Focus Area 10 : Basic Sciences, Emerging Technologies and Indigenous Knowledge

Introduction

It is a well-known fact that the technology always originates from basic sciences confirming the saying that today's science will become tomorrow's technology. Technology cannot grow in vacuum. The medium in which technology grows is the basic science. It opens up new avenues for technological developments and the progress of technology stagnate after some time and demands new discoveries through basic science research. A classic example is solar cells, which is awaiting for a scientific breakthrough of finding an efficient material at low cost for producing highly efficient solar cells. Therefore, basic scientific research and technology has to be developed in parallel, although it takes many years for some findings in basic science to be materialized as a technology. Without an adequate foundation in basic scientific research, technology will not be able to survive. A country cannot develop technologically and economically unless it has its own basic scientific research infrastructure and S&T personnel necessary to support its R&D efforts.

Rapid development of basic sciences has paid the way for the development of new technologies that we normally referred to as emerging technologies. Some of the emerging technologies that deserve our attention are Space Technology, Microelectronics, Photonics, Robotics, Mechatronics and New Materials. Today space technology plays an important role in telecommunication, weather forecasting, remote sensing the Earth, GPS systems and navigation. Unmanned Air Vehicles (UAVs) are useful in for purposes such as aerial surveying, aerial surveillance, remote sensing, traffic monitoring, search and rescue operations, maritime patrol, early detection of forest fire, and oil, gas and mineral exploration The multidisciplinary field of mechatronics has many applications in areas such as automation and robotics, sensing and control systems, automotive engineering, computer driven machines, computer aided design, 3D-printing, servo-mechanics, and various consumer products. The other emerging technologies including new materials have very important applications that are closely linked with economic gains.

Sri Lanka is a country blessed with a rich repository of indigenous knowledge collected and practiced over a long period of time that spans over two and half millennia. This knowledge system encompasses areas such as civil engineering, irrigation and water management, medicine and agriculture. As in many other Asian and European countries at that era, Astrology has also played an important role in the social life of Sri Lanka. Most of the practices that we had in the past are highly environment friendly and have wide applications today. It is necessary to study our indigenous knowledge systems systematically to see how well we can use them in the future development agenda of the country. There are certain areas of indigenous knowledge that can be successfully blended with modern scientific knowledge while there are other areas that are needed to be left to grow within its own environment without any outside interference. Indigenous knowledge on medicinal plants, as an example, has a tremendous potential to bring benefits to the country, if the knowledge of science and technology is used to study, extract and formulate products. Such studies have been conducted by several scientists for some time, however, up to date facilities to produce quality results and relevant industries to produce marketable products has to be developed

Sub Areas, Issues and Relevant Interventions

Table 1: Sub Areas and Justifications

Sub Areas	Justifications
1) Basic Sciences	Basic Sciences develop the fundamental knowledge in understanding the nature and the world. It is essential to have up-to date fundamental scientific knowledge to develop new technologies.
2) Emerging Technologies *i) Space technology* *ii) Micro-electronics, Photonics and Robotics* *iii) Mechatronics* *iv) New materials*	Space technology would bring many benefits to the development of the country. Use of drones can be used for areal surveying, traffic monitoring, areal surveillance and maritime patrol. Gravitational and magnetic fields measurements can be used for minerals, oil and gas exploration. Micro-electronics, photonics and robotics can be used to make a significant improvement in local industries (improving the quality of local products and enhancing the efficiency of processes). Mechatronics can be used in sensing and control systems, automotive engineering, computer-driven machines, 3D printing and consumer products. There is potential for producing value-added new materials from locally available minerals. There is a need to harness the technological potential of new materials such as polymers, ceramics and composites through new industries.
3) Indigenous Knowledge	Sri Lanka has a rich traditional knowledge base in agriculture, irrigation, medicine etc. Due to rapid transfer of modern scientific knowledge many Indigenous Knowledge systems are facing the risk of extinction. Indigenous Knowledge can be used to find sustainable solutions for many pressing issues with relevant to agriculture, environment and health.

Table 2: Issues/Problems, R&D Needs and Relevant Interventions

Sub Areas	Issues/Problems	Research and Development Needs	Relevant Interventions
1) Basic Sciences	I) Research in basic sciences not developed up to satisfactory standards II) No involvement of organized researchers in state-of-the-art experiments, conducting fundamental research III) Lack of collaboration with centers of excellence in other countries IV) Interest of students to follow basic sciences is decreasing V) Lack of job opportunities for scientists in local industries V) Industries not getting involved in R&D for quality improvement of their products VI) Unavailability of essential state-of -the –art equipment for scientific research	i) Recognize the importance of research on basic sciences and promote them. ii) Capacity development iii) Provide financial assistance for collaborative research and facilitate them iv) Establish scholarship schemes to attract students for higher studies in basic sciences v) Provide incentives for small-scale industries to involve in R&D and provide employment for young generation vi) Encourage industries for collaborative research with universities vii) Establishment of high-tech research laboratories	**Policy Studies** a) Recognize the importance of research on basic science and allocate funds b) Provide financial assistance for scientists and postgraduate students for collaborative research with world leading basic science research laboratories and institutes to bring up to date knowledge to the country c) Establish special scholarship programs for bright young students to study science up to postgraduate level, including postgraduate studies at well recognized universities and world class research institutes d) Create postdoctoral positions in universities and research institutes through grants to improve the productivity and quality of research e) Encourage industries for collaborative research with universities using tax benefits **Capacity Building** a) Strengthen existing research institute(s) mandated to carry out fundamental research b) Establishment of high-tech research laboratories that provide easy access to scientists

Sub Areas	Issues/Problems	Research and Development Needs	Relevant Interventions
2) Emerging Technologies	I) Lack of expertise II) Available satellite data not properly utilized III) Available man power under utilized IV) Equipment cost is high and available equipment is not accessible to all scientist V) Information on available manpower and equipment - not available VI) High quality minerals are exported without value addition VII) Reserves such as Limestone, dolomite are not properly used VIII) Transfer of knowledge to industrial sector is very low	i) Capacity building through scholarships, advanced training etc. ii) Identify and pool experts for relevant emerging technology sub-areas iii) Provide training for equipment handling/repairs iv) Establish a central station for equipment v) Develop a directory of human resources/scientific equipment vi) Research on value addition to materials such as Titanium vii) Enhance Cement/Lime industries, Chemical industries etc. viii) Establish "S&T Knowledge Transfer Unit" at the MoTR	**Policy Studies** a) Develop a Directory on S&T experts in the country b) Promote industries for value addition to local minerals c) Promote industries that produce high-tech products such as silicon chips **Pure and Applied Research** Use Remotely sensed satellite data on ocean waters for identifying fishing grounds and for studies on meteorological parameters **Capacity Building** a) Develop an adequate human resource pool for relevant Emerging Technology Sub-areas, by providing incentives, scholarships, advanced training, etc. and establishing a mechanism to recruit, retain and put into productive use of these experts after completing their training. b) Establish "Science and technology knowledge transfer and information unit" at the Ministry of Technology and Research

Sub Areas	Issues/Problems	Research and Development Needs	Relevant Interventions
			c) Identify key priority areas in S&T needed for rapid economic development of the country and launch d) R&D facilities or schemes with application/ commercialization possibilities e) Information unit shall establish a mechanism to link universities, R&D institutes or pool of experts with industries as needed to solve problems of local industries f) Establish a central station for costly equipment and train technicians to handle and also repair these equipment
3) Indigenous Knowledge(IK)	I) There is a great risk of extinction of indigenous knowledge II) Not much attention is given to indigenous knowledge by policymakers and scientists. IK has not been scientifically backed and sufficiently protected	i) Establish a mechanism to gather available information on IK in the country and properly record them for preservation and further study ii) Encourage Scientists for research on IK providing research grants, protecting IPR for the benefit of the country	**Policy Studies** Formulation of a policy to use and protect IK **Pure and Applied Research** Encourage research on IK **Innovations** Innovations to incorporate 'Green technology' in agriculture

Sub Areas	Issues/Problems	Research and Development Needs	Relevant Interventions
	III) Large number of indigenous medical treatments and medicines practiced for generations has not been formally approved.	iii) Study and analyze various indigenous medical treatments and medicines to prove their success and provide approval for such treatments by a recognized body iv) Support the incorporation of relevant IK in agriculture (Make use of recently popular green technology v) Systematic study on medicinal plants to identify their chemical composition vi) Support studies on ancient construction methods vii) Establish a committee within a relevant government institution to look into legal aspects of growing, transporting and using medicinal plants for commercial aspects.	**Testing, Standardization and Accreditation** a) Accreditation of Indigenous medicinal products b) Develop standards to practice indigenous medicine
	IV) Direct conventional technology transfer ignoring the indigenous knowledge, has created problems in particular in agriculture sector		**Capacity Building** Develop legislations relevant to use of Indigenous medicinal Plants
	V) Many medicinal plants available in the country with very high potential of health and economic benefits has not been well studied scientifically.		**Popularization** Popularize IK
	VI) The type of material used as cement and methods used in constructing ancient structures is not known		
	VII) Some legal barriers in growing, expanding and transporting indigenous plants for commercial aspects		

***Table 3: Interventions and Key Performance Indicators**

Sub Areas and Issues/ Problems	Interventions/Activities									
	Policy Studies	Pure and Applied Research	Innovation	Information and Communication Technologies	Nanotechnology	Biotechnology	Indigenous knowledge & Intellectual Property Rights(IPR)	Testing, Standardization & Accreditation	Capacity Building	Popularization
1) Basic Sciences										
i) Research in basic sciences not developed up to satisfactory standards	√								√	
Time Frame(TF)	Medium									
KPIs i) No. of publications from research on IK ii) Innovations, technologies developed using IK										
Lead Institute (LI)	NASTEC	universities								

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