

14. SCIENCE AND TECHNOLOGY

“Technology is a non-linear tool that can effect the most fundamental change in the ground rules of economic competitiveness”

[from *Envisioning an Empowered Nation* by the President A.P.J Abdul Kalam with A.Sivathanu Pillai]

Science and technology have profoundly influenced the course of human civilization. Science has provided remarkable insights into the world we live in. India has a long and distinguished tradition in science and technology from the ancient times to great achievements during this century. These cover many great scientific discoveries and technological achievements in mathematics, astronomy, architecture, chemistry, metallurgy, medicine, natural philosophy and other areas. A great deal of this traveled outwards from India. Equally, India also assimilated scientific ideas and techniques from elsewhere, with open-mindedness and a rational attitude characteristic of a scientific ethos.

At the time of Independence, scientific and technological infrastructure was neither strong nor organised as compared to the developed world. This had resulted in India being technologically dependent on the skills and expertise available in other countries. In the past five decades, an infrastructure and capability largely commensurate with meeting national needs has been created minimising India's dependence on other countries. These include research laboratories, higher educational institutions and highly skilled human resource. Indian capabilities in Science and technology cover an impressive range of diverse disciplines, areas of competence and of applications. India's strength in basic research is recognized internationally. Successes in agriculture, health care, chemicals and pharmaceuticals, nuclear energy, astronomy and astrophysics, space technology and applications, defense research, biotechnology, electronics, information technology and oceanography are widely acknowledged. Major national achievements include very significant increase in food production, eradication or control of several diseases and increased life expectancy of the citizens.

There is now a reservoir of expertise well acquainted with the most modern advances in basic and applied areas that is equipped to make choices between available technologies, to absorb readily new technologies and provide a framework for future national development.

India has been committed to the task of promoting the spread of science. The key role of technology as an important element of national development is well recognized. The Scientific Policy Resolution of 1958 and Technology Policy Statement of 1983 enunciated the principles on which the growth of science and technology in India has been based over the past several decades. These policies have emphasized self-reliance, as also sustainable and equitable development. They embody a vision and strategy that are applicable today and would continue to inspire the people in their endeavours.

The pressure of rapid population growth, resource depletion, and ecological damage have lent urgency to the need to realise the potential benefits of science and technology. What is needed is better diffusion, adaptation, and use of the new technologies to local problems and conditions. Science and Technology is not merely a tool for economic development, but a major change agent that exerts a continuing influence on the social, cultural and management aspects of the society.

The effective use of technological advances is viewed as the key to successful and sustainable development. Technological literacy has to be emphasized in the schools and encouraged throughout the population. The effective

use of technology means "*matching solutions in search of problems to problems in search of solutions*". Research laboratories must focus on the specific needs of the country. In developing countries, this means emphasizing applied research and development while maintaining a core of basic researchers who can follow and participate in world advances. As in industrial countries, scientific, technological, and social specialists must work together, materials engineering needs to interact with biology, computer science with linguistics, medicine with sociology, and engineering with economics and the law.

Technology is not a package that can be bought off the shelf and become immediately productive; it is a cumulative process of learning. So, for developed, developing countries alike, the ability to realize knowledge-based productivity gains depends on a country's capacity to tap the global system of generation and transmission of knowledge, generate indigenous knowledge, diffuse and transfer information, and use knowledge in productive activity.

The education system must, therefore, give students practice in understanding the systems, manipulating them, talking about them to one another, and envisioning the function from many viewpoints. The use of tools for managing information complexity needs to become part of schooling for an ever-increasing portion of the population. Preparing them to use technology requires a combination of skill-development, practice with complexity and the development of adaptive problem-solving capabilities.

Science and technology in all its facets has to be supported in recognition of its central role in raising the quality of life of the people of the country, particularly of the disadvantaged sections of society, in creating wealth for all, in making India globally competitive, in utilizing natural resources in a sustainable manner, in protecting the environment and ensuring national security.

In order to build a blue print for future programmes of Science and Technology and to give a direction to the initiatives to be undertaken, the Government of India announced the Science and Technology Policy 2003. The policy outlines the approach to Science and Technology governance, optimal utilisation of existing physical and knowledge resources, development of innovative technologies, systems and technologies for mitigation and management of natural hazards, generation and management of intellectual property and creation of awareness amongst general masses about the use and benefits of science and technology.

The objectives of the new Science and Technology Policy 2003 are:

- To ensure that the message of science reaches every citizen of India, man and woman, young and old, so that we advance scientific temper, emerge as a progressive and enlightened society, and make it possible for all our people to participate fully in the development of science and technology and its application for human welfare. Indeed, science and technology will be fully integrated with all spheres of national activity.
- To ensure food, agricultural, nutritional, environmental, water, health and energy security of the people on a sustainable basis.
- To mount a direct and sustained effort on the alleviation of poverty, enhancing livelihood security, removal of hunger and malnutrition, reduction of drudgery and regional imbalances, both rural and urban, and generation of employment, by using scientific and technological capabilities along with our traditional knowledge pool. This will call for the generation and screening of all relevant technologies, their widespread dissemination through networking and support for the vast unorganized sector of our economy.

- To vigorously foster scientific research in universities and other academic, scientific and engineering institutions; and attract the brightest young persons to careers in science and technology, by conveying a sense of excitement concerning the advancing frontiers, and by creating suitable employment opportunities for them. Also to build and maintain centres of excellence, which will raise the level of work in selected areas to the highest international standards.
- To promote the empowerment of women in all science and technology activities and ensure their full and equal participation.
- To provide necessary autonomy and freedom of functioning for all academic and R & D institutions so that an ambience for truly creative work is encouraged, while ensuring at the same time that the science and technology enterprise in the country is fully committed to its social responsibilities and commitments
- To use the full potential of modern science and technology to protect, preserve, evaluate, update, add value to, and utilize the extensive knowledge acquired over the long civilizational experience of India
- To accomplish national strategic and security-related objectives, by using the latest advances in science and technology.
- To encourage research and innovation in areas of relevance for the economy and society, particularly by promoting close and productive interaction between private and public institutions in science and technology. Sectors such as agriculture (particularly soil and water management, human and animal nutrition, fisheries), water, health, education, industry, energy including renewable energy, communication and transportation would be accorded highest priority. Key leverage technologies such as information technology, biotechnology and materials science and technology would be given special importance.
- To substantially strengthen enabling mechanisms that relate to technology development, evaluation, absorption and upgradation from concept to utilization.
- To establish an Intellectual Property Rights (IPR) regime which maximizes the incentives for the generation and protection of intellectual property but all types of inventors. The regime would also provide a strong, supportive and comprehensive policy environment for speedy and effective domestic commercialization of such inventions so as to be maximal in the public interest.
- To ensure, in an era in which information is key to the development of science and technology, that all efforts are made to have high-speed access to information, both in quality and quantity, at affordable costs; and also create digitized, valid and usable content of Indian origin.
- To encourage research and application for forecasting, prevention and mitigation of natural hazards, particularly, floods, cyclones, earthquakes, drought and landslides.
- To promote international science and technology co-operation towards achieving the goals of national development and security, and make it a key element of our international relations.
- To integrate scientific knowledge with insights from other disciplines, and ensure fullest involvement of scientists and technologists in national governance so that the spirit and methods of scientific enquiry permeate deeply into all areas of public policy making.

Government of Tamil Nadu has long recognized the critical role that knowledge, and in particular, science and technology (S & T) plays in promoting

economic growth and social progress. One of the points in the Chief Minister's 15 point programme is Technological Leapfrogging. A special thrust would be given to research in frontier areas of Science and technology like Bio-Technology and Information Technology with the objective of increasing the employment and investment potential and improving the quality of life.

The scientific and technological activities in the country are carried out in higher educational institutions, public and private sector industry, research laboratories, semi - autonomous organisations set up by the Government of India and the State Government.

The State Government has established The Tamil Nadu State Council for Science Technology, the Science City, the Tamil Nadu Science and Technology Centres. Besides the Universities carry out research programmes.

A resource scarce State like Tamil Nadu must depend on and make optimum use of science and technology and carry out advanced studies, research and application of science and technology in a substantial way. With these goals and objectives in mind, priority areas of research were identified and schemes were formulated and implemented during the past Five Year Plan periods by the various organisations / agencies in Tamil Nadu.

Tenth Five Year Plan

For the Tenth Five Year Plan (2002-07), a sum of Rs.47.35 crores has been provided for taking up various schemes under Science and Technology.

Annual Plan 2002-03

For the year 2002-03 the actual expenditure was Rs.180.53 lakhs against the outlay of Rs.203.70 lakhs.

Annual Plan 2003-04

For the year 2003-04, an amount of Rs.186.79 lakhs was provided for the sector. Against this the expenditure anticipated is Rs.221.74 lakhs.

Annual Plan 2004-05

A sum of Rs.195.52 lakhs has been provided for taking up various schemes under this head during the year 2004-05. This includes a sum of Rs.44.35 lakhs provided for taking up new schemes.

Tamil Nadu Science and Technology Centres (Outlay Rs.87.01 lakhs)

Tamil Nadu Science and Technology Centre was established in the year 1993 and is functioning with financial support from the Government of Tamil Nadu. This centre comprises the Periyar Science and Technology Centre, B M Birla Planetarium and Anna Science Centre including Planetarium at Trichy.

The Government of Tamil Nadu has sanctioned seed money of Rs.10 lakhs towards alienation of land for the establishment of Regional Science Centre including a Planetarium at Coimbatore. A land measuring 5.91 acres at Vilankurichy near Coimbatore city has been identified and taken possession by the Centre and the land has been fenced. A building to establish the Planetarium at an estimated cost of Rs.300 lakhs will be constructed. The Projector and other accessories required for the planetarium are to be imported at a cost of Rs.600 lakhs. For meeting the cost of Projector, a fund raising committee has been proposed to be constituted.

Other activities

The Centre has proposed to establish a District Science centre at Vellore for which a sum of Rs.5 lakhs has already been sanctioned as seed money for alienation of land for the centre. Land measuring 0.30-5 hectare has been taken

possession of by the Centre. The apex Centre has also proposed to develop 25 District Science Centres in various districts of Tamil Nadu with an outlay of Rs.250 crores at the rate of Rs.10 crores per district centre.

For the year 2004-05, a sum of Rs.87.01 lakhs has been proposed towards salary of staff and other maintenance expenditure of the Centre. This includes a sum of Rs.10.00 lakhs for taking up new schemes. The details are given separately.

Tamil Nadu State Council for Science and Technology, Chennai (Outlay Rs.67.71 lakhs)

The Tamil Nadu State Council for Science and Technology was established as an apex body in 1984 and registered as a society. Its objective is to initiate, direct and co-ordinate research activities of Government departments, Universities, and other professional bodies with a view to aid development of scientific research in the State. The State Government provides funds to the Council to meet its revenue expenditure under the State Plan. Under the scheme of providing assistance for development of State Council on Science and Technology the Department of Science and Technology of the Government of India assists the State Government by way of annual grant to meet the expenditure on professionals and secretarial staff of the Council. This includes a sum of Rs.25.00 lakhs for taking up new schemes. The details are given under new schemes.

The following important schemes that are currently under implementation by the State Council are programmed to be continued during 2004-05:

1. Student Project Scheme

The scheme envisages utilisation of tremendous student talent and potential by providing financial and academic support to the final year B.E. / B.E. (Agri) and other students in professional colleges and post graduate science students of University departments and affiliated colleges in Tamil Nadu to carry out projects, which are relevant to the society and to provide solutions to the local problems in Tamil Nadu. The students may also choose to work in Small Scale Industries / rural voluntary organisations. A certain number of projects will be allocated to every branch of study depending upon the importance of the thrust areas of science and technology. The scheme was initiated during 1992-93. During the 9th plan 644 projects have been supported. During 2001-02, 234 students projects were sanctioned. This programme will be continued during 2004-05.

2. Science and Technology Projects

The aim of this programme is to encourage research in development sectors that would contribute to the socio-economic development of the State. During 2004-05 also funds have been provided for taking up new Science and Technology Projects.

3. Adoption of Young Student Scientists

The aim is to produce highly talented scientists in the country. This is a gift scheme to benefit rural people in Tamil Nadu. In each district 50 bright students studying in 8th standard from various schools will be selected through a written test. They will stay in college campus and will be trained in all scientific subjects. During the year 2001-02 this scheme was conducted in 24 centres and 1,400 students benefitted. This will be continued during 2004-05 also.

4. Young Scientists Fellowship Schemes

Under the Young Scientist Fellowship programme, assistance is given to Young Scientists working in various Research Institutions in Tamil Nadu to undergo "Research Training" in various Research Centres and Universities. This programme is implemented with financial assistance from DST - Government of India on 50:50 basis. During Ninth Plan 52 Young Scientists have been supported. This programme will be continued during 2004-05.

5. Partial Financial Assistance for Seminars / Symposia and Workshops

The aim of this programme is to offer partial financial assistance to organisations for conduct of conference / Seminar / Symposia / Workshop in important areas of Science & Technology such as Agriculture, Bio-technology, Veterinary Sciences, Medicine, Environment, Engineering and Technology, Energy etc., which will provide a suitable platform to Scientists, Technologists, Administrators, Industrialists and others to interact and exchange ideas in their fields. Further action in research and development will be discussed and evolved through these programmes apart from adding valuable scientific literature to the concerned areas. About 20 seminars / symposia will be supported.

6. Application of Science and Technology to Rural Areas

This scheme will enable upliftment of the economic status of the people through transfer of Science & Technology techniques and findings to rural areas. This scheme involves identification of agencies and village panchayats in districts, setting up of Steering Committee for monitoring the progress of the committee, visiting the panchayats and motivating the people in the panchayats to involve themselves in projects etc.

7. Popularisation of Science and Technology

The aim of this programme is to take Science and Technology to people and, in particular, children to inculcate in them scientific awareness and foster inquisitiveness so as to combat exploitation through superstition. The Council organizes National Science Day Celebrations, Science and Technology Exhibitions, In-service Teacher Training Programme and Science Awareness Programmes. During 2004-05, all these programmes are proposed to be conducted through out the year in schools, colleges and villages, and about 150 Organisations will be supported.

8. Incentive to young scientists - Travel grant to young Scientists fellowship

The objective of this programme is to encourage young scientists in institutions to know of developments in frontier areas in science and technology by their contribution at National / International Seminars, with partial financial assistance for Travel. The awardees are to share the information acquired with fellow Scientists at a Seminar to be arranged at one of the Institutions. Under this programme, initiated in 1988, 332 Young Scientists have been assisted upto 2001. This scheme will be continued during 2004-05 and about 25 Scientists will be supported.

9. Assistance to S & T Publications and Science Magazines in Tamil - Ariga Arivial, Arivukkan, Thulir etc.

The aim of this programme is to foster the creative talent of writers by bringing out Science and Technology publications in Tamil which will help to spread Science & Technology among children and masses. It is also proposed to continue the provision of financial subsidy in 2003-04 to Organisations for bringing out the Science Magazines in Tamil for Children viz., Ariga Arivial, Arivukkan, etc. Besides financial assistance is to be provided for bringing out in Tamil some of the text books to be used at the undergraduate studies in engineering as well as scientific disciplines. During 9th plan 7 journals were supported. This scheme will be continued in 2004-05 also.

10. Tamil Nadu Scientists' Award scheme (TANSA)

Under this scheme, the Scientists of Tamil Nadu who have contributed significantly to science by way of new discoveries, developing models/methods in each field of science such as medical engineering agriculture, fisheries, veterinary, basic sciences, computer science and other branches of sciences will be honoured with award. Each award will carry a cash prize of Rs.10,000 and a citation. During the 9th plan period 32 awards have been given to outstanding scientists apart from 9 women scientists. This scheme will be continued during the year 2004-05 also.

11. National Technology Day

The Tamil Nadu State Council for Science & Technology is observing the "National Technology Day" Science 2000. The programme content involves large number of activities such as exhibitions, elocution competition, computer training, essay competitions, seminars, popular lectures etc. The State Council has been involving voluntary agencies, Higher Secondary schools, Colleges and Universities of the State in these activities. NCSTC, DST, Govt. of India sanctions matching grant on 50:50 basis for this programme.

12. Career Fair

In order to have a close coordination between Industry and educational institutions and with the aim at bringing together service providers, students, working professional and self-employed people in search of enhancing their skill and potential, the Confederation of Indian Industry will organise a two-day event called "Career Fair 2003" at Madurai and this will be useful to students studying in Engineering, MBA, MCA and P.G. in Arts, Science and Commerce. The Council will support the above fair.

Thus a total sum of Rs.67.71 lakhs is proposed as grant for the Council for the year 2004-05 for continuing the ongoing schemes and for meeting the staff salary attached to the institute. This outlay also includes a sum of Rs.25.00 lakhs provided for taking up new schemes under Science and Technology Project during the year 2004-05.

Anna University

Institute of Remote Sensing

The Government has set up the Institute of Remote Sensing (IRS) at Anna University to fully exploit the capabilities of satellite remote sensing techniques for optimal utilization of natural resources of the State. In the earlier years, IRS had completed several projects comprising both State and national levels covering thrust and emerging areas. A training centre building has been added to the Institute to develop human resources in the area of Remote Sensing.

Apart from this, the Government of Tamilnadu has been supporting a scheme for setting up of a Research Documentation Laboratory for Textile Chemistry implemented under State Plan which was assisted by the UGC upto March 1992. Since then, the scheme is being financed by the State Government. A sum of Rs.0.25 lakh has been proposed for the Annual Plan 2004-2005.

Chennai Science City (Outlay Rs.40.55 lakhs)

The Chennai Science City was established in the year 1994-95 based on the recommendations of a Working Group with the objective of encouraging the spirit of enquiry among people in general and to foster the research capabilities in the scientific community. Hence, an agglomeration of Institutions connected with scientific research and development in Guindy - Tharamani Institutional belt totalling to nearly 60 like IIT, Anna University, CLRI, Periyar Science and Technology Centre belonging both to State and Central Governments have been declared as Science City with the objective of promoting Science and Technology.

These Institutions in the Science City have more than 1500 Ph.D. holders, 3500 research scholars with more than 1500 research projects in the field of Science, Engineering and Technology. Equipments worth about Rs.500 crores are available. An initial outlay of Rs.1 crore was provided to the Science City during 1994-95. Since then it has been receiving continued Government assistance.

A sum of Rs.40.55 lakhs has been proposed during 2004-05 for schemes like Creation of Database pertaining to the scientific knowledge base available in Science city area which will immensely help the Government and the NGOs, Newsletter and photography which will create awareness to the public in the recent scientific advancements in science and technology within the Science City. The other schemes like popularisation of science, Gender Cell, Networking of Libraries, Environment Related activities, setting up of Information Systems etc. will receive State assistance. This outlay includes provision of funds for taking up new schemes costing Rs.9.35 lakhs for which details are given under new schemes.

New Schemes

I Tamil Nadu Science and Technology Centre

(i) Modernisation of existing galleries in the Periyar Science and Technology Centre (Outlay Rs.10.00 lakhs)

There are at present 8 galleries in the Centre. Information Technology and Urban Development gallery are going to be added in due course. The exhibits in the above galleries are participatory in nature. The visiting public and student community can gain scientific knowledge by operating the exhibits themselves. The exhibits installed in the galleries have to be renovated in tune with new technology and new type of the exhibits with reference to current technology are also proposed to be added. Hence a sum of Rs.10.00 lakhs is provided for the above purpose during 2004-05.

II Tamil Nadu State Council for Science and Technology

(2) Grants to State Council for taking up Science and Technology Project (Outlay Rs.25.00 lakhs)

The Tamil Nadu State Council for Science and Technology has been extending financial support for taking up Science and Technology Project in selected areas in order to promote research activities in the State in general and in the Universities and Colleges in particular. So far it has supported more than 95 research projects and thereby motivated research activities in the State. In furtherance of this objective it is proposed to provide financial assistance for taking

up Science and Technology Project during 2004-05. Hence a sum of Rs.25.00 lakhs is provided for this purpose.

III Chennai Science City

(3) *Development of infrastructure facilities in the new Auditorium constructed in Science City (Outlay Rs.9.35 lakhs)*

The Science City is constructing an office building which includes an auditorium with a seating capacity of 140. The auditorium will be used for organising science related programmes. It is proposed to equip this auditorium with all the latest equipments and also to air-condition the auditorium for which a sum of Rs.9.35 lakhs is included in the annual plan 2004-05 under new scheme.

Annual Plan 2004-05

A total sum of Rs.195.52 lakhs is provided in the budget estimate for 2004-05 for continuing the ongoing schemes and for new schemes under this head. The agency wise outlays proposed are as follows:

(Rs. in lakhs)		
Sl.No.	Schemes	Outlay for 2004-05
1.	Assistance to Tamil Nadu Science & Technology Centre	87.01
2.	Grant to Tamil Nadu State Council for Science and Technology	67.71
3.	Grants to Anna University	0.25
4.	Chennai Science City	40.55
	Total - Scientific Services & Research	195.52