THE DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA

NATIONAL SCIENCE AND TECHNOLOGY POLICY

NATIONAL SCIENCE AND TECHNOLOGY COMMISSION

MINISTRY OF SCIENCE AND TECHNOLOGY

2008

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Document Map

The National Science and Technology Policy document presents the VISION of the Policy and is compiled in two sections;

Section A: Executive Summary
Section B: National Science and Technology Policy

Section A gives the background to this document in the Preamble. This is followed by an outline of the policy development process, the intended implementation approach, and a summary of the policy objectives and strategies.

Section B elaborates the National Science and Technology Policy. The policy includes 10 objectives and for each policy objective a brief rationale and related strategies are presented. This is followed by the identified challenges for each strategy and the initiatives to overcome the challenges.

The document also includes two annexes. Annex 1 lists some proposed agencies/ organizations responsible for the implementation of the different policy strategies/ initiatives, Annex 2 lists the scientists, technologists and other stakeholders who contributed to the development of this policy.

List of Abbreviations

AEA	Atomic Energy Authority
BICOST	Biennial Conference on Science and Technology
CARP	Council for Agricultural Research Policy
CEA	Central Environment Authority
CHPB	Centre for Housing Planning and Building
CRI	Coconut Research Institute
CRP	Collaborative Research Programme
DMS	Dept. of Management Services
DWLC	Dept. of Wildlife Conservation
GDP	Gross Domestic Product
GERD	Gross Domestic Expenditure on Research and Development
GIS	Geological Information System
HR	Human Resources
ICT	Information and Communication Technology
ICTA	Information and Communication Technology Agency
ICTAD	Institute for Construction Training and Development
IDB	Industrial Development Board
IP	Intellectual Property
IPHT	Institute of Post Harvest Technology
IPR	Intellectual Property Rights
ITI	Industrial Technology Institute
IUCN	International Union for Conservation of Nature
MOST	Ministry of Science and Technology
MoU	Memorandum of Understanding
MRI	Medical Research Institute
NASTEC	National Science and Technology Commission
NBRO	National Building Research Organization
NERD Centre	National Engineering Research and Development Centre
NGO	Non-government Organization
NIE	National Institute of Education
NIPO	National Intellectual Property Office
NRC	National Research Council
NSC	National Science Council
NSF	National Science Foundation
OTEC	Ocean Thermal Energy Conversion
PGRC	Plant Genetic Resources Centre
QA	Quality Assurance
QMS	Quality Management Services
RRI	Rubber Research Institute
SLAAS	Sri Lanka Association for the Advancement of Science
SLAB	Sri Lanka Accreditation Board for Conformity Assessment
SLSI	Sri Lanka Standards Institution
SME	Small and Medium Enterprises
TRI	Tea Research Institute
UGC	University Grants Commission

Contents

Vision

"A Prosperous Nation of

Scientifically Literate

and

Innovative People,

with

a Strong and Stable Economy,

based on

Highly Developed

Scientific and Technological Capabilities."

Section A

Executive Summary

Preamble, Policy Development, Policy Implementation, Policy Objectives and Strategies

I) Preamble

Scientific and technological innovations enable the country to improve competitiveness and productivity giving the means to achieve a higher standard of living and a better quality of life. They offer solutions to many of the important global and national issues, providing the knowledge and the means to generate economic activity, to improve health and living standards, to alleviate poverty, to enhance public safety and security, to preserve the quality of the environment, and manage the natural resources. In the increasingly competitive global economy, Science and Technology clearly is an important strategic driver to achieve balanced national development. It is therefore imperative that a strong commitment is made to harness the potential of Science and Technology as a key driver in raising the national capacity to acquire and utilize knowledge, to foster innovations and simultaneously ensure economic development and human welfare.

The need for a comprehensive, officially accepted, and consistently implemented national policy on Science and Technology has been felt for a long time, and its absence has contributed to Sri Lanka's economy lagging behind those of many neighbouring countries in South and Southeast Asia.

Sri Lanka has many advantages, including a literate population and a relatively high per capita income, and also scores reasonably well in such statistics as the number of scientists and technologists per million of population. However, Sri Lanka's gross domestic expenditure on Research and Development (GERD), a key indicator, historically around 0.15-0.2% of GDP, is low by international standards, and has not facilitated the desired growth in Science and Technology capability. Inadequate resources and facilities, cumbersome procedures, a lack of focus and direction, and the fact that many of the best scientists from Sri Lanka have sought employment elsewhere, has retarded the achievement of a critical mass of high quality scientists and technologists. Growth in Science and Technology has been slow, with many indicators remaining largely static over the past decade or more.

The history of Science and Technology development in Sri Lanka has been a long one. The early impetus came from the lobbying efforts of the Ceylon Association for the Advancement of Science (now the Sri Lanka Association for the Advancement of Science) through the fifties and sixties. This resulted, over time, in Science and Technology being assigned to a Ministry. In 1994 greater weightage was given to the subject with the establishment of a separate Ministry for Science and Technology.

The National Science Council (NSC) initiated work on a National Science and Technology Policy, resulting in the first policy statement in 1978. In 1991, a Presidential Task Force on Science and Technology Development drafted an expanded Science and Technology Policy. The 1994 Science and Technology Development Act resulted in a new body, the National Science and Technology Commission (NASTEC) being established in 1998 with policy advisory functions vested in it.

NASTEC has continued the work to develop a complete and comprehensive National Science and Technology Policy. The present document is a distillation of the foregoing draft policy documents and of the new thinking that has occurred in response to the rapid advances and changes in global Science and Technology, as well as the social, political and economical developments in Sri Lanka.

In the context of this policy, 'Science' refers to all the sciences, natural and social, both pure and applied, including engineering, medicine, agriculture and related areas. The term 'Scientists' should likewise be understood to include the natural and social scientists, as well as engineers and all other qualified professionals in the sciences.

To raise Sri Lanka to developed status this Science and Technology Policy along with others must be integrated with other inputs such as infrastructure (transport, telecommunications, power, etc.), a fair and efficient legal system, including law enforcement, and above all peace and security. National development can only truly be achieved in an atmosphere in which individuals have faith in the system and feel comfortable investing in productive enterprises.

II) Policy Development

In developing this policy NASTEC has gone through an extensive consultation process. The draft prepared based on the previous documents and the new thinking was made available to the public and the Senior Scientists Forum of NASTEC for comments. The document incorporating these comments was then discussed by five expert committees of eminent scientists and other stakeholders. The version with their input formed the basic document discussed and critically reviewed at the Fifth Sri Lanka Conference on Science and Technology (BICOST), in June 2008 with the participation of over 150 scientists as well as other stakeholders over a three-day period. An extensive process of revision has been carried out thereafter to incorporate the BICOST recommendations. This process is illustrated in Annex 1.

This National Science and Technology Policy deals with issues on two major aspects; development of Science and Technology in the country, and the application of Science and Technology for national development. The aspect of development of Science and Technology focuses on the elements of science technology and innovation culture, capabilities in Science and Technology, and priorities for research. The aspect of application of Science and Technology focuses on technology transfer, sustainable use of natural resources, Science and Technology based indigenous knowledge, Science and Technology for human security. This policy also addresses certain common elements such as quality and performance, innovations and intellectual property rights, as well as ethics in Science and Technology.

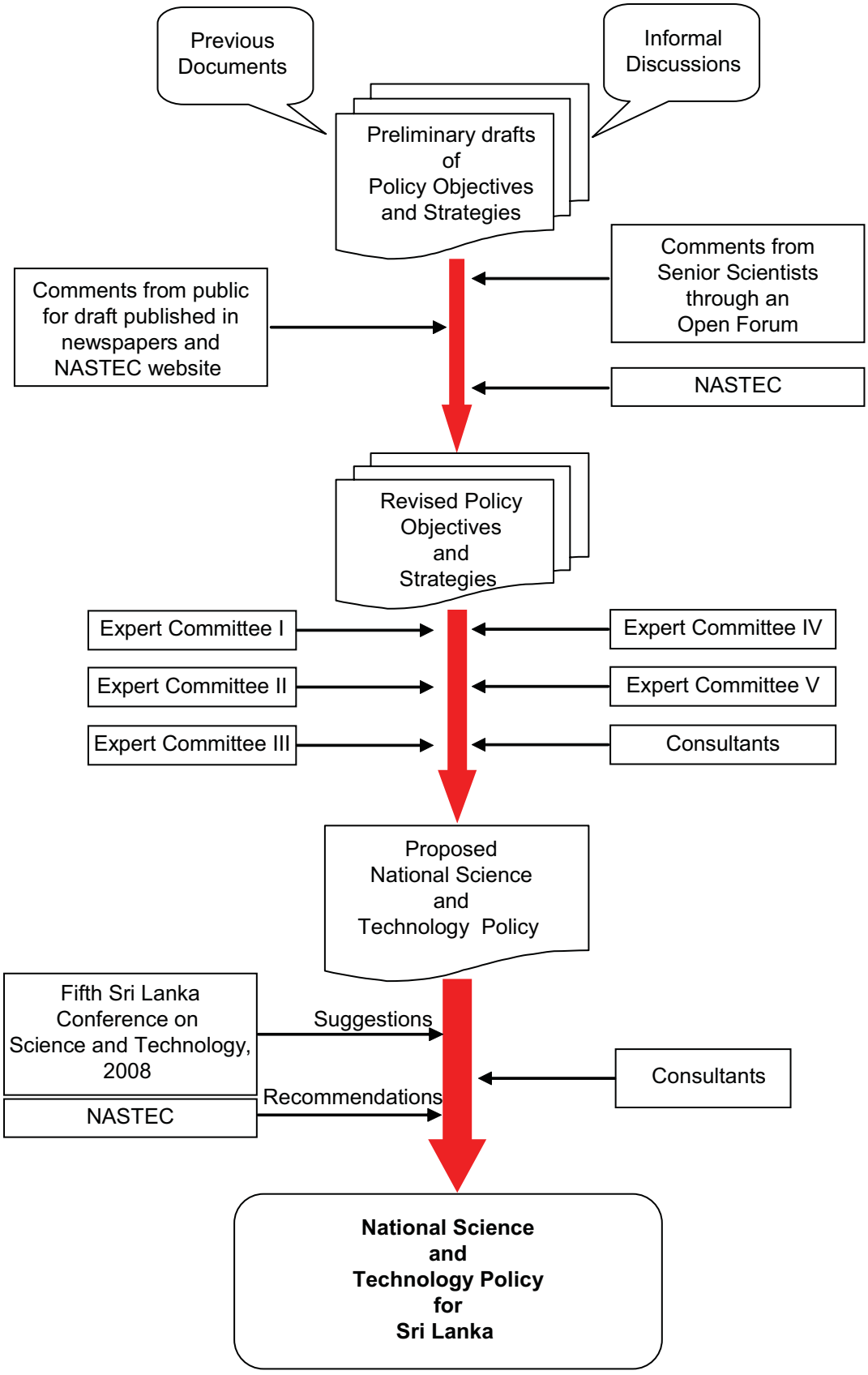
The objectives and strategies embedded in this National Science and Technology Policy will form the basis for the attainment of a scientifically and technologically advanced society and for a holistic approach to strengthen and develop Science and Technology in the country. These policy objectives constitute an overarching statement that provides a framework for more specific policies and implementation plans to be drawn up by relevant institutions. They have been designed keeping in mind the social and material well being of the people of the country, protection of the environment, and the need for sustainable growth and development, as well as national security and other considerations. It is envisaged that this National Science and Technology Policy, will provide a consistent, long-term framework for growth and development of Science and Technology in the country, contributing significantly to the achievement of the status of a developed nation in the foreseeable future.

III) Policy Implementation

It is envisaged that this policy will form the basis of other detailed policies in specific areas in Science and Technology, which will become incorporated into the strategic plans of the related institutions. Some proposed agencies/organizations responsible for implementation of the strategies/initiatives are given in Annex 1.

As the implementation will be under the purview of a range of Science and Technology institutions in the country reporting to various line ministries, the policy recommends the establishment of an inter-ministerial committee chaired by the Head of State with the Minister of Science and Technology as the Vice Chairman. The Ministry of Science and Technology will function as the executive arm of this committee. This will ensure the successful coordination and implementation of strategies and the achievement of policy objectives. Further, this will also give due importance to Science and Technology and significantly help in establishing the required Science and Technology culture in the country.

Policy Development Process



IV) Policy Objectives and Strategies

1 Science, Technology and Innovation Culture

Policy Objective: **Foster a science, technology and innovation culture that effectively reaches all citizens of the country**

Strategies

a) Provide equal and adequate opportunities for all to acquire a basic science education

b) Encourage among students an inquiring mind and the application of scientific methodologies for efficiency and productivity in every day life

c) Promote an appreciation of Science and Technology among the public, leading to a culture of innovation and entrepreneurship, as an essential aspect of a progressive society

2 Capability in Science and Technology for National Development

Policy Objective: **Enhance Science and Technology capability for national development, make use of Science and Technology expertise in the national planning process, and strengthen governance and policy implementation mechanisms**

Strategies

a) Progressively increase the investment for Science and Technology up to 1.5 % of GDP by the year 2016, with the public sector contribution being at least 1%

b) Develop and strengthen the existing Science and Technology institutions and universities to generate quality research and train scientists

c) Improve the autonomy and flexibility of Science and Technology institutions

d) Promote strong linkages with global Science and Technology initiatives and with international centres of excellence in collaborative Research and Development and technology development

e) Include scientists and technologists in the formulation of national development policies and plans, review strategies, legislation, and in decision-making and implementation, at the national and provincial levels, properly utilizing relevant scientific data

f) Establish an Inter-Ministerial Committee with the Head of State as the Chairman and the Minister of Science and Technology as Vice Chairman to direct, coordinate and monitor the implementation of Science and Technology Policy. The Ministry of Science and Technology shall be the executive arm of the committee

3 Human Resource Base

Policy Objective: **Build up, and progressively expand and improve the resource base of scientists and technologists necessary to respond to the developmental needs of the country**

Strategies

a) Increase the number of researchers to reach the world average and develop a critical mass of scientists and technologists trained, particularly in advanced technologies, to effectively support the socio-economic needs of the country

b) Increase the number of engineering graduates and attract engineers to Research and Development while ensuring opportunities for their advanced training with international collaboration, and support from the public and private sectors

c) Provide opportunities for scientists and technologists to acquire advanced knowledge in research and international practices in Science and Technology

d) Establish a National Research Cadre of high caliber scientists and technologists including Sri Lankan expatriate scientists, based on international criteria, ensuring suitable incentives to enable cutting-edge research

e) Improve the remuneration systems, recognition and incentive schemes, and the working conditions of scientists and technologists in Science and Technology institutions

f) Ensure opportunities for all segments of the population for vocational and tertiary education in Science and Technology irrespective of gender, language, economic status or similar considerations and attract them to the Science and Technology field for their full and equal participation

4 Research and Development

Policy Objective: **Promote basic, applied and developmental research, particularly in areas of national importance and priority**

Strategies

a) Give priority to Research and Development in water, food, energy and environment and in the fields of nanotechnology and biotechnology, as well as information and communication technology, electronics, advanced materials and mechatronics

b) Establish world class research centres to carry out cutting edge research in areas important for national development

c) Improve facilities including state of the art ICT, for access to current scientific literature for all researchers and for effective networking

d) Encourage collaborative research partnerships between Science and Technology institutions and industries

e) Ensure that safe and ethical practices are observed in all Research and Development activities

f) Establish a national research system under the Ministry of Science and Technology to coordinate, monitor and evaluate state funded Research and Development activities to ensure that they achieve the desired socio-economic benefits

5 Technology Transfer

Policy Objective: **Develop, or acquire and adapt, scientific knowledge and technologies for transfer to achieve progressive modernization of all sectors and to enhance the country's competitiveness in the world economy**

Strategies

a) Facilitate scaling-up of research based innovative processes and technologies to pilot and commercial scales

b) Encourage industries and Research and Development institutions to give greater emphasis to high-tech innovations, technology transfer and commercialization

c) Develop appropriate technologies suitable for transferring to small and medium enterprises, particularly in rural areas, through collaboration among Research and Development institutions, the SME sector and other stakeholders using mechanisms such as Vidatha Resource Centres

d) Encourage international collaboration in Research and Development activities and joint ventures, for cost effective and rapid transfer of modern technologies, while ensuring adequate controls through well developed agreements for shared benefits

e) Facilitate entrepreneurship and foresight activities among scientists, technologists, researchers and inventors

6 Natural Resources and the Environment

Policy Objective: **Ensure sustainable use of natural resources for development while protecting the environment**

Strategies

a) Promote research related to conservation and sustainable use of biodiversity, and mineral, marine and other natural resources

b) Strengthen the scientific capability for effective implementation of laws and regulations to protect natural resources and the environment

c) Promote cleaner production technologies

7 Indigenous Knowledge

Policy Objective: **Document, research into the scientific basis of, and promote indigenous knowledge based technologies**

Strategies

a) Retrieve, collate and document available indigenous knowledge and practices

b) Research into the scientific basis of the available indigenous knowledge and technologies

c) Ensure further development of traditional technologies to promote their application for demand driven value addition while ensuring Intellectual Property Rights

8 Innovations and Intellectual Property Rights

Policy Objective: **Develop a culture of innovation and Intellectual Property and ensure the protection of Intellectual Property Rights (IPR)**

Strategies

a) Inculcate IP awareness among scientists, technologists, science and technology teachers and students and develop an IP culture in Research and Development institutions, universities, technical colleges and similar institutions

b) Develop institutional policies and guidelines regarding innovations and IPR

c) Establish mechanisms to facilitate scientists, technologists and inventors to patent their innovations

d) Establish suitable mechanisms to effectively exploit innovations

9 Quality and Performance of Science and Technology Institutions

Policy Objective: **Ensure quality standards of Science and Technology Institutions, products and services to achieve national and international recognition**

Strategies

a) Ensure the effectiveness of activities of the Science and Technology institutions to maintain quality standards of institutional products and services by establishing, implementing and maintaining internationally recognized quality management systems with periodical national and international review

b) Promote Science and Technology institutions to achieve certification of management systems and laboratory accreditation status wherever applicable as per internationally recognized standards

c) Ensure the effectiveness of certification and accreditation bodies and processes

10 Science and Technology, and Human Security

Policy Objective: **Promote the application of Science and Technology for human welfare, disaster management, adaptation to climate change, law enforcement and defence, to ensure human and national security**

Strategies

a) Use Science and Technology inputs to ensure security in water, food, shelter, energy, health and wellbeing

b) Promote research on causal factors and effects of natural and man-made hazards to support mitigation and management of disasters

c) Develop research programmes to address mitigation, vulnerability and adaptation aspects in respect of climate change effects

d) Ensure security from crime through the application of Science and Technology methodologies

e) Ensure national defence capability through research and the application of modern Science and Technology interventions

Section B

National Science and Technology Policy

Objectives, Strategies, Challenges and Initiatives

1 Science, Technology and Innovation Culture

Policy Objective: **Foster a science, technology and innovation culture that effectively reaches all citizens of the country**

Sri Lanka has a high literacy rate. However, the absence of a broad based scientific literacy with an integrated approach to Science, Technology and the Arts, has restrained the growth of an innovation culture in Sri Lanka.

Over the past few years, reforms in education have led to the redesigning of methods of Science and Technology teaching to inculcate and understanding of both the conceptual and philosophical basis of scientific principles, promoting an understanding of value systems and critical inquiry. However, the undesirable examination orientation of the system continues to remain a major hurdle in achieving the desired goals, and the emergence of a broadened attitude and outlook among students has not been realized.

It is expected that the planned further reforms, with a competency based student centered and activity oriented approach to learning and teaching, will yield the desired results.

It is generally recognized that excellence in academic performance alone does not imply excellence in innovation capability. The character of innovation can be an inherent quality of a person, but it could also be a feature that has been imbibed from a culture of science, technology and innovation. In this context it has been observed that those with a sound hands-on practical technical education can often turn out to be good innovators. Hence technical education as well as vocational training if provided in the appropriate context could serve as the breeding grounds for an innovation culture.

Strategy 1-a

Provide equal and adequate opportunities for all to acquire a basic science education

Challenges

- Creating an interest and appreciation for science among students
- Overcoming the inequality and inadequacy in human and other resources for science education in the school system
- Need for additional supporting activities to facilitate creativeness and innovativeness of students

Initiatives

i. Ensuring that all secondary schools, particularly the rural ones, have trained teachers and facilities for science teaching

ii. Popularizing science education among students through targeted activities by Science and Technology institutions and professional associations

iii. Collaborating with relevant educational authorities in curriculum development, teacher training and supporting activities

iv. Strengthening and networking relevant state and other organizations that have the capacity to contribute to improve scientific literacy

Strategy 1-b

Encourage among students an inquiring mind and the application of scientific methodologies for efficiency and productivity in every day life

Challenges

- The process of independent, logical and lateral thinking and curiosity orientation needs to be cultivated particularly in the younger generation
- The memory-based exam-orientation has hindered questioning minds and independent thinking

Initiatives

i. Supporting the development and planning of real-time, interactive, problem-oriented and student-centered guided projects and activities in the school curriculum

ii. Encouraging field and laboratory exercises as an essential component of science teaching to develop aptitudes of students

iii. Supporting the introduction of a system of testing the students' skills and conceptual understanding of the underlying scientific principles in practical applications

Strategy 1-c

Promote an appreciation of Science and Technology among the public, leading to a culture of innovation and entrepreneurship, as an essential aspect of a progressive society

Challenges

- A conceptual understanding of scientific principles behind technological applications is a prerequisite to promoting innovations and entrepreneurship
- An innovation culture takes root in a society that has a pervasive awareness of the practical applications of Science and Technology in everyday life
- Necessity to improve the appreciation of Science and Technology and their practical application in every day life among the public

Initiatives

i. Strengthening vocational and technical education/training, to provide conceptual understanding of scientific principles behind technological applications

ii. Establishing science centers and science exploratoria with interactive facilities to expose the students/ public to the concepts of Science and Technology in practical applications and innovations

iii. Strengthening organizations that can assist in widening the Science and Technology knowledge base of the general public, particularly the entrepreneurial community

iv. Encouraging the mass media to actively disseminate scientific knowledge among the general public

2 Capability in Science and Technology for National Development

Policy Objective: **Enhance Science and Technology capability for national development, make use of Science and Technology expertise in the national planning process, and strengthen governance and policy implementation mechanisms**

In a rapidly changing globalised environment and relatively easy knowledge exchange, it appears possible that the country can depend to a large extent on global Science and Technology advances. However, issues of cost and relevance of Science and Technology developments prevent the acquisition of Science and Technology capability as the country needs it. There are specific areas of importance and of special country relevance where it is important to develop its own indigenous capability to meet national priorities. The development of these capabilities within the country becomes even more important for times of crisis and other difficult situations.

The country also needs to be the custodian of its own knowledge base to be strong partners in the global knowledge exchange scenarios for the benefit of all.

It is therefore necessary to develop a high level of Science and Technology capability (personnel, knowledge and infrastructure) to be clearly not-dependent in identified critical areas of national importance, maximizing our indigenous capabilities and ability to assimilate and adapt imported technology. It is necessary to be mindful that this is a dynamic state and must evolve continually in line with global changes.

The primary means of Science and Technology capability enhancement is through Research and Development. The present level of investment for Research and Development in Science and Technology is grossly inadequate and is one of the lowest in the region. A significant increase in investment in Science and Technology among other things is necessary for the country to achieve the desired development.

Enhanced scientific and technological capability and the integration of scientific and technological considerations into national development planning are also essential and can best be achieved by scientists and technologists working alongside planners and policy makers. Current systems need to be improved to achieve this.

There is also a multitude of organizations in different development sectors engaged in implementing Science and Technology related development plans and activities. To derive maximum benefits from these national efforts coordination and integration of the directions of these organizations is essential. This coordination effort must be directed by a body at the highest level possible for it to be effective.

Strategy 2-a

Progressively increase the investment for Science and Technology up to 1.5% GDP by the year 2016, with public sector contribution being at least 1%

Challenges

- Successive Governments have not considered investment in Science and Technology as a priority. The investment for Research and Development remained around 0.15% of GDP for the past several years (one of the lowest in the Asian region) with a decreasing trend. This figure for developed countries is around 2.3% and around 1% for developing countries. It is necessary to increase the investment significantly
- Effectively communicating the contribution of Science and Technology to the economy to policy makers/industry/community and that expenditure for Research and Development is an investment for development
- Figures for private sector investments in Research and Development are not readily available, but are estimated to be as low as 1.5% of the country's Research and Development budget. A significant increase is essential

Initiatives

i. Carrying out an Impact Evaluation Study on Research and Development outputs in relation to past investment, either institution wise or sector wise relating such outputs to specific national initiatives as far as possible. Methodology needs to be developed to evaluate or estimate these figures at regular intervals

ii. Developing and establishing improved, innovative communication routes/methodologies between the Science and Technology community and all stakeholders, in particular with policy makers/politicians, to convince the need for increased adequate investment in Research and Development

iii. Establishing where applicable Research and Development funds to supplement state sector investment with contributions from local industries and importers of manufactured goods in order to encourage industry sponsored local Research and Development

iv. Providing adequate incentives and a stable government policy scenario which is transparent and consistent to encourage private sector to invest in development oriented research

v. Progressively increasing the state sector investment in Science and Technology up to 1% of the GDP by the year 2016

vi. Facilitate increasing the non-state sector investment in Research and Development to at least 0.5% of the GDP by the year 2016

Strategy 2-b

Develop and strengthen the existing Science and Technology institutions and universities to generate quality research and train scientists

Challenges

- Research and Development institutions need to better plan and focus research activities within exiting constraints of finances, infrastructure and human resources and yet ensure clear deliverables
- The current institutional management systems tend to induce good scientists to deviate to management/administration positions for better remuneration, benefits and recognition. Alternative comparable career paths in Research and Development must be established
- Inadequacy of funds for maintenance and development of Science and Technology capability of institutions
- Inadequate focused initiatives by individual institutions to generate donor funds from local and foreign sources

Initiatives

i. Orienting the senior management of Science and Technology institutions to progressive management techniques particularly in research management through training programmes, seminars etc

ii. Establishing state of the art HR systems including career progression pathways, effective performance evaluation and related remuneration systems, and mechanisms to attract and retain mid-level research leaders

iii. Upgrading the Science and Technology institutions with necessary infrastructure facilities and equipment to carry out quality research and orienting them more towards achieving practical end results with commercial value, recognizing that fundamental and relevant basic research has to be carried out by specific institutions

iv. Establishing a peer-review system for periodical evaluation of academic and Research and Development institutions and developing key performance indices using criteria such as publications, innovations, patents, commercialized technology transfers etc., striking an acceptable balance between different criteria for different institutions

v. Considering the peer-review findings as an aspect for state grant support to Research and Development institutions

vi. Training and encouraging research staff to actively seek research funding through well prepared proposals

Strategy 2-c

Improve the autonomy and flexibility of Science and Technology institutions

Challenges

- Reduced autonomy and flexibility of Science and Technology institutions negatively impact the efficiency and productivity of institutions
- The higher level management staff of Science and Technology institutions needs to be trained and strengthened to take decisions and to be responsible for quality outputs and be accountable
- With increased autonomy, focused control is necessary to ensure adherence to the institutional management systems such as human resource and quality assurance systems

Initiatives

i. Delegating administrative and financial autonomy to Science and Technology institutions within limits of clearly defined spheres and levels where the responsibility and accountability can be ensured by the Governing Boards of such institutions, and amending relevant Acts and Ordinances where necessary

ii. Giving adequate authority for Science and Technology institutions for recruiting scientific staff in line with approved corporate plans and cadre so that the necessary critical mass can be systematically developed and sustained

iii. Developing specific fund raising strategies and capabilities within individual institutions with focused and trained personnel

Strategy 2-d

Promote strong linkages with global Science and Technology initiatives and with international centres of excellence in collaborative Research and Development and technology development

Challenges

- Opportunities for linkages with regional countries/institutions are not fully explored by scientists and managers
- Paucity of international science conferences held in the country
- Under utilization of bilateral Science and Technology Cooperation agreements

Initiatives

i. Establishing and strengthening international Science and Technology cooperation agreements with relevant governments international organizations, universities and industries with improved implementation

ii. Facilitating international and regional conferences and undertaking focal point work for international/regional programmes

iii. Disseminating information on opportunities for international collaboration, global initiatives and progress of Science and Technology in a timely manner

iv. Attracting international organizations to establish research laboratories in Sri Lanka for mutual benefit with agreements to safeguard IPR and national interests

v. Attracting international conferences to the country to enable and improve interaction among scientists and technologists

Strategy 2-e

Include scientists and technologists in the formulation of national development policies and plans, review strategies, legislation, and in decision-making and implementation, at the national and provincial levels, properly utilizing relevant scientific data

Challenges

- Inadequate systems to integrate Science and Technology input into national planning

Initiatives

i. Establishing consultative mechanisms to involve scientists and technologists in the formulation of plans and policies, and in decision making in development planning

ii. Strengthening linkages between the policy makers and planners at all levels and bodies responsible for advising the government on Science and Technology policy issues via the necessary administrative, legal and financial instruments

iii. Instituting provincial Science and Technology Advisory Cells in order to ensure that relevant scientific data are collated for the province to be used for planning and decision making

Strategy 2-f

Establish an Inter-Ministerial Committee with the Head of State as the Chairman and the Minister of Science and Technology as Vice-chairman to direct, coordinate and monitor the implementation of Science and Technology Policy. The Ministry of Science and Technology shall be the executive arm of the Committee

Challenges

- Absence of an institutional mechanism at the highest level to mandate and coordinate Science and Technology policy implementation and related development activities across all relevant sectors of the government
- Need for a periodic review and improved effectiveness of Science and Technology governance

Initiatives

i. Establishing an Inter–Ministerial Coordination Committee chaired by the Head of State to mandate the periodic Science and Technology governance review and coordinate Science and Technology policy implementation and related development activities across all relevant sectors of the government.

ii. Restructuring, and strengthening the Ministry of Science and Technology with appropriate Science and Technology personnel, and facilitate its functioning as the executive arm of the Inter-Ministerial Committee, to ensure effective implementation of the Science and Technology Policy

3 Human Resource Base

Policy Objective: **Build up, and progressively expand and improve the resource base of scientists and technologists necessary to respond to the developmental needs of the country**

Sri Lanka at around 250 of Research and Development personnel per 1,000,000 population (237 in 2004) continues to remain below the average figure for developing countries at around 400 and well below the World figure of around 900. It is also noted that the number of engineers in research and development is low.

If Sri Lanka is to move from being a mere buyer/acquirer of technology to a generator of knowledge and new technology, there is a dire need to enhance substantially the number of scientists and technologists and create a critical mass of high quality scientists and technologists.

In order to do so, education and training in Science and Technology must be appropriately reformed to meet the specific needs of the country. It is also necessary to ensure that the terms and conditions of service of scientific personnel are attractive enough to retain high calibre Science and Technology personnel. It is necessary to develop new mechanisms to attract expatriate scientists too, to contribute to Sri Lanka's national development activities.

The improved functioning and progress of scientific organizations depends heavily on the scientists. Therefore it is imperative that scientists be provided opportunities for advancement based purely on merit irrespective of other considerations such as gender and language.

There is also a need to assure career opportunities for young scientists and technologists with an aptitude for research, through exposure and interaction with international Science and Technology activities, and through advanced training in well recognized institutions. To ensure and encourage high quality output by the researchers, which will have a significant impact on the economy of the country, it is necessary to provide additional incentives to such researchers. This could be achieved by the establishment of a National Research Cadre of recognized researchers where they receive individual grants for research and additional remuneration. Absorption of researchers in to and continuation in this cadre will be performance based.

Strategy 3-a

Increase the number of Researchers to reach the world average and develop a critical mass of scientists and technologists trained, particularly in advanced technologies to effectively support the socio-economic needs of the country

Challenges

- Inadequate number of research positions in the public and private sector institutions
- Unattractive remuneration and facilities of public sector research positions
- Inadequate state/institutional funds for planned training, leading to dependence on donor-funded overseas postgraduate training often irrelevant to needs of the country
- Lack of supervisors/ trainers for HR development in specific areas, particularly in advanced technologies
- Inadequate collaboration between the state and non-state sectors in HR development
- Lack of a coordinated approach to training within the institutions and nationally

Initiatives

i. Increasing the number of research positions in the public and private sector institutions ensuring attractive remuneration and facilities

ii. Establishing a comprehensive system of training needs assessment of all stakeholders in both the public and private sector in line with national development strategies, to form the basis for training scientists and technologists

iii. Establishing and maintaining a dynamic national database of needs and resources including information on scientists and their expertise with collaboration among institutions such as NSF, UGC, NIE, NASTEC, CARP, TVEC and NRC

iv. Establishing a competitive, comprehensive structured training scheme for scientists and technologists including an orientation programme at entry level to inculcate basics of research planning, procedures and implementation along with ethics and management skills.

v. Strengthening the currently available 'pathways' of training scientists

- Promoting and Institutionalizing collaborative postgraduate research between the academia and government research institutes (e.g. TRI, CRI, RRI, ITI etc) and the private sector
- Promoting split PhD programmes on problems related to country needs. Collaboration between universities and expatriate Sri Lankan scientists presents a special opportunity

Strategy 3-b

Increase the number of engineering graduates and attract engineers to Research and Development while ensuring opportunities for their advanced training with international collaboration and support from the public and private sectors

Challenges

- Insufficient capacity to produce adequate numbers of Engineers to meet the country needs
- Lack of facilities for Research and Development oriented postgraduate training of engineers
- Relatively unattractive remuneration and facilities in the public sector engineering research positions

Initiatives

i. Providing a Research and Development oriented educational facility with international collaboration and support from the public and private sectors, to increase the number of engineers and ensure their advanced training

ii. Ensure competitive remuneration schemes for research and development positions

Strategy 3-c

Provide opportunities for scientists and technologists to acquire advanced knowledge in research and international practices in Science and Technology

Challenges

- Regional exchange programmes are not effectively exploited
- Delayed transmission of information on training opportunities to the relevant institutions

- A need for simplified and streamlined travel approval procedures for Science and Technology personnel
- Inadequate dissemination of knowledge acquired through training

Initiatives

i. Facilitating short visits/ attachments by Sri Lankan scientists in relevant disciplines to regional and international centres of excellence in Science and Technology for familiarization with international practices, updating of Science and Technology capacities and to promote collaborative Research and Development activities

ii. Enhancing the capacity of scientific personnel undertaking postgraduate work in local universities by facilitating short term attachments with international centres of excellence

iii. Encouraging mechanisms for dissemination of knowledge acquired by scientists during their specialized training abroad to other interested Science and Technology personnel in the country

iv. Streamlining procedures for scientists to travel overseas for professional activities

Strategy 3-d

Establish a National Research Cadre of high caliber scientists and technologists including Sri Lankan expatriate scientists, based on international criteria, ensuring suitable incentives to enable cutting-edge research

Challenges

- Absence of a mechanism to ensure adequate rewards and recognition for excellence in research and innovations
- Current working conditions do not encourage retention of high caliber scientists nor does it attract expatriate scientists

Initiatives

i. Developing a tier based system with appropriate additional remuneration and other incentives to absorb recognized researchers to the 'National Research Cadre' based on internationally accepted criteria

ii. Establishing innovative procedures to obtain the expertise of recognized high calibre expatriate scientists, where local expertise is not available

Strategy 3-e

Improve the remunerations systems, recognition and incentive schemes, and the working conditions of scientists and technologists in Science and Technology institutions

Challenges

- Remuneration levels are significantly below regional standards
- Working conditions in remote locations are far from desirable, with inadequate facilities to ensure a reasonable work-life balance
- It is difficult for the regional scientists to keep abreast of recent developments and participate in professional activities
- Disparities of remuneration structures and other benefits among different Science and Technology institutions

Initiatives

i. Ensuring that remuneration, benefits and other incentives are at least in keeping with regional standards

ii. Improving working and living conditions in regional research locations in order to facilitate work-life balance

iii. Encouraging inter-institutional collaboration and scientist visits and exchange by providing the necessary facilities including accommodation at visit location

iv. Ensuring that research institutes and universities have comparable recruitment criteria, remuneration levels and other benefits, while leaving room for suitable performance based incentive schemes

v. Strengthening public and national recognition schemes that are practiced today such as the National Science and Technology awards and the NSF merit awards, and establishing new avenues for recognition where necessary

vi. Establishing systems to identify, expose, train and nurture the qualified, capable and high calibre young scientists and provide career paths for rapid advancement, creating additional opportunities where necessary

Strategy 3-f

Ensure opportunities for all segments of the population for vocational and tertiary education in Science and Technology irrespective of gender, language, economic status or similar considerations and attract them to the Science and Technology field for their full and equal participation

Challenges

- Inadequate facilities for vocational and technical training in the national languages
- Inadequate facilities and systems for women to balance domestic responsibilities and professional activities for their full participation
- Inadequate financial assistance to economically disadvantaged students for vocational and tertiary education

Initiatives

i. Providing vocational and technical training programmes in the relevant languages

ii. Providing measures such as flexi hours, crèches in working places, working from home etc. to accommodate special needs of parents to facilitate their contribution

iii. Enhancing financial assistance schemes specifically for economically disadvantaged students in post-secondary education including vocational training

4 Research and Development

Policy Objective: **Promote basic, applied and developmental research, particularly in areas of national importance and priority**

Science and Technology exert a growing influence on society and the economy. Scientific achievements continue to expand the frontiers of knowledge and increasingly contribute to the technological progress that affects the way people live and work. New science-based technologies help protect the environment, build safer homes, schools and factories, and develop energy saving transport systems. Advances in medicine save lives and improve health standards throughout the world.

In this scenario, it is important to work on advancing knowledge in areas that are particularly important to us and where we have a solid base of knowledge with comparative, competitive advantages. It is also important to develop our own capability in the frontier sciences, at least to the level of being able to accept related technologies if not to drive them.

Continuing progress in biotechnology, nanotechnology and ICT promises further improvements in living standards and economic performance. Such benefits, will not, however, occur without a strong commitment to research.

Advances in knowledge gained through research are necessary for translation into technologies that result in new products, processes and services.

Strategy 4-a

Give priority to Research and Development in water, food, energy and environment and in the fields of nanotechnology and biotechnology, as well as information and communication technology, electronics, advanced materials and mechatronics

Challenges

- Current investment for research in the identified priority areas in Science and Technology is inadequate
- Human resources in the frontier research areas are limited
- Inadequate expertise for repair and maintenance of advanced scientific instruments
- Existing institutions have inadequate capacity to conduct required research in some of the new and emerging fields

Initiatives

i. Conducting a needs assessment study to identify and prioritise research in the relevant areas

ii. Establishing a coordinated national scheme to up-grade infrastructure of the research institutions and providing enhanced funding

iii. Establishing systems and facilities to encourage leading Sri Lankan expatriate scientists to return and contribute to research in the prioritized frontier areas

iv. Enhancing the funding for research, particularly goal-oriented multidisciplinary research, to address identified national needs

v. Setting up strategically located advanced instrument centres with appropriately trained scientists and technologists for operation, maintenance and repair services, closely interacting with universities and Research and Development institutions

vi. Establishing new research centres where necessary, with new management and governance mechanisms to ensure their effectiveness

Strategy 4-b

Establish world class research centres to carry out cutting-edge research in areas important for national development

Challenges

- Lack of world class facilities for research in emerging sciences and technologies of national importance

Initiatives

i. Strengthen existing Research and Development institutions to establish centres of excellence in appropriate fields, e.g. electronics at ACCIMT, mechatronics at NERD centre and biotechnology at ITI

ii. Establish world class new research centres with advanced facilities in emerging technologies of national importance, e.g. nanotechnology

Strategy 4-c

Improve facilities including state of the art ICT, for access to current scientific literature for all researchers and for effective networking

Challenges

- Poor accessibility to current scientific literature for research scientists and technologists
- Knowledge management should be recognized as a key tool for improving quality in research and related activities
- Good knowledge management systems in Science and Technology institutions are essential for quality research
- Inadequate networking among the researchers

Initiatives

i. Setting up a comprehensive, central digital library of Science and Technology, subscribing to all major international journals, with ready on-line access for all scientists and technologists

ii. Promoting the publication of research findings in peer-reviewed journals

iii. Improving the quality of national journals including strengthened peer-review processes to achieve standards acceptable to be cited in recognized scientific indices

iv. Establishing good broadband connectivity and networking amongst Universities, Research and Development institutions, and other relevant stakeholders, facilitating and promoting sharing of data, information and knowledge, and also for use in effective management of joint programmes

v. Developing formal knowledge management systems in Science and Technology institutions for capturing and disseminating institutional knowledge and passing on tacit knowledge

Strategy 4-d

Encourage collaborative research partnerships between Science and Technology institutions and industries

Challenges

- The culture of the Science and Technology bodies (institutions and researchers) does not encourage partnership building and knowledge sharing
- Mutual lack of confidence among universities, Science and Technology institutions and industry
- Inconsistency of relevant state policies frequently hinders setting up partnerships with both local and foreign institutions
- Inadequacy of platforms for interaction between the Science and Technology community and industry
- Intellectual Property Rights (IPR) issues prevent ready collaboration
- Industry preference to acquire technology from abroad rather than through local Research and Development

Initiatives

i. Developing clear institutional policies, approaches and systems for collaborative research partnership management with instruments such as operational agreements and MoUs, in particular relating to IPR

ii. Encouraging collaboration by having industry representation in the governing bodies of state sector Research and Development institutions and Universities, as well as have regular consultative meetings with broader participation

iii. Promoting and facilitating private sector contribution to research through mechanisms such as research grants, endowment research professorships, funding research laboratories etc. by individual companies as well as industry bodies such as the Chamber of Commerce, Planters' Association etc.

iv. Facilitating the exchange of resources (including personnel) among Science and Technology organizations and private industry to promote collaborative Research and Development work

v. Enhancing systems for attractive tax and other concessions for industries who significantly engage in innovation through collaborative Research and Development

vi. Establishing specially funded multi stakeholder Collaborative Research Programmes (CRPs) to address identified developmental problems that are time, cost and objective bound

Strategy 4 e

Ensure that safe and ethical practices are observed in all Research and Development activities

Challenges

- Improving the appreciation of values and ethics, on issues such as authorship, plagiarism, reluctance to share knowledge and resources, and insensitivity to national regulations, all affecting the professionalism of scientists

Initiatives

i. Introducing systems in Science and Technology organizations to ensure that their activities adhere to ethical practices and inculcate right values among the scientists and technologists

ii. Developing opportunities for institutions and scientists to share good practices related to values and ethics

iii. Developing institutional procedures to deal with violations of accepted codes of ethics

iv. Ensuring systems and procedures for hazardous waste disposal and occupational safety in laboratories

Strategy 4-f

Establish a national research system under the Ministry of Science and Technology to coordinate, monitor and evaluate state funded Research and Development activities to ensure that they achieve the desired socio-economic benefits

Challenges

- Inadequacy of current systems to coordinate, monitor and evaluate state-funded Research and Development activities

Initiatives

i. Establishing under the Ministry of Science and Technology a framework (National Research System), which will coordinate, monitor and evaluate all matters related to state funded research including the research programmes, research personnel, infrastructure and other facilities to ensure that the desired socio-economic benefits are achieved.

ii. Developing a mechanism for the national research system to liaise with the non-state sector funded research activities

5 Technology Transfer

Policy Objective: **Develop, or acquire and adapt, scientific knowledge and technologies for transfer to achieve progressive modernization of all sectors and to enhance the country's competitiveness in the world economy**

The adaptation of foreign or local technologies and their transfer and dissemination is crucial for the economic and social development of the country. It is important to manage the transfer process by creating an active enabling environment with suitable policies and systems. This will ensure that the technology needs of the industry and entrepreneurs are met through a facilitation process by the state. This is not adequately addressed in the current policy and strategy scenario. In addition, assistance to identify the technology needs, particularly for smaller entrepreneurs, is necessary.

The technology transfer process must be devised to manage a matrix of socioeconomic needs on the one hand and different levels of technology on the other and possibly different transfer routes as well. While technology needs of the industry are aimed at business development, at the village level they lead to providing improved livelihoods to individuals. For effective technology development and transfer, the Science and Technology inputs needs to be increasingly multi-disciplinary and calls for multi-institutional and multi-sectoral approaches.

A major weakness in the technology development process is that most of the Research and Development work in the country is compartmentalized and individualized. Collaboration between different institutes and researchers of different disciplines is at a level far less than desired. This must be rectified for optimum outcomes to be realized. In most cases the technology transfer process is limited to transferring the technology package without adequate training. The other key elements such as marketing, finance and administration support also need to be packaged in. Mechanisms to improve this process must be instituted.

Strategy 5-a

Facilitate scaling-up of research based innovative processes and technologies to pilot and commercial scales

Challenges

- Inadequacy of centralized or institutional level facilities for scaling-up of research
- Weaknesses in links between Research and Development institutions and central scaling up units
- Poor collaboration between relevant state sector institutions prevents success in scaling-up of research
- Poor team culture prevents collaborative work among scientists and negatively affects scaling up work
- Inadequacy of national level coordination for scaling-up of research

Initiatives

i. Improving coordination of, and investment in, pilot plant facilities at appropriate institutions

ii. Improving interaction between scientists and engineers at early stages of Research and Development programmes and encouraging team work to enable easy scaling-up of technologies

iii. Developing national level coordination mechanisms for optimal use of facilities and personnel for effective scaling-up of targeted research

Strategy 5-b

Encourage industries and Research and Development institutions to give greater emphasis to high-tech innovations, technology transfer and commercialization

Challenges

- Research and Development output should be demand driven to ensure both current and anticipated needs
- Technology packages and services should be priced so as to make them affordable to small scale industries and entrepreneurs
- No specific incentives are provided for industries to promote and adopt local Research and Development
- Poor communication by the Research and Development institutions highlighting their respective outputs as well as not understanding the industry needs
- Absence of a mature IPR environment does not facilitate sound technology transfer agreements
- Industry often lacks skills to accept , adapt and_sustain technology inputs

Initiatives

i. Restructuring management systems in Research and Development institutions to give increased authority and autonomy to Researchers/Research Groups to manage research projects and liaise with industry ensuring adequate controls

ii. Developing methodologies for individual institutions to offer incentives to researchers who carry out high quality development oriented research resulting in effective commercialization, preferably in partnership with the private sector

iii. Establishing facilitating mechanisms such as study visits and collaborations for specific training of researchers on prioritized technology transfer projects

iv. Establishing joint ventures with foreign commercial organisations to enable rapid and continuing transfer of technology, with adaptation research by local Research and Development institutions, where necessary

v. Developing mechanisms for the transfer package to include the technology elements as well as finance, marketing and training in technology and management

vi. Establishing technology incubator facilities and technology parks

vii. Strategically orientating the physical infrastructure facilities at Research and Development centres in Science and Technology parks to promote flow of Research and Development output into industries and create a demand for new technologies

Strategy 5-c

Develop appropriate technologies suitable for transferring to small and medium enterprises, particularly in rural areas, through collaboration among Research and Development institutions, the SME sector and other stakeholders using mechanisms such as the Vidatha Resource Centres

Challenges

- Technology developed in Research and Development institutions is often not demand based and hence not easily marketable
- Coordination amongst relevant ministries/departments and other authorities is essential to link developed technologies and entrepreneurs
- Inadequate collaboration between Research and Development institutions, SME sector and other stakeholders, particularly end users at community level
- Inadequate focus on dissemination of information on technologies, particularly in Sinhala and Tamil languages
- Technology transfer mechanisms at rural level have to be strengthened taking into account their special needs

Initiatives

i. Identifying and developing the technologies necessary to improve the productivity and quality of the existing industries

ii. Identifying and developing the technologies based on sustainable use of natural resources as raw materials for potential new industries, at the regional and rural levels

iii. Setting up mechanisms for improved coordination between different ministries/ departments/ authorities at the district and divisional levels and with organizations such as Vidatha Resource Centres to facilitate technology transfer

iv. Networking Research and Development institutions with the Chambers of Commerce and Industries, national extension agencies such as IDB and grass root level programmes such as the Vidatha programme for identification, development and transfer of technologies

Strategy 5-d

Encourage international collaboration in Research and Development activities and joint ventures, for cost effective and rapid transfer of modern technologies, while ensuring adequate controls through well developed agreements for shared benefits

Challenges

- A stable policy environment is necessary to establish joint venture Research and Development and commercial operations
- Inadequate capacity to negotiate terms and agreements in joint venture activities for equitable sharing of benefits
- Joint ventures will enhance the capacity for accepting transferred modern technologies

Initiatives

i. Developing clear and consistent national policies and guidelines for joint venture operations in Research and Development activity

ii. Promoting commercial joint ventures with clear Science and Technology acquisition elements, with local Science and Technology institutions as a partner, while ensuring that the local capacity to receive and manage the technology is in place

iii. Establishing strong partnerships between Research and Development institutions and local counterpart industries, as a necessary precondition for successful negotiation and implementation of joint ventures

Strategy 5-e

Facilitate entrepreneurship and foresight activities among scientists, technologists, researchers and inventors

Challenges

- Scientific organizations give more recognition for research publications than for commercially viable inventions and innovations that could contribute to industrial and national development
- Inadequate rewards to Research and Development Personnel for development of new and innovative products and processes, suitable for commercialization
- Inadequate institutional support for patenting of innovations of their research staff

Initiatives

i. Developing schemes for incentives and recognition to scientists and scientific institutions that promote quality and productivity in Research and Development leading to commercialization of research findings

ii. Setting up institutional systems to expose Science and Technology personnel to business culture, and technology foresight activities so as to enhance entrepreneurial thinking

6 Natural Resources and the Environment

Policy Objective: **Ensure sustainable use of natural resources for development while protecting the environment**

The climate and topography of Sri Lanka has resulted in a rich biodiversity that includes a wide range of ecosystems. The natural resources of the country fall into living, non-living, renewable and non-renewable categories. The major resources include land, water, terrestrial and aquatic microorganisms, plants and animals of the varied ecosystems, as well as mineral resources.

In the past these natural resources have been exploited for commercial purposes often in an uncontrolled manner, in spite of the existence of reasonably adequate legislation for their sustainable use, and preservation of the environment.

However, for the development of the country it is imperative that the available natural resources are used in a sustainable manner while protecting the environment. This can be ensured if policies for the above are based on accurate and current scientific and technological data.

Strategy 6-a

Promote research related to conservation and sustainable use of biodiversity, and minerals, marine and other natural resources

Challenges

- The existence of gaps in the Science and Technology knowledge base related to natural resources and their sustainable use
- Despite the existence of laws, regulations, fiscal measures, and enactments, exploitation in many instances appears to evade the concepts of sustainable extraction and utilization
- The natural environment is under serious threat of degradation due to hasty and poorly planned development programmes, often without effective environmental impact assessments
- Controlled access to natural resources is important to conserve them and promote their sustainable use for economic and social benefits

Initiatives

i. Initiating research programmes on ecosystems and aquatic and terrestrial fauna and flora with special reference to endemic species with a view to conservation and sustainable use within the framework of national development activities

ii. Promoting research in propagation, conservation and sustainable utilization of unexploited and under-exploited plants and other organisms of commercial value

iii. Promoting research aimed at value addition to plant based natural resources through the production of high quality and standardized end products such as medicines and derivatives of essential oils

iv. Researching into quantification of existing carbon assets and potential for further development

v. Retrieving, collating and packaging the relevant research outputs into policy briefs for effective communication between researchers and policy formulators

vi. Develop capabilities to assess and maintain databases on minerals and marine resources

Strategy 6-b

Strengthen the scientific capability for effective implementation of laws and regulations to protect natural resources and the environment

Challenges

- The necessity of updating and widening the scientific knowledge base to enhance the capability for implementation of the laws and regulations

Initiatives

i. Updating and widening the scope of scientific knowledge and technical knowhow related to natural resources through research

Strategy 6-c

Promote cleaner production technologies

Challenges

- The technology element of cleaner production must be supported by Research and Development
- The on-going efforts to facilitate, promote and transfer clean technologies needs strengthening

Initiatives

i. Providing appropriate Science and Technology support for industries to replace fossil fuel based energy with renewable or cleaner energy sources

ii. Providing appropriate Science and Technology support and incentives for industries to adopt cleaner production technologies that generate less waste and improve productivity

7 Indigenous Knowledge

Policy Objective: **Document, research into the scientific basis of, and promote indigenous knowledge based technologies**

The universal consideration of the "limits of growth" in a development context, and the paradox of inequity, poverty and loss of a harmonious living environment, has made the global community to look back for alternative pathways, which include the harnessing of what is now appreciated as traditional wisdom. The unrivalled features and concepts in the ingenious traditional systems of conservation and sustainable use of natural resources were clearly ingrained in Sri Lanka's ancient cultural and religious traditions. This is well illustrated in our traditional agricultural, water management and medicinal practices which have been time tested and are practiced even today by certain sections of the society. However, there is inadequate research and documentation concerning the scientific basis of these practices.

Research to determine their basis and their documentation and dissemination will lead to improvement of the practices, upgrading of technologies and wider adoption, resulting in improved contribution to the socio-economic advancement of the country.

Strategy 7-a

Retrieve, collate and document available indigenous knowledge and practices

Challenges

- Traditional knowledge and practices are either not documented or not in the public domain
- The Intellectual property aspects of these traditional knowledge and practices, usually in the form of ethical obligations, needs to be safeguarded when documenting

Initiatives

i. Developing mechanisms to retrieve, collate and document information on indigenous knowledge and practices

ii. Establishing and improving access to new databases on traditional knowledge and practices, while ensuring Intellectual Property Rights

iii. Designing and establishing a meta-database by a designated state institution for ready access by networked institutions, the researchers and the public

Strategy 7-b

Research into the scientific basis of the available indigenous knowledge and technologies

Challenges

- The scientific basis of indigenous practices has not been adequately researched and documented preventing wider adoption

Initiatives

i. Researching into the chemical, biological and medicinal basis of specific practices in the traditional systems of medicine

ii. Promoting research into the scientific basis of the traditional knowledge and practices in areas such as natural resource conservation, water management, agricultural practices, construction practices and various cottage level industries

Strategy 7-c

Ensure further development of traditional technologies to promote their application for demand- driven value addition while ensuring Intellectual Property Rights

Challenges

- Inadequate focus and attention on identification of traditional technologies and further development
- Absence of promotional policies and mechanisms for encouraging the development and upgrading of identified traditional technologies
- Application of traditional knowledge and practices require a legal framework for protection against unscrupulous exploitation

Initiatives

i. Developing institutional policies and mechanisms that will direct Research and Development institutions and universities to establish research programmes for further development of traditional practices and techniques to viable technologies

ii. Establishing national platforms for researchers and institutions to gain recognition for further development of indigenous technologies

iii. Formulating and implementing a regulatory or legal framework for the protection, conservation and sustainable use of traditional knowledge and practices

8 Innovations and Intellectual Property Rights

Policy Objective: **Develop a culture of innovation and Intellectual Property and ensure the protection of Intellectual Property Rights (IPR)**

There are three important factors to be considered in addressing Science and Technology based innovations and inventions. First, an innovation or invention must be established as a creative, novel and distinctive product or process that has potentially useful applications. Second, the applicability of the innovation or invention has to be convincingly demonstrated at least at a pilot plant level application. Third, once the innovation or invention has been established as something new, novel and distinctive, its property rights must be protected through the patenting system.

Most of the innovations and inventions protected through patents are creations based on the practical experience of craftsmen or technicians, who may not have had an exposure to a sound education in the basic principles of Science and Technology. Such creative and talented persons need to be identified and provided with a mechanism to acquire such knowledge in the disciplines that are of relevance to their fields of activities.

On the other hand, research scientists and technologists take pride in being creative only up to the stage when a breakthrough has been made in the laboratory of a scientific problem, which provides them the opportunity to publish a research article. The more important step of demonstrating applicability and usefulness as well as the novelty and creativity of their findings in a national venture or development activity is generally not pursued.

The paucity of national and institutional level mechanisms for granting recognition and awards for Science and Technology based innovation and inventions, has been a dampening factor for creative scientific work. At a time when there is a need to create or inculcate an innovation culture, it would appear paradoxical that there are few processes to reward and recognize creativity.

A scheme of rewards for innovations, and assisting in the protection of Intellectual Property Rights of innovators and inventors will give a necessary impetus to develop an innovation and IPR culture.

Strategy 8-a

Inculcate IP awareness among scientists, technologists, science and technology teachers and students, and develop an IP culture in Research and Development institutions, universities, technical colleges and similar institutions

Challenges

- Despite broad-based awareness creating programmes, an effective innovation and IPR culture has failed to take root in Research and Development institutions, as well as among Science and Technology personnel
- Inadequacy of regular programmes to sensitize the society at all levels on the importance of safeguarding intellectual property; the facilities available for protection; and on measures available to counter any infringements of the IPR Law

Initiatives

i. Strengthening and sustaining awareness programmes on patenting and IPR law, among the Science and Technology institutions and society at all levels

ii. Training of trainers on the significance of safeguarding intellectual property and the importance of registration of patents

iii. Promoting awareness of IPR at all levels of general education through appropriate activities

Strategy 8-b

Develop institutional policies and guidelines regarding innovations and IPR

Challenges

- Inadequacy or absence of institutional policies as well as protocols regarding innovations and IPR regulations
- Inadequate institutional initiatives to promote patenting of innovations and research findings
- Lack of resources to patent major innovations internationally

Initiatives

i. Developing institutional policies and guidelines to safeguard the institutional and individual rights to research information, as well as to assist researchers to patent their innovations and inventions

ii. Establishing HR policies in respect of recruitment, career development, and rewards that ensure creativity and innovation

Strategy 8-c

Establish mechanisms to facilitate scientists, technologists and inventors to patent their innovations

Challenges

- Inadequate information and guidance to innovators regarding the obtaining of patents

Initiatives

i. Developing systems at Science and Technology institutions for innovators to obtain information on IPR regulations, and guidelines for patenting, and for liaising with the Intellectual Property Office and other concerned organizations

Strategy 8-d

Establish suitable mechanisms to effectively exploit innovations

Challenges

- Need for additional more effective mechanisms to identify and channel innovations to national technology transfer systems for exploitation.

Initiatives

i. Developing a system for prospecting for unrecorded innovations, as well as those emerging from national and regional innovation promotion activities

ii. Developing databases of patented innovations

iii. Developing schemes to assist innovators to further develop their innovations up to commercial level

9 Quality and Performance of Science and Technology Institutions

Policy Objective: **Ensure quality standards of Science and Technology institutions, products and services to achieve national and international recognition**

As the Science and Technology institutions get broad based, as they gradually become more autonomous with degrees of flexibility built in, there is a need to establish more rigour and improve the quality of research outputs and services to enhance their economic and social benefits. The accountability of Science and Technology institutions resides in their scientific outputs, be it research publications, product packages for commercialisation or teaching. The reliability and quality of these outputs need to be assured. This will enable standardizing outputs as far as possible, and gain credibility and recognition amongst all stakeholders. Assurance of quality is not only important in the local context but also to gain a competitive advantage in global knowledge sharing activities as well as in other economic activities.

The applicable international quality and other management systems such as ISO 9001, ISO 14000, and ISO 22000 etc. are now widely applied in the country, but the scientific institutions generally lag behind in terms of adopting these to upgrade and ensure the effectiveness and the quality of their outputs. The next stage after adoption of a system would be to obtain certification against these standards, which perhaps no Science and Technology institution has attempted so far. While laboratory accreditation based on international standards such as ISO 17025 etc. are more widely applied standards such as ISO 27001 covering the requirements in information handling are hardly applied.

General awareness and top level commitment in making use of these approaches is inadequate and a wider campaign is necessary to ensure that these issues are addressed.

Means of evaluating both the performance of public research organisations and the efficiency of support by such organisations to enterprises, through Research and Development, need to be established. Good practices regarding methodologies and institutional mechanisms for evaluation, that reflect changing policy priorities, need to be identified.

Strategy 9-a

Ensure the effectiveness of activities of the Science and Technology institutions to maintain quality standards of institutional products and services by establishing, implementing and maintaining internationally recognized quality management systems with periodical national and international review

Challenges

- The need for quality standards of services and outputs of Science and Technology institutions is not adequately recognized
- There is a necessity for strong commitment and understanding in implementing quality standards in Science and Technology institutions by institutional senior management

- Most institutions have no specific budget allocations for quality improvement programmes and developing a quality culture
- Competence of the staff in implementing internationally recognized quality systems and maintaining them is inadequate
- The prevalence of a wrong perspective that QMS hampers research work

Initiatives

i. Establishing a program to increase awareness of the need for quality management systems amongst the senior managements of Science and Technology institutions and to encourage them to adopt applicable internationally recognized quality management systems

ii. Promoting Science and Technology institutions to obtain certification status

iii. Enhancing the capacity and the capability of a core group of Science and Technology Personnel at Science and Technology institutions by providing them the required training on basic quality concepts and programs for continual improvement

iv. Organizing regular interactive sessions among the institutions to share the experiences and best practices on quality and performance improvement programmes

v. Incorporating parameters based on the adopted quality system and the certification status, as criteria to the institutional review process instituted by NASTEC, reflecting quality issues in the overall performance index of the institution

vi. Instituting an institutional reward and recognition scheme based on the review outcomes

Strategy 9-b

Promote Science and Technology institutions to achieve certification of management systems and laboratory accreditation status wherever applicable as per internationally recognized standards

Challenges

- There is a necessity for institutional senior management to recognize that certification adds value to the established quality systems in creating discipline and gaining credibility
- More media and public awareness of the importance of laboratory accreditation will drive more laboratories to work towards accreditation

Initiatives

i. Establishing sound programmes in collaboration with Sri Lanka Accreditation Board for Conformity Assessment, Sri Lanka Standards Institution and other certifying bodies to familiarize the senior managements of Science and Technology institutions and scientists on the importance of quality system adoption and certification, and laboratory accreditation

ii. Engaging certifying and accrediting bodies to be proactive in promoting quality systems in Science and Technology institutions and industry, and creating media and public awareness as a pressure factor for the institutions to get certification and accreditation

iii. Devising suitable mechanisms to encourage Science and Technology institutions to obtain accreditation for their laboratories

Strategy 9-c

Ensure the effectiveness of certification and accreditation bodies and processes

Challenges

- Sri Lanka Accreditation Board for Conformity Assessment is a young institution and further capacity development is needed
- Regular review of affiliation/ certifying conditions is needed to ensure effectiveness of certifying bodies and processes

Initiatives

i. Enhancing the capacity of Sri Lanka Accreditation Board to enable expansion of accreditation activities

ii. Ensuring that all certifying and accrediting bodies have formal affiliations or recognition with nationally or internationally accepted organizations

iii. Developing a system to ensure that the conformity assessment programmes of institutions and laboratories are carried out at regular agreed intervals by the certifying and accrediting bodies

10 Science and Technology, and Human Security

Policy Objective: **Promote the application of Science and Technology for human welfare, disaster management, adaptation to climate change, law enforcement and defence, to ensure human and national security.**

Human and national security in the current day context, are not limited to national independence, sovereignty and integrity of the nation, but extends to the realm of health, poverty, inequity, availability and accessibility of food, water, energy, safe shelter and sanitation.

Water security implies availability and accessibility to water of acceptable standards for food and goods production, sanitation and health.

In recent times national security in food and energy has been subjected to threats of unprecedented magnitude due to global increases in the prices of rice and wheat, as well as of fossil fuel.

Sri Lanka's heavy dependence on imported fossil fuels for energy is of serious concern. In this context there should be a concerted effort towards strong conservation programmes and a shift to alternate or renewable energy sources.

Sri Lanka's healthcare and well-being are considered satisfactory. However, the prevalence of vector-borne and environmentally related health risks is cause for much concern.

In recent years human security has also been threatened due to the increased frequency of occurrence and increased intensity of natural disasters. These include cyclones, floods, landslides, earth slips, drought, storm surges and coastal inundation, tornadoes, forest fires, breaches of dams, lightning strikes etc.

These disasters are the result of a complex interplay of several factors that include climate change. Hence prevention, mitigation and management of natural disasters need a multi-pronged approach.

In terms of national security the country is deficient in the application of Science and Technology research both for law enforcement and defence. Science and Technology could play a significant role in areas such as forensic science and ICT in law enforcement. Sri Lanka also faces concerns about the possible threats due to chemical and biological weapons. There are also improvised non-conventional explosive devices, which have in recent years affected life and property causing enormous distress and trauma.

It is therefore important to build up capabilities to face these challenges through research and application of modern Science and Technology interventions.

Strategy 10-a

Use Science and Technology inputs to ensure security in water, food, shelter, energy, health and well-being.

Challenges

- Population growth and economic advancement along with changing life styles negatively impact resource availability
- Security in food, water, health, shelter, sanitation and energy are either directly or indirectly associated with uncontrolled and undesirable development processes
- Water scarcity being an impending issue, water management supported by Science and Technology inputs should become a key element in national planning
- Inadequate use of technology for effective stock piling of food and fuel

Initiatives

i. Developing a Science and Technology based national water conservation and management strategy, based on a country wide assessment of surface and ground water resources with respect to quality, availability and demand

ii. Facilitate scientific research on cultivation and post-harvest technologies of cereals, field crops and horticultural crops

iii. Instituting programmes of waste water management and recycling in the main cities and towns using new or adapted technologies

iv. Undertaking research programmes to develop food crop varieties that have low water requirements and/or have the capacity to respond to water stressed conditions

v. Conducting scientific studies to develop safe and well conceived stock piling methodologies for essential basic food items, especially cereals

vi. Strengthening quarantine procedures to ensure that organisms threatening food security are prevented from entering the country

vii. Conducting research into cost effective construction materials and methodologies, and safe housing and sanitation suited for different locations

viii. Conducting multi-disciplinary research on environment related health problems such as the widespread occurrence of kidney failure in the North Central Province and increased prevalence of vector borne diseases

ix. Institute research programmes for energy conservation

x. Institute research programmes to explore a wide range of energy generating alternatives including dendro thermal power, bio-fuels, solar power, wind power, and ocean thermal energy conversion (OTEC) without compromising the resource needs for food security

Strategy 10-b

Promote research on causal factors and effects of natural and man-made hazards to support mitigation and management of disasters

Challenges

- Inadequate research information with respect to natural and man-made hazards and disasters
- The need for more platforms and opportunities for the interaction of scientists and researchers in the field
- Necessity to improve support for research work in the field through increased funding and facilities.
- Absence of a protocol for assessments of risks and vulnerabilities associated with various disasters and for identification of strategic management measures
- Inadequacy of resolution or limitations of information in maps, or in certain cases absence of maps, of disaster prone areas results in difficulties in developing disaster management programmes

Initiatives

i. Instituting research studies into maintenance and management of critical sites such as dams, reservoirs, drainage systems, wetlands and unstable steep sloping lands, that may increase the risks of hazards

ii. Sponsoring research on causal, preventive and mitigation factors of natural and man-made disasters, and disseminating the findings

iii. Promoting research on environmental aspects in restoration and rehabilitation of the hazard affected areas, and resettlement of affected communities

iv. Using scientific and technology based methodologies such as remote sensing and GIS tools to identify and map hazard prone areas and risk assessment ensuring adequate resolution and detail

Strategy 10-c

Develop research programmes to address mitigation, vulnerability and adaptation aspects in respect of climate change effects.

Challenges

- Inadequate research activity on mitigation and adaptation measures in relation to climate change impacts

Initiatives

i. Undertaking location specific and national level modeling studies on crop cultivation particularly in rice to understand impacts arising from climate induced changes in respect of water availability, pest damage, soil nutrients etc.

ii. Developing suitable adaptation methods for anticipated impacts due to climate change

Strategy 10-d

Ensure security from crime through the application of Science and Technology methodologies.

Challenges

- Science and Technology methodologies are not adequately used to ensure security from crime
- Absence of a national information sharing framework in relation to crime
- A country-wide communication and information dissemination facility using mobile and radio telecommunication systems is important
- Increased reliance on forensic science for detection and investigation of crimes is important

Initiatives

i. Establishing a mechanism for improved interaction between police and scientific community for identifying research based solutions for prevention and detection of crime

ii. Establishing a broadband ICT facility for a National Operations Room which links institutions dealing with information on public security, law and order, and defence, with a public help desk to facilitate rapid communication and action in relation to crime detection

iii. Strengthening the human resource base for effective application of forensic science in crime detection

Strategy 10-e

Ensure national defence capability through research and the application of modern Science and Technology interventions

Challenges

- The need for increased Research and Development efforts in relation to national defence issues
- Need for a scientific system to collect and analyze intelligence information on unconventional weapons
- Bilateral as well as multi-lateral national defence and security agreements for exchange of information on technologies and material support is important
- Need to rapidly acquire information regarding modern defence technologies
- Necessity to enhance the Science and Technology capability of personnel in the use of modern defence applications

Initiatives

i. Developing technical and human resource capabilities through activities including the establishment of bilateral and multi-lateral links amongst scientists in areas such as defence technologies including technologies pertaining to control of and defence against chemical, biological and nuclear weapons

ii. Instituting a scientific system for collection and analysis of intelligence information on unconventional weapons and developing related response plans through research

iii. Strengthening facilities and enhancing human resource capability in Research and Development to deal with country specific defence issues

Annex 1

Proposed Main Agencies for Implementation of Strategies/Initiatives

Policy Objectives	Agencies / Organizations
Policy Objective 1 Foster a science, technology and innovation culture that effectively reaches all citizens of the country	▪ Ministry of Science and Technology ▪ Ministry of Education ▪ Ministry of Vocational and Technical Training ▪ Universities, UGC ▪ NIPO, NIE, NSF ▪ SLAAS, and other professional associations
Policy Objective 2 Enhance Science and Technology capability for national development, make use of Science and Technology expertise in the national planning process, and strengthen governance and policy implementation mechanisms	▪ Ministry of Science and Technology ▪ Ministry of Finance and Planning ▪ NSF, NRC ▪ CARP,UGC, ICTA ▪ SLAAS ▪ NASTEC
Policy Objective 3 Build up, and progressively expand and improve the resource base of scientists and technologists necessary to respond to the developmental needs of the country	▪ Ministry of Science and Technology ▪ Ministry of Education ▪ Ministry of Finance and Planning ▪ NIE, universities and higher education institutes ▪ NSF, NERD Centre, ITI, ICTA ▪ Inventors Commission ▪ NASTEC ▪ DMS, Salaries and Cadre Commission
Policy Objective 4 Promote basic, applied and developmental research, particularly in areas of national importance and priority	▪ Ministry of Science and Technology ▪ NSF, IFS, NRC ▪ UGC, Universities ▪ NASTEC ▪ Chamber of Commerce
Policy Objective 5 Develop, or acquire and adapt, scientific knowledge and technologies for transfer to achieve progressive modernization of all sectors and to enhance the country's competitiveness in the world economy	▪ Ministry of Science and Technology ▪ Ministry of Enterprise Development and Investment Promotion ▪ NSF ▪ CARP
Policy Objective 6 Ensure sustainable use of natural resources for development while protecting the environment	▪ Ministry of Environment and Natural Resources ▪ Ministry of Agricultural Development and Agrarian services ▪ Ministry of Indigenous Medicine ▪ Ministry of Plan Implementation ▪ Ministry of Power and Energy ▪ DWLC, Forest Department, PGRC ▪ Institute of Indigenous Medicine

Policy Objectives	Agencies / Organizations
Policy Objective 7 Document, research into the scientific basis of, and promote indigenous knowledge based technologies	▪ Ministry of Environment and Natural Resources ▪ Biodiversity Secretariat ▪ Universities ▪ Research Institutes
Policy Objective 8 Develop a culture of innovation and Intellectual Property and ensure the protection of Intellectual Property Rights (IPR)	▪ NSF, CARP ▪ IPR office ▪ NIE ▪ Universities
Policy Objective 9 Ensure quality standards of Science and Technology institutions, products and services to achieve national and international recognition	▪ SLSI, SLAB ▪ NSF, CARP ▪ NASTEC
Policy Objective 10 Promote the application of Science and Technology for human welfare, disaster management, adaptation to climate change, law enforcement and defence, to ensure human and national security	▪ Ministry of Defense, Public Security, Law and Order ▪ Ministry of Environment and Natural Resources ▪ Ministry of Power & Energy ▪ Ministry of Finance and Planning ▪ Ministry of Healthcare and Nutrition ▪ Dept. of Irrigation, Department of Excise, Dept. of Agriculture ▪ Sri Lanka Customs ▪ ICTAD, IPHT, MRI, ITI ▪ Geological Survey and Mines Bureau ▪ Urban Development Authority, NBRO, CHPB ▪ AEA, CEA, Mahaweli Authority, Sustainable Energy Authority ▪ NSF and other funding organizations ▪ Kotalawala Defence Academy ▪ Plant Quarantine Unit and Animal Quarantine Office ▪ NASTEC ▪ Provincial councils, Municipalities

Annex 2

Policy Development Committees

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