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BASIC SCIENCES, EMERGING TECHNOLOGIES AND KNOWLEDGE SERVICES

Introduction

It is a well-known fact that most of present day technologies have originated from basic sciences confirming the saying that today's science will become tomorrow's technology. Technology cannot grow in a vacuum. The medium in which modern technology grows is the basic science. Therefore, it opens up new avenues for technological developments. The progress of technology stagnates after some time demanding new discoveries in basic science research for its resuscitation. A classic example is solar cells, which awaits for a scientific breakthrough of finding an efficient material at low cost for producing highly efficient solar cells. Therefore, basic science research and technology has to be developed in parallel, although it takes many years for some findings in basic sciences to be materialized as a technology. Without continuous contribution from basic sciences, technology will cease to progress. A country cannot develop technologically and economically unless it has its own basic science research infrastructure and S&T personnel necessary to support its R&D efforts.

Rapid development of basic sciences has paved 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 for purposes such as aerial surveying, remote sensing and rescue operations. 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 important applications that are closely linked with economic gains.

Sri Lanka is a country blessed with a rich repository of indigenous knowledge developed 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 helps to understand the nature. Discoveries in basic sciences lead to the development of new technologies.
2) Emerging Technologies *i) Space technology* *ii) Micro-electronics, Photonics and Robotics* *iii) Mechatronics* *iv) New materials* *v) Nanotechnology* *vi) Biotechnology*	Space technology, such as remote sensing has many useful applications related to the development of the country. Drones can be used for areal surveying and traffic monitoring, etc. 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. Mechatronics can be used in control systems, automotive engineering and computer-driven machines. There is a potential for producing value-added new materials from locally available minerals.
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 (IK) may 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 are not developed up to satisfactory levels compared to neighboring countries	i) Due recognition should be given to research on basic sciences	**Policy Studies** a) Recognize the importance of research on basic sciences 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 promising young students to study science up to postgraduate level at recognized universities and world class research institutes d) Create postdoctoral positions in universities and research institutes e) Encourage industries to fund basic research providing tax benefits **Capacity Building** a) Strengthen existing research institutes to carry out fundamental research b) Establish state-of-the-art national equipment Centre(s)
	II) Lack of trained personnel in basic sciences	ii) Identifying areas in basic sciences where training is required	
	III) Lack of collaboration with centers of excellence for fundamental research (in other countries)	iii) Provide financial assistance for collaborative research and facilitate them	
	IV) Interest of students to follow science degree programs is decreasing	iv) Establish scholarship schemes to attract students for higher studies in basic sciences	
	V) Unavailability of essential state-of -the –art equipment for scientific research	v) Establishment of a state-of-the –art National Equipment Centre	

Sub Areas	Issues/Problems	Research and Development Needs	Relevant Interventions
2) Emerging Technologies	I) Lack of expertise II) Transfer of knowledge to industrial sector is very low III) Available manpower is underutilized IV) Equipment cost is high and available equipment are not accessible to all scientist in the relevant fields V) Lack of initiative in producing new materials using locally available minerals VI) Available satellite data are not properly utilized	i) Capacity building through scholarships, advanced training etc. ii) Establish a specialized unit for transferring S&T knowledge to industry iii) Identify and pool experts for relevant emerging technology sub-areas iv) Provide training for equipment handling/repairs v) Establish a Central Equipment Laboratory vi) Develop a database of human resources/scientific equipment	**Policy Studies** a) Promote industries for producing new materials utilizing local minerals b) Promote foreign direct investments to produce high-tech products such as silicon chips **Pure and Applied Research** a) Use remotely sensed satellite data for purposes such as for identifying fishing grounds and for studies related to weather forecasting **Capacity Building** a) Develop an adequate human resource pool for relevant Emerging Technology Sub-areas, by providing scholarships for advanced training and retain them by offering incentives b) Establish "Science and technology knowledge transfer and information unit" linking universities and R&D institutes with facilities for commercialization of research under the relevant line ministry c) Establish a central station for training technicians/instrumentation experts to handle and repair equipment **Information and Communication Technologies** a) Develop an on-line database on S&T personnel in the country

Sub Areas	Issues/Problems	Research and Development Needs	Relevant Interventions
3) Indigenous Knowledge(IK)	I) There is a risk of extinction of Ik II) Not much attention is given to IK by policymakers and scientists. Scientific basis of IK is not properly understood and sufficiently protected III) Direct technology transfer ignoring the IK, has created problems, particularly in agriculture sector IV) Many medicinal plants available in the country with very high potential of health and economic benefits has not been well studied scientifically V) Some legal barriers in growing, expanding and transporting indigenous plants for commercial purposes	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 iii) Support the incorporation of relevant IK in agriculture iv) Systematic study on medicinal plants to identify their chemical composition v) Support studies on ancient construction methods vi) Establish a committee within a relevant government institution to review legal aspects of growing, transporting and using medicinal plants for commercial purposes.	**Policy Studies** a) Formulation of a policy to preserve and use IK b) Develop legislations relevant to use of Indigenous medicinal plants **Pure and Applied Research** a) Provide grants for research on IK. Establish specialized committees under funding agencies for identifying relevant research areas and monitoring the progress **Innovations** a) Innovations to incorporate IK in agriculture specially in large scale farming **Testing, Standardization and Accreditation** a) Standardization of Indigenous medicinal products b) Develop standards to practice indigenous medicine **Popularization** a) Popularize IK