utilization	%	1.00	100	98	95	92	90
		[4.13] Preparing independent status report on impact/outcome of Technology Development Programmes	[4.13.1] Number of Projects reviewed and status report submitted	Number	1.00	5	4	3	2	1
[5] Societal interventions of S&T	14.00	[5.1] Assisting Technology Entrepreneurs under the National Science & Technology Entrepreneurship Development Board	[5.1.1] Number of entrepreneurs assisted	Number	2.00	125	120	110	100	80
		[5.2] Assisting micro enterprises under the National Science & Technology Entrepreneurship Development Board	[5.2.1] Number of micro enterprises assisted	Number	2.00	2550	2540	2500	2450	2400
		[5.3] Support to Women for gender parity in S&T	[5.3.1] Number of projects supported	Number	3.00	165	160	150	140	130
		[5.4] Projects supported for S&T inputs for development of Weaker Sections for equity	[5.4.1] Number of projects supported	Number	3.00	60	55	50	45	40
		[5.5] Field projects and research programmes supported for science popularization and communication	[5.5.1] Number of projects supported	Number	2.00	230	225	220	215	210

Section 2:
Inter se Priorities Among Key Objectives, Success Indicators and Targets

Objective	Weight	Action	Success Indicator	Unit	Weight	Target / Criteria Value				
						Excellent	Very Good	Good	Fair	Poor
						100%	90%	80%	70%	60%
		[5.6] Child Scientist participation in National Children Science Congress	[5.6.1] Number of Child Scientists participating	Number	1.00	1100000	1000000	950000	900000	850000
		[5.7] To develop a sustainable model for S&T backed entrepreneurships for tribal population	[5.7.1] Date development of the model	Date	1.00	27/02/2012	07/03/2012	14/03/2012	21/03/2012	31/03/2012
[6] S&T co-operation / Partnerships and Alliances	10.00	[6.1] Signing agreements, MoUs and protocols for S&T cooperation and partnerships	[6.1.1] Number of agreements signed	Number	2.00	45	40	35	30	25
		[6.2] Development and synergy of National knowledge networks for S&T cooperation	[6.2.1] Number of Nodes developed and synergized	Number	2.00	24	22	20	18	16
		[6.3] Exchange of professionals for international cooperation	[6.3.1] Number of exchange visits facilitated	Number	2.00	1200	1150	1100	1050	1000
		[6.4] Developing State S & T councils mechanism for S&T outreach	[6.4.1] Ratio of Programmatic fund released to State S & T councils as a percentage of core grants sanctioned for manpower	Ratio	2.00	1.10	1.05	1.00	0.50	0.25
		[6.5] Projects sanctioned through the Joint research fund	[6.5.1] Number of research Projects funded under the Joint research fund	Number	1.00	12	10	8	6	4

Section 2:
Inter se Priorities Among Key Objectives, Success Indicators and Targets

Objective	Weight	Action	Success Indicator	Unit	Weight	Target / Criteria Value				
						Excellent	Very Good	Good	Fair	Poor
						100%	90%	80%	70%	60%
		[6.6] Innovation Funding through NASSCOM (National Innovation Fund)	[6.6.1] Number of innovative companies supported	Number	1.00	4	3	2	1	0
* Efficient Functioning of the RFD System	3.00	Timely submission of Draft for Approval	On-time submission	Date	2.0	07/03/2011	08/03/2011	09/03/2011	10/03/2011	11/03/2011
		Timely submission of Results	On- time submission	Date	1.0	01/05/2012	03/05/2012	04/05/2012	05/05/2012	06/05/2012
* Improving Internal Efficiency / Responsiveness / Service delivery of Ministry / Department	10.00	Implementation of Sevottam	Resubmission of revised draft of Citizens' / Clients' Charter	Date	2.0	16/01/2012	18/01/2012	20/01/2012	23/01/2012	25/01/2012
			Independent Audit of Implementation of Grievance Redress Mechanism	%	2.0	100	90	80	70	60
		Ensure compliance with Section 4(1) (b) of the RTI Act, 2005	No. of items on which information is uploaded by February 10, 2012	No	2.0	16	15	14	13	12
		Identify potential areas of corruption related to departmental activities and develop an action plan to mitigate them	Finalize an action plan to mitigate potential areas of corruption.	Date	2.0	26/03/2012	27/03/2012	28/03/2012	29/03/2012	30/03/2012
		Develop an action plan to implement ISO 9001 certification	Finalize an action plan to implement ISO 9001 certification	Date	2.0	16/04/2012	17/04/2012	18/04/2012	19/04/2012	20/04/2012
* Ensuring compliance to the Financial Accountability Framework	2.00	Timely submission of ATNS on Audit Paras of C&AG	Percentage of ATNS submitted within due date (4 months) from date of presentation of Report to Parliament by CAG during the year.	%	0.5	100	90	80	70	60

* Mandatory Objective(s)

Section 2:
Inter se Priorities Among Key Objectives, Success Indicators and Targets

Objective	Weight	Action	Success Indicator	Unit	Weight	Target / Criteria Value				
						Excellent	Very Good	Good	Fair	Poor
						100%	90%	80%	70%	60%
		Timely submission of ATRs to the PAC Sectt. on PAC Reports.	Percentge of ATRs submitted within due date (6 months) from date of presentation of Report to Parliament by PAC during the year.	%	0.5	100	90	80	70	60
		Early disposal of pending ATNs on Audit Paras of C&AG Reports presented to Parliament before 31.3.2011.	Percentage of outstanding ATNs disposed off during the year.	%	0.5	100	90	80	70	60
		Early disposal of pending ATRs on PAC Reports presented to Parliament before 31.3.2011	Percentage of outstanding ATRs disposed off during the year.	%	0.5	100	90	80	70	60

* Mandatory Objective(s)

Section 3:
Trend Values of the Success Indicators

Objective	Action	Success Indicator	Unit	Actual Value FY 09/10	Actual Value FY 10/11	Target Value FY 11/12	Projected Value for FY 12/13	Projected Value for FY 13/14
[1] Formulation of policies relating to Science and Technology	[1.1] Finalization of National Science, Technology and Innovation Policy	[1.1.1] Date of finalization of National Science, Technology and Innovation Policy	Date	--	--	07/03/2012	--	--
	[1.2] Finalization of National Data Sharing on Access Policy Framework Document	[1.2.1] Date of finalization of National Data Sharing on Access Policy Framework Document	Date	--	--	12/09/2011	--	--
	[1.3] To develop suitable measurement systems for the science, technology and innovation output indictors for India	[1.3.1] Date of development of the measurement system	Date	--	--	07/03/2012	--	--
	[1.4] To devise Performance related Incentive Systems for promoting basic research in the country	[1.4.1] Date of developing the System	Date	--	--	07/03/2012	--	--
[2] Strengthening Basic research and Expanding R&D base -Human Capacity	[2.1] Number of INSPIRE awards released	[2.1.1] Number of students covered as an indicator of penetration of INSPIRE	Number	50000	180000	190000	200000	200000
	[2.2] Number of INSPIRE internships covered through winter camps	[2.2.1] Realization of quantitative target for number of youth attracted to summer/winter camps	Number	40000	50000	45000	55000	60000

Section 3:
Trend Values of the Success Indicators

Objective	Action	Success Indicator	Unit	Actual Value FY 09/10	Actual Value FY 10/11	Target Value FY 11/12	Projected Value for FY 12/13	Projected Value for FY 13/14
	[2.3] Number of scholarships for Higher Education awarded	[2.3.1] Number of scholarships released	Number	900	1300	1900	2500	3200
	[2.4] Institution of INSPIRE faculty position	[2.4.1] Number of INSPIRE faculty position	Number	--	--	45	80	120
	[2.5] To establish new alliances with the Ministry of Human Resources Development for strengthening institutional capacities in the area of Research and Development	[2.5.1] Date of establishing the alliance	Date	--	--	07/07/2011	--	--
	[2.6] Mapping of the publications/patents of the Indian researchers in Indexed Journals as an indicator of competitiveness of India	[2.6.1] Number of status reports prepared per year	Number	--	--	4	5	6
[3] Strengthening Basic research and Expanding R&D base -Institutional Capacity	[3.1] Capacity building through Fund for infrastructure strengthening S&T (FIST)	[3.1.1] Level of utilization of competitive grants	%	100	100	98	100	100
	[3.2] Development and proactive promotional programmes for strengthening institutional capacities through	[3.2.1] Number of Universities supported	Number	--	14	25	30	30

Section 3:
Trend Values of the Success Indicators

Objective	Action	Success Indicator	Unit	Actual Value FY 09/10	Actual Value FY 10/11	Target Value FY 11/12	Projected Value for FY 12/13	Projected Value for FY 13/14
	Promotion of University Research and Scientific Excellence (PURSE)							
	[3.3] Development and proactive promotional programmes for strengthening Women Universities through Consolidation of University Research Innovation and Excellence (CURIE)	[3.3.1] Number of institutions supported	Number	--	2	5	6	6
	[3.4] Expanding S&T infrastructure through special pacakages like those presently available for J&K and NE states	[3.4.1] Date of delivery of the package	Date	--	--	07/01/2012	--	--
[4] Implementing Technology Development Programs	[4.1] Number of technologies assisted for application and absorption	[4.1.1] Number of technologies applied and promoted	Number	30	32	35	40	45
	[4.2] Implementation of Public-Private Partnership (PPP) programmes under Drug and Pharma Research Programme	[4.2.1] Level of fund utilization	%	100	100	98	100	100
	[4.3] Number of convergent technology solutions for water challenges identified and	[4.3.1] Number of technology solutions for water found out	Number	10	10	4	4	4

Section 3:
Trend Values of the Success Indicators

Objective	Action	Success Indicator	Unit	Actual Value FY 09/10	Actual Value FY 10/11	Target Value FY 11/12	Projected Value for FY 12/13	Projected Value for FY 13/14
	selected							
	[4.4] Initiation of Programmes envisaged in Detailed Project Report for indigenous Solar Energy Research initiative	[4.4.1] Number of research projects supported	Number	--	--	6	8	10
	[4.5] R&D programmes under Security Technology initiative	[4.5.1] Number of research projects supported	Number	--	--	8	10	12
	[4.6] Implementation of application oriented nano S&T R&D projects in Public-Private Partnership (PPP) ventures under nano mission	[4.6.1] Number of PPP projects sanctioned under Nano Mission	Number	--	3	4	5	6
	[4.7] PhD/M.Tech. students trained in the area of nano science and technology in the country under nano mission	[4.7.1] Quantitative number of PhD/PG outputs	Number	--	110	120	130	140
	[4.8] Implementing new thrust areas: Cognitive science	[4.8.1] Number of researchers supported	Number	40	50	50	60	65
	[4.9] R&D programmes for establishing knowledge networks in the areas of climate change and clean energy	[4.9.1] Number of programmes taken up	Number	--	--	8	10	12

Section 3:
Trend Values of the Success Indicators

Objective	Action	Success Indicator	Unit	Actual Value FY 09/10	Actual Value FY 10/11	Target Value FY 11/12	Projected Value for FY 12/13	Projected Value for FY 13/14
	[4.10]Programme initiation for promotion of Public Private Partnerships for R&D areas and increased engagement of Private sector in R&D	[4.10.1] Number of study reports generated	Number	--	--	4	5	6
	[4.11]To create a test bed for potash technology from sea water with a capacity of 0.75 TPD and provide inputs to evidence based policy inputs to Ministry of Chemicals and Fertilizers	[4.11.1] Date of commissioning of the unit	Date	--	--	07/03/2012	--	--
	[4.12]Strengthening and Promotion of Innovation clusters	[4.12.1] Level of fund utilization	%	--	--	98	100	100
	[4.13]Preparing independent status report on impact/outcome of Technology Development Programmes	[4.13.1] Number of Projects reviewed and status report submitted	Number	--	--	5	5	5
[5] Societal interventions of S&T	[5.1] Assisting Technology Entrepreneurs under the National Science & Technology Entrepreneurship Development Board	[5.1.1] Number of entrepreneurs assisted	Number	90	100	120	130	135
	[5.2] Assisting micro enterprises under the National Science &	[5.2.1] Number of micro enterprises assisted	Number	2100	2200	2540	2600	2650

Section 3:
Trend Values of the Success Indicators

Objective	Action	Success Indicator	Unit	Actual Value FY 09/10	Actual Value FY 10/11	Target Value FY 11/12	Projected Value for FY 12/13	Projected Value for FY 13/14
	Technology Entrepreneurship Development Board							
	[5.3] Support to Women for gender parity in S&T	[5.3.1] Number of projects supported	Number	120	180	160	170	175
	[5.4] Projects supported for S&T inputs for development of Weaker Sections for equity	[5.4.1] Number of projects supported	Number	40	55	55	65	70
	[5.5] Field projects and research programmes supported for science popularization and communication	[5.5.1] Number of projects supported	Number	175	293	225	225	230
	[5.6] Child Scientist participation in National Children Science Congress	[5.6.1] Number of Child Scientists participating	Number	900000	1110000	1000000	1100000	1200000
	[5.7] To develop a sustainable model for S&T backed entrepreneurships for tribal population	[5.7.1] Date development of the model	Date	--	--	07/03/2012	--	--
[6] S&T co-operation / Partnerships and Alliances	[6.1] Signing agreements, MoUs and protocols for S&T cooperation and partnerships	[6.1.1] Number of agreements signed	Number	40	42	40	45	50
	[6.2] Development and synergy of National knowledge networks for S&T cooperation	[6.2.1] Number of Nodes developed and synergized	Number	21	22	22	28	30

Section 3:
Trend Values of the Success Indicators

Objective	Action	Success Indicator	Unit	Actual Value FY 09/10	Actual Value FY 10/11	Target Value FY 11/12	Projected Value for FY 12/13	Projected Value for FY 13/14
	[6.3] Exchange of professionals for international cooperation	[6.3.1] Number of exchange visits facilitated	Number	1000	1100	1150	1200	1250
	[6.4] Developing State S & T councils mechanism for S&T outreach	[6.4.1] Ratio of Programmatic fund released to State S & T councils as a percentage of core grants sanctioned for manpower	Ratio	1.00	1.05	1.05	1.10	1.20
	[6.5] Projects sanctioned through the Joint research fund	[6.5.1] Number of research Projects funded under the Joint research fund	Number	--	--	10	12	14
	[6.6] Innovation Funding through NASSCOM (National Innovation Fund)	[6.6.1] Number of innovative companies supported	Number	--	--	3	4	5
* Efficient Functioning of the RFD System	Timely submission of Draft for Approval	On-time submission	Date	--	05/03/2010	07/03/2011	--	--
	Timely submission of Results	On- time submission	Date	29/04/2010	02/05/2011	03/05/2012	--	--
* Improving Internal Efficiency / Responsiveness / Service delivery of Ministry / Department	Implementation of Sevottam	Resubmission of revised draft of Citizens' / Clients' Charter	Date	--	--	20/12/2011	--	--
		Independent Audit of Implementation of Grievance Redress Mechanism	%	--	--	95	--	--

* Mandatory Objective(s)

Section 3:
Trend Values of the Success Indicators

Objective	Action	Success Indicator	Unit	Actual Value FY 09/10	Actual Value FY 10/11	Target Value FY 11/12	Projected Value for FY 12/13	Projected Value for FY 13/14
	Ensure compliance with Section 4(1) (b) of the RTI Act, 2005	No. of items on which information is uploaded by February 10, 2012	No	--	--	15	--	--
	Identify potential areas of corruption related to departmental activities and develop an action plan to mitigate them	Finalize an action plan to mitigate potential areas of corruption.	Date	--	--	15/02/2012	--	--
	Develop an action plan to implement ISO 9001 certification	Finalize an action plan to implement ISO 9001 certification	Date	--	--	15/02/2012	--	--
* Ensuring compliance to the Financial Accountability Framework	Timely submission of ATNS on Audit Paras of C&AG	Percentage of ATNS submitted within due date (4 months) from date of presentation of Report to Parliament by CAG during the year.	%	--	0	90	--	--
	Timely submission of ATRs to the PAC Sectt. on PAC Reports.	Percentge of ATRs submitted within due date (6 months) from date of presentation of Report to Parliament by PAC during the year.	%	--	100	90	--	--
	Early disposal of pending ATNs on Audit Paras of C&AG Reports presented to Parliament before 31.3.2011.	Percentage of outstanding ATNs disposed off during the year.	%	--	100	90	--	--
	Early disposal of pending ATRs on PAC Reports presented to Parliament before 31.3.2011	Percentage of outstanding ATRs disposed off during the year.	%	--	100	90	--	--

* Mandatory Objective(s)

Section 3:
Trend Values of the Success Indicators

Objective	Action	Success Indicator	Unit	Actual Value FY 09/10	Actual Value FY 10/11	Target Value FY 11/12	Projected Value for FY 12/13	Projected Value for FY 13/14

* Mandatory Objective(s)

Section 4:
Acronym

Sl.No	Acronym	Description

SECTION 4: DESCRIPTION AND DEFINITION OF SUCCESS INDICATORS AND PROPOSED MEASUREMENT METHODOLOGY

A total number of 14 new initiatives are being proposed under all the six objectives of the Department. Total of 40 success indicators for covering the six overall objectives have been selected with a blend of 37 non-financial and 3 financial targets. Wherever more than two types of outputs and external actions (like peer review, recommendations of Expert committees for decision making, etc.) are involved, for convenience, measurement of performance and success of actions is linked to financial delivery. Performance indictors for non-linear processes in Science, Technology and Innovation require some process innovations based on global bench marks. Performance improvement through enhanced system efficiencies of a department like DST with a mandate to expand the R&D base in the country can be assessed by measuring the expansion of the stake holder base. Specified and number based quantitative targets have been selected wherever appropriate. For improving State-Center cooperation in S&T, a new parameter like ratio of programmatic fund to core fund has been designed for measuring S&T outreach and it is proposed to fine tune the same during the next year. Strengthening of the institutional capacities and scientific excellence based on measurement of global bench marks like H-index for institutions to provide research incentive grants and special packages for North East and J&K regions are based on transparent parameters. Transparent decision logic is embedded in financial targets wherever feasible.

Objective-wise Measurement System

1. For the formulation of policies relating to S&T, keeping in view, the consultation process involved among stake holders, a completion date has been selected as the success indicator.

2. In the category of strengthening basic research and expanding R&D base with human capacity interface two types of success indicators are used namely number and date. The implementation of INSPIRE Awards, INSPIRE Internships, Scholarships for Higher Education (SHE) and INSPIRE Faculty positions are captured by number of awards/internships/scholarships/ faculty positions awarded. The number of such components clearly demonstrates the depth of penetration of these schemes across the country. The modalities of grand alliance with the Ministry of Human Resource Development for strengthening institutional capacities in the area of Research and Development is being worked out, therefore a date target has been assigned to this activity for measurement. To measure the R&D competitiveness of the country, it has been proposed to generate the status reports on mapping of the publications/patents of the Indian researchers in Indexed Journals as an indicator of competitiveness of India . A number of status reports prepared will give the right measurement method.

3. Apart from a financial delivery target, there are number and date indicators used in the category of strengthening basic research and expanding R&D base with institutional capacity. A developmental programme like FIST where the infrastructure building is a centre of concern, the level of funds utilized is appropriate success indicator. PURSE is an evidence based incentive programme. Hence the number of Universities fall under the umbrella of PURSE shows the enhancement of quality of research in the global setting. CURIE Programme is also measured in number. A proactive initiative to offset the setting of regional imbalances in the S&T system is proposed to be tackled by introducing special packages. One regional package per year is envisaged. Hence the date of delivery of the package is set as a success indicator.

4. In implementation of technology development programmes, number, date and level of fund utilization are used as success indicators. Using a number target in technology assisted, convergent water technology solutions, projects supported under Solar Energy Initiative, cognitive science and Security technology, Nano Mission programmes, knowledge networks in climate change and clean energy will clearly demonstrate the progressive development, reach and depth of penetration of the programme. In drug and pharma PPP models, where both loan and grants are involved, the level of fund utilization has been used as a success indicator. The same parameter is used in measuring the impact of promotion of innovation cluster ecosystems. Creation of a test bed for potash technology from sea water and its delivery capacity for this year has been fixed. Hence, the date of commissioning has been chosen as the success indicator.

5. Apart from setting a date indicator for developing a model for S&T backed entrepreneurships for tribal population and all other activities under the societal interventions are measured in number terms. Here also the number of entrepreneurs assisted and projects developed for tribal and other weaker sections indicates the reach of the programme.

6. International S&T cooperation was well captured in terms of the number of MoUs signed, visits facilitated. For improving State-Center cooperation in S&T, a new parameter like ratio of programmatic fund to core fund has been designed for measuring S&T outreach.

Section 5:

Specific Performance Requirements from other Departments

Department	Relevant Success Indicator	What do you need?	Why do you need it?	How much you need?	What happens if you do not get it?
	Number of Students covered across the country under INSPIRE and SHE	Partnership in implementation	They have presence at the implementation levels and are linked to the State mechanism	Their partnerships would enhance the effectiveness of the Programme	We will have to identify alternate mechanisms
	Number of Students covered across the country under INSPIRE and SHE	Partnership in implementation	They are the controlling department for and would help in identification of students to be supported	Their partnership would increase the reach and spread of the Programme	Their support is vital and critical
Ministry of Human Resource Development	Number of Students covered across the country under INSPIRE and SHE	Partnership in implementation	They are the controlling department for and would help in identification of students to be supported	Their partnership would increase the reach and spread of the Programme	Their support is vital and critical

	Date of establishing the MHRD-MoST Grand Alliance		Strengthening institutional capacities in the area of Research and Development	Their partnership will strengthen the R&D capacity of institutions	This will affect the increase in research base planned under the Grand Alliance
Ministry of External Affairs	Number of International MoUs agreements and protocols signed	Partnership in implementation	They are the main Ministry for external relations and our agreements are within the frame work of country cooperation	For enhancing Technology Diplomacy with relevant Nations their support is required	The number of agreements, MoUs and protocols will get affected
Ministry of Chemicals &Fertilizers	Date of commissio ning of the unit	Partnership in implementation	They are the main partner Ministry in Technology Transfer	Their full co-operation in implementing the project	The partnership will address subsidies in fertilizers

Section 6:
Outcome/Impact of Department/Ministry

Outcome/Impact of Department/Ministry	Jointly responsible for influencing this outcome / impact with the following department (s) / ministry(ies)	Success Indicator	Unit	FY 09/10	FY 10/11	FY 11/12	FY 12/13	FY 13/14
1 Strengthening the basis R&D base of the country	Central ministries, state government, industries, research centers, universities	Increased R&D spend by Industry	Rs. In crores	--	--	TBD	--	--
2 Improved commercialization of technology (except those covered by DSIR)	R&D organizations, Industry Associations	No. of innovative products/ processes successfully demonstrated & and commercialized	No	--	--	TBD	--	--
3 Improved Institutional Capacity	Universities and Scientific institutions/ colleges, M/o HRD	Total no. of seats available in Institutions	No	--	--	TBD	--	--
4 Enhanced human capacity	Universities and Scientific institutions/ R&D organizations	Total no. of scientists with super specialized degree in S&T	No	--	--	TBD	--	--
		-No. of patents filed	No			TBD		
5 Enhanced International cooperation	International S&T community, M/o. External Affairs	Total no. of JV/International S&T project funded	No	40	40	42	45	45

Performance Evaluation Report

Objective	Weight	Action	Success	Unit	Weight	Target / Criteria Value					Achiev-ement	Performan	
						Excelle	Very	Good	Fair	Poor		Raw Score	Weigh-ted Score
						100%	90%	80%	70%	60%			
1 Formulation of policies relating to Science and Technology	13.00	Finalization of National Science, Technology and Innovation Policy	Date of finalization of National Science, Technology and Innovation Policy	Date	4.00	27/02/2012	07/03/2012	14/03/2012	21/03/2012	31/03/2012	27/02/2012	100.0	4.0
		Finalization of National Data Sharing on Access Policy Framework Document	Date of finalization of National Data Sharing on Access Policy Framework Document	Date	3.00	05/09/2011	12/09/2011	19/09/2011	25/09/2011	30/09/2011	05/09/2011	100.0	3.0
		To develop suitable measurement systems for the science, technology and innovation output indictors for India	Date of development of the measurement system	Date	3.00	27/02/2012	07/03/2012	14/03/2012	21/03/2012	31/03/2012	27/02/2012	100.0	3.0
		To devise Performance related Incentive Systems for promoting basic research in the country	Date of developing the System	Date	3.00	27/02/2012	07/03/2012	14/03/2012	21/03/2012	31/03/2012	27/02/2012	100.0	3.0
2 Strengthening Basic research and Expanding R&D base -Human Capacity	17.00	Number of INSPIRE awards released	Number of students covered as an indicator of penetration of INSPIRE	Number	3.00	200000	190000	180000	170000	160000	243501	100.0	3.0
		Number of INSPIRE internships covered through winter camps	Realization of quantitative target for number of youth attracted to summer/winter camps	Number	3.00	50000	45000	40000	35000	30000	50330	100.0	3.0
		Number of scholarships for Higher Education awarded	Number of scholarships released	Number	4.00	2000	1900	1800	1700	1600	5032	100.0	4.0
		Institution of INSPIRE faculty position	Number of INSPIRE faculty position	Number	4.00	50	45	40	35	30	74	100.0	4.0
		To establish new alliances with the Ministry of Human	Date of establishing the alliance	Date	1.50	30/06/2011	07/07/2011	15/07/2011	25/07/2011	30/07/2011	30/06/2011	100.0	1.5

Performance Evaluation Report

Objective	Weight	Action	Success	Unit	Weight	Target / Criteria Value					Achiev-ement	Performan	
						Excelle	Very	Good	Fair	Poor		Raw Score	Weigh-ted Score
						100%	90%	80%	70%	60%			
		Resources Development for strengthening institutional capacities in the area of Research and Development											
		Mapping of the publications/patents of the Indian researchers in Indexed Journals as an indicator of competitiveness of India	Number of status reports prepared per year	Number	1.50	5	4	3	2	1	5	100.0	1.5
3 Strengthening Basic research and Expanding R&D base -Institutional Capacity	13.00	Capacity building through Fund for infrastructure strengthening S&T (FIST)	Level of utilization of competitive grants	%	4.00	100	98	95	92	90	100	100.0	4.0
		Development and proactive promotional programmes for strengthening institutional capacities through Promotion of University Research and Scientific Excellence (PURSE)	Number of Universities supported	Number	4.00	30	25	20	15	10	30	100.0	4.0
		Development and proactive promotional programmes for strengthening Women Universities through Consolidation of University Research Innovation and Excellence (CURIE)	Number of institutions supported	Number	2.00	6	5	4	3	2	6	100.0	2.0
		Expanding S&T infrastructure through special pacakages like those presently available	Date of delivery of the package	Date	3.00	31/12/2011	07/01/2012	15/01/2012	20/01/2012	27/01/2012	31/12/2011	100.0	3.0

Performance Evaluation Report

Objective	Weight	Action	Success	Unit	Weight	Target / Criteria Value					Achiev-ement	Performan	
						Excelle	Very	Good	Fair	Poor		Raw Score	Weigh-ted Score
						100%	90%	80%	70%	60%			
		for J&K and NE states											
4 Implementing Technology Development Programs	18.00	Number of technologies assisted for application and absorption	Number of technologies applied and promoted	Number	2.00	40	35	30	25	20	42	100.0	2.0
		Implementation of Public-Private Partnership (PPP) programmes under Drug and Pharma Research Programme	Level of fund utilization	%	2.00	100	98	95	92	90	77	0.0	0.0
		Number of convergent technology solutions for water challenges identified and selected	Number of technology solutions for water found out	Number	2.00	5	4	3	2	1	6	100.0	2.0
		Initiation of Programmes envisaged in Detailed Project Report for indigenous Solar Energy Research initiative	Number of research projects supported	Number	1.50	8	6	5	4	2	8	100.0	1.5
		R&D programmes under Security Technology initiative	Number of research projects supported	Number	1.00	10	8	6	4	2	8	90.0	0.9
		Implementation of application oriented nano S&T R&D projects in Public-Private Partnership (PPP) ventures under nano mission	Number of PPP projects sanctioned under Nano Mission	Number	1.50	5	4	3	2	1	0	0.0	0.0
		PhD/M.Tech. students trained in the area of nano science and technology in the country under nano mission	Quantitative number of PhD/PG outputs	Number	2.00	130	120	100	90	80	140	100.0	2.0

Performance Evaluation Report

Objective	Weight	Action	Success	Unit	Weight	Target / Criteria Value					Achiev-ement	Performan	
						Excelle	Very	Good	Fair	Poor		Raw Score	Weigh-ted Score
						100%	90%	80%	70%	60%			
		Implementing new thrust areas: Cognitive science	Number of researchers supported	Number	1.00	60	50	40	30	20	80	100.0	1.0
		R&D programmes for establishing knowledge networks in the areas of climate change and clean energy	Number of programmes taken up	Number	1.00	10	8	6	4	2	12	100.0	1.0
		Programme initiation for promotion of Public Private Partnerships for R&D areas and increased engagement of Private sector in R&D	Number of study reports generated	Number	1.00	5	4	3	2	1	1	60.0	0.6
		To create a test bed for potash technology from sea water with a capacity of 0.75 TPD and provide inputs to evidence based policy inputs to Ministry of Chemicals and Fertilizers	Date of commissioning of the unit	Date	1.00	27/02/2012	07/03/2012	14/03/2012	21/03/2012	31/03/2012	27/02/2012	100.0	1.0
		Strengthening and Promotion of Innovation clusters	Level of fund utilization	%	1.00	100	98	95	92	90	100	100.0	1.0
		Preparing independent status report on impact/outcome of Technology Development Programmes	Number of Projects reviewed and status report submitted	Number	1.00	5	4	3	2	1	4	90.0	0.9
5 Societal interventions of S&T	14.00	Assisting Technology Entrepreneurs under the National Science & Technology Entrepreneurship Development Board	Number of entrepreneurs assisted	Number	2.00	125	120	110	100	80	138	100.0	2.0

Performance Evaluation Report

Objective	Weight	Action	Success	Unit	Weight	Target / Criteria Value					Achiev-ement	Performan	
						Excelle	Very	Good	Fair	Poor		Raw Score	Weigh-ted Score
						100%	90%	80%	70%	60%			
		Assisting micro enterprises under the National Science & Technology Entrepreneurship Development Board	Number of micro enterprises assisted	Number	2.00	2550	2540	2500	2450	2400	2560	100.0	2.0
		Support to Women for gender parity in S&T	Number of projects supported	Number	3.00	165	160	150	140	130	283	100.0	3.0
		Projects supported for S&T inputs for development of Weaker Sections for equity	Number of projects supported	Number	3.00	60	55	50	45	40	60	100.0	3.0
		Field projects and research programmes supported for science popularization and communication	Number of projects supported	Number	2.00	230	225	220	215	210	230	100.0	2.0
		Child Scientist participation in National Children Science Congress	Number of Child Scientists participating	Number	1.00	1100000	1000000	950000	900000	850000	1000000	90.0	0.9
		To develop a sustainable model for S&T backed entrepreneurships for tribal population	Date development of the model	Date	1.00	27/02/2012	07/03/2012	14/03/2012	21/03/2012	31/03/2012	27/02/2012	100.0	1.0
6 S&T co-operation / Partnerships and Alliances	10.00	Signing agreements, MoUs and protocols for S&T cooperation and partnerships	Number of agreements signed	Number	2.00	45	40	35	30	25	47	100.0	2.0
		Development and synergy of National knowledge networks for S&T cooperation	Number of Nodes developed and synergized	Number	2.00	24	22	20	18	16	28	100.0	2.0
		Exchange of professionals for international cooperation	Number of exchange visits facilitated	Number	2.00	1200	1150	1100	1050	1000	1250	100.0	2.0

Performance Evaluation Report

Objective	Weight	Action	Success	Unit	Weight	Target / Criteria Value					Achiev-ement	Performan	
						Excelle	Very	Good	Fair	Poor		Raw Score	Weigh-ted Score
						100%	90%	80%	70%	60%			
		Developing State S & T councils mechanism for S&T outreach	Ratio of Programmatic fund released to State S & T councils as a percentage of core grants sanctioned for manpower	Ratio	2.00	1.10	1.05	1.00	0.50	0.25	1.10	100.0	2.0
		Projects sanctioned through the Joint research fund	Number of research Projects funded under the Joint research fund	Number	1.00	12	10	8	6	4	15	100.0	1.0
		Innovation Funding through NASSCOM (National Innovation Fund)	Number of innovative companies supported	Number	1.00	4	3	2	1	0	4	100.0	1.0
* Efficient Functioning of the RFD System	3.00	Timely submission of Draft for Approval	On-time submission	Date	2.0	07/03/2011	08/03/2011	09/03/2011	10/03/2011	11/03/2011	07/03/2011	100.0	2.0
		Timely submission of Results	On- time submission	Date	1.0	01/05/2012	03/05/2012	04/05/2012	05/05/2012	06/05/2012	30/04/2012	100.0	1.0
* Improving Internal Efficiency / Responsiveness / Service delivery of Ministry / Department	10.00	Implementation of Sevottam	Resubmission of revised draft of Citizens' / Clients' Charter	Date	2.0	16/01/2012	18/01/2012	20/01/2012	23/01/2012	25/01/2012		N/A	N/A
			Independent Audit of Implementation of Grievance Redress Mechanism	%	2.0	100	90	80	70	60	61.9	61.9	1.24
		Ensure compliance with Section 4(1) (b) of the RTI Act, 2005	No. of items on which information is uploaded by February 10, 2012	No	2.0	16	15	14	13	12	16	100.0	2.0
		Identify potential areas of corruption related to departmental activities and develop an action plan to mitigate them	Finalize an action plan to mitigate potential areas of corruption.	Date	2.0	26/03/2012	27/03/2012	28/03/2012	29/03/2012	30/03/2012	28/03/2012	80.0	1.6

* Mandatory Objective(s)

Performance Evaluation Report

Objective	Weight	Action	Success	Unit	Weight	Target / Criteria Value					Achiev-ement	Performan	
						Excelle	Very	Good	Fair	Poor		Raw Score	Weigh-ted Score
						100%	90%	80%	70%	60%			
		Develop an action plan to implement ISO 9001 certification	Finalize an action plan to implement ISO 9001 certification	Date	2.0	16/04/2012	17/04/2012	18/04/2012	19/04/2012	20/04/2012	04/04/2012	100.0	2.0
* Ensuring compliance to the Financial Accountability Framework	2.00	Timely submission of ATNS on Audit Paras of C&AG	Percentage of ATNS submitted within due date (4 months) from date of presentation of Report to Parliament by CAG during the year.	%	0.5	100	90	80	70	60	14.28	0.0	0.0
		Timely submission of ATRs to the PAC Sectt. on PAC Reports.	Percentge of ATRs submitted within due date (6 months) from date of presentation of Report to Parliament by PAC during the year.	%	0.5	100	90	80	70	60	100	100.0	0.5
		Early disposal of pending ATNs on Audit Paras of C&AG Reports presented to Parliament before 31.3.2011.	Percentage of outstanding ATNs disposed off during the year.	%	0.5	100	90	80	70	60	28.57	0.0	0.0
		Early disposal of pending ATRs on PAC Reports presented to Parliament before 31.3.2011	Percentage of outstanding ATRs disposed off during the year.	%	0.5	100	90	80	70	60	100	100.0	0.5

* Mandatory Objective(s)

Total Composite 91.64

The audit observations to be included in the Annual Report for the year
given below:

Sl. No.	Year	No. of Paras/PA Reports on which ATNs have been submitted to PAC after vetting by Audit	Details of the Paras/PA reports on which	
			No. of ATNs not sent by the Ministry even for the first time	No. of ATNs sent returned with observations and Audit is awaiting resubmission by Ministry
1.	5 of 2004 (SD)			**1 (3.1) (*)**
2.	5 of 2005(SD)			**1 (5.1)**
3.	1 of 2006 – Union Govt.			**1 (3.1 to 3.9) (***
4.	PA13 of 2007 (Scientific Departments), DST		**1 (5.3.1 to 5.3.8)**	
5.	CA2 of 2008 Union Govt.(Civil)-Autonomous bodies, DST			**1 (1.1.2) (*)**
6.	CA 3 of 2008 (SD), DST			**1 (5.1)**
7.	CA 3 of 2008 (SD), DST			**1 (5.2)**
8.	CA 16 of 2009 (SD), DST			**1 (5.1)**
9.	CA 16 of 2009 (SD), DST		**1 (5.2)**	
10.	CA 16 of 2009 (SD), DST		**1 (5.3)**	
11.	1 for the year 2008-09 (Accounts of the Union Govt.), DST			**1 (2.11) (*)**
12.	CA 15 of 2008 -09 Union Govt (Civil)			

DEPARTMENT OF SCIENCE A

SUMMARY OF FINANCIAL

Sl. No.	HEAD OF DEVELOPMENT PROJECTS / PROGRAMMES / SCHEMES	ACTUALS 2011-2012		
		Plan	Non-Plan	Total
1	2	3	4	5
1	SECRETARIAT ECONOMIC SERVICES			
1.1	SECRETARIAT, EXHIBITION & FAIRS & Pr. ACCOUNTS OFFICE	0.00	45.89	45.89
	TOTAL - SECRETARIAT ECONOMIC SERVICES	0.00	45.89	45.89
2	R&D SUPPORT			
2.1	MULTI-DISCIPLINARY RESEARCH IN SCIENCE & ENGINEERING (SERC)			
2.2	RESEARCH AND DEVELOPMENT SUPPORT (SERC)	395.41	1.34	396.75
2.3	DRUGS AND PHARMACEUTICALS RESEARCH	41.92	0.00	41.92
2.4	NATIONAL MISSION ON NANO-SCIENCE & NANO-TECHNOLOGY	88.44	0.00	88.44
	TOTAL - R&D SUPPORT	525.77	1.34	527.11
	TOTAL - R&D PROMOTION PROGRAMMES	525.77	1.34	527.11
3	TECHNOLOGY DEVELOPMENT PROGRAMME	127.05	0.00	127.05
	TOTAL - TECHNOLOGY DEVELOPMENT PROGRAMME	127.05	0.00	127.05
4	TECHNOLOGY PROJECTS IN MISSION MODE			
4.1	TECHNOLOGY FOR BAMBOO PRODUCTS	20.00	0.00	20.00
	TOTAL - TECHNOLOGY PROJECTS IN MISSION MODE	20.00	0.00	20.00
5	S&T PROGRAMMES FOR SOCIO-ECONOMIC DEVELOPMENT			
5.1	SCIENCE AND SOCIETY PROGRAMME	8.72	0.00	8.72
5.2	WOMEN COMPONENT PLAN	42.31	0.00	42.31
5.3	SCIENCE AND TECHNOLOGY ENTREPRENEURSHIP DEVELOPMENT			
	AND EMPLOYMENT GENERATION	43.61	0.00	43.61
5.4	SCIENCE AND TECHNOLOGY COMMUNICATION AND POPULARISATION	20.24	0.00	20.24
	TOTAL - S&T PROGRAMMES FOR SOCIO ECONOMIC DEVELOPMENT	114.88	0.00	114.88
6	SPECIAL COMPONENT PLAN FOR SCHEDULED CASTES			

6.3	SPECIAL COMPONENT PLAN FOR THE DEVELOPMENT OF SCHEDULED CASTES	2.97	0.00	2.97	4.00	0.00	4.00	4.00	0.00	4.00	29.00	0.00	29.00
6.4	AUTONOMOUS SCIENTIFIC INSTITUTIONS	0.00	0.00	0.00	12.00	0.00	12.00	12.00	0.00	12.00	12.00	0.00	12.00
6.5	R&D SUPPORT (SERC)	0.00	0.00	0.00	8.00	0.00	8.00	0.00	0.00	0.00	0.00	0.00	0.00
6.6	TECHNOLOGY DEVELOPMENT PROGRAMME	0.33	0.00	0.33	6.00	0.00	6.00	0.35	0.00	0.35	0.00	0.00	0.00
6.7	STATE SCIENCE & TECHNOLOGY PROGRAMME	0.44	0.00	0.44	5.00	0.00	5.00	0.45	0.00	0.45	0.00	0.00	0.00
6.8	NATIONAL MISSION ON NANO-SCIENCE & NANO-TECHNOLOGY	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6.9	INSPIRE	3.75	0.00	3.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6.10	SCIENCE & ENGINEERING RESEARCH BOARD	15.00	0.00	15.00	3.93	0.00	3.93	3.93	0.00	3.93	3.93	0.00	3.93
6.11	DISHA PROGRAMME FOR WOMEN IN SCIENCE	0.00	0.00	0.00	1.00	0.00	1.00	0.24	0.00	0.24	0.00	0.00	0.00
6.12	ALLIANCE AND R&D MISSION	0.00	0.00	0.00	17.00	0.00	17.00	5.00	0.00	5.00	17.00	0.00	17.00
6.13	SUPER COMPUTING FACILITY & CAPACITY BUILDING	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.63	0.00	2.63
6.14	NATIONAL GEOGRAPHIC INFORMATION SYSTEM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.87	0.00	4.87
	TOTAL - SCSP	22.49	0.00	22.49	61.93	0.00	61.93	25.97	0.00	25.97	69.43	0.00	69.43
7	SCHEDULED TRIBE SUB-PLAN												
7.1	S&T COMMUNICATION AND POPULARISATION	0.00	0.00	0.00	0.50	0.00	0.50	0.07	0.00	0.07	0.00	0.00	0.00
7.2	S&T ENTREPRENEURHSIP DEVELOPMENT	0.00	0.00	0.00	0.50	0.00	0.50	0.25	0.00	0.25	0.00	0.00	0.00
7.3	TRIBAL SUB-PLAN	2.87	0.00	2.87	4.00	0.00	4.00	4.00	0.00	4.00	25.00	0.00	25.00
7.4	AUTONOMOUS SCIENTIFIC INSTITUTIONS	0.00	0.00	0.00	12.00	0.00	12.00	1.00	0.00	1.00	12.00	0.00	12.00
7.5	TECHNOLOGY FOR BAMBOO PRODUCTS	5.00	0.00	5.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7.6	R&D SUPPORT (SERC)	0.00	0.00	0.00	8.00	0.00	8.00	0.00	0.00	0.00	0.00	0.00	0.00
7.7	TECHNOLOGY DEVELOPMENT PROGRAMME	0.00	0.00	0.00	6.00	0.00	6.00	2.30	0.00	2.30	0.00	0.00	0.00
7.8	STATE SCIENCE & TECHNOLOGY PROGRAMME	0.93	0.00	0.93	5.00	0.00	5.00	1.31	0.00	1.31	0.00	0.00	0.00
7.9	NATIONAL MISSION ON NANO-SCIENCE & NANO-TECHNOLOGY	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7.10	INSPIRE	3.75	0.00	3.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7.11	SCIENCE & ENGINEERING RESEARCH BOARD	15.00	0.00	15.00	7.93	0.00	7.93	7.93	0.00	7.93	7.93	0.00	7.93
7.12	DISHA PROGRAMME FOR WOMEN IN SCIENCE	0.00	0.00	0.00	1.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00
7.13	ALLIANCE AND R&D MISSION	0.00	0.00	0.00	17.00	0.00	17.00	5.00	0.00	5.00	17.00	0.00	17.00
7.14	SUPER COMPUTING FACILITY & CAPACITY BUILDING	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.25	0.00	2.25
7.15	NATIONAL GEOGRAPHIC INFORMATION SYSTEM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.25	0.00	5.25
	TOTAL - TSP	27.55	0.00	27.55	61.93	0.00	61.93	21.86	0.00	21.86	69.43	0.00	69.43

8	INTERNATIONAL COOPERATION PROGRAMMES												
8.1	INDO-FRENCH CENTRE FOR THE PROMOTION OF ADVANCED												
	RESEARCH (IFCPAR)	9.78	0.00	9.78	10.00	0.00	10.00	10.00	0.00	10.00	11.00	0.00	11.00
8.2	SCIENCE COUNSELLORS ABROAD	0.00	6.38	6.38	0.00	7.35	7.35	0.00	6.50	6.50	0.00	8.35	8.35
8.3	INDO-US SCIENCE AND TECHNOLOGY FORUM	10.06	0.00	10.06	10.00	0.00	10.00	10.30	0.00	10.30	11.00	0.00	11.00
8.4	INDO-GERMAN SCIENCE & TECHNOLOGY CENTRE	5.00	0.00	5.00	5.00	0.00	5.00	8.00	0.00	8.00	8.00	0.00	8.00
8.5	S&T COOPERATION WITH OTHER COUNTRIES	47.69	0.00	47.69	65.00	0.00	65.00	60.70	0.00	60.70	60.00	0.00	60.00
	TOTAL - INTERNATIONAL COOPERATION PROGRAMMES	72.53	6.38	78.91	90.00	7.35	97.35	89.00	6.50	95.50	90.00	8.35	98.35
9	STATE SCIENCE AND TECHNOLOGY PROGRAMME	39.93	0.00	39.93	60.00	0.00	60.00	35.00	0.00	35.00	30.00	0.00	30.00
10	TECHNOLOGY DEVELOPMENT BOARD	0.00	0.00	0.00	0.00	25.00	25.00	0.00	22.50	22.50	0.00	15.00	15.00
	TOTAL- OTHER SCIENTIFIC RESEARCH	950.20	7.72	957.92	896.86	33.85	930.71	782.83	30.00	812.83	807.86	24.54	832.40
11	SCIENTIFIC SURVEYS (MODERNISATION OF MAPPING ORGANIZATIONS (SoI & NATMO)												
11.01	SURVEY OF INDIA	21.70	273.87	295.57	34.20	297.38	331.58	34.20	280.96	315.16	30.00	310.60	340.60
11.02	NATIONAL ATLAS AND THEMATIC MAPPING ORGANISATION	4.41	11.81	16.22	5.80	13.48	19.28	5.80	12.11	17.91	5.00	14.14	19.14
	TOTAL - SCIENTIFIC SURVEYS	26.11	285.68	311.79	40.00	310.86	350.86	40.00	293.07	333.07	35.00	324.74	359.74
12	AUTONOMOUS SCIENTIFIC INSTITUTIONS	642.75	15.00	657.75	676.00	12.60	688.60	676.00	11.34	687.34	687.00	14.50	701.50
	TOTAL - SCIENTIFIC INSTITUTIONS	642.75	15.00	657.75	676.00	12.60	688.60	676.00	11.34	687.34	687.00	14.50	701.50
13	SYNERGY PROJECTS (O/o the PRINCIPAL SCIENTIFIC ADVISER) (including CHAIN)	14.01	0.00	14.01	18.00	0.00	18.00	13.00	0.00	13.00	15.00	0.00	15.00
	TOTAL	14.01	0.00	14.01	18.00	0.00	18.00	13.00	0.00	13.00	15.00	0.00	15.00
14	INFORMATION TECHNOLOGY	1.21	0.00	1.21	5.00	0.00	5.00	1.00	0.00	1.00	1.00	0.00	1.00
15	NATIONAL TRAINING PROGRAMME FOR SCIENTISTS & TECHNOLOGISTS	4.91	0.00	4.91	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	TOTAL	6.12	0.00	6.12	5.00	0.00	5.00	1.00	0.00	1.00	1.00	0.00	1.00
	NEW SCHEMES (Eleventh Five Year Plan)												
16	SCIENCE & ENGINEERING RESEARCH BOARD	170.00	0.00	170.00	388.14	0.00	388.14	388.14	0.00	388.14	522.14	0.00	522.14
17	SCHOLARSHIPS FOR SCIENCE IN HIGHER EDUCATION (OVERSIGHT COMMITTEE RECOMMENDATION)	75.00	0.00	75.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18	WATER TECHNOLOGY INITIATIVE	24.58	0.00	24.58	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19	INNOVATIONS IN SCIENCE PURSUIT FOR INSPIRED RESEARCH (INSPIRE)	222.40	0.00	222.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	INNOVATION CLUSTERS	11.32	0.00	11.32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
21	SECURITY TECHNOLOGY INITIATIVE	4.69	0.00	4.69	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
22	MEGA FACILITIES FOR BASIC RESEARCH	20.00	0.00	20.00	30.00	0.00	30.00	20.00	0.00	20.00	50.00	0.00	50.00
	TOTAL	527.99	0.00	527.99	418.14	0.00	418.14	408.14	0.00	408.14	572.14	0.00	572.14

	NEW SCHEMES (Twelfth Five Year Plan)												
23	POLICY RESEARCH CELL	0.00	0.00	0.00	10.00	0.00	10.00	2.00	0.00	2.00	10.00	0.00	10.00
24	DISHA PROGRAMME FOR WOMEN IN SCIENCE	0.00	0.00	0.00	47.00	0.00	47.00	47.00	0.00	47.00	53.00	0.00	53.00
25	ALLIANCE AND R&D MISSION	0.00	0.00	0.00	366.00	0.00	366.00	205.03	0.00	205.03	311.00	0.00	311.00
26	SUPER COMPUTING FACILITY & CAPACITY BUILDING	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	95.12	0.00	95.12
27	NATIONAL GEOGRAPHIC INFORMATION SYSTEM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	189.88	0.00	189.88
	TOTAL	0.00	0.00	0.00	423.00	0.00	423.00	254.03	0.00	254.03	659.00	0.00	374.00
	GRAND TOTAL	2167.18	354.29	2521.47	2477.00	405.86	2882.86	2175.00	384.83	2559.83	2777.00	418.39	2910.39