



NATIONAL SCIENCE AND TECHNOLOGY POLICY-2011

**GOVERNMENT OF THE PEOPLE'S REPUBLIC OF BANGLADESH
MINISTRY OF SCIENCE AND TECHNOLOGY**

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1. PREAMBLE

1.1 The rapid developments in science and technology in the last century have radically changed the face of the earth and impacted on transportation and communication, trade and commerce, education and learning, and agriculture and industry, health and medicine, environment and ecosystem etc. In fact, these developments brought in a new world order. Countries, which used these innovations and adapted them to their social conditions, changed their levels from developing countries to developed ones. Many countries in South and South-East Asia emerged as Asian Tigers.

1.2 Science and technology has become not only a way of life, but has now been identified as an instrument of change. However, in order that we use science and technology as a vehicle for development, the government needs to adopt a science and technology policy reflecting the commitments of the politicians and legislators for effective use of science and technology in improving the living conditions of people and their environment. Beside the political commitment, the bureaucrats, administrators, financial managers, scientists, technologists, planners, people involved in the communication media and all concerned sectors of the population including people at the grass-root level have not only to appreciate the role of science and technology, but also to have a clear understanding about effective application and management of science and technology for development.

1.3 It is now generally realized that the inherent strength of a nation lies in the skills of its people which can be acquired and enhanced through the practice of science and technology in every field. The promotion of scientific knowledge and development of technology, through their increasing application, create the necessary conditions for socio-economic development of a country.

1.4 Science and technology, as an instrument of change can play a decisive and pivotal role in achieving the national goals on poverty reduction and ensuring sustainable development through value addition to resources, creation of jobs, reducing environmental pollution, control and mitigation of natural hazards, increasing production and improving life style of people belonging to different strata of the population.

1.5 Human resources, institutions and their physical facilities & infrastructures and finance are important components of S&T management system, but the most important factor is that S&T development issues must be integrated with the overall economic development of the country. Thus, all sectors in which science and technology can play a dominant role for bringing about changes in the light of millennium development goals (MDG) must be identified and integrated under the umbrella of economic development plan of the country. Value-addition to products and processes, which is the ultimate aim of S&T researches, should be a central theme of all production processes.

2. BACKGROUND

2.1 Bangladesh has been struggling to meet the basic needs of its people, viz., food, clothing, shelter, health, education and the like and to substantially raise the living standards throughout the country. In order to achieve these goals and to keep up with the rest of the world, Bangladesh, too, must harness science and technology to reach its national goals. It is only through the use of S & T as effective instruments of change that a happy and prosperous future for the people of Bangladesh can be ensured.

2.2 Scientific research and development is a vast field in which various ministries, government and semi-government agencies, universities and private enterprises participate. Coordination of scientific research in the research institutions and universities and also that between industries and research organizations are extremely important. Owing to a low base and poor infrastructure, we have been able to undertake research work in only a relatively small number of areas. In these areas also, progress of research and development activities has not been very satisfactory so far. The limitation of resources, shortage of skilled manpower in many areas, inadequate research facilities and skill development programmes, lack of coordination among scientific organizations, outmoded science curricula in the educational institutions, dependence on foreign technology, brain drain and emigration of trained manpower and poor social consciousness of the role of science and technology in national development-all of these factors have added up to keep us backward.

2.3 Bangladesh now recognizes that given the limitations of her factor endowments, the mounting problems of providing for the basic needs of the people, ensuring a reasonable standard of living and accelerating the pace of economic development cannot be achieved without the help of science and technology. It is, therefore, essential to provide high national priority to scientific and technological considerations in the overall development strategy of the country.

2.4 To this end, there is a need for a national science and technology policy (NSTP) for integrating all science and technology issues with the objective of enhancing sustainable development. It needs to be stressed that S&T inputs are necessary for enhancing the development activities of all the economic sectors. Important items necessary for the success of S&T based sectoral development are: sectoral & sub-sectoral policies, policy instruments, infrastructures, production facilities, research facilities, S&T manpower and related institutions. It is envisaged that sectoral policies would consider intra-sectoral issues related to integration of S&T issues (infrastructure, production and research facilities) to enhance development of respective sectors. On the other hand, NSTP would address integration of inter-sectoral and cross-sectoral S&T issues necessary for successful application of science, technology and innovation for the overall socio-economic development of the country.

2.5 The NSTP of 1986 enunciated the principles on which growth of science and technology ought to be based. The policy emphasized scientific and technological competence and self reliance and stressed the need for an effective synchronization of the policy with the socio-economic, cultural, educational agricultural and industrial policies of the country. Now we are at the beginning of the second decade of a new century when the advances in science and technology have been

spectacular with new and emerging areas influencing society and economy resulting in significant changes in political equations. This has been more pronounced with the present state of globalization and intellectual property regime. It has thus become imperative for the government to revisit the NSTP adopted earlier and update it in the light of changing global situation and reaffirm its commitment to the growth of science and technology which must act as the instrument of change for accelerating socio-economic development.

2.6 It is imperative that the message of science and technology reaches all cross-sections of people so as to motivate them in its development. The provision of the national ICT policy and the facilities of that particular sector can be profitably and efficiently utilized for this purpose.

2.7 New and emerging science and technology including those related to biotechnology, nano-technology, materials science etc. need to be properly assessed and applied as one of vital enabling instruments for poverty reduction and national development.

2.8 An effective mechanism is required to establish linkage between S&T policy and the national development plan so as to facilitate smooth implementation of the stated policy.

2.9 In the light of the above mentioned background, NST policy 1986 and the draft national science & technology policy, 2006 have been reviewed and the present national science and technology 2011 have been formulated.

3. VISION

To establish science and technology as the main vehicle of socio-economic development through effective and innovative leadership in the development, promotion and application of science and technology and to ensure that traditional as well as modern advances in all branches of science and technology are effectively applied in all sectors of economy including agriculture, industry, environment and services for sustainable national development to build a happy, prosperous S&T led Bangladesh.

4. MISSION

The core theme of the new science & technology policy is to ensure that it becomes an important and integral component of all development plans and activities in the country. To that end the policy will have the following missions:

4.1 To place S&T as the basis for formulation of national development plan for economic and cultural development

4.2. To build a strong foundation for development, promotion and application of S&T for sustainable prosperity

4.3 To develop quality human resources, infrastructures and institutions for science and technology so as to create a strong, creative, innovative and competitive nation in the world wide knowledge-based society

4.4 To promote basic sciences and innovative practices and ensure effective use of science, engineering & technology to fulfil basic needs of its people

4.5 To encourage generation, adaptation, transfer and assimilation of technology appropriate for basic, applied and developmental research

4.6 To ensure the development and use of traditional science & technologies and upgrade indigenous community knowledge to provide quality goods and services to all sectors

4.7 To encourage research on

- Green technology to harness natural resources
- Ecosystem which acts as a carbon sink and a buffer against climate change
- Information and communications technology, biotechnology, nanotechnology etc.
- Basic Sciences

4.8 To create adequate infrastructure of R&D in science & technology areas of national need and encourage private sectors to set up R&D centres for quality products

4.9 To provide adequate training and skill development opportunities and promote scientific literacy to empower and enrich the society

4.10 To strengthen and protect intellectual property rights of various technologies generated in the country

4.11 To provide special technology support and services to export-oriented industries viz. agricultural, agro-industrial, pharmaceutical, medicinal and aromatic plants, jute, leather, textiles, readymade garments, handicrafts etc.

4.12 To develop SME friendly Technology for the sustainable growth of small and medium enterprises.

5. OBJECTIVE AND POLICY ACTIONS

5.1 Objectives

In recognition of the fact that the formulation of a comprehensive and coherent NSTP, designed to contribute to the achievement of the country's development objectives is necessary for the effective application of science and technology for development, the Government of Bangladesh considers it appropriate to formulate a revised national science and technology policy.

The prime objective of the updated NSTP is to ensure application(s) of science, technology and innovation (ST&I) for achieving sustainable economic growth with due attention to employment generation, poverty alleviation, gender equity and environmental sustainability.

NSTP is designed to fulfill the following objectives:

(a) To attain scientific and technological competence and self-reliance in various sectors and sub-sectors of the economy to ensure food, agricultural, nutritional, environmental, water, health and energy security of the people on a sustainable basis

(b) To help increase production and employment in various sectors and sub-sectors of the economy

(c) To provide an effective synergy between science & technology in all their manifestations on the one hand and national development and poverty reduction on the other

(d) To be in consonance with the socio-economic, cultural, educational, agricultural, industrial, environmental and health policies of the nation

(e) To contribute to the global pool of scientific and technological knowledge

(f) To seek out and recognize high talents particularly amongst the younger generation in various areas of science and technology

(g) To promote regional and international science and technology cooperation towards achieving the goals of national development and make it a key element of our international relation

(h) To provide guidelines for institutional arrangements or rearrangements in the R&D structure including capacity building in education and training

(i) To promote the empowerment of women in all science & technology activities and ensure their full and equal participation

(j) 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

(k) To encourage research and applications to forecast, prevent and mitigate natural disasters and hazards like earthquakes and floods, drought, cyclones, erosions, sea level rise etc caused by climate changes.

(l) To encourage research and innovation in areas of relevance for the economy and society, particularly by promoting close and productive interactions between private and public institutions in science & technology and public & private partnership in R & D activities

(m) To establish an intellectual property rights (IPR) regime that maximizes the incentives for the generation and protection of intellectual property by all categories of inventions

(n) To integrate scientific knowledge with insights from other disciplines, and ensure full 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

5.2 Policy Actions

Applications of science, technology and innovation (ST&I) are to be considered for all sectors of economic and social development. The key areas for policy action are stated as follows.

5.2.1 Policy Formulation

- Sectoral and sub-sectoral policies should be formulated to make development process transparent and participatory
- Sectoral and sub-sectoral policies should be aimed at achieving sustainable development to meet both local and global needs
- Importance of technology dynamics (e.g. traditional, conventional, modern and emerging technologies), globalization and environmental factors should be duly considered in sectoral and sub-sectoral policies

5.2.2 Policy Instruments

- Introduction of appropriate legal and policy instruments for the implementation of science, technology and innovation (ST&I).
- Strengthening of intellectual property rights regime (e.g. enactment and enforcement of laws, strengthening of administrative and judiciary institutions) of the country
- Promotion of awareness about the importance of ST&I among politicians, bureaucrats, researchers, managers, administrators, academics, professionals, members of the public and other stake holders
- Mobilization of sufficient research and training funds, venture and investment capitals from government, public, private and external sources for the promotion and application of ST&I

5.2.3 Infrastructure and Production Facilities

- Strengthening and development of infrastructure to support development
- Strengthening and development of production facilities

5.2.4 Research Facilities

- Strengthening and development of research facilities for different development sectors under public and private sector managements
- Promotion and strengthening of research capabilities; which should include policy research, research on acquisition, transfer, adaptation, development, diffusion and management of local and imported technologies and research on applied and basic sciences
- Promotion of co-ordinated (multi-institutional & multi-disciplinary) national research programmes on cross-sectoral issues
- Strengthening and development of research co-ordinating bodies (e.g. research council) for planning, managing and evaluation of research programmes.
- Creation of R&D facilities for physically disadvantaged group

5.2.5 S&T Manpower

- Strengthening and development of capable S&T manpower at different levels-vocational (non-formal and formal), school, pre-university, university, formal post-graduate and non-formal post-graduate (continuing education and training) to meet the needs of research and production systems of different sectors

5.2.6 Institutions

- Promotion of innovative production and marketing systems in public and private sectors involving innovative technologies, products, processes, services and institutions
- Establishment and strengthening of regulatory regimes (e.g. regulatory and enforcement authorities) for effective promotion of ST&I in public and private sectors
- Strengthening and establishment of institutions for standardization of S&T based products and services
- Strengthening and development of S&T capacities and capabilities for effective management of natural disasters (e.g. floods, cyclones, droughts, earthquakes, tsunamis, SLR and landslides)
- Promotion of pro-active collaborative relations among government organizations, public & private production systems, research organizations, universities and professional bodies for effective use of trained manpower, natural and physical resources for sustainable development
- Promotion of international cooperation in S&T education and research in achieving national development objectives

- Formation of technical advisory committees in all relevant ministries (including MOSICT) for dealing with S&T matters with relevant scientists and technologists to assist them
- Dissemination of information on sectoral policies, policy instruments, natural resources, production facilities, research facilities, development of S&T manpower and relevant institutions to all concerned through print and electronic media for undertaking S&T based development programme
- Development of concrete guidelines for proper utilization of the findings- Policy formulae, Strategies, Methods, Committees, Secretariat, Financial rules and regulations, Implementation procedures, Monitoring and Evaluation, Refreshing etc.
- Creation of database of R&D organization and professionals with provisions of regular updating

6. THE NATIONAL COUNCIL ON SCIENCE AND TECHNOLOGY (NCST) AND EXECUTIVE COMMITTEE OF THE NCST (ECNCST)

With a view to ensuring that policy formulation and implementation in science and technology and their cultivation and application in various sectors proceed in a coordinated manner, the Government of Bangladesh constituted on 16 May, 1983, a centrally institutionalized mechanism called the National Committee on Science and Technology which is now called National Council on Science and Technology (NCST) and an Executive Committee of NCST (ECNCST), which would submit recommendations on the points mentioned in Section 5 and also monitor the implementation of the directives and decisions of the NCST.

The NCST will

- (a) Formulate national policies on science and technology for social and environmental development and devise strategy for technological self-reliance
- (b) Consider recommendations of the Executive Committee of the NCST (ECNCST) on priorities to specific research programmes, evaluate the quality and effectiveness of research programmes undertaken by various agencies and assess the extent to which results are put to actual use
- (c) Consider measures suggested by the ECNCST for coordination of scientific research and development activities undertaken by different S&T institutions
- (d) Consider the ECNCST recommendations on goal oriented research plans and programmes
- (e) Ensure suitable environment for scientific and technological work
- (f) Such other matters as may be considered relevant by the government

6.1 The NCST, headed by the Head of the Government of the People's Republic of Bangladesh, with State Minister of MOST as the Vice-Chairmen, concerned ministers, concerned secretaries and prominent scientists/technologists/educationists as its members. The composition of the NCST will be notified by the Government in a gazette.

6.2 The Government can constitute by gazette notification the ECNCST headed by the State Minister for The Science and Technology and sub-committees, technical committees, advisory panels, expert panels and consultants, as required.

7. MAJOR ELEMENTS OF SCIENCE AND TECHNOLOGY POLICY

For successful application of science, technology and innovation in national development as a first step it is necessary to assess science and technology issues of different sectors having sectoral policies. In the subsequent step it may be advisable to develop sectoral policies in development sectors having no approved policy.

Important elements considered in assessing sectoral policies are executing ministry, extension agencies, technology transfer process, regulatory agency, testing standardization and quality control system, research council, research organizations, grassroots level training system, S&T manpower, postgraduate education, training & research, linkages with other policies, consistency with national priorities, methods of measuring the performance of policy implementation.

Solution of the problems of the national economy calls for multidisciplinary application of science and technology. Given the limitation of resources, an integrated approach is essential for evolving a comprehensive and coherent national science and technology policy which will serve, *inter alia*, the following purposes:

7.1 Planning, coordinating and monitoring of all research and development work concerning science and technology in the country:

Bangladesh has considerable numbers of R&D institutions and supporting facilities administered by research councils, development agencies, government departments, non-governmental organizations (NGO's) and educational institutions. Coordination among them is, however, inadequate. Often no specific targets are set, no monitoring and control measures exist and not enough consideration is given to the development of marketable products from these endeavours. The net result is fragmentation of research activity with little returns accruing from the effort.

In view of this, the role of the NCST as the central coordinating agency assumes critical importance. The NCST would advise the government on selected areas of research and development which would help realize the stated objective meant to accelerate economic recovery and then assign these areas of research and development to the specific agencies best equipped to carry them to a successful completion and ensure their high performance. The NCST will also evolve a mechanism for establishing linkages of R&D institutions horizontally amongst themselves and vertically with the private manufacturing/industrial sector, and ministries dealing with S&T activities.

In view of the above mentioned points, it is considered appropriate that the ECNCST should also carry out the following functions:

- (a) Recommend measures for technology assessment, development, adaptation, adoption and diffusion in the country
- (b) Suggest measures to integrate a science and technology plan with the development plans prepared by the Planning Commission
- (c) Introduce effective institutional arrangements in the various organs of the government to help promote and monitor the implementation of the science and technology plan
- (d) Secure funds and allocate them to the various R& D institutions in the light of national development priorities
- (e) Recommend to the government on science and technology related policies in the areas of taxation, import, export and industrialization with intent to create appropriate infrastructure for maximizing technology transfer and economic development
- (f) Suggest measures to strengthen environmental pollution monitoring and control to ensure sustainable development
- (g) Take adequate steps to popularise science and technology among people in general
- (h) Promote regional and international cooperation in science and technology on bilateral and multilateral basis towards achieving the goals of national development and make it a key element of international relations

7.2 Engineering Research Council

An Engineering Research Council maybe created to provide vital link in the commercialization of research results and in acquisition, adoption and adaptation of imported technology. Its prime objectives will be to:

- (a) Identify thrust areas for research in engineering sciences
- (b) Promote in-house research and design capability in both public and private sector industries
- (c) Coordinate and develop research in the existing engineering research organizations
- (d) Provide facilities for inter-agency consultation for adoption, adaptation and assimilation of foreign technology
- (e) Offer other related services to different organizations

7.3 Identification of fields where solutions are likely to have a significant impact on the economic and socio-cultural development of the country:

This will be achieved by formulating science and technology plans commensurate with sectoral priorities arising from national development objectives, establishing targets for each science and technology sector, critically evaluating the resources required and effectively monitoring the performance of each sector. Special emphasis must be given for research and development in the following sectors in view of their overwhelming importance to national development in general, and poverty reduction in particular:

(a) Environmental Science & Technology:

1. Natural hazards particularly floods, cyclones, earthquakes, draughts, tsunamis, sea level rise etc, control/mitigation.
2. Environment
3. Meteorology
4. Space research and remote sensing
5. Earth sciences
6. Marine sciences
7. Waste management

(b) Natural Resources & Energy:

1. Agricultural, land, livestock, poultry, forestry and fisheries
2. Water resources, land reclamation and deltaic studies
3. Energy
4. Electronics
5. Mining

(c) Health & Related Life Sciences & Technology:

1. Health nutrition and family welfare
2. Biotechnology and genetic engineering
3. Pharmaceuticals and Herbal medicine

(d) Information & Communication Technology:

1. ICT
2. Communications
3. Science City

(e) Others:

1. Large scale industries including engineering and metal industries/industrial sciences
2. Small scale and rural industries.
3. Transportation.
4. Housing and public works, etc.
5. Ecotourism and culture activities

The NCST upon recommendation of the ECNCST shall identify priority areas warranting special attention, which will be considered in the context of national development plan .

7.3.1 Strategic planning for individual R&D institution and institutional sustainability:

(a) Each R&D institution should develop a strategic plan, considering its activities/programmes with short, medium and long-term perspectives, goals and objectives.

(b) R&D programmes of the institutions should have a judicious mix of basic and applied research focused on one or more of the national problems.

(c) Each R&D organization should make serious efforts to use R&D results for production purposes or for providing services in order to improve institutional self reliance and sustainability by gradually reducing dependence on public funds.

In view of the resource constraint, each R&D institution should optimize capacity utilization of the existing manpower and facilities. The road map for implementation of the strategic plan should be clearly defined.

7.3.2 Promotion of research and strengthening the competence and capability of research institutions including the universities:

Nurturing of national talent must be ensured by substantial improvement in the facilities of the research institutions including the universities through capacity enhancement and infrastructure building:

7.3.3 Capacity enhancement:

(a) Creation of modern and adequate instrumentation/laboratory facilities in research institutions

(b) In house capacity & capability should be enhanced for repair and maintenance of scientific instruments. Facilities should be made available to those who do not have adequate facility capability, sharing of lab facilities should be encouraged at all levels

(c) Strengthening of science and technology information bases through an integrated information system for all research institutions

(d) ICT, including networking should be an integral part of any R&D institution

7.3.4 Ensure availability of multi-disciplinary manpower for goal-Oriented research:

(a) Sufficient scientific professionals should be made available for goal oriented research programmes. Efforts should be made to develop this skilled manpower base.

(b) Make provision for sufficient number of chemical, mechanical, electrical, water resources and agricultural engineers, for design and engineering services and other facilities for technical feasibility studies, pilot plant extension studies, design development, etc.

(c) Make provision for properly trained economists and market research specialists for each research institution

7.3.5 Review mechanism for accountability in R & D organizations:

In goal-oriented research and development project, individual scientists, groups and teams, operational units and institutes entrusted with the work should be accountable for their total output within a time frame. The accountability factor should be a built-in element in the R & D mechanism. The evaluation process should be done by a team of experts.

7.4 Establishment of new organizations & centres of excellence:

Existing research and educational institutions having proven competence and track record may be turned into centres of excellence in relevant fields through strengthening the respective infrastructure and where needed, new institution may be established for dealing with field of new and emerging science & technologies such as ICT, biotechnology and genetic engineering, materials science, nanotechnology etc. Such centres of excellence will be set up in different parts of the country with due regard to the availability of top quality manpower.

7.5 Science Education

Basic science education is a very important component of human resource development programme of any country. The primary function of the science education system is to supply the society with scientifically literate citizens. An essential prerequisite to a country's technological advancement is the necessity of recognition of a good science education system. In summary it can be said that the basic problems of the developing countries are the weak educational and scientific infrastructures and lack of appreciation of the importance of science as an essential ingredient of economic and social development. Science education policy in Bangladesh should aim:

- (i) To provide good quality science and technology education
- (ii) To generate new technologies
- (iii) To adopt technology developed elsewhere to suit local condition
- (iv) To transfer technology essentially unchanged but relocated
- (v) To devise different appropriate technologies appropriate for the country

7.5.1 Current status of science education at the tertiary level in Bangladesh:

Science education at the tertiary level depends on the input of science students from the primary, secondary & higher secondary levels. Science education at primary and secondary levels is very much outdated. The classroom education system in our primary, secondary and higher secondary schools and colleges lack various appropriate components of science education. The content of

school science curriculum, the characteristics of science programme, the nature of science teaching and assessment practices are not in conformity with the present day need of science teaching. There is no appropriate system for the training, certification, and employment of science teachers. The number of science students has increased about 10 fold over the last four decades (mostly because of the rise in population) in almost all the higher secondary educational institutions but the logistics for science teaching including lab facilities have not increased accordingly. In effect the facilities have decreased in some institutions.

Policies that influence the practice of school science education in Bangladesh are not congruent with the purpose of science teaching. These policies do not contain provisions for supplying the necessary text materials, laboratories with scientific apparatuses, accessories and reagents, Resources are in short supply and decisions about their allocation are difficult to get. As a result of these poor conditions of science education the student, becomes less interested in science and opts for other disciplines, at higher (tertiary) level.

At the tertiary level the status of science education should be more improved, although in most of the departments of the universities, the curriculum for science education is updated every two to three years. The theoretical part of the syllabus is somehow completed during the stipulated period of the session by the teachers. However the students resort to the study of questions on a selective basis which limit their horizon of knowledge. In exams they may score very high marks which may not be a true reflection of their depth of knowledge. Majority of the students aim at passing the examination without comprehending the subject.

7.5.2 Employment opportunities of science graduates:

This is a crucial factor in the development of science education of any country. A science graduate should get a job in a research laboratory or a teaching & research position in a university or college or an R&D job in an appropriate industry. But in most cases the science graduates end up in doing a job (if he gets one at all) which is in no way related to his expertise. Because of this more & more students are avoiding the study of science.

7.5.3 Ph.D. Programme:

The bulk of the scientific developments in the developed countries are provided by the successful Ph.D. programme of their universities/Institute. Regular Ph.D programmes in science are not up to the desire level in different university of Bangladesh due to insufficient facilities & qualified manpower and as such its contribution to the national development is not significant.

7.5.4 Specialization:

Specialized subjects like biotechnology and genetic engineering, nano-technology, energy production & management, IT are being taught in our universities. Infrastructure should be adequately developed to educate manpower in these important areas of knowledge, to get enormous return from these disciplines for the socio-economic development of our country. As

Bangladesh is a littoral country so universities either in the public or private sector offering undergraduate and post-graduate level degree in ocean Sciences require for Bangladesh.

7.6 Improvement of standard of scientific knowledge at all levels from the school to the university:

This effort will comprise the following:

- (a) Adequate emphasis should be given on simple concepts of science and mathematics from the primary stage and the school curriculum should be oriented in such a way that problem solving skills of the pupils are enhanced and the inter-disciplinary character of science is reflected.
- (b) ICT should be included in the curriculum at secondary and higher levels of education and curriculum should be updated on a regular basis.
- (c) Primary resources for education and training, namely, qualified teachers, physical facilities, equipment, books, journals, teaching aids, etc. should be ensured.
- (d) Adequate provision and proper arrangements for higher training and research in the universities should be made.
- (e) Higher education in science and technology should be accessible to all based on merit which will be supported by a liberal- government scholarships schemes.
- (f) Science education will also be imparted through the Bangladesh Open University and other modes of distant education.
- (g) Scientific & technological libraries should be expanded geographically to bring all cross-section of people under their coverage. This may also take the form of IT based virtual library, expansion of scientific documentation centres at different parts of the country.

7.7 Training of personnel and specialized scientific technological staff in the research institutions/laboratories and industrial establishments:

Manpower training is an essential condition for technical progress. Therefore, policies for the enhancement of a scientific and technological manpower capacity shall, *inter alia*, aim at the following:

- (a) Ensure scientific and technological training and higher academic programmes at all levels, on a continuous basis, at home and abroad, as and when required, so that the research capability of the scientists and technologists is continuously developed and harnessed.
- (b) Give incentives to universities, research institutions, and other educational institutions so that they may become more responsive to the problems of society, particularly by integrating them with the production system, economy and the cultural pattern suiting the ethos of the country.

(c) Develop mechanisms and programmes for professional and technical updating so as to train specialized personnel required to cover all the links in the chain that relate research and development to products and marketing.

(d) Facilitate constant training, development and upgrading of labour force, relevant vocational training, and, in particular, adequate training of researchers and technicians employed by production units.

(e) Develop an indigenous managerial and administrative capacity in science and technology.

(f) Make a thorough evaluation of the brain-drain problem including the emigration of skilled manpower with a view to identifying measures for tackling the problem and reversing the exodus of scientific and technological manpower.

(g) Encourage undertaking of Ph.D programme locally on topics having relevance to our national needs and infrastructural capacities and such students and supervisors should be adequately supported financially.

(h) Ensure participation of teachers, scientists and technologists in various seminars, workshops and conferences at national, regional and international levels to enhance their professional skills and competence.

(i) Research institutions should develop their own training institution/capacity in keeping with their R&D and higher academic programmes with short, medium and long term goals.

7.8 Ensure suitable environment for scientific and technological research:

For achieving this objective the following measures are envisaged –

(a) Attractive incentive packages should be offered to talented scientists and technologists. Appropriate measures should be taken to find young talented scientists through talent hunting with state patronization.

(b) Scientists and technologists working in the country will be given the opportunity to reach the highest national grade of pay. They will continue their service in their positions in recognition of outstanding services in research on the basis of a procedure of assessment and evaluation to be evolved. Posts of distinguished scientists/researcher should be created in R&D institutions.

(c) Scientists and technologists should not be promoted on the basis of seniority in service alone but due recognition should be given to meritorious achievements to be evaluated periodically. Emphasis should be given on merit for the promotion along with seniority. Appropriate service rules for various scientific organizations should be framed for this purpose.

(d) In order to encourage scientists and technologists to be more effective in their research and innovation financial incentives must be given to them as research allowance and Ph.D. allowance.

(e) Scope of lateral entry should be provided at all levels for distinguished scientists and technologists from outside on the basis of selection.

(f) Scientists' freedom of thought and communication with the world community of scientists should be given preferential and priority treatment.

(g) A corps of highly skilled technicians should be developed as the first step for setting up of infrastructure for research.

(h) Scientific academies, associations and societies should be given adequate support so as to enable them to play their due role in society more effectively and to popularize science and technology.

(i) Coordination, interchangeability and appropriate linkage between the universities and the research institutions shall be established so that exchange of scientific personnel between universities and R & D organizations can take place smoothly.

(j) Maximum autonomy, through appropriate decentralization of power, should be given to the science organizations to create a sense of freedom and thereby increase efficiency of R&D efforts.

(k) Due incentives in the form of awards and national recognition should be given to scientists and technologists for meritorious achievements.

(l) Retirement age of the scientific professionals linked to R&D programmes should be increased. Though Scientists or Technologists whose inventions or innovations or creative works which have been acknowledged nationally and internationally, the government may offer them the position of 'National Scientist' / Scientist Emeritus / Supernumerary / Honorary scientist for life-time and be given appropriate remuneration and office in scientific establishments.

7.9 Media and Information

A strong information base is a prerequisite for an S&T plan with self-reliance as one of its principal objectives. Creation of scientific awareness among the general masses of people through popularization of science and technology and encouraging innovative activities, especially among the younger generation is a must. This will be achieved through:

(a) Launching of an intensive nationwide programme for the popularization of science and technology through the effective use of mass media like radio, television, newspapers and through scientific societies/associations and science clubs in order to create an environment in which the general masses of people can apply scientific principles to their daily living. It is through popularization of science that the problems of environmental degradation and of disaster management can be communicated to our people in simple parlance.

(b) Strengthening of the National Museum of Science and Technology and launching of mobile museums to display devices derived from various theories of science and models of various

instruments, processes and techniques with a view to increasing public understanding of scientific principles and their practical applications, and with intent to encourage the people's creative abilities and interest.

(c) Arranging lecture tours by scientists/technologists which stimulate interest in science and technology among students and young people and encourage them to apply scientific principles to their daily living and induce them to become scientists and technologists themselves.

(d) Creating awareness among people about the implications of the emerging science and technology options in areas which impinge directly upon their lives, including social and economic benefits / aspects through electronic and printing media. Each R&D organization may establish a Cell / Division to support to disseminate, popularize and promote science & technology.

A closer interaction of those involved in science & technology, social sciences, humanities, and other scholarly pursuits should be facilitated to bring about mutual reinforcement, added value, and impact. ICT facilities should be strengthened and expanded to meet the above mentioned objectives.

8. ESTABLISHMENT OF NATIONAL CAPABILITIES / CAPACITY FOR DEVELOPMENT OF INDIGENOUS TECHNOLOGY AND ACHIEVEMENT OF A NATIONAL CAPACITY/TALENT FOR ADOPTION OF FOREIGN TECHNOLOGY:

The objectives of the development of indigenous technology and efficient assimilation of imported technology are to:

(a) Guide the formulation of a technology plan which is to be integrated with the national plan

(b) Attain national capacity for autonomous decision-making in technological matters through promotion of technological competence and self-reliance

(c) Ensure transfer of research results to the production sectors and their optimal utilization by the national economy

(d) Ensure provision of facilities for transfer and productive utilization of research results through the institutionalization of engineering design, prototype development, pilot plant and eventually commercialization of products in the relevant sector corporations and individual units in both public and private enterprises. Fiscal incentives like, venture capital and tax holiday may be envisaged for this purpose.

(e) Reduce vulnerability, particularly in strategic and critical areas, making optimal blend of 'indigenous and imported technological resources.'

(f) Devise appropriate legal, fiscal and financial modalities for selection, importation, absorption, and adaptation of foreign technology.

- (g) Ensure establishment of institutional facilities for relevant knowledge assimilation and skill development for learning the absorption process for imported technology.
- (h) Generate technologies which are internationally competitive, particularly those with export potential to make the country economically strong. These aspects require technology foresight, which involves not only forecasting and assessment of technologies, but also their social, economic and environmental consequences.
- (i) Ensure development of support facilities like information and documentation services, computer services and soft-ware packages, standardization and quality control.
- (j) Ensure due considerations to matters relating to ecology, environment, energy conservation, employment generation and social justice, etc., while importing a certain technology.
- (k) Ensure conservation of environment particularly water resources both ground and surface water and land resources from pollution. Water harvesting technologies may get priority.
- (l) Provide support to emerging technologies like nanotechnology, biotechnology and genetic engineering, micro-electronics, new and renewable sources of energy, materials, etc.

In order to fulfill the broad aims and objectives of the technology policy outlined above it is envisaged to strengthen and establish relevant institutions and coordinate activities of the different organizations in respect of technology transfer. With this strategy in view the relevant institutions such as the Institute of Appropriate Technology at BUET will be strengthened and given responsibility for policy research on matters related to technology assessment, forecasting, evaluation, etc. Such institutions will act in close cooperation with and, among other things, may receive research assignment from “ National centre for Technology Development and transfer” to be instituted as a ‘think tank’ for the NCST.

The growth rate in productivity of the Bangladesh economy has been below its true potential and the contribution to it of technological factor is inadequate. The current Bangladeshi exports today derive their comparative advantage through labour rather than through the power of technological innovation. The transformation of the new ideas for the commercial success is of vital importance to the nation’s ability to achieve high economic growth and global competitiveness. Accordingly special emphasis will be given not only to R&D, but also to other equally important social, institutional, and market factors needed for adoption, diffusion, and transfer of innovation to the productive sectors.

With further development of a policy regime for technology transfer and institution of appropriate legal, fiscal and financial instruments for imported technology, a national centre for technology development and transfer may be established in due course to serve as a focal point to provide information, training, consultancy and extension services in respect of technology transfer. The proposed National Centre for Technology Development and Transfer may act as an incubation centre for technology development, adaptation, acquisition and transfer which is a dire need of the

SMEs in Bangladesh. The initial efforts in such directions may be made through the formation of an inter-ministerial consultative committee on technology transfer constituted by the NCST.

9. INTELLECTUAL PROPERTY RIGHT (IPR)

Bangladesh is a party to WTO and its provisions are mandatory for Bangladesh and, in particular, intellectual property right is to be implemented in its entirety. So the NSTP attaches vital importance to the need of protecting similar rights and meeting the related obligations. Therefore, it is urged as follows:

(a) The intellectual property right (IPRs) in all its manifestations such as trade related aspects of IPR (TRIPs), patent/copy right, etc. will have to be properly taken into account in pursuing any scientific and technological R&D pursuit and to that end all administrative and technical competence will have to be developed.

(b) Scientists and technologists should be encouraged to develop entrepreneurship and patent their products, processes and important research findings that have commercial potentials.

(c) The government will take appropriate measures to prevent bio-piracy and patent important resources related to national bio-diversity

(d) While encouraging use of traditional knowledge with all its manifestations, adequate legal procedures will be developed to protect IPR`s related to our bio-diversity.

(e) Legal provisions on protection of IPR in case of indigenous resources, traditional community knowledge, products and processes and also those of others should be updated and enforced.

(f) Traditional medicinal plants, herbs, shrubs will have to be protected from bio piracy through proper documentation

(g) IPR should be introduced as a part of the curricula at the university level.

10. CREATION OF CENTRAL FACILITIES FOR COLLECTION AND DISSEMINATION OF SCIENTIFIC INFORMATION AND RESEARCH FINDINGS:

To facilitate rapid documentation and dissemination of indigenously collected information and those obtained from outside sources, a well organized and institutionalized system is required which would conform to the international standards and be available within the resource constraints of the country. In Bangladesh, scientific and technical information are handled at the moment by several organizations which are collating, cataloguing and storing information in different fields.

For effective functioning, a three-tier national system is proposed with the following three levels of operation:

10.1 The Central Documentation Centre:

Bangladesh National Scientific and Technical Documentation Centre (BANSDOC)

As per provision of Bangladesh National Scientific and Technical Documentation Centre (BANSDOC) Act, it will be headed by a Director General. He will be appointed by the Government and his service terms and conditions will be fixed by the Government. It will have the following basic facilities:

- (a) Centralized storage (archiving) and cataloguing
- (b) Central physical facility for data line connections and documentation
- (c) Liaison with various international documentation agencies, and
- (d) Overall administrative control of the national documentation facilities

BANSDOC under the Ministry of Science and Technology will be developed as the central documentation centre and also the national focal point of regional and international scientific and technological information centers.

The National Science Library of BANSDOC will be strengthened.

10.2 Four sub-groups situated in convenient institutions to deal with the following subject areas:

- (a) Physical Sciences- to include documentation facilities for all physical, chemical, mathematical, statistical, and nuclear science subject areas.
 - (b) Agricultural Sciences- Crop, livestock, fisheries and forestry to cover agriculture food & nutrition, rural development and social and economic sciences
 - (c) Medical and biological sciences- to include medical, health, nutrition, biological and public health areas
 - (d) Engineering and technology- to include all engineering subjects, architecture, urban planning, naval architecture & marine engineering, industrial engineering, energy, technology, environment, housing, communication, transportation, water resources, etc.
- These four sub-groups would have independent facilities for storage, documentation, copying, microfilm/microfiche, etc. in their respective areas. The four agencies would be linked together directly and through the centralized one tier administrative and functional mechanism

10.3 Institutional Facilities:

All the scientific institutes (research and educational) would continue to have their library facilities and subject-matter specialization. These libraries will perform the function of collecting and documenting basic local information in their respective areas and feed the same to the respective sub-groups and ultimately to the central storage for permanent documentation and international exchange.

This three-tier scheme would operate under the general supervision of the NCST.

11. FUNDING FOR THE STR SECTOR FOR DEVELOPMENT OF INFRASTRUCTURE FOR R&D ACTIVITIES:

In recognition of the fact that science and technology are essential tools for the socio-economic uplift of a nation, the industrially advanced countries spend large resources on scientific and technological activity. Typically, they spend between 2 and 3 percent of the total value of their goods and services *i.e.* their gross national product (GNP) on research and development (R&D). Several times this amount is additionally spent in converting the results of the R&D into socially valued arte facts which are then made readily available to the potential buyers and users.

Efforts should, be made to ensure adequate resources for the effective implementation of science and technology policies. Apportionment of at least 2% of GNP will be targeted for R&D and the target will be reached as soon as possible by phase-wise increases in the allocation in this sector. For this, appropriate financial mechanism will be established and the functions of which would include:

- (a) Linkages of the users of science and technology through their participation in the formulation and execution of projects concerned.
- (b) Special arrangements to ensure continuous financing for science and technology.
- (c) The procurement and utilization of funds from national sources, both public and private, international agencies/organizations and the UN system, which, however, should conform to the overall national development objectives.

In addition, “Science and Technology Development Trust” will be created for spreading knowledge and awareness related with science among the students and the other section of people through informal science education, regular arrangement of science fair from national to institutional level, providing financial assistance to the science club/organization in arranging science fair, workshop and other functions, providing financial assistance for the development of science education in secondary and higher secondary level, inspiring activities for the science students, science related development works of the students and for participation in the national and international workshop, congress etc. A “Board of Trustees” will be constituted to run the activities of the trust and financial assistance has to be provided for the above mentioned activities form the trust fund.

12. BILATERAL, SUB-REGIONAL, REGIONAL AND INTERNATIONAL SCIENTIFIC AND TECHNICAL COOPERATION:

Bangladesh is totally committed to acquiring scientific and technological capability to be able to reach her socio-economic goals as soon as possible. Concerted efforts will be made to foster scientific and technical co-operation with developed and developing countries to build up a sound science and technology base in the country. In this respect sub-regional, regional and international collaborative arrangements with agencies like South Asian Association for Regional Co-operation (SAARC), IAEA Regional Cooperation Agreement (RCA) for Asia and Pacific countries, Forum for Nuclear Cooperation in Asia (FNCA), Commonwealth Science Council (CSC), Economic and Social Commission for Asia and the Pacific (ESCAP), Asian and Pacific Centre for Transfer of Technology (APCTT) United Nations Educational, Scientific and Cultural Organization (UNESCO), Islamic Foundation for Science, Technology and Development (IFSTAD), COMSTECH, COMSATS, UN Centre for Science and Technology for Development (UNCSTD), and international organization like IAEA, FAO, UNICEF, WHO, etc. and also other bilateral and regional arrangements will be given due importance.

Common goals can be effectively addressed by pooling both material and intellectual resources particularly with countries that share mainly common problems. International collaboration (bilateral agreements and MOUs) in science & technology should be fully used for furthering national interest as an important component of foreign policy initiatives.

13. SCIENCE AND TECHNOLOGY ACTION PLAN

The priorities for the scientific and technological development in the country will be identified on the basis of the above-mentioned considerations by the NCST for the formulation of appropriate science and technology action plan (STAP). In drawing up the S & T plan, the NCST will endeavour to combine sectoral approaches keeping in view the totality of the nation's scientific and technological needs for relatively short, medium, and long term goals. In the short and medium term Science and Technology Action Plan, the R&D projects are to be derived from the committed development programmes on priority basis. The long-term Science and Technology Perspective Plan is to be formulated for technology based development planning which may identify country's priorities with respect to production of goods and provision of services for the next 20-25 years considering the indigenous or local resources, possible imported resources, and human resources of the country.

The actual planning and programming should be undertaken by panels of scientists and technologists belonging not only to the research laboratories and universities alone but also from design, engineering and manufacturing units, natural resources survey agencies and extension organizations. This will be done in collaboration with economists, administrators, planners and other professional groups.

It should be ensured that the scientific and technological projects are derived from committed development programmes. In short, the S & T plan will be an interactive and collaborative process.

13.1 NCST monitoring cell:

A monitoring cell should be formed in the concerned ministry to coordinate, monitor and proper documentation of the activities of the NCST. The success of the science and technology policy and the speed with which the various facets of the policy are implemented depend on an efficient monitoring, review and guidance by the NCST. For the implementation of the policy the NCST will spell out guidelines in detail for ministries and agencies of the government as well as for industries and entrepreneurs dealing with science and technology.

14. WAY FORWARD

The formulation of the science and technology policy, the preparation of an S & T Plan, the provision of adequate financial resources and the effective implementation of the plan can secure the necessary conditions for proper use of science and technology geared to fulfill national goals. Implementation of the policies will require a commitment on the part of the government to undertake the much needed organizational and managerial reforms not only in agencies and institutions which generate science and technology but also in all public and private enterprises which use science and technology. In fact, the effectiveness of the science and technology policy would depend upon the strength of the linkage between the political and scientific/technological systems. Above all, the entire population must be imbued with self-confidence and pride in the national capability. Science and technology must be duly harnessed to unleash the creative potential of the people for transforming Bangladesh into a prosperous nation.

GLOSSARY :

BANSDOC	:	Bangladesh National Scientific and Technical Documentation Centre
BUET	:	Bangladesh University of Engineering and Technology
CCS&T	:	Cabinet Committee on Science and Technology
CU	:	Chittagong University
DU	:	Dhaka University
ECNCST	:	Executive Council of National Committee on Science and Technology
ICT	:	Information & Communication Technology
IPR	:	Intellectual Property Rights
JU	:	Jahangirnagar University
MOICT	:	Ministry of Information & Communication Technology
MOST	:	Ministry of Science and Technology
NCST	:	National Council on Science and Technology
NSTP	:	National Science and Technology Policy
NSTF	:	National Science and Technology Foundation
R&D	:	Research and Development
RU	:	Rajshahi University
S&T	:	Science and Technology
SAARC	:	South Asian Association for Regional Co-operation
STAP	:	Science and Technology Action Plan
ST&I	:	Science, Technology and Innovation
STR	:	Science and Technology Research
SUST	:	ShahJalal University of Science and Technology