Implementation Strategies of National Research and Development Framework (NRDF)

National Science and Technology Commission (NASTEC)

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Chapter 01

1. Introduction

The National Research and Development Framework (NRDF) is a comprehensive document which is intended to be used as the blueprint for guiding research and development-related activities in the Science and Technology (S & T) sector in Sri Lanka towards national development. It was developed through a consultative process which involved a representative cross-section of the S & T community including public sector institutional researchers, academia and relevant personnel from the private sector and the non-governmental organization (NGO) sector. The draft NRDF was discussed and ratified by the S & T community at the 7th Biennial Conference on Science & Technology (BICOST VII) held on 7th July 2014. It was subsequently approved by the Cabinet of Ministers on 03 May 2016.

As the NRDF has been approved by the Cabinet of Ministers as the National Framework for Research and Development of Sri Lanka, it is the duty of all stakeholders to provide their maximum support for its implementation.

The main objective of the National Research and Development Framework (NRDF) is to provide directions to scientists, administrators, policy makers and other relevant decision makers to make a concerted effort to take the country forward through appropriate Research and Development (R&D) activities.

The NRDF has identified 10 areas and their relevant significant issues on which R & D activities should be focused. These areas are; i) Water, ii) Food, Nutrition and Agriculture, iii) Health, iv) Shelter, v) Environment, vi) Energy, vii) Mineral Resources, viii) Textile & Apparel, ix) Information, Communication Technology and Knowledge Services, and x) Basic Sciences, Emerging Technologies and Indigenous Knowledge. The first five areas of the list cater to improving quality of life while the latter five contribute to economic development.

In the NRDF, each focus area has been further divided into sub-areas. Under each sub-area, issues and problems that prevailed at the time of formulating the NRDF have been identified. Furthermore, the NRDF outlines broad R & D needs to effectively address the identified issues/problems and specific interventions.

The specific objective of BICOST VIII, held on 24th and 25th November 2016, was to formulate a strategy for the implementation of the interventions identified in the NRDF in the 10 focus areas. As was done in the development of NRDF, its implementation strategy was also formulated through a consultative process culminating in BICOST VIII.

The NRDF has suggested more than 450 interventions under ten major fields to solve the issues/problems identified. The ten fields are; i) Policy formulation, ii) Pure and

applied research, iii) Promotion of innovation, iv) Application of nanotechnology, v) Application of biotechnology, vi) Application of indigenous knowledge, vii) Testing, standardization, accreditation, and assurance of Intellectual Property Rights (IPR), viii) Capacity building, xi) Application of Information Communication Technologies (ICT), and x) Popularization.

The NRDF has been developed as a 10 x 10 matrix consisting of 10 focus areas AND 10 R & D interventions (Table 1).

Table 1: Basic framework of NRDF as a 10 x 10 matrix -

Interventions Focus areas	Policy Formulation	Pure & Applied Research	Promotion of Innovation	Application of Nanotechnology	Application of Biotechnology	Application of Indigenous Knowledge	Testing, Standardization & Accreditation and Assurance of IPR	Capacity Building	Application of ICT	Popularization
Water										
Food, Nutrition & Agriculture										
Health										
Shelter										
Environment										
Energy										
Mineral Resources										
Textile and Apparel										
ICT & Knowledge Services										
Basic Sciences, Emerging Technologies & Indigenous Knowledge										

If all R&D activities are properly planned and implemented as recommended in the NRDF, the country is expected to progress steadily towards sustainable development, where the economy, environment and the society are benefitted equally. -. To achieve this, it is necessary that all stakeholders work together in a concerted manner contributing their intellectual skills, time and other resources.

Implementation of NRDF will be carried out via the following multiple pathways:

1. Implementation in terms of directives:

The NRDF can be implemented through formulation of policies and regulations for, accreditation, standardization popularization and IP rights.

2. Implementation by prioritization and persuasion through incentives:

I. Prioritization:

The NRDF can be promoted among the R & D personnel by according priority to areas identified in the NRDF when awarding research grants from state-sector organizations (NSF, NRC, CARP, Other grants from Treasury and foreign funds)

II. Incentives:

The NRDF can be promoted further by introduction of special reward schemes for scientists working on problems identified in NRDF. Furthermore, introduction of revisions to the existing evaluation schemes for granting promotions to R & D personnel which gives recognition to work related to NRDF could accelerate implementation of R & D as identified as prioritized in the NRDF.

2. Development of the NRDF implementation strategy

The 10 expert groups which prepared the respective sections of the NRDF in the 10 focus areas met prior to BICOST-VIII and provided suggestions on the implementation strategy for NRDF. These suggestions have been further discussed at the Steering Committee of BICOST-VIII, which included Chairpersons of the 10 expert committees– (Chapter 3).

The recommendations made at BICOST-VIII were to formulate a generic implementation strategy, which would provide broad guidelines and structures within which implementation strategies specific to each focus area could be incorporated.

2.1 Generic Implementation Strategy

The generic implementation strategy will consist of the following:

(2.1.1) Awareness creation and implementation of interventions outlined in the NRDF

(2.1.2) Progress monitoring and evaluation (PME) of implementation

(3.1.3) Reviewing and updating the NRDF

Suggested operational details of the above strategies are given in **Chapter 1**.

(2.2) Implementation strategies specific to each focus areas

Recommendations made at the BICOST- VIII are given in **Chapter 2**.

The specific implementation strategies discussed during BICOST-VIII are included in **Chapter 3**.

Chapter -02

Suggested Organizational structure for the implementation of NRDF (ref. Organogram in Figure 1)

The above strategies shall be implemented by an institutional framework consisting of three committees as shown in the organogram given. **According to the relevant cabinet decision,** the onus to oversee the implementation of NRDF is entrusted upon the Secretary to the Ministry of Science, Technology and Research (MSTR).

The suggested institutional framework will consist of three committees **(Figure 1)**:

I. A Presidential Task Force (PTF)

As the 10 focus areas fall within the purview of several ministries, it is suggested that a high powered Presidential Task Force (PTF) be constituted to oversee implementation of the NRDF. Suggested composition of the PTF is given in Figure 1. Provision to invite/co-opt relevant personnel shall be allowed as and when necessary. The PTF shall meet bi-annually.

II. An Inter-Ministerial Committee (IMC)

For closer monitoring and evaluation of progress of implementation of the NRDF, it is further suggested that an Inter-Ministerial Committee (IMC) be constituted with the MoSTR as the focal point. Suggested composition of the IMC is given in Figure 1. Provision to invite/co-opt relevant personnel shall be allowed as and when necessary. The IMC shall meet quarterly.

III. A Working Committee of Technical Experts (WC)

It is proposed that a Working Committee consisting of technical experts, who will be nominated by the Secretaries of relevant ministries, be constituted to undertake the implementation measures (e.g. specific programmes and projects) that are agreed upon in the 10 focus groups. The working committee will be chaired by a technical expert nominated by the Hon. Minister of STR and will consist of a minimum of one technical expert each from the ten focus areas. Focus groups which incorporate several focus areas (e.g. Food, Nutrition and Agriculture) may nominate more than one technical expert to the Working Committee. It is proposed that one of the four representatives of the MoSTR in the Inter-Ministerial Committee be co-opted to the Working Committee to liaise between the two committees. A Senior Scientific Officer from NASTEC should be co-opted to the Working Committee to co-ordinate convening and reporting of its activities. Other scientists may be invited to specific meetings as and when required depending on the agenda of the meeting .

It is proposed that the Working Committee meet once in every two months, preferably 1–2 weeks prior to the quarterly Inter-Ministerial Committee meeting. This will ensure that technical progress in the implementation of NRDF programmes and projects is

presented to the Inter-Ministerial Committee and any constraints and bottlenecks are reported and addressed promptly.

It is recommended that provision is made available to co-opt technical experts to this Working Committee as and when necessary. By ensuring the participation of technical experts from all focus areas, the proposed Working Committee is expected to ensure adequate inter-sectoral co-ordination in the implementation of multi-disciplinary and inter-disciplinary R & D programmes and projects identified in the NRDF.

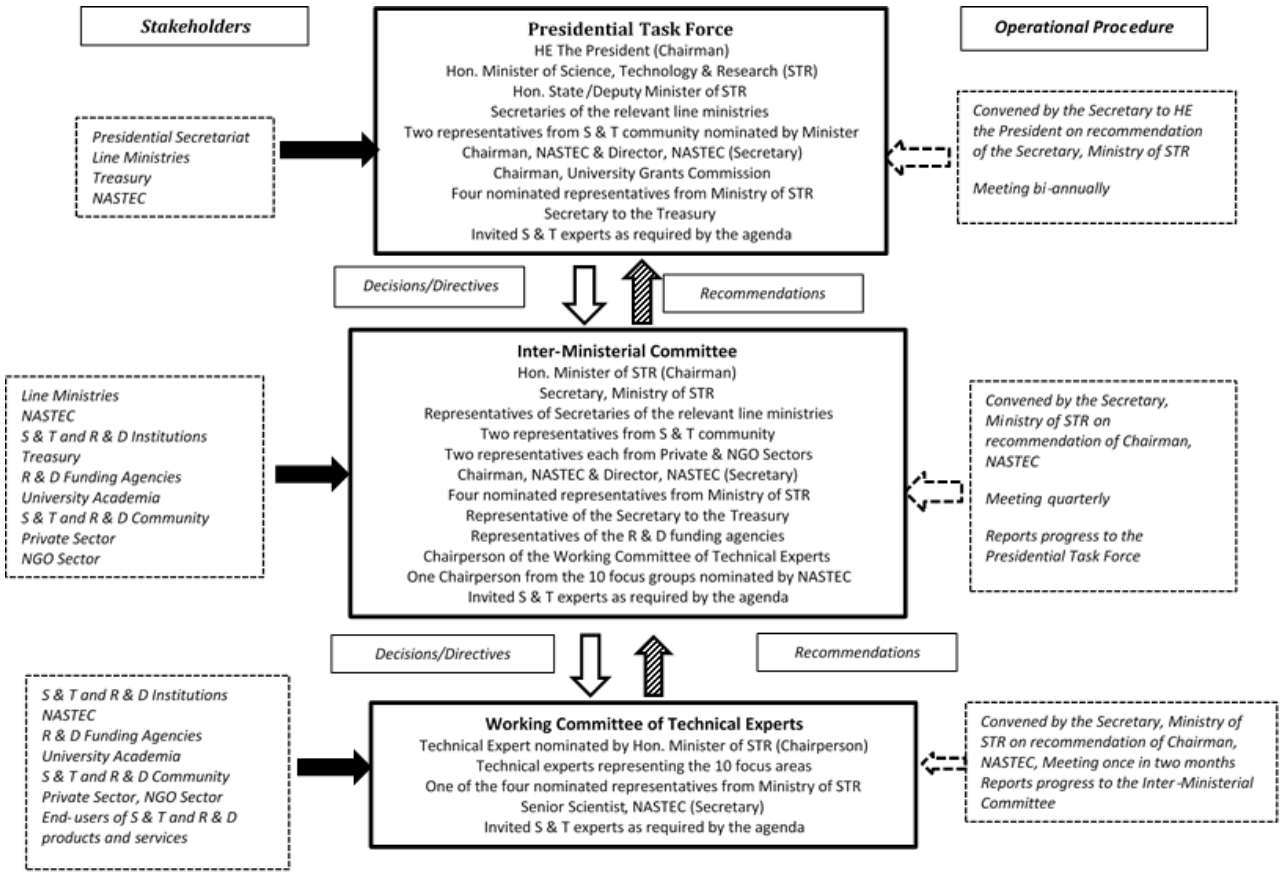

Figure 1: Proposed Institutional Framework for Implementation of NRDF

Chapter 03:

Suggested Operational Details of Implementation Strategies

(1) Strategies for awareness creation and implementation of interventions outlined in NRDF

(1.A) Creating awareness on NRDF among the stakeholders

1. A. 1 Creating awareness among funding agencies

As funding is important for successful implementation of the NRDF, NASTEC should do awareness creating presentations to highlight the importance of the Framework for the senior officials of the General Treasury, the External Resources Department (ERD), the Department of National Planning University Grants Commission, National Science Foundation and National Research Council, Council for Agriculture Research Policy at their respective offices. At these presentations, the necessity of giving priority to R & D work identified in the Framework needs to be highlighted. The Treasury/Department of National Planning should request the national funding agencies and the UGC/universities to give high priority to the projects/programmes which are aligned with the recommendations of the NRDF.

Furthermore, it is proposed that the above agencies and other such agencies use the NRDF as the principal blueprint for funding R & D activities in the S & T sector.

It is also proposed that NASTEC, via the Working Committee and the Inter-Ministerial Committee, explore the possibility of securing international donor funding for implementation of programmes and projects that have been identified in the NRDF.

1. A. 2 Creating awareness among S & T/ R&D institutions and relevant line ministries

It is recommended that a meeting of the Forum of Directors of the NASTEC be called and be requested to propose how best they could implement the NRDF in their respective institutions. It is suggested that they be asked to identify areas where they could initiate implementation. Subsequently, NASTEC may advice the treasury to provide necessary funds for those identified activities. As R & D activities carried out in the university sector also play an important role, UGC/universities should also be involved in the decision making process for successful implementation of the identified activities. It should be realized that more than 75% of the active R & D workforce in the country comes from the university sector. Therefore, it is imperative that awareness presentations are done at each institute and university faculty.

It is suggested that institutions that are under the purview of the MSTR be requested to identify activities/interventions in the framework where initiation of implementation is feasible. They may be requested to formulate detailed plans and time lines for these identified activities. Implementation of these activities could begin with the overall direction of the Secretary to the MoSTR and the respective Directors of the institutions. R & D activities relevant to institutions which do not come under the purview of the

MoSTR (e.g. agricultural research institutes, MRI, NARA etc.) could be initiated with the direction of Secretaries of the respective Ministries.

It is suggested that institutions that are not under the purview of the MoSTR, be sent directives through the Inter-Ministerial Committee to initiate implementation of the interventions of the Framework which are relevant to their focus areas.

1. A. 3 Creating awareness among researchers from universities and higher educational institutions

Universities play an appreciable role in conducting research. As such, it is suggested that the UGC and the Committee of Vice-Chancellors and Directors (CVCD) are made aware of the NRDF so that interventions identified in the NRDF are accorded priority when allocating UGC funding for research. Furthermore, the CVCD could be advised to consider achievements in R & D activities identified in the NRDF in selecting university researchers for CVCD awards.

It is also important that the promotion criteria for university academics be linked to the NRDF by allocating more points (for promotions) for successfully implemented NRDF based research projects. This way, the university R & D can be focused more on NRDF based activities.

1. A. 4 Creating awareness among the private sector and the NGO sector

Although the amount of research conducted in the private sector organizations and in the NGO sector is limited, these two sectors could be important vehicles for transfer of technologies generated through research for their commercialization. Therefore, it is suggested that awareness about the NRDF is created among the private sector through consultations between officials of NASTEC and umbrella organizations such as the National Chamber of Commerce and various institutions representing different areas of the private sector. Similarly, awareness creation within the NGO sector could be carried out via consultations between NASTEC and selected NGOs.

1. A. 5 Creating awareness among professional organizations

Professional organizations bring together professionals in a given focus area from a wide range of institutions and sectors. As such, they can play an important role in disseminating knowledge about the NRDF and its proposed interventions. Therefore, awareness about the NRDF could be created among the professional organizations such as SLAAS, ICHEM, IPSL, IESL, IEPSL and IOB through consultations between their office bearers and NASTEC officials.

(1.B) implementation of interventions outlined in NRDF

1. B. 1 Streamlining of the on-going R & D activities along with activities proposed in the NRDF

It is recognized that many of the on-going R & D activities in most R & D institutions and universities are either directly- or indirectly related to the problems/issues identified in the NRDF. Therefore, it is proposed that these on-going R & D activities are streamlined along with the *activities proposed in the* NRDF and financial and infrastructure support is provided.

1. B. 2 Implementation of new initiatives/programmes/projects based on suggested interventions in the NRDF

Strategies for implementation of new initiatives as outlined in the NRDF have been suggested by the 10 focus groups. These are included in **Chapter 4** under specific implementation strategies.

(2) Strategy for progress monitoring and evaluation (PME) of implementation

Progress monitoring and evaluation of NRDF implementation will be overseen by the institutional framework consisting of the three committees (Figure. 1):

- The high powered Presidential Task Force chaired by His Excellency the President, which meets biannually
- The Inter-Ministerial Committee chaired by the Hon. Minister of STR, which meets quarterly
- The Working Committee of Technical Experts chaired by a Technical Expert nominated by the Minister of STR, which meets once in two months

(3) Strategy for reviewing and updating the NRDF

It is recognized that the NRDF, in its present form, may not be all-encompassing in its identification of sub-areas, issues/problems, R & D needs and relevant interventions within each of the 10 focus areas. As such, it is suggested that the NRDF be reviewed and updated on an annual/biennial basis. It is suggested that NASTEC identify a specific month of the year for reviewing and revising the NRDF. Prior to this specific month, NASTEC may contact all relevant stakeholders for their suggestions for revision of the NRDF. After careful deliberation, these suggestions may be forwarded to the Working Committee, Inter-Ministerial Committee and the Presidential Task Force for ratification.

Further suggestions on operational strategy of the institutional framework

Appointment of ministry representatives to the Inter-Ministerial Committee

It is emphasized that either the Secretary of the relevant line ministry or a representative of the Secretary should be appointed to the Inter-Ministerial Committee (IMC). Secretary/Representative should be a permanent member and he/she needs to attend all meetings of the IMC. If a representative is nominated, NASTEC is expected to advice the Ministry Secretary regarding the suitability (i.e. be a knowledgeable and interested person in the specific focus area) of the person to be nominated.

Appointment of the representative from the Treasury to the Inter-Ministerial Committee

It is suggested that NASTEC request Secretary to the Treasury to appoint a suitable person to serve in the IMC. Further, the Treasury is expected toeducate its senior officials on the activities related to implementation of NRDF, which is approved and mandated by the Cabinet of Ministers.

Regular meetings between NASTEC and the Treasury

It is suggested that regular meetings be held between NASTEC and the Treasury regarding the implementation of programmes and projects of the NRDF. In particular, it is suggested to have a series of meetings prior to finalizing the national budget proposals.

Identification of funding avenues for implementation of NRDF

NASTEC is expected to identify alternative local and international funding agencies for the implementation of activities proposed in the NRDF. Further, NASTEC should maintain records of funding agencies that operate within the country. This may include agencies such as the UGC, NSF, NRC, CARP, Focal point of the Global Environmental Facility (GEF), UNDP and ERD, the government agency that approves foreign funded projects. It is proposed that NASTEC maintain a record of on-going and proposed projects for funding in order to monitor the progress of NRDF implementation.

Further activities to create awareness about the prioritized research areas in the NRDF

Further to the initial activities to create a general awareness about the NRDF, it is proposed that NASTEC carry out activities to create awareness about the prioritized research areas in the NRDF among the relevant academic and research institutes.

Creating linkages among organizations in the public-, private- and NGO sectors through Public-Private Partnerships (PPP)

In keeping with the government policy, it is suggested that NASTEC facilitate establishment of linkages among organizations/institutions of the public- and private sectors via PPP. It is further suggested to create awareness and subsequent linkages with the NGO sector via consultation between NASTEC and selected NGOs. It is emphasized that careful identification of relevant and important NGOs is necessary in this process.

Continuation of awareness creation activities

It is suggested that awareness creating programs among universities, professional organizations and other stakeholder organizations be organized on a regular basis. Similarly, it is suggested to conduct regular progress monitoring programs.

Awareness creation among expert committees within ministries and R & D organizations

It is proposed that NASTEC create awareness among expert committees in relevant ministries and R & D organizations regarding prioritized research areas and obtain status reports on on-going research. It is suggested that continuous updates and feed backs are obtained from those bodies. Appropriate action for facilitation, trouble-shooting and course-correction may be taken through the three committees in the institutional framework as outlined in Fig. 1.

Chapter 4

Suggested specific implementation strategies in the 10 focus areas (pre-BICOST VIII)

Focus Area 01: Water

- Take the Sustainable Development Goals (SDGs) in to consideration when implementing the NRDF
- Incorporate Integrated Water Resources Management (IWRM) in the implementation plan of NRDF and establish a regime for IWRM

Focus Area 02: Food, Nutrition and Agriculture

- The high powered Presidential Task Force (PTF) should act as the authorized body in formulation, selection, approval, funding and coordination of R & D related to Food, Nutrition and Agriculture (FNA) sectors.
- Private sector to be included in the PTF.
- Develop a data base, linked with ICT, on research carried out, ongoing research and proposed research in all research institutes, universities and higher educational institutes and make it available to the three committees in the institutional framework.
- Develop a user-friendly National Centre for Information, linked with ICT and available in the public domain, to act as a repository of information for consumers and farmers to collect relevant information.
- Promote user-friendly methods to test quality of foods. Example: User-friendly equipment to test toxins in foods
- Revise and update research programs in FNA sectors in the NRDF biennially. Minor revisions in research programs to be carried out quarterly.
- The three committees in the institutional framework should develop a grading system for evaluation of scientists. A greater weightage should be given for locally-applicable research in this evaluation after assessing their impacts.
- Solicit funding from international donor agencies for implementation of interventions outlined in the NRDF.

Focus Area 03: Health

- A meeting with all governmental funding agencies and the External Resources Department (ERD) to express their commitment to NRDF as a guide for providing funds for R & D programmes and projects

- When implementing R & D activities identified in the NRDF, not only their commercial returns but also their social returns have to be taken in to consideration.

Focus Area 04: Shelter

- A Research/Knowledge Centre to be established as a central point of contact for R & D and as a knowledge management platform on all aspects of shelter
- This Centre is to be established in the Ministry of STR so that all aspects of shelter including the architectural, town planning, construction and sociological aspects could be accorded adequate priority and consideration

Focus Area 05: Environment

- Ministry of Disaster Management and some of the agencies that will be established in the near future to focus on addressing climate change-related issues (e.g. Climate Change Commission, Green Growth Institute etc..) are included in the list of implementation agencies in this focus area
- Key policy interventions on environmental issues (e.g. environmental pollution) to be included in the implementation plan
- Expert Committee (Environment) will review progress reports obtained from research programmes/projects related to NRDF when NASTEC requests Expert committee needs to evaluate effective implementation of policies related to environmental issues and needs to recommend improvements and help update them (policies) based on the current situation rather than making new policies.
- As environmental pollution is increasing, continuous monitoring is necessary and as such it is recommended to set up a monitoring unit at a relevant institute (e.g. CEA).
- It is necessary to create proper public awareness programs related environmental hazards in specific areas such as health, solid waste disposal etc.
- It is recommended that the expert committee provide inputs for implementing international conventions related to environment.
- After agreeing to the Paris Agreement on Climate Change, H.E. the President launched a programme called "Sri Lanka NEXT – Blue Green Era" focusing on economic development of Sri Lanka using natural resources of the vast ocean belonging to us and the land resources available in an environment friendly and sustainable manner. Also in association with the Paris agreement, Sri Lanka has submitted Nationally Determined Contributions (NDCs) to be implemented in the future. NDCs include Energy, Transport, Industry, Waste Management and Forestry as sectors for climate change mitigation initiatives. Sectors identified for adaptation are Health, Water, Food Security (Agriculture, Livestock, and Fisheries), Water and Irrigation, Coastal and Marine sector, Biodiversity, Urban infrastructure, and Human Settlement and Tourism. Further, the committee on

climate change and natural disasters at the NSF has initiated a thematic research programme on Climate Change. Therefore, it is suggested to have a dialogue with the Climate Change Secretariat of the Ministry of Environment and Climate Change and Natural Disaster committee at the NSF to discuss future directions that should be taken in implementing NRDF.

Focus Area 06: Energy

Relevant implementing agencies for interventions given in NRDF in the respective sub-areas within the Energy sector are given in Table A2.1.

Table 2 Implementing agencies for interventions identified in NRDF in the sub-areas of the Energy sector

No.	Sub areas	Agency
1	Assessment of indigenous energy resources	SEA (Sustainable Energy Authority of Sri Lanka)
2	RE technology development for electricity generation	SEA
3	RE technology development for Thermal Energy applications	NIFS
4	RE technology development for Transport applications	University of Colombo, Department of Economics
5	RE for other energy uses and non-energy services	NIFS
6	Indigenous resource development	Bio Energy Association
7	Effective energy storage systems	Develop pump storage systems- CEB Develop battery technologies- ITI
8	National Electricity Infrastructure/Grid Architectures	CEB
9	Energy conservation in the domestic sector	NERDC
10	Energy conservation in the Commercial and Industrial sectors	Green Building Council
11	Energy conservation in the power sector	CEB
12	Energy conservation in the Transport sector	University of Moratuwa Department of Mechanical Engineering
13	Energy Efficient Zones/ Communities	UDA
14	Smart metering	LECO

Focus Area 07: Mineral Resources

- The sub-committee on Mineral Resources considers the proposals of NRDF are relevant within the context of the present times.
- It is recommended that monitoring of implementation of NRDF be conducted by scientists and technical experts.
- The sub-committee recognizes the importance of identifying all relevant institutions in the implementation plan of NRDF.

Focus Area 08: Textile and Apparel

Resources and financing schemes

- To maximize synergies and avoid redundancies, both private and public sector R&D Programmes must be coordinated to avoid duplication in project funding, which can come through treasury funding, donor funding through the ERD, private funding and private public partnerships.
- For textile and apparel sector, all the funding could be channeled through the Textile Division of the Ministry of Industry and Commerce (MIC). Funding should be allocated to all the Textile universities and the research institute that comes under other ministries through the MIC.
- Private-public partnerships are encouraged as there is no state textile and apparel industry.
- R&D commercialization and product development has to be done in collaboration with the industry. Funding from both government and private sectors could be obtained by establishing a consortium through JAAF, Universities, SLITA and private sector R &D entities.
- The allocation of resources is critical to the success of the NRDF and the achievement of a balanced textile and apparel research portfolio. In this respect textile R&D steering committee should develop guidelines as to how resources will be allocated and reviewed through various criteria across the R & D portfolio and by research type.

Management/Regulatory frame work

Setting up a steering committee

Recommend setting up a R & D steering committee headed by the Minister of Industry and Commerce, comprising a team of skilled and experienced members from relevant ministries, universities, institutes, and private sector.

Functions of the steering committee will be to:

- Access innovative and potentially transformational ideas across the textile and apparel sector

- Engage with a broader audience to expand demand-driven T & A research
- Develop and support a culture of innovation within Universities, R & D institutes and the industry
- Bring to T & A industry a greater diversity of cross-disciplinary R & D such as textile materials, nanotechnology, innovative dyeing & finishing, textile process and product improvement as identified in the NRDF

Collaborative partnerships with industry in R & D delivery

- Collaborative partnerships are intended to support commercialization of research ideas coming from state R & D institutes. It is proposed to set up an Industry Advisory Committee to evaluate and endorse their potential for commercialization.
- The R & D Steering Committee should give priority to industry oriented forward-looking R & D investments that have national interest.

Textile Research Institute

- Setting up a Textile Research Institute is recommended to cater to this very important industry

Monitoring of R & D Achievement

The Steering Committee should promote the process and a culture T & A R & D and monitor its success via the following activities:

a) Regular reviews of the projects under NRDF R&D investments.

b) External independent assessment of overall research and development performance

c) Annual surveys of industry and all stakeholders

d) Evaluation of NRDF project impact on industry development

R & D Project performance could be assessed through:

a) Financial performance and analysis

b) Audits and reviews

c) R & D portfolio analysis

d) Research dissemination (publication, patents etc.)

Industry performance could be assessed through:

a) Surveys of industry stakeholders and customers

b) New Product/ Process developments / Patents

c) Technological, economic, social, environmental performance of the industry

Focus Area 09: Information Communication Technology and Knowledge Services

This focus group did not meet prior to BICOST VIII. Therefore, the activities and sub-activities identified in Chapter 5 will form the basis for specific implementation strategies in this focus area.

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

- R & D projects, rather than strategies, should be identified with cost-benefit analyses

Chapter 5

Specific implementation strategies in the 10 focus areas discussed during BICOST VIII

Focus Area 01: Water

Sub Area and Issues/Problems	Relevant Interventions	Priority H-High, M-Medium, L-Low	Actions	Implementing Agency/Agencies	Funding Agency / Agencies
Sub Area – 1)Water availability **Issues/Problems-** I) Absence of measures incorporated into meeting drinking water demand and supply in emergencies caused by climate change and other disasters	**Pure and Applied Research** a) Assessments on quality and quantity of surface water/ground water	H	Assess quality and quantity of water, Increase funding	DoA, NWSDB, WRB, ID, MASL, PCs, NIFS, ITI, Universities, CEA, Department of Agrarian Development(DAD)	GoSL, Donor Agencies
	b) Conjunctive land and water planning, green infrastructure, flood protection, environmental protection considering climate change, population increase, industrial and economic growth based on modelling	M	Collection of primary and secondary data for prediction and forecasting , Developing interventions, Implementing the interventions	Universities, DoA, UDA, Local Governments(LGs), Provincial Councils(PCs), Ministry of Megapolis and Western Development(MoMWD)	GoSL, Donor Agencies
II) Adverse impacts of droughts and	**Pure and Applied Research** a) Hydrological modeling to	M	Data collection, Consultancy and training,	Universities, NWSDB, NIFS, WRB, IWMI	GoSL, Donor Agencies

other extreme events due to climate change on water resources	determine changes in runoff		Development of models		
III) Depletion of water sources due to extensive pumping, urbanization, climate change, afforestation and deforestation	**Pure and Applied Research** a) Quantification of water use by sector	M	Collection of data, Preparation of water budget for each sector	NWSDB, WRB, DoA, ASD, DAD, MASL, IWMI	GoSL, Donor Agencies
IV) Inadequacy of water supply	b)Projection of water demand	M	Data collection and modelling	NWSDB, WRB, DoA, DAD, ID, MASL, IWMI	GoSL, Donor Agencies
V) Increasing demand for water	**Innovations** a)Reuse of reclaimed water	H	Promotional technologies	WRB, NSWDB, DoA, Universities, NIFS, ITI, SLINTEC,NERD Centre, Mo Industries(MI)	GoSL, Donor Agencies, Private Sector
	Popularization a) Water conservation	H	Create awareness on water conservation among all sectors of the population	CEA, Universities, DAD, WRB, NSWDB, DoA, DI, MASL, Professionals Associations, Ministry of Education, PCs, PEA, Mass Media, Telecom Service Providers	GoSL, Donor Agencies, Private Sector, Telecom Service Providers
	b) Control deforestation (watershed management)	H	Create awareness on water conservation among all sectors of the population	CEA, Universities, DAD, WRB, NSWDB, DoA, DI, MASL, Professionals Associations, Ministry of Education, PCs, PEA, Mass Media, Telecom	GoSL, Donor Agencies, Private Sector

				Service Providers, Department of Forest Conservation	
Sub Area – 2)Water quality (drinking /irrigation water) **Issues/Problems-** I) Deteriorating water quality due to soil erosion, sand mining and salt water intrusion etc.	**Policy Studies** a) Control of land erosion and sediment transport	H	Formulate study groups with expertise on erosion assessment, Monitoring sediment flows, Develop policies, Publish policies for public comments, Validate the policies , Validate Cabinet approval, Implement policies, Formulate rules and regulation based on policies, Get necessary approval, Impose rules and regulation	DoA, RDA, MASL, SLLRDC, NBRO, DAD, NASTEC, Universities, Mo Lands(ML), PEA, LGs, PCs, CEA, Land Use Policy Planning Department(LUPPD)	GoSL, Donor Agencies
	b) Monitoring and management of sand mining in major rivers and streams	H	Formulate study groups with expertise, Develop policies, Publish policies for public comments, Validate the policies , Validate Cabinet approval, Implement policies, Formulate rules and regulation based on policies, Get necessary approval, Impose rules and regulation	GSMB, CEA, DSDs, DI, PEA, WRB, NASTEC	GoSL, Donor Agencies
	Pure and Applied Research a) Water quality monitoring network (Water data sharing)	H	Collecting data, Creating a common database, Encourage data sharing	NWSDB, WRB, MASL, CEA, PEA, Universities, NIFS, ITI, DAD, ICTA	GoSL, Donor Agencies

	Innovations a) Interventions against saltwater intrusion and contamination	M	Geophysical data collection, modelling, Developing innovations, Application of the innovation	NWSDB, WRB, CEA, Universities, DoA, NIFS, ITI, ID, NERD Centre	GoSL, Donor Agencies
	Testing, Standardization and Accreditation a) Establishment of water quality monitoring network	M	Establishing and maintaining network	NWSDB, WRB, CEA, Universities, NIFS, PEA, ITI, DAD, ICTA, ID, MoI	GoSL, Donor Agencies
II) Impacts on water due to uncontrolled dumping of household, industrial and hospital waste, wastewater discharge, intensive fertilizer and pesticide application, and sewage disposal	**Policy Studies** a)Manage point and non-point source pollution	M	Formulate study groups with expertise, Develop policies, Publish policies for public comments, Validate the policies , Validate Cabinet approval, Implement policies, Formulate rules and regulation based on policies, Get necessary approval, Impose rules and regulation	NASTEC, CEA, LUPPD, PEA NWSDB, WRB, Universities, NIFS, MASL, MOSTR, UDA, LGs, PCs, MOMWD	GoSL, Donor Agencies
	Pure and Applied Research a)Water treatment before return flow enters streams and rivers	M	Monitor quality of effluent water at the point of discharge and along the streams and rivers	NWSDB, CEA, LGs, Universities, NIFS, PEA, PCs, ITI, MOI, BOI	GoSL, Donor Agencies
	Testing, Standardization and Accreditation a) Development of standards for locating water supply wells and tanks	M	Formulate expert groups, Developing new standards, Revising existing standards	CEA, MoH, ITI, NWSDB, WRB, Universities, NIFS, PEA, SLSI, SLAB	GoSL, Donor Agencies
III) Lack of solid waste management	**Policy Studies** a) Plans for solid waste management	H	Formulate study groups with expertise, Develop	NASTEC/MOSTR, WMA, CEA, PEA, LGs,	GoSL, Donor Agencies

practices			policies, Publish policies for public comments, Validate the policies , Validate Cabinet approval, Implement policies, Formulate rules and regulation based on policies, Get necessary approval, Impose rules and regulation	PCs, NWSDB, MASL, WRB, UDA, MoMWD, LUPPD	
	Innovations a) Generating energy from solid waste	M	Develop innovations for generating energy from solid waste	Universities, NERD Centre, LGs, PCs, CEA, PEA, Private sector, MoPE, SEA	GoSL, Donor Agencies, Private sector,
IV) Water quality deterioration due to floods	**Pure and Applied Research** a) Flood studies (water security)	L	Conducting research on floods, Data collection, Modelling , Forecasting	ID, Universities, LGs,PCs, SLLRDE, MASL	GoSL, Donor Agencies
	Innovations a) Drainage improvements both regionally and locally	M	Identification of drainage pathways, Rehabilitation of existing drainage systems	SLLRDC, DI, MASL, DAD, LGs, PCs, MoMWD, DI	GoSL, Donor Agencies
	Biotechnology a) Storm water management	L	Identification of drainage pathways, Rehabilitation of existing drainage systems	SLLRDC, DI, MASL, DAD, LGs, PCs, MoMWD, DI	GoSL, Donor Agencies
	Indigenous Knowledge and Intellectual Property Rights a) Rehabilitation of tank cascade system	H	Restoration of available tanks systems, Upper catchment and command management	DI, MASL, NGOs, Universities, MASL, DAD	GoSL, Donor Agencies
V) Lack of data on water quality, quantity, temporal	**Information and Communication Technologies** a) Centralized database available to	H	Create a centralized database, Data sharing,	ICTA, DI, IWMI, NSF, DAD	GoSL, Donor Agencies

changes and future predictions	public		QA/QC by the authority, Awareness		
VI) Lack of interest in rainwater harvesting and treating and reusing wastewater	**Pure and Applied Research** a) Research on the quality, and health issues related to rainwater and reuse of treated wastewater	M	Monitoring rainwater periodically, Research on safe collection of rainwater, Awareness	ITI, CEA, PEA, NSWDB, WRB, Lanka Rainwater Harvesting Forum (LRHF), MoH, Universities, NIFS	GoSL, Donor Agencies
	Innovations a) Low-cost house-hold rainwater harvesting systems	H	Recharge excess rainwater into existing wells, Promotion of PATHAHA systems, Incentives	NSWDB, WRB, LRHF, NERD Centre	GoSL, Donor Agencies
	b) Wastewater treatments	H	Separation of different grades of water, Promotion of ecological sanitation, Encourage multiple usage of water	CEA, NSWDB, WRB, ACCIMT, NIFS, Universities	GoSL, Donor Agencies
	Testing, Standardization and Accreditation a) Quality assessment	M	Collecting rainwater, Determine the quality parameters, Determine whether quality conforms to the standards	ITI, CEA, PEA, Universities, SLSI, SLAB	GoSL, Donor Agencies
	Popularization a) Promote rainwater harvesting, especially in dry the zone	M	Popularization of rainwater harvesting structures, Providing incentives	LGs, PCs, UDA NSWDB, WRB, LRHF, MASL, DAD, DI, DoA	GoSL, Donor Agencies
Sub Area – 3) Planning, development, management and governance	**Capacity Building** a) Strengthening existing institutional arrangements for water resources management	H	Widening the outlook on water beyond the relevant agencies, Inter-Agency coordination, Improving institutional capacities	MoSTR, DI, NWSDB, WRB, MASL, ASD	GoSL, Donor agencies

Issues/Problems- I) Institutional fragmentation, lack of coordination	b)Establishment of an all-inclusive water council of the stakeholders	H	Periodic consultation of relevant agencies	MoSTR, DaD, DI, MASL, WRB, NWDSB, DoA, Department of Fisheries & Aquatic Resources(DFAR), Universities, ITI, NASTEC, SLLRDC, GSMB, UDA, LGs, CEA, PEA, MoMWD	GoSL, Donor Agencies
	Indigenous Knowledge and IPR a)Research on Indigenous knowledge based water conservation & tank cascade management	M	Data gathering on indigenous methods of water conservation using questionnaire survey and perusing ola-leaf manuscripts	DAD, DI, MASL, PCs, NGOs, Universities, MASL	GoSL, Donor Agencies
	Popularization a) Popularization Integrated Water Resource Management	H	Popularization Integrated Water Resource Management	Professional bodies, Universities, MoE, DI, DAD, LRHF, Mass media, Telecom service providers, NSF	GoSL, Donor Agencies, Private sector
II) Lack of comprehensive policy, planning, and implementation	**Policy Studies** a)Evaluate the existing policies for consistency	M	Appointing study groups with experts, Finding gaps, Revising existing policies, Getting Cabinet approval	NASTEC, WRB, NWDSB, MASL, DI, DAD, CEA, PEA	GoSL, Donor Agencies
	b)Introduce sector- wise water resources planning	M	Appointing study groups with relevant experts, Develop policies, Publishing policies for public comment,	MoSTR/NASTEC	GoSL, Donor Agencies

			Validation of Policies, Cabinet approval, Implementing policies		
Sub Area – **4) Water conservation** **Issues/Problems-** I) Inappropriate arrangements for managing wastewater	**Policy Studies** a) Enforce existing laws	M	Enforce existing laws	Police, Judiciary, CEA, PEA, DI, MASL, WRB, NWDSB, DAD, SLLRDC	GoSL
	Pure and Applied Research a) Funding more research towards low cost water treatment options	H	Promoting Electrocoagulation, Bio sand filtration, Material research, Low cost water treatments methods	Universities, Private sector, NERD Centre, Mo Industries(MI)	NGOs, UNICEF, WHO, GoSL
	Innovations a) Develop practical treatment techniques	H	Develop treatment systems which can small and households	Universities, NERD Centre, Private sector, MI, ITI	NGOs, UNICEF, WHO, GoSL
	Nanotechnology a)Nanotechnology based wastewater treatment systems	M	Increase research collaboration, Develop nanotechnology based wastewater treatment systems	SLINTEC, NWDSB, WRB	GoSL, Donor Agencies
	Testing, Standardization and Accreditation a)Establishment of monitoring networks	M	Establishment of monitoring networks	CEA, PEA, ITI, ICTA, NSF, LGs, NIFS, UDA, DAD, DI	GoSL, Donor Agencies

Focus Area 02: Food, Nutrition and Agriculture

Sub Area and Issues/Problems	**Relevant Interventions**	**Priority** **H-High,** **M- Medium,** **L-Low**	**Actions**	**Implementing Agency/Agencies**	**Funding Agency / Agencies**
Sub Area – **1) Crop production and productivity** **Issues/Problems-** I) Lack of high quality varieties/ planting materials	**Pure and Applied Research** a) Research on high-yielding varieties tolerant to biotic and abiotic stresses with required quality characteristics, nutritional value	H	Potential of incorporating traditional germplasm resources to all crop varieties	All crop research institutes, Relevant University faculties, Private sector, Companies	GoSL, Donor Agencies, Private sectors
	b)Research on multiplication methods	H	Developing efficient multiplication low cost and easily applicable methods of high quality varieties/ planting material	All crop research institutes, Relevant University faculties, Private sector, Companies	GoSL, Donor Agencies, Private sectors
II) Absence of accurate assessment programmes on national seed requirement	**Pure and Applied Research** a) Survey on accurate assessment of national seed and planting material requirement	H	A mechanism to ensure adequate supply of quality seeds and PM	Ministry of Agriculture, Department of Agriculture, Its relevant centres and seed farms, Private sector,	GoSL, Donor Agencies, Private sectors

				seed & planting material producing organizations	
	Capacity Building a)Train Agricultural Officers(AOs) on assessment	M	Providing training to AOs on the methods of assessment of seed requirement	Ministry of Agriculture, Department of Agriculture,	GoSL, Donor Agencies, Private sectors
III) Poor nutrient and soil erosion management	**Policy Studies** a) Policy for upgrading soil erosion and nutrient management	M	Formulation of study groups consisting of relevant experts, Developing policy, Obtaining public comments, Validation, Cabinet approval	Ministry of Agriculture, Ministry of Lands, Ministry of Environment, NASTEC	GoSL
	Pure and Applied Research a) Research on sustainable erosion control methods	H	Taking into account natural erosion control measures, Soil rehabilitation, Assessment of the impact of national land preparation methods, Selection of crops based on land suitability classification, Implementation of soil conservation act, Measures to minimize soil disturbances	NRMC, ENVT MIN, FMRC –on land preparation equipment, Private sector	GoSL, Private sector, Donor Agencies
	Innovations a) Community based erosion control methods	H	Development of erosion control methods with the participation of	Ministry of Agriculture, Ministry of	GoSL, Donor Agencies,

	Capacity Building a) Train AOs on new methods	M	farmers and other communities, Conducting training programmes to AOs	Lands, Ministry of Environment, Department of Agriculture, Central Environmental Authority, Relevant University Faculties	Private sectors
IV) Lack of demand driven production system and unplanned cultivation	**Pure and Applied Research** a) Market research on demand and supply	H	Conducting market research on demand supply of agricultural crops	HARTI, Socio Economic and Planning, Centre of the DOA, IPS, Relevant University Faculties	GoSL, Private sectors
	Information and Communication Technologies a) Database on market information	M	Coordination with the private sector institutions in marketing, Collection of information, Preparation of database	Ministry of Agriculture, Department of Agriculture, HARTI	GoSL, Private sectors
	Popularization a) Create awareness among farmers on market needs, climate changes etc.	M	Use of mass media more frequently to provide information, Use of social media and mobile platforms, Conducting frequent awareness programmes	Ministry of Agriculture, Department of Agriculture, Mass media, Telecom service providers,	GoSL, Private sectors

				Private sectors	
V) Lack of labor and mechanization	**Pure and Applied Research** a) Research on development of machinery suitable to local conditions	M	Conducting research to develop low cost affordable, Eco-friendly machinery suitable to local conditions	FMRC, FMTC, Private sector, Relevant Universities, NERD Centre, Relevant crop research institutes	GoSL, Donor Agencies, Private sectors
	Capacity Building a) Train farmers on use of machinery	L	Conducting training programmes to farmers on the use and maintenance of machinery	FMRC, FMTC, Relevant University Faculties, Private sectors	GoSL, Private sectors
VI) Poor water use efficiency	**Pure and applied Research** a) Research on water-conservation farming systems	L	Analysing the water requirement of crop plants to produce maximum yields, Conducting research to develop water conservation farming systems	All the CRIs Irrigation Department Provincial DOA, Relevant University Faculties, IWMI	Donor agencies
	Innovations a) Cultivation systems with minimum/efficient water use	M	Develop systems that use maximum requirement of water	Crop research institutes, Relevant University Faculties	GoSL, Private sectors, Donor Agencies
	Popularization a) Create awareness among farmers	M	Create awareness among farmers and all stakeholders on the	Extension service of the Department of	GoSL, NGOs

			need of conserving water and use of water efficient farming systems	Agriculture, Provincial Departments of Agriculture, Mass media, Telecom service providers	
Sub Area – **2) Food and Nutrition** **Issues/Problems-** I) Lack of awareness on nutritional value of traditional food	**Pure and Applied Research** a) Research on nutrient value/contents of traditional and other food and their functionality b) Proper cooking methods to minimize nutrition losses c) Establish food composition tables	H	Research on a) Nutrient value of traditional food and non-traditional foods and their functionality b) Cooking methods that minimize the nutrient loses, Formulation of diets to give the highest nutritional needs, Develop simple methods to identify nutritive value of foods	Department of Education, National Institute of Education, ITI, Ministry of Health, Relevant University Faculties, Food Research units of DOA	GoSL, Private sectors
	Popularization a) Create awareness among the general public	M	School curriculum with nutrient aspects of foods, School education regarding negative impact processed foods, Home science as a subject, Programmes to	ITI, Ministry of Health, Relevant university faculties, Mass media, Telecom service providers,	GoSL, Private sectors

			popularize and create awareness of the traditional foods, Making it compulsory that caloric value and composition of nutrients display in that label	Relevant professional organizations	
II) Lack of simple method to identify quality food	**Pure and Applied Research** a) Research on food contaminations and toxicities	L	Develop simple methods to identify nutritive value of foods, Conducting research on foods contaminations and toxicities and developing simple methods to detect them	Relevant Ministries (MOH, MOA, MO S and T), ITI & other relevant R & D institutes, Relevant University and Faculties	GoSL, Private sectors, Donor agencies
III) Unethical and misleading advertisements	**Policy Studies** a) Development of policies/ regulations for food advertisements	M	Develop policies on food advertisement and get cabinet approval, Analyse the existing regulations, study the gap and prepare new regulations, Make compulsory on displaying caloric value, fat content etc in the label, Strengthen the legal framework	MOH, NASTEC, Minstry of Trade, Consumer Affairs Authority	GoSl

	Popularization a) Create awareness among the general public on proper nutrition	M	Establish regulatory body for importing food, Use of mass media, mobile platform, seminars to create awareness among the general public on proper nutrition	MoH, MoE, Mass media, Telecom service providers, Professional organizations, NGOs	GoSL. NGOs, Private Sectors
Sub Area – **3) Food Safety risk Assessment** **Issues/Problems-** I) Absence of scientific investigation and data on chemical residuals	**Pure and Applied Research** a)Research on agrochemicals and microbiological residues and their impact on human health b) Research on food additives and their influence on health c) Punishment system survey on the occurrence and toxicity of food crops and their control	H	Conducting research on a) agrochemicals and microbiological residues and their impact on human health b) food additives and their influence on health, Regular analysis of food for agrochemical and microbial remedies, Conducting a survey on the occurrence and toxicity of food crops and their control	MoH, relevant R & D institutes, University Faculties, Food control laboratories, Government/ Department analyst	GoSL, Private sectors
II) Lack of proper surveillance programs	**Pure and Applied Research** a) Research on methods to reduce toxicity in food	H	Conducting research on methods of reducing toxicity and developing easily usable such methods	MOH, MRI, Relevant University Faculties, ITI	GoSL, Donor Agencies
III) Food borne -disease outbreaks	**Pure and Applied Research** a) Research on food borne diseases and control measures	M	Conducting research on food borne diseases and measures of controlling them	MOH, MRI, Relevant University Faculties	GoSl, Donor Agencies

	Popularization a) Create awareness among general public on food poisoning	M	Conduct awareness programme on food borne diseases and food allergies, Include these aspects in the school and university curricula, Use mass media and mobile platforms to create awareness	Relevant R & D institutes and universities, MOH, MRI, MoED, NIE, Mass media, Telecom service providers	GoSL, Private sectors, NGOs
Sub Area – **4) Eco Friendly Agriculture** **Issues/Problems-** I) Low priority to indigenous species/ indigenous knowledge	**Pure and Applied Research** a) Research to Improve the indigenous varieties to compete with exotic species	L	Conducting research on indigenous varieties to improve their yields, the environmental condition required to give high yields, resistance to pests and diseases fertilizer requirements etc	All the relevant CRIs, University Faculties, Relevant R & D Institutes, NGOs, Private sector	GoSL, Private sectors, Donor Agencies
	Popularization a) Promote use of indigenous species	M	Conducting awareness programmes on the qualities of indigenous crop varieties using mass media, mobile platforms etc, Including the lessons on the qualities of indigenous varieties in school curricula	Relevant R & D institutes and universities, MOH, MRI, MoED, NIE, Mass media, Telecom service providers	GoSL, NGOs, Private sector

II) High- dependency on external inputs	**Pure and Applied Research** a) Research on cost effective farming systems	H	Conducting research on cost effective farming systems	All relevant CRIS and R & D institutes, University Faculties, Private sectors	GoSL, Private sector
III) Lack of knowledge on bio pesticides & biologically active compounds	**Pure and Applied Research** a) Research on bio pesticides	H	Conducting research on bio-pesticides	All relevant CRIS and R & D institutes, University Faculties, Private sectors	GoSL, Private sector
	Indigenous Knowledge and Intellectual Property Rights a) Produce bio-pesticides using Indigenous knowledge	L	Gathering indigenous knowledge on bio-pesticides, Producing such bio-pesticides	All relevant CRIS and R & D institutes, University Faculties, Private sectors	GoSL, Private sector
	Popularization a) Create awareness among farmers and Agriculture Officers	L	Conducting awareness programmes and AOs on the relevant bio-pesticides for different crops and the advantages of using them	All relevant CRIS and R & D institutes, University Faculties, Private sectors	GoSL, Private sector
IV) Competitive species	**Pure and Applied Research** a) Identification of invasive species and research on control measures	M	Conduct research to identify invasive species in aquatic and terrestrial environment, their impacts and on suitable measures to control them	All relevant CRIS and R & D, Universities, MASL, Private sectors, DI, DAD	GoSL

	Popularization a) Create awareness among farmers		Conduct awareness programmes among farmers on identification of invasive species, their impacts and control, Use mass media to social media to create awareness	Mass media, Social media, Mobile service providers, Professional Associations	GoSL, NGOs
Sub Area – **5) Postharvest handling and processing** **Issues/Problems-** I) Poor supply chain management/marketing and un-planned harvesting	**Pure and Applied Research** a) Market research	H	Conduct research on processing and value addition, Product development, Conduct market research on postharvest products and on supply chain management and marketing	IPHT, HARTI, ITI, MOA, SEPC, NARA, All relevant Ministries, University Faculties, R & D Institutes	GoSL, Private sectors
	Information and Communication Technologies a) Develop databases to supply market information	M	Develop databases to supply market information, Train all stakeholders in the supply and value chain to record all data in soft form	MoA, DoA, HARTI	GoSL
	Capacity Building a) Train farmers on post-harvest handling and processing		Provide training programmes to farmers on post-harvest handling and processing	DoA	GoSL, Private sector, Donor Agencies
II) Higher energy cost	**Pure and Applied Research** a) Research on low cost postharvest processing methods	M	Conduct research on low cost postharvest processing methods	Ministry of Business development, DoA, CRIs, ITI	GoSL, Donor Agencies

	Innovations a) Energy efficient post-harvest processing methods and machinery b) Waste utilization for other products		Develop bioenergy methods and encourage utilization within the farm, Provide venture capital for method development postharvest, Develop methods and machinery that uses less energy and/ or solar power, Develop methods that use waste products to generate energy to be used in postharvest methods	IPHT,ITI,NERD, FMRC, FMTC, University Faculties	GoSL, Private sector, Donor Agencies
III) Poor postharvest quality of agricultural products	**Pure and Applied Research** a) Research on traditional/new/eco-friendly/biodegradable packaging materials and postharvest technologies /value added products	H	Application of nanotechnology on developing novel biodegradable packaging material, Conduct research on traditional/new/eco-friendly/biodegradable packaging materials and postharvest technologies /value added products	ITI, IPHT, University Faculties, R & D Institutes	GoSL, Private sector
Sub Area – **6) Commercial and Small Farmer profits** **Issues/Problems-**	**Information and Communication Technologies** **a**) Develop information channels/databases etc.	H	Develop information channels/databases etc.	Farmer societies, NICC, ICTA, SEPC, Private Sector	GoSL, Private sector

I) Absence of proper communication in farmers' clusters	**Popularization** a) Create awareness among farmers	M	Use of mass media, social media, mobile phones	ICTA, MoTDI, DoA, Mobile phones service providers	GoSL, Private sector
Sub Area – **7) Livestock production and Fisheries** **Issues/Problems-** I) Use of illegal and unregulated fishing methods	**Innovations** a) Designing of efficient , low cost fishing gear and crafts	L	Designing of efficient , low cost fishing gear and crafts	NARA, University of Ruhuna, University of Jaffna, Private sector	GoSL, Private sector
	b)New techniques/sustainable fishing methods	L	Developing new technologies for sustainable testing	NARA, University of Ruhuna, University of Jaffna, Private sector	GoSL, Private sector
	Capacity Building a) Develop capacity for marine fishing	H	Invest on deep sea fishing	Private sector, MoFAR	Donor agencies, Private sector
	Popularization a) Popularize sustainable fishing		Mass media, Social media	NARA, MoFAR, Universities	GoSL
II) Lack of efficient/suitable captive breeding methods for fish	**Pure and Applied Research** a) Research on suitable captive breeding methods **Capacity Building** a) Development of infrastructure with facilities for culturing marine fish in captivity	M	Conduct research on suitable captive breeding methods Development of infrastructure with facilities for culturing marine fish in captivity	Universities, MoFAR, NARA, NAQDA, Private sector NAQDA, MoFAR, Private sector	GoSL, Private sector GoSL, Private sector

III) Underutilized and unutilized fish stocks	**Pure and Applied Research** a) Research on natural diversity and density of fish	M	Conduct research on natural diversity and density of fish	NARA, Relevant University Faculties, NAQDA	GoSL, Private sector
IV) Issues relevant to Aquaculture (including mari-culture)	**Policy Studies** a) Development/implementation of relevant policies/ regulations for aquaculture	M	Formulation of study groups with relevant experts, Development of policies, Validation and Cabinet approval, Development of regulations, Gazetting the regulations	MoFAR, MoSTR/NASTEC MoFAR	GoSL
	Pure and Applied Research a) Research on suitable freshwater, brackish water and marine food fish varieties		Conduct research on suitable freshwater, brackish water and marine food fish varieties for aquaculture	NARA, NAQDA, Relevant University Faculties, Private sector	GoSL, Private sector
	b) Development of high quality low cost feed using locally available material			NARA, NAQDA, Relevant University Faculties, Private sectors	GoSL, Private sector
	c) Research on algae species suitable for cultivation			NARA, NAQDA, Relevant University Faculties, Private sectors	GoSL, Private sector
	d) Development of temperature and salinity tolerant food fish species			NARA, NAQDA, Relevant University	GoSL, Private sector

				Faculties, Private sectors	
	e) Identify impact of climate change on economically important fish (freshwater brackish water and marine) and coastal aquaculture			NARA, NAQDA, Relevant University Faculties	GoSL
	f) Study the impact of temperature and salinity on coastal aquaculture systems			NARA, NAQDA, Relevant University Faculties	GoSL
	Innovations a) Development of value-added products from fish and fish waste, sea weeds		Use of fish waste for devt of value added products	NARA, NAQDA, Relevant University Faculties, Private sectors	GoSL, Private sector
	Biotechnology a) Identify suitable fish species for local conditions		Development of natural disease controlling methods/systems	NARA, NAQDA, Relevant University Faculties	GoSL
	b) Development of disease resistant varieties			NARA, NAQDA, Relevant University Faculties, Private sectors	GoSL, Private sector
	Capacity Building a) Development of infrastructure and training	M	Identifying solutions to existing usual, providing necessary infrastructure and training for personnel	NAQDA, NARA, Relevant Universities, MoFAR	GoSL, Donor agencies, Private sector
V) Poor postharvest handling and processing	**Pure and Applied Research** a) Development of value added products, safe and attractive packaging techniques to improve shelf life, to increase consumer attraction and	H	Conducting research to develop value added products, safe and attractive packaging techniques to improve	NARA, NAQDA, Fish Processors, Private sector	GoSL, Donor agencies, Private sector

	demand for livestock and fish products		shelf life, to increase consumer attraction and demand for livestock and fish products		
	Indigenous Knowledge & Intellectual Property Rights a) Use of traditional knowledge in postharvest handling		Collect and record indigenous knowledge on postharvest handling, Use of traditional knowledge in postharvest handling	NARA, DoFAR, MoFAR, Private sector	GoSL, Private sectors
	Testing, Standardization & Accreditation a) Introduce testing services to maintain the quality of products		Introduce testing services to maintain the quality of products	MoFAR, ITI, SLSI	GoSL
	Capacity Building a) Development of accredited laboratories for testing of products and toxicity studies		Call application from relevant laboratories and accredit them	DoFAR, SLAB	GoSL
	b) Development of mechanized systems for loading, unloading, transporting, postharvest handling and processing		Develop mechanized system for loading, unloading, transporting, postharvest handling and processing	Private sector, DFAR, NERD Centre	GoSL, Private sector
VI) Issues relevant to dairy industry (Insufficient milk production and poor quality of milk)	**Pure and Applied Research** a) Improve/upgrade local species	M	Conduct research to improve local species	Veterinary Research Institute(VRI), Relevant University Faculties, Department of	GoSL, Private sector, Donor Agencies

				Annual Production and Health (DAPH), NLDB	
	b) Research on increasing milk production		Implement the existing breeding policy, Introducing farmer useable potable milking machines	Veterinary Research Institute(VRI), Relevant University Faculties, Department of Annual Production and Health (DAPH), NLDB	GoSL, Private sector, Donor Agencies
	c) Development of value-added products	M			
VII) Disease outbreaks	**Policy Studies** a) Adopt strict quarantine procedures b) Expand veterinary services c) Create awareness among farmers on disease outbreaks d) Research on appropriate husbandry methods	M	Adopt strict quarantine procedures, Expand veterinary services, Create awareness among farmers on disease outbreaks, Conduct research on appropriate husbandry methods	VRI, DAPH, NCDB, Private sector	GoSL, Private sector
	Pure and Applied Research a) Develop resistance breeds		Develop resistance breeds	DAPH, VRI, relevant University Faculties, Private sector, NLDB	

	b) Develop new vaccines		Develop new vaccines	DAPH, VRI, relevant University Faculties, Private sector, NLDB	
	c) Identify disease causing factors		Identify disease causing factors	DAPH, VRI, relevant University Faculties, Private sector, NLDB	
VIII) Lack of breeding animals	**Pure and Applied Research** a) Establish cattle breeder farms b) Issuing of high quality breeds cows/calves c) Establish farmer cooperatives	H	Establish cattle breeder farms, Issuing of high quality breeds cows/calves, Establish farmer cooperatives	NLDB, Private sector, DAPH	GoSL, Private sector, Donor Agencies
	d) Research on appropriate husbandry methods			VRI, NLDB,	GoSL, Private Sector
IX) Insufficient feed supply and Poor quality	**Pure and Applied Research** a) Research on new feed varieties	H	Encourage commercial forage production	VRI, Private sector, Other relevant government institutes,	GoSL, Private Sector
	b) Research on efficient pasture conservation and utilization methods			VRI, NLDB	GoSL,
X) Lack of value added products	**Pure and Applied Research** a) Research on value-added products	M	Breeding animals	DAPH, NLDB, Private sector, Other relevant government institutes	GoSL, Private sector

Focus Area 03: Health

Sub Area and Issues/Problems	Relevant Interventions	Priority H-High, M-Medium,	Proposed Actions	Proposed Implementing Agency/Agenci	Funding Agency / Agencies
	b) Research on utilization of by products and waste			VRI, Private sector, Other relevant government institutes	GoSL, Private sector

		L-Low		**es**	
Sub Area – **I) Reliable, affordable and equitable healthcare** **Issues/Problems-** I)Need for national health systems research centre which could also function as a health observatory to monitor equity and access II) Address equity across systems	**Innovations** a) Establishing a National Health Systems Research Centre cum Health Observatory	H	Ministry of Health to facilitate the establishment of National Health Systems Research Centre cum Health observatory with research facilities	Ministry of Health, NHRC, IHP, NSF, SLMA	Ministry of health (MoH), Universities, Donor Agencies
	b) Identifying priorities for studies to improve equity and healthcare(e.g. palliative care for terminally ill), Monitoring access and equity related data	H	Identifying priorities for studies to improve equity and healthcare(e.g. palliative care for terminally ill), Monitoring access and equity related data, Paying special reference to SDGs	NHRC, Ministry of Health, SLMA	Ministry of Health, Universities, Donor Agencies
	c) Study the feasibility of providing integrated 'western' and ayurvedic care in a carefully selected list of conditions in which such potential is identified.	M	To call for specific proposals by MoH/ NHRC Apply for funding from NSF/ NRC	IIM, Universities, MRI	GoSL, Universities, UGC, NSF, NRC, Donor Agencies
Sub Area – **2) Prevention, control and management of Non Communicable Diseases (NCDs)** **Issues/Problems-** I) Ageing population, high disease burden from chronic NCDs and	**Pure and Applied Research** a) Cost-benefit analysis of HPV vaccine in high risk groups	M	Cost-benefit analysis of HPV vaccine in high risk groups	Universities, NHRC, SLMA	UGC, NRC, Universities, NSF, UGC, Donor Agencies
	b) Identifying molecular markers Validating model /marker in high risk populations.	H	Meta-analysis and herbal therapy in the area of CKDU and in other high risk population of NCDs	Universities, MRI	MoH, NRC, Donor Agencies, UGC, NSF

escalating costs of treatments II) High burden of CKDU amongst farmers in North Central Province. III) High disease burden due to cancer. IV) Need for accurate epidemiological data on cancer V) High morbidity and mortality due to oral cancer VI) Inadequacy of data on role of Human Papilloma Virus (HPV)in oral and cervical cancer	**Innovations** a) Development of low cost devices for weight reduction, home based oxygen delivery, diabetic foot care, wound healing devices, devices for bronchial asthma, self-operated infusion devices for iron chelating thalassemia, appliances for the elderly/disabled	H	Establish public and private partnership facilities	Universities, MRI, Private sector	Universities, UGC, Private sector, Donor Agencies, GoSL, NRC, NSF
	b) Development of low cost diagnostics glucometers, simple population screening diagnostic tools for NCDs, Sleep study diagnostics	H	Establish public and private partnership facilities	Universities, SLITEC, MRI,	Universities, UGC, GoSL, NSF, NRC,
	c) Establishing a central mechanism for developing, validating and marketing above mentioned devices Develop a urinary biomarker for CKDU	H	Need to evaluate technology assessment, Develop medical technological assessment committee, No capacity to approve devices made in SL, Need to send to an expert evaluator about new technologies and product to strengthen NMRA with a broaden committee	Medical supplies division, MoH of National Medicines Regulatory Authority(NMRA)	GoSL, Private sector, NSF

	Indigenous Knowledge and Intellectual Property Rights a) Identify ayurvedic/ herbal recipes with potential as a drug for cancer and further develop them and progress to clinical trials	H	Identify ayurvedic/ herbal recipes with potential as a drug for cancer and further develop them and progress to clinical trials	IM, GWAI, Univeristies, ITI, KDU care, Bandaranayaka Memorial Research Institute(BMRI)	NSF, NRC, Universities, UGC, Donor Agencies
	b) Development of topical anti-oxidant preparations from herbal ingredients for the prevention of oral and pharyngeal cancers	H	Development of topical anti-oxidant preparations from herbal ingredients for the prevention of oral and pharyngeal cancers	BMRI, IIM, GWAI, Univeristies, ITI, KDU care, Centre of research in oral cancer, University of Peradeniya	NSF, NRC, Universities, UGC, Donor Agencies
Sub Area – **3) Improved utilization of mathematical modelling and computer application in Health care** **Issues/Problems-** Lack of data (e.g. spatial data) from a range of sources and novel methods required to better understand disease epidemics	**Pure and Applied Research** a) Development of mathematical models	H	Cadre created in MoH, Data gathered in different hospitals to be pooled into one mathematical model, Developing a mechanism to make the data available, Strengthen the universities to analyze data and identify gaps, Overcoming the deficiencies in data in ayurveda, OPD and in private sector	Universities, MoH, NHRC	Ministry of Health, NSF, NRC, Donor Agencies, Universities, UGC
	Information and Communication Technologies a) Use of satellite images	L	Getting the satellite images, Use of satellite images	ICTA, Universities, MoH, MRI	GoSL, NSF, NRF, Donor Agencies

	b) Risk mapping	L	Risk mapping	ICTA, Universities, MoH, MRI	GoSL, NSF, NRF, Donor Agencies
Sub Area – **4) Public health innovation for improving nutritional status** **Issues/Problems-** I) Lack of infrastructure for standardization and quality testing of ayurvedic /herbal medicines	**Innovations** a) Development of low cost complementary food for infants above 6 months and developing a social marketing mechanism for same	H	Develop a low cost high nutritional complementary food and combining with the social marketing	Ministry of Health, ITI, Private sector, Universities	GoSL, Donor Agencies, Private sector, Universities , UGC
	Information and Communication Technologies **a)** Establishing a mobile phone platform for advising Infant and Young Child Feeding practices		Establishing a mobile phone platform for advising Infant and Young Child Feeding practices in order to contact mothers and give one to one contact as a supplementary	Family Health Bureau(FHB), Health Education Bureau(HEB), Universities, Telecommunication Regulatory Commission(TRC), Telecom Service Providers	GoSL, NRC, NSF, Private sector, Universities , UGC

Sub Area – **5) Local & export market for indigenous medicine** **Issues/Problems-** I) Lack of systematic cultivation and utilization of herbal materials through direct contacts between farmers and manufactures II) Inadequate attention to produce high quality ayurvedic drugs with local ingredients	**Testing, Standardization & Accreditation** a) Validation of drugs/drug regime as per prioritized schedule	M	Setting up a bioethics committee, Study how drugs are validated with suitable foreign consultancy and adopt it to Sri Lanka, Creation of high powered advisory committee at BMRI, strengthening human resources	IIM, BMRI, Other Universities, GWAI, Private sector	GoSL, Private sector, Universities, UGC, Donor Agencies
	b) Standardization of raw materials and drugs	H	Standardization of raw materials and drugs	ITI, BMRI, SLSI, AMC	Industry, UGC, Universities, GoSL, Donor Agencies
	c) Setting up testing facilities for herbal drugs	H	Setting up testing facilities for herbal drugs	ITI, BMRI, Private sector	GoSL, Private sector, Donor Agencies
	Popularization a) Popularization and active intervention in the cultivation of herbal plants in suitable agro-climate zones		Improve cultivation of ayurvedic plants, Department of Ayurveda and department of Agriculture to grow Ayurvedic plants in commercial scale, Establishing of a unit for growing and harvesting herbal medicinal plants at the MoH, Use mass media to popularize and actively engage in the cultivation of herbal plants in suitable agro-climate zones	Universities, Ministry of Health, Ministry of Agriculture, Professional associations, Mass media	GoSL, NSF, Universities, UGC

III) Exploiting the full potential of indigenous knowledge for better health	**Indigenous Knowledge & Intellectual Property Right** a) Research into ancient texts and oral traditions in the country in order to identify or recognize other forms of treatments.	M	Conducting research on ancient texts and oral traditions in the country in order to identify or recognize other forms of treatments	Universities, IIM, GWAI, NHRC	GoSL, NSF, Universities , UGC
IV) Lack of a credible regulatory mechanism for ayurvedic/herbal medicines meant for export	**Policy Studies** a) Develop relevant policies and establish a credible regulatory body for ayurvedic/herbal medicines	H	Formulate a study group with relevant expertise, Develop policies, Publish for public comment and validate the policies to obtain cabinet approval, Establish a regulation body for Ayurvedic/ herbal Medicine	Department of Ayurveda, Ministry of Health, Universities, Sri Lanka Ayurvedic Medical Council (AMC), NASTEC, MoH	GoSL
V) Use of indigenous knowledge in medicine for income generation	**Testing, Standardization & Accreditation** a) Validation and Standardization of services (physical environment of service providing Institutes, HR and other facilities)	M	Validation and Standardization of services (physical environment of service providing Institutes, HR and other facilities)	SLAB, AMC	GoSL
VI) Use of indigenous knowledge blend with novel technology	**Innovations** a) Reverse pharmacological approach to identify effective herbal medicines	M	Carrying out reverse pharmacological approach to identify effective herbal medicines	BMRI, IIM, GWAI, Relevant University Faculties,	NRC, NSF, Donor Agencies, Universities

				Industry	, Private sector
	Pure and Applied Research a) Herbal clinical product development through clinical research - crude form, fractional form and single molecular level		Conducting research on herbal clinical products and developing them in crude form, fractional form, and single molecular level through clinical research	Universities, IIM, GWAI, BMRI, Industry	NRC, NSF, Donor Agencies, Universities , Private sector
VII) High burden of NCD in the country and need for alternative therapeutic modalities	**Testing, Standardization & Accreditation** a)Authentication of herbs , minerals and other ingredients in formulae of current ayurveda pharmacopeia including possible adverse reactions or any other complications	M	Authentication of herbs , minerals and other ingredients in formulae of current ayurveda pharmacopeia including possible adverse reactions or any other complications	IIM, Ayurvedic Department, Ministry of Health, BMRI, Ayurvedic medical council, SLSE, GWAI	Universities , MoH, UGC, MoSTR
	b) Develop standards for finished ayurvedic products	M	Developing standards for finished ayurvedic products	IIM, GWAI, BMRI, AMC, SLSI	Universities , UGC, MoH

VIII) Development of the methodologies that considerably shorten drug discovery process using reverse chemical biology	**Innovations** a) Development of target specific isolation techniques to isolate and characterize biologically active therapeutic molecules from Ayurveda herbal extracts which are non-toxic and time tested, and clinically verified	M	Developing the relevant isolation techniques	Universities and KDU care, MRI, BMRI, IIM, GWAI	Ministry of Health, NSF, NRC, Donor Agencies, Universities, UGC
IX) Preparation of comprehensive national level database for the country	**Information and Communication Technologies** a) With the help of the Dept. of National Archive, preserving the traditional medicinal knowledge as databases using high performance server facility	M	Collection of data from ola-leaf manuscripts and from traditional knowledge, Development of new innovative methods	Department of National Archives, Universities, IIM, GWAI, BMRI	GoSL, NSF, NRC, Donor Agencies, Private sector
Sub Area – **6) Prevention ,control and management of Vector Borne Diseases (VBD)** **Issues/Problems-** I) Use novel technologies in vector control, understanding disease transmission and pathogenesis and drug development	**Innovations** a)Larval control using innovative methods (e.g- nanotechnology, biotechnology, biological control) b)Use of new and existing techniques to understand vector biology in order to understand transmission dynamics of VBDs and to coordinate these activities by a dedicated centre/institute	M	Development of new innovative methods	Universities, SLINTEC, MoH, IBMMB, MRI	Universities, UGC, GoSL, NRC, NSF, Funding Agencies
		M	Use of new and existing techniques to understand vector biology in order to understand transmission dynamics of VBDs and to coordinate these activities by a dedicated centre/institute	Universities, MRI, MoH	GoSL, NRC, NSF, Funding Agencies, Universities, UGC

	Innovations a) Develop novel, rapid, easy- to-use, diagnostic methods (e.g. saliva based tests, dip-stick tests, finger-prick methods) for diagnosis of Leishmaniosis, Japanese Encephalitis (JE) and Malaria.	M	Develop the novel rapid easy to use diagnostic method	MoH, Universities, MRI	GoSL, NRC, NSF, Funding Agencies, Universities , UGC
	b) Immunoassays to identify biomarkers or prognostic markers for VBDs		Develop immunoassays to identify biomarkers or prognostic markers for VBDs	MoH, MRI, Universities	GoSL, NRC, NSF, Donor Agencies, Universities , UGC
	Pure and Applied Research a) Research on immuno-epidemiology of dengue infections in order to understand dengue transmission dynamics and immune correlates of protection in implementing dengue vaccines		Conduct research on immuno-epidemiology of dengue infections in order to understand dengue transmission dynamics and immune correlates of protection in implementing dengue vaccines, Carry out mathematical modelling to understand dengue transmission dynamics	MRI, Universities	GoSL, NRC, NSF, UGC, Universities , Donor agencies
	Information and Communication Technologies a) Use of GIS technology for understanding environmental factors contributing to VBD transmission		Use of GIS technology for understanding environmental factors contributing to VBD transmission	MRI, Universities	GoSL, NRC, NSF, UGC, Universities

	Nanotechnology a) Drug development using Nano-technology		Drug development using Nano-technology	MRI, SLINTEC, Universities	GoSL, NSF, NRC, UGC, Universities, Donor agencies
	Innovations a) Understanding the pathogenesis of common VBDs such as Dengue, Leishmaniosis and JE, so that already existing drugs could be used in the treatment of these diseases (e.g. many existing drugs that are used for other diseases can be effectively utilized for treatment of Dengue if we can determine the mediators that cause severe disease, liver injury etc.)		Conducting relevant research and determining which drugs that are used for other diseases could be effectively used for treatment of Dengue, Leishmaniosis and JE	MRI, Universities	GoSL, NSF, NRC, UGC, Universities, Donor Agencies
Sub Area – **7) Control of common tropical diseases** **Issues/Problems-** I) The establishment of	**Innovations** a) Development of vaccine candidates for rabies b) Production of monoclonal antibodies for snake venom.	M	Good Manufacturing Practices(GMP) certified antibody facilities to be developed for rabies, snake, venom, malaria, and dengue	KDU care and Universities, MRI, SLSI, SLAB, Private sector	NRC, NSF, Industry, GoSL, Donor Agencies

Good Management Practices (GMP) certified antibody production plant for the first time in Sri Lanka. This can be applied to any of the future needs in infectious diseases	c) Improvement of currently clinically failed vaccines (e.g. Malaria) using a newly established proteomics technique d) Production of high quality Dengue specific monoclonal antibodies and virology reagents for research and diagnostics.				
	Innovations a) One-pot neutralization technique for hydrogen peroxide based disinfection		Developing GMP certified copy	University, MRI, SLSI, SLAB, Private sector	NRC, NSF, Industry, GoSL, Donor Agencies
Sub Area – **8) Utilizing modern technology for health promotion and community empowerment in Health** **Issues/Problems-** Innovative social technologies for health promotion and community empowerment using IT is needed	**Information and Communication Technologies** **a)** Mobile phone based health information platform to disseminate health information	M	Development of mobile phone based health information platform to disseminate health information	Universities, Telecommunication Regulatory Commission (TRC), Mobile phone service providers	Universities, UGC, Private sector, GoSL, Donor Agencies
	Pure and Applied Research a) Study the interventions for following; Tobacco use, Reducing underweight in young children, Reversing obesity	H	Study the interventions for following; Tobacco use, Reducing underweight in young children, Reversing obesity	MRI, MoH, Universities	GoSL, Universities, UGC, NSF, NRC

	b) Minimizing alcohol-induced aggressive behavior	H	Conducting research on minimizing alcohol-induced aggressive behaviour	MRI, MoH, Universities	GoSL, Universities , UGC, NSF, NRC
Sub Area – **9) Enhanced R&D activities on Genomics** **Issues/Problems-** I) Need for regulation of the ethical aspects of bio-medical research	**Policy Studies** a) Establishment of a National Bio-ethics Authority with wide ranging regulatory powers.	H	Establishment of more ethics committees around the country Need of Establishment of a National Bioethics Authority under the H.E. the President with appropriate representation	MOH, MoSTR	GoSL
II) Need for comprehensive genetic testing and a central facility for Sri Lankan scientists to use for both service and research	**Capacity Building** a) Establishment of a fully equipped National Genome Center	H	Establishment of a National Genomic Centre and many more satellite centres in the country, Establishment of a genetic data repository	Universities, MRI,	GoSL, Private sector, Donor Agencies
III) Need for a central repository to obtain information about genetic variations of Sri Lankans when planning research.	**Information and Communication Technologies** a)Establishment of a National Genome Data Repository	M	Establishment of a National Genome Data Repository	IHP, NHRC, MoH	GoSL
IV) Enabling equitable access to the facilities to all Sri Lankan scientists.	**Policy Studies** a) Establishment of a Governing Mechanism and Policies for accessing the National Genome Centre and the National Genome Data Repository.	M	Formulate a study group with relevant expertise, Develop policies, Publish for public comments, Validation, Cabinet approval for policies, Develop governing mechanism	IHP, NHRC, MoH, NASTEC, Private sector	GoSL

	Pure and Applied Research a)Conducting a comprehensive study to map the genetic diversity of the Sri Lankan population	M	Conducting a comprehensive study to map the genetic diversity of the Sri Lankan population	SLMA, NHRC, IHP, MoH	GoSL
V) Reduce unnecessary expenditure on import of drugs that are harmful and/or ineffective for Sri Lankans because of their unique genetic makeup	**Information and Communication Technologies** Cataloguing the prevalence of pharmaco-genomically important genetic variations in the Sri Lankan population	M	Cataloguing the prevalence of pharmaco-genomically important genetic variations in the Sri Lankan population	NHRC, MoH	GoSL
Sub Area – **10) Develop facilities for Regenerative Medicine** **Issues/Problems-** Aging is a rising problem in Sri Lanka. This reduces the workforce efficiency and affects the country's economic progress.	**Innovations** a) Use of antioxidants as potential anti-aging agents targeting mitochondrial dysfunctions and biochemical changes associated with ageing	M	Conducting research on the use of antioxidants as potential anti-aging agents targeting mitochondrial dysfunctions and biochemical changes associated with ageing, Developing antioxidants as potential anti-ageing agents after getting ethical clearance	MRI, Universities	GoSL, NSF, NRC, Donor Agencies, Universities , UGC
	b)Use of antioxidants as agents preventing mitochondrial DNA damages associated with ageing		Conducting research on the use of antioxidants as agents preventing mitochondrial DNA damages associated with ageing,	MRI, Universities	GoSL, NSF, NRC, Donor Agencies, Universities , UGC

			Developing antioxidants that have a potential to prevent mitochondrial DNA damage with agency		
Sub Area – **11) Seed funding for National Health Cohort studies** **Issues/Problems-** Health changes will occur differently in developing countries experiencing demographic and health transitions. They need to be monitored over a long period	**Pure and Applied Research** Recruit national cohort at birth and early adulthood and track long-term changes in health status, disease and their determinants	H	Recruit national cohort at birth and early adulthood and track long-term changes in health status, disease and their determinants	Ministry of Health, IHP	GoSL
Sub Area – **12) Research for better understanding of Sri Lanka`s exceptional achievements in health** **Issues/Problems-** Lack of understanding and recognition of exceptionally high achievements related to health in Sri Lanka, globally as well as locally	**Pure and Applied Research** a) Award competitive grants for research into the aspect of Sri Lanka's achievements in health	M	Formulate proposals, Get ethical clearance, Apply for competitive grants	Relevant University Faculty, MRI	NSF, NRC, GoSL

Focus Area 04: Shelter

Sub Area and Issues/Problems	Relevant Interventions	Priority H-High, M-Medium, L-Low	Actions	Implementing Agency/Agencies	Funding Agency / Agencies
Sub Area – **1) Shelter as a process and an integral part of human settlements** **Issues/Problems-** I) Large portions of Sri Lanka's rural and urban populations live in substandard and under-served settlements. II) Lack of community participation in planning and management of human settlements III) Inaccessibility of documented materials on dry zone settlement	**Policy Studies** a) Improve and expand human settlement planning	H	1. Development of an inclusive policy and implementation guidelines 2. A need assessment for housing sector has to be done at DS level 3. Consideration of the success stories of past local experience in housing 4. Identifying bottlenecks/inefficiencies and taking relevant action to overcome	Institute of Policy Studies(IPS), NASTEC, Ministry of Housing, NHDA, Relevant University faculties/Departments, Divisional sectaries offices	GoSL, Foreign Funding

systems consequent to the stalling of the Mahaweli Development areas. IV)Loss of institutional memory resulting from the fragmentation of institutions V)Inadequate guidelines on settlement planning VI) Providing sustainable houses for internally displaced people due to natural disasters	b) New models of planning and management, which involve greater partnership between public sector, NGOs and more involvement of the community	H	1. Develop a strategic plan to motivate private sector to provide small and medium financial services (LKR 4,000,000) 2. Conducting preliminary experimental projects 3. Promote a paradigm shift in housing market by encouraging investors to do large amounts of small/ medium scale housing, thereby earning profit from large numbers		GoSL, NGOs, Private sector, Private public partnership, NGOs
	Capacity Building a) Include subjects to undergraduate and postgraduate studies relevant to human settlements	H	1. Identifying the minimum Sri Lankan standards for housing through localized knowledge from which the masses can benefit 2. Ancient eastern architectural theory and philosophy to be seriously considered in university education and construction technology 3. University of Moratuwa, SLIA, ITPSL and all teaching institutions of social sciences to include more	Relevant University Faculties/ Departments especially UoM, UoK, SLIA, ITPSL	GoSL

			human settlements related subjects with compulsory on-site learning 4. The art of community engagement based on empathy as the core value should be incorporated in the curriculums of above institutions 5. All above syllabuses to have a certain percentage of local success stories to learn from and maximum engagement with practitioners who have tried new housing projects in SL		
	b) Establish a Research Centre with knowledge management platform as a central point of contact for R&D	H	1. Establish the Centre within an apex implementation agency 2. Introduce a responsive and sensitive government structure that values private sector involvement in enhancing policy and implementation	NHDA	GoSL

Sub Area – **2)Housing projects Issues/Problems-** I) Inadequate lands suitable for housing with the increasing demand for houses	**Policy Studies** a) Government incentive programmes for investors for social housing (encourage private sector to invest in social housing)	H	1. Tax releases for the private sector who invest in social housing, 2. Develop a facilitative PPP framework that promotes private sector involvement in social housing	GoSL, BOI, NHDA, Chambers of Commerce	Private sector, GoSL
II) Lack of community involvement in design and construction of housing projects III) Lack of proper understanding of community and social needs of inhabitants IV) Most of the housing projects are concentrated in urban areas V) Inability of social-housing projects by the Government to meet the increasing demand VI) Lack of access by low-	b) Improve urban and regional planning in a systematic and sustainable manner	H	1. Every large scale development, and/or resettlement projects to have a direct consultation with general public using most up-to-date media 2. An interactive Period of Review after all large and medium scale development projects 3. Annual review of success cases as a mean of improving urban planning practice and to develop awareness on cross-sectorial impact 4. User focused monitoring and feedback has to be an integral part of the planning process	State and Private mass Media, Ministry of Housing, Plan making agency, Ministry of Megapolis, Local Government, Provincial Councils, Telecom service providers	GoSL

income groups, even for social housing VII) Issues in community adaptation to multistory apartment buildings including community management of public entities VIII) Lack of teaching IX) materials and curricular for community architecture teaching programmes	c) Introduce new and more flexible tenure for social housing		1. Increase the choice in terms of kinds of housing to match different levels of affordability 2. Experiment with much wider dwelling options based on complex housing needs of different groups (i.e: Colombo's empty nesters and students migrating from the rural areas)	Relevant University Faculties/ Departments, NHDA, Local governments, Provincial councils (PCs), Private sector, NGOs	Private sector, NGOs
	Pure and Applied Research a) Research on housing projects and programs in Sri Lanka		1. Local level housing research to be promoted through the involvement of universities, Professional organizations and government organizations 2. Local climate and culture responsive designs to be studied and promoted	Universities, NHDA, Institute of Architect, Institute of Engineers NGO, Private sector Agencies	GoSL, NGOs, Private sector
	b) Research into sustainable use of under-utilized lands		1. Create capacity at local and regional level to proactively track the trends and check on land use and experience 2. Informal sector to be included in the land use and economy based research and documentation	Local Government Authorities, PCs, Private sector, Relevant University Faculties/ Departments, NGOs	GoSL, Private sector

	Capacity Building a) Enable community to involve in design, construction and management of housing projects through awareness creation		1. Community contracting to be promoted through state and NGO led development projects	NHDA, Institute of Architects, Institute of Engineers	GoSL, NGOs, Private sectors
	b) Promote postgraduate research on community adaptation to multistory apartment buildings		1. Degree programs in sociology, community development and social work to be focused on studying cases of community driven development projects around the country	Relevant University Faculties/ Departments	GoSL
Sub Area – **3) Shelter as a product** **Issues/Problems-** I) Available building materials are generally wasteful in energy use in manufacturing and too costly for low-income families II) Several useful materials and innovative techniques developed in the public sector are very poorly	**Pure and Applied Research** a) Research on low-cost, energy efficient and easy to use building materials		National level competitions to promote local/regional climate and culture responsive housing designs/ technology	NERD, NBRO, NHDA, Relevant Universities, NGOs, Private sector	GoSL, NGOs, Private sector
	Indigenous Knowledge & Intellectual Property Rights a) Research into local knowledge on building techniques and traditional building materials		Promote serious research into studying the use of local material and technology in all areas of housing including slums	Relevant University Faculties/ Departments, NGO, NBRO, NHDA, Private sector	GoSL, NGOs, Private sector

marketed III) Variable and sometimes sub-standard quality materials and components	**Testing, Standardization and Accreditation** a) Develop quality standards for building materials as well as shelter provided for low-income groups		1. Develop the sense of ownership and the capacity of the community to maintain the houses built by/with them (not provided)	SLSI	
	Popularization a) Popularize low-cost housing construction materials developed by the public sector		1. Exhibitions around the country to identify and encourage the use of low-cost housing methods 2. Use of mass media, web and mobile platforms	NHDA, Institute of Engineer, Institute of Architects, Private sector, NBRO,	GoSL, Private sector

Focus Area 05: Environment

Sub Area and Issues/Problems	Relevant Interventions	Priority H-High, M-Medium, L-Low	Actions	Implementing Agency/Agencies	Funding Agency / Agencies
Sub Area – **1) Climate change mitigation and adaptation** i. Climate prediction (seasonal and long range) & future projections for Sri Lanka ii. Adaptations to climate changes iii. Mitigatory measures for Climate Changes **Issues/Problems-** I)Insufficiency of accurate seasonal	**Pure and Applied Research** a) Adaptation of existing methodologies for climate prediction	H	Purchase/Develop equipment and methodologies for accurate climate predictions	Department of Meteorology (DM)	GoSL
	Information and Communication Technologies a) Development of a database for climate data	H	Development of a database for climate data	DM, ICTA, Ministry of Environment and Mahaweli Development (MEMD)	GoSL
	Capacity Building a) Train individuals for accurate climate prediction and natural and man-made disaster management	H	Introduce relevant undergraduate, postgraduate courses, Certificate courses and Diploma courses in the Universities, Introduce short term training programmes in Universities and other institution, Provide overseas training to relevant staff	DM, Universities, NBRO, ITI, Private HEIs	GoSL, Private sector
	Pure and Applied Research a) Create new models and customize existing models for climate change predictions	H	Provide access to international models and other technical facilities, Create new models and customize existing models for climate change predictions	Universities, DM, MEMD	GoSL

and long range climate prediction II)Lack of appropriate downscaling tools for local environment	**Information and Communication Technologies** a) Establish a database of sea level rise, shoreline retreat, salinity, acidity and temperature based on regularly collected data	H	Establish a database of sea level rise, shoreline retreat, salinity, acidity and temperature based on regularly collected data and monitoring	NARA, Universities, CCD, NERD center	
III) Inappropriate adaptation methods	**Pure and Applied Research** a) Develop suitable adaptation measures for climate changes	H	Conduct research and develop suitable adaptation measures for climate changes	Universities, Relevant University Faculties/Department, NBRD, CEA, WRB, IMWI, Research institutes of Ministry of Agricilture(MoA), Ministry of Plantation, Industries	GoSL, Donor Agencies
	Popularization a) Create awareness among people on adaptation measures	H	Awareness programs Use public media	Social media, Mass media (print and visual), DAD, Professional Organization, NSF, MoA, Universities, PEA, CEA, NGOs, Mobile telecom services	GoSL, Private sector, NGOs, Donor Agencies

IV) Lack of mitigatory measures for climate changes	**Policy Studies** a) Develop proper policy for mitigation of adverse effects of climate change	M (policy is in place)	Formulate study group with experts, Study the gaps in existing policy, Prepare a new/amended Policy, Publish for public comments, Validation, Cabinet approval	MoSTR, NASTEC, Ministry of Disaster Management (MDM)	GoSL
	Popularization a) Create awareness among people on mitigation	H	Awareness programs Use public media, Special awareness for industry, transport, waste management, forestry and energy generation	Social media, Mass media (print and visual), DAD, Professional Organization, NSF, MoA, Universities, PEA, CEA, NGOs, Mobile telecom services	GoSL, Private sector, NGOs, Donor Agencies
Sub Area – **2) Environment and climate change related disasters (natural and manmade)** i) Assessment and monitoring of environment related disasters ii) Development of adaptation measures	**Information and Communication Technologies** a) Development of a database of available information	H	Collect data from various agencies related to climate change related disasters (make use of UNDP project on environment management data/ Rio reporting) and develop the database	MDM, DM, NBRO, ICTA, Universities, CEA, MEMD	GoSL, Donor Agencies

iii) Development of appropriate mitigatory measures **Issues/Problems-** I) Non-use of available information on disasters					
II) Lack of appropriate technologies for adaptation measures, trained human resources, equipment, financial resources and awareness of all stakeholders	**Policy Studies** a) Develop policies for disaster management	M	Formulate study group with experts, Study the gaps in existing policy, Prepare a new/amended Policy, Publish for public comments, Validation, Cabinet approval	MoSTR/ NASTEC, MoDM, NBRO, MoEMD, CEA, Disaster Management Centre(DMC)	GoSL, Donor Agencies
	Pure and Applied Research a) Identification and development of adaptation technologies for disaster management	H	Research to develop new technology and innovation Review of existing documents	NBRO,DMC, NERD Centre, Research Institutes and Universities	GoSL, Donor Agencies
	b) Map disaster-prone areas	H	Hazards and risk mapping has to be done	NBRO,DMC, IWMI, Irrigation Department, MASL, Survey Department(SD)	GoSL, Donor Agencies

	Innovations **a)** Adopt appropriately existing technologies for disaster management (e.g. Rainwater harvesting technology as a preparatory measure for drought)	H	Use UAV (Unmanned Arial vehicle) satellite images for disaster management	SD, DMC, ACCIMT, Sri Lanka Air Force(SLAF), Armed Forces, NBRO, Police Departments	GoSL, Donor Agencies, NGOs
	Capacity Building a) Train individuals for accurate climate prediction and natural and man-made disaster management	H	Develop technology transfer schemes, Establish Inter institutional collaborations, Develop short term training programmes, Incorporate climate prediction and disaster management to undergraduate and post graduate curricula, offer certificate and diploma courses	Research institutes, Universities, Relevant International agencies, Private HEIs, Professional Institutes	GoSL, Donor Agencies, Private sector
	Popularization Conduct awareness programs on disaster preparedness for all stakeholders including people prone to natural disasters	H	Conduct awareness programs on disaster preparedness for all stakeholders including people prone to natural disasters	Social media, Mass media (print and visual), Telecom service providers, Professional organizations, NGOs, CEA, PEA, NSF, MoEd	GoSL, Donor Agencies, NGOs, Private sector
Sub Area – **3) Biodiversity** i) Threats and issues related to biodiversity	**Pure and Applied Research** a) Research on adverse effects on biodiversity due to climate change, pollution etc.	H	Assess development induced impacts on biodiversity, Identification of environmental sensitive habitats	Biodiversity secretariat (BS), Universities, IUCN, Department of Wildlife	GoSL, Donor Agencies

ii) Mitigatory measures to control and minimize development induced impacts iii) Conservation of bio diversity and sustainable use iv) Rehabilitation of degraded ecosystems **Issues/Problems-** I) Threats due to climate change, land degradation, pollution, deforestation, fragmentation, invasive species and urbanization				Conservation (DWC), Department of Forest Conservation (DFC)	
	b) Develop methods of landscaping to enhance urban biodiversity	H	Carry out research on suitability and compatibility on variety of species in different type of landscapes	NBRO, BS, MoMWD, UDA, LGs, PCs, CEA, PEA, Universities	Donor Agencies
	c) Research on quantification of the exploitation level of natural	H	Investigation on sustainable use of natural resources	NARA, DFC, GSMB, NBRO	Donor Agencies

	resources			Universities	
	d) Quantitative research on visitor and ecological carrying capacity of protected areas	M	Conduct research on Quantitative research on visitor and ecological carrying capacity of protected areas	DFC, DWC, Universities	Donor Agencies
	e) Development of a computerized model to assess impacts of climate change on biodiversity	L	Identification of climate change and other development project on biodiversity and migratory species, Carryout research on vulnerable species, Assess and quantify invasive species and develop methodologies to control them	NARA, Universities, DWC, DFC, MDM, MPPA	Donor Agencies
	Popularization a) Create awareness among general public on threats to biodiversity due to pollution, deforestation and invasive species	H	Develop methodologies on citizen science to facilitate decentralize data collection and enhance awareness, Create awareness among general public on threats to biodiversity due to pollution, deforestation and invasive species	LGs, PCs, CEA, PEA, DFC, DWC, Mass Media, Social Media, Telecom service Providers, MoED, NSF, Professional Associations, NGOs	GoSL, Donor Agencies, Private sector, NGOs
II) Inadequate environmental concerns of development interventions	**Policy Studies** a) Develop policies and regulations to mitigate impacts of development projects on the environment	M	Formulate study groups consisting of relevant experts, Conduct research on the effectiveness of existing policies and regulations on conserving environment , Develop policies/amend existing policies,	NBRO, CEA, PEA, MEMD, MoSTR/ NASTEC, BS, DWC, DFC	GoSL, Donor Agencies

			Publish policies for public comments, Validation workshops, Cabinet approval for the policy, Development of rules and regulations, Gazetting rules and regulations		
	b) Carry out survey to identify lapses in implementation of existing regulatory measures	H	Conduct research on the effectiveness of existing policies and regulations on conserving environment	NBRO, CEA, PEA, MEMD, MoSTR/ NASTEC, BS, DWC, DFC	GoSL, Donor Agencies
	Pure and Applied Research **a)** Research on environmental impacts of development projects.		Conduct research on the impact of development project on ecosystem health and services	NBRO, CEA, PEA, MEMD, MoSTR/ NASTEC, BS, DWC, DFC	GoSL, Donor Agencies
	b) Carry out research to provide evidence based recommendations to take effective decisions on development projects (e.g. impact of wind power plants on birds etc.)	H	Conduct research on the impact of development project on ecosystem health and services	NBRO, CEA, PEA, MEMD, MoSTR/ NASTEC, BS, DWC, DFC	GoSL, Donor Agencies
	Innovations a) Innovate mitigatory measures to reduce impact of development on biodiversity	H	Conduct research on novel methodologies for mitigating adverse impact from development projects	NBRO, CEA, PEA, MEMD, MoSTR/ NASTEC, BS, DWC, DFC	GoSL, Donor Agencies
III) Lack of awareness on social issues related to threats on bio diversity	**Pure and Applied Research** a) Surveys on social aspects related to threats on biodiversity	M	Carryout research on adverse impact from population increase including urbanization, land reclamation on ecosystem health and services	NBRO, CEA, PEA, MEMD, MoSTR/ NASTEC, BS, DWC, DFC	GoSL, Donor Agencies

	Popularization a)Conduct public awareness programs	H	Conduct public awareness programs	Social media, Mass media, Telecom Service providers, DWC, DFC, MoEd, Professional organizations, NSF, NGOs, CEA, PEA, BS	GoSL, Donor Agencies, NGOs
IV) Non-compliance and inadequate provisions in regulatory environment	**Policy Studies** a) Develop policies and regulations to minimize human-wild life conflict	H	Assess the effectiveness of the existing policies on human-wild life conflict and wild life conservation, Develop policies/amend existing policies, Publish policies for public comments, Validation workshops, Cabinet approval for the policy, Development of rules and regulations, Gazetting rules and regulations	NBRO, CEA, PEA, MEMD, MoSTR/ NASTEC, BS, DWC, DFC	GoSL, Donor Agencies
	b) Investigate the level of compliance by development projects to the regulatory environment imposed by relevant authorities	H	Conduct research on the level of compliance of development project after they have received approval	NBRO, CEA, PEA, MEMD, MoSTR/ NASTEC, BS, DWC, DFC	GoSL, Donor Agencies
V) Lack of awareness and interest of decision makers and general public	**Pure and Applied Research** a) Conduct a survey on awareness and attitudes related to biodiversity	H	Carryout survey on awareness and attitudes of people related to biodiversity conservation	Research institutes, Universities and Environment ministry	GoSL, Donor Agencies

on benefits of biodiversity	**Popularization** a) Conduct awareness programs among decision makers and general public		Identify the relevant decision makers and conduct awareness programmes for them, Carry out awareness program for general public	DFC, DWC, CEA, PEA NBRO, CEA, PEA, MEMD, MoSTR/ NASTEC, BS, DWC, DFC	GoSL GoSL, Donor Agencies, NGOs
Sub Area- **4) Pollution prevention and control** i) Waste management ii) Prevention of air pollution, noise pollution and visual pollution iii) Prevent oil spills **Issues/Problems-** I) Unplanned urbanization and industrialization	**Policy Studies** a) Formulation of new policies to regulate unplanned urbanization and industrialization b) Develop strategies to implement policies effectively	H	a) Formulate study groups with relevant experts, Develop policies, Publish for public comments, Validation, Cabinet approval b) Formulate study groups with relevant experts, Develop relevant strategies	NASTEC/ MoSTR, NBRO, DMC, UDA,DFC, MDM, CEA, ITI, MPPA, SLLRDC, MoMWD	GoSL, Donor Agencies
	Pure and Applied Research a) Research on pollution due to urbanization and industrialization	H	Conduct research on air and water quality, pollution due to solid waste, land pollution, marine pollution	Universities, CEA, PEA, MPPA, BS, ITI, DMC, NBRO	GoSL, Donor Agencies
II) Unavailability of proper disposal methods and sites	**Pure and Applied Research** a) Generating national solid waste management profile	H	Research and development on use of solid waste as a resource. Eg. waste to energy ,	CEA, NERD, Centre, Private sector, NBRO,	GoSL, Donor Agencies, Private

for solid waste			Use of 3R concept	ITI, Universities, International Research Institutes, NGOs	sector, NGOs
	b) Research on non-biodegradable waste	H	Research and development on use of solid waste as a resource. Eg. waste to energy , Use of 3 R concept	CEA, NERD, Centre, Private sector, NBRO, ITI, Universities, International Research Institutes, NGOs	GoSL, Donor Agencies, Private sector, NGOs
	Innovation a) Develop technologies for utilization of biodegradable waste	H	Research and development on use of solid waste as a resource. Eg. waste to energy Use of 3R concept	CEA, NERD, Centre, Private sector, NBRO, ITI, Universities, International research Institutes, NGOs	GoSL, Donor Agencies, Private sector, NGOs
	b) Technologies for biogas generation c) Technologies for resource recovery from non-bio degradable waste	H	Research on development of technologies for biogas generation from biodegradable waste and resource recovery from non-biodegradable waste, Adaption of already developed technologies for biogas generation and resource recovery from non-biodegradable waste	CEA, NERD, Centre, Private sector, NBRO, ITI, Universities, International Research Institutes, NGOs, SEA	GoSL, Donor Agencies, Private sector, NGOs

	Popularization a) Create awareness on proper solid waste disposal, compost preparation, utilization of bio degradable waste	H	Awareness programs using public media	Social media, Mass media, Telecom providers, Professional organizations, NSF, NGOs, PEA, CEA, Universities	GoSL, Donor Agencies, NGOs
III) Health issues, soil contamination and coastal pollution due to sewage sludge	**Innovation** a) Develop environment friendly sewage/sludge management techniques	H	Research and development on environment friendly waste management techniques	CEA, NERD, Centre, Private sector, NBRO, ITI, Universities, International Research Institutes, NGOs, SEA	GoSL, Donor Agencies, Private sector, NGOs
IV) Inadequate capacity and facilities to manage clinical waste	**Policy Studies** a) Develop policies for clinical waste management	H	Formulate study group with relevant experts, Examine existing policies and identify gaps if any of gaps are present amending the existing policies, Publishing amended policies for public comments, Validation of amended policies and getting Cabinet approval	CEA, MoH, PEA, MoSTR/NASTEC, GoSL	GoSL
	Pure and Applied Research a) Island wide survey to identify clinical waste management practices used by hospitals and diagnostic laboratories	H	Conduct an Island wide survey to identify clinical waste management practices used by hospitals and diagnostic laboratories	MoH, Universities, CEA, PEA, LGs, PCs, MEMD	GoSL, Donor Agencies

	Innovations a) Development of cost effective technologies for clinical waste management	H	R & D on low cost technologies	NERD Centre, CEA, Universities, MoH, Private sector	GoSL, Donor Agencies, Private sector
	Testing, Standardization & Accreditation a) Pay special attention to clinical waste management when accrediting diagnostic laboratories	H	Getting information on clinical waste management when accrediting diagnostic laboratories, Pay special attention to clinical waste management when accrediting diagnostic laboratories	SLAB	GoSL
	Popularization a) Awareness campaigns for relevant stakeholders on clinical waste management	H	Awareness campaigns for relevant stakeholders on clinical waste management	MoH, CEA, PEA	GoSL
V)Sedimentation and eutrophication in inland tanks/ water bodies due to soil erosion, heavy rain and flash floods	**Pure and Applied Research** Research to identify and promote plant species with special reference to economic values that can be used to minimize sedimentation	M	Conducting research on plant species that can minimize sedimentation	Universities, ITI, NIFS, CEA, WRB	GoSL
	Innovation Develop technologies to prevent sedimentation and eutrophication	H	Develop technologies to prevent sedimentation and eutrophication	Universities, ITI, NIFS, NERD centre, CEA, WRB	GoSL

VI) Lack of effective and efficient methodologies for effluent/emission/ industry and domestic waste management	**Pure and Applied Research** a) Assess assimilation capacity of waste in environment	H	Conduct research, Use existing models or develop new models, Assess assimilation capacity of waste	Universities, CEA, NBRO, DMC	GoSL, Donor Agencies
	b) Assess industrial waste load in water bodies	H	Conduct research, Use existing models or develop new models, Assess Industrial waste load	Universities, CEA, NBRO, ITI	GoSL, Donor Agencies
	c) Develop models to predict pollution levels	H	Develop models to predict pollution levels	Universities	GoSL
	Innovation a) Develop low cost waste treatment methods for Industries	H	Do relevant research and develop low cost waste treatment methods for Industries	NERD Centre, CEA, Universities, Industries, NGOs	GoSL, Donor Agencies, Private sector, NGOs
	b) Develop affordable central waste treatment facilities	H	Do relevant research and develop affordable central waste treatment facilities	CEA, Universities, NERD Centre, Industries	GoSL, Donor Agencies, Private sector, NGOs
	c) Develop low cost ground water treatment methods		Carry out necessary research and develop low cost ground water treatment methods	ITI, NERD Centre, CEA, Universities, Private sector, NGOs	GoSL, Donor Agencies, Private sector, NGOs

	Capacity building a) Train individuals for treatment of industrial and domestic waste and hazardous waste management		Offer short term certificate and diploma courses on the subject, Incorporate treatment of industrial and domestic waste and hazardous waste management to undergraduate and post graduate courses offered by Universities and private HEIs, Provide training on the subject to government and private sector employees	Universities, Private HEIs, Private sector, Professional associations	GoSL, Private sector
VII)Inadequate technologies, facilities, trained HR to manage e-waste and nuclear waste	**Policy studies** a) Review and upgrade policies to manage hazardous waste	H	Formulate study groups with relevant experts , Study the gaps in existing policies, Prepare a new amended policy, Publish for public comments, Validation of policies, Cabinet approval	MoSTR/NASTEC , MoEMD, CEA, UDA, MoMWD, MoH, PEA	GoSL, Donor agencies
	Innovation a) Low cost water treatment methods	H	Conduct research and develop low quality water treatment methods	Universities, NWSDB, WRB, ITI, CEA, NIFS, NERD Centre, Private sector, NGOs	GoSL, Donor Agencies, Private sector, NGOs
	b) Development and implementation of recycling methodologies	H	Conduct research on recycling methods, Develop recycling methodologies, Implement the developed methodologies	Universities, CEA, PEA, UDA, NERD Centre, NGOs, LGs, PCs, Private sector	GoSL, Donor Agencies, Private sector, NGOs

	c) Technologies for hazardous waste management	H	Conduct research on hazardous waste management, Develop technologies for hazardous waste management	Universities, CEA, PEA, UDA, NERD Centre, NGOs, LGs, PCs, Private sector	GoSL, Donor Agencies, Private sector, NGOs
	Capacity building a) Train individuals for treatment of industrial and domestic waste and hazardous waste management	H	Offer short term courses on the subject, Incorporate courses on treatment of industrial and domestic waste management to undergraduate and postgraduate curricula, Offer certificate and Diploma courses on the subject, Provide training on the subject to government and private sector employees	Universities, Private HEIs, BOI, CEA, Professional associations	GoSL, Donor agencies, Private sector
VIII) Lack of awareness and attitudinal constraints on e-waste and nuclear waste	**Capacity building** a) Conducting awareness programmes for e-waste collectors on hazardous effect pf e-waste	H	Conducting awareness programmes for e-waste collectors on hazardous effect of e-waste	Universities, CEA, Professional Associations	GoSL, Donor Agencies
	Popularization a) Create awareness on e-waste	H	Conduct awareness programme on e-waste to every sector of the population	CEA, NSF, PEA, Professional Associations, Universities, MoEd, NGOs	GoSL, Donor Agencies, NGOs
IX) Air pollution due to urbanization and industrialization	**Policy studies** a) Develop policies to control air and noise pollution and to mitigate transboundary pollution, pay due attention to	H	Formulate study group with relevant expertise, Study existing policies and identify gaps, Prepare new policies/amended	MoSTR/NASTEC , Mo Foreign Affairs, CEA, MoEMD, UDA, MoH	GoSL

	international treaties		policies, Publish for public comments, Validation of policies, Cabinet approval		
	b) Develop policies to prevent air pollution leading to formation of smog	L	Formulate study group with relevant expertise, Study existing policies and identify gaps, Prepare new policies/amended policies, Publish for public comments, Validation of policies, Cabinet approval	MoSTR/ NASTEC, CEA, MoEMD, MoI, BOI, UDA, MoH	GoSL
	c) Develop regulations on air noise pollution for industrial zones	M	Formulate study group with relevant expertise, Study existing policies and identify gaps, Prepare new regulations and gazette them	CEA, PEA, MoI, BOI	GoSL
	Pure and applied research a) Research on effects of air pollution and noise pollution on human health	H	Conduct research on effects of air pollution and noise pollution on human health	MRI, Relevant University Faculties/ Departments	GoSL, Donor agencies
	b) Survey on pollution levels	H	Conduct surveys on the levels of air pollution and noise pollution	CEA, ITI, PEA, Universities	GoSL, Donor Agencies
	c) Assess the levels of transboundary pollution and	H	Conduct survey on the levels of transboundary pollutants	CEA, ITI, Universities	GoSL, Donor Agencies

	identify methods to mitigate		Formulate study groups with relevant expertise on methods of mitigating pollution, Develop methods to mitigate transboundary pollution	CEA, MoEMD, MoFA, Relevant University Departments	
	d) Research on low cost emission treatment methods	H	Conduct research on low cost emission treatment methods	NERD Centre, Industries, ITI, CEA, Universities	GoSL, Donor agencies
	e) Review studies on available knowledge on formation of smog and its hazardous effects	L	Review studies on available knowledge on formation of smog and its hazardous effects	Universities, ITI, CEA	GoSL
	f) Develop models to predict and illustrate air pollution and noise pollution	L	Compile existing data	Universities, Institute of Applied statistics of Sri Lanka(IASSL)	GoSL
	Testing, standardization and Accreditation a) Accredit emission treatment process	M	Accredit emission treatment process	SLAB	GoSL
	Popularization a) Create awareness on air pollution and noise pollution (Origin, impacts, mitigation, regulation etc)	M	Conduct awareness programmes to all sectors of the population on air pollution and noise pollution covering all aspects including origin, impacts, mitigation, regulation etc., Incorporate aspects of air pollution and noise pollution to	CEA, PEA, NSF, Professional associations, Private sector, NGOs, NIE, Universities, Private HEIs, Mass media, Social media,	GoSL, Private sector, NGOs

			school science curricula and University curricula	Telecommunication service providers	
X)Sound and noise pollution due to urbanization and industrialization	**Pure and Application Research** Research on effects of sound and noise on human health	H	Conduct research on effects of sound and noise on human health	MRI, Relevant University Faculties/Departments	GoSL, Donor Agencies
	Popularization Create awareness on effects of sound and noise pollution and safety measures		Conduct awareness programmes to all sectors of the population on air pollution and noise pollution covering all aspects including origin, impacts, mitigation, regulation etc., Incorporate aspects of air pollution and noise pollution to school science curricula and University curricula	CEA, PEA, NSF, Professional associations, Private sector, NGOs, NIE, Universities, Private HEIs, Mass media, Social media, Telecommunication service providers	GoSL, Private sector, NGOs
XI)Visual pollution that occurs due to unplanned urbanization and inadequate regulations	**Policy studies** Develop appropriate policies and regulations to minimize visual pollution in urban areas	M	Formulate study groups with expertise in the field, Examine existing policies and regulations and identify gaps and deficiencies, Formulate new policies and regulations, Publish for public comments, Validation workshops and Cabinet approval for policies, Gazetting of regulations under	CEA, UDA, MoMWD, PEA, NASTEC, MoEMD	GoSL

			relevant Acts of Parliament		
	Pure and Applied Research a) Research on health issues related to visual pollution	M	Conduct research on health issues related to visual pollution	MRI, Universities	GoSL, Donor agencies
	b) Behavioural changes of human beings due to visual pollution	M	Conduct research on behavioural changes of human beings due to visual pollution	Universities, MRI	GoSL, Donor agencies
	Popularization a) Create awareness on visual pollution	M	Conduct awareness programme to all sectors of the population on visual pollution, Incorporate aspects of visual pollution including health issues to school curricula and university courses	CEA, PEA, Professional Associations, NIE, MoE, Universities, NGOs, Private HEIs, Mass media, social media, Telecom service providers	GoSL, Private sector, NGOs
XII)Lack of technologies and capacity to deal with large scale oil spills	**Policy studies** a) Formulate policies that promote adoption of international regulations related to oil spills	H	Formulate study groups with expertise in the field, Examine existing policies and regulations and identify gaps and deficiencies, Formulate new policies and regulations, Publish for public comments, Validation workshops and	MPPA, CCCRMD, MoFAR, MoFA, NASTEC	GoSL

			Cabinet approval for policies		
	Pure and Applied research a) Develop technologies to remove oil spills	L	Examine existing technologies and improve them where necessary, Develop new technologies	MPPA, NARA, Universities	GoSL, Donor Agencies
	b) Develop models to illustrate and assess damages of oil spills	M	Collect data, Develop models, Validate models	Universities, MPPA	GoSL, Donor Agencies
	Capacity building a) Train people to remove oil spills	M	Train people to remove oil spills	MPPA	GoSL, Donor Agencies
I) Lack of awareness, resources, attitudes and regulations	**Innovations** a) Develop environmental sustainable technologies/ products	H	Develop environmental sustainable technologies/ products	Universities, All R & D institutes, Industries, Private sector	GoSL, Donor Agencies, Private sector
	Testing standardization and Accreditation a) Accredit the processes of developmental sustainable product	M	Train personnel on the subject Accredit the processes	SLAB	GoSL, Donor Agencies

	Popularization a) Create awareness on environmental sustainable technologies	M	Conduct awareness programmes to all sectors of the population on the subject, Incorporate aspects of environmental sustainable technologies to school curricula and university courses	CEA, PEA, Professional Associations, NIE, MoE, Universities, NGOs, Private HEIs, Mass media, Social media, Telecom service providers	GoSL, Private sector, NGOs

Focus Area 06: Energy

Sub Area and Issues/Problems	Relevant Interventions	Priority H-High, M- Medium, L-Low	Actions	Implementing Agency/Agencies	Funding Agencies

(A) Indigenous Energy Resources and Technologies (Renewables, Nuclear, Fossil)					
Sub Area – **1) Assessment of indigenous energy resources** **Issues/Problems-** I) Lack of indigenous RE resource maps/inventories	**Policy Studies** a) Policy interventions for RE road map with long term targets	H	Appoint Working Committee for the development of policy elements; Conduct regional/ international policy review on the subject; Organize stakeholder consultation workshop/s; Develop and endorse policy framework for the RE road map with long-term targets.	Sri Lanka Sustainable Energy Authority (SLSEA); Ceylon Electricity Board (CEB); Universities; Institute of Policy Studies (IPS); NASTEC	GoSL (SLSEA, CEB, NSF, NRC); Multilateral Donor Agencies (ADB; UNDP}
	Pure and Applied Research a) Development of RE resource maps, inventory and roadmaps	H	Identify present status and gaps of RE resource maps, inventories and roadmaps; Establish criteria and indicators for the characterization, evaluation & ranking of RE resource-technology-application options for the development inventories and roadmaps; Obtain feedback from stakeholders for the endorsement of RE resource maps,	SLSEA, CEB, Universities	GoSL (SLSEA, CEB, NSF, NRC); Multilateral Donor Agencies (ADB; UNDP)

			inventories and roadmaps.		
	Information and Communication Technologies a) Integration of ICT for resource measurements and mappings	M	Review ICT tools and methodologies available for RE resource measurements, characterization and mapping; Develop ICT protocol for RE resource characterization; Establish ICT integrated system for RE resource characterization.	SLSEA, CEB, Information and Communication Technology Agency (ICTA), Universities	GoSL (SLSEA, CEB); Multilateral Donor Agencies (ADB; UNDP)
	Capacity Building a) Capacity building on modelling/ simulation	M	Organize training workshops with local and international experts as resource persons for staff of relevant stakeholder organizations; Organize conferences to share the modelling and simulation results	SLSEA, CEB, Universities	GoSL (SLSEA, CEB); Multilateral Donor Agencies (ADB; UNDP; JICA; KOICA)
II) Inadequacy of information on local fossil fuel resource availability	**Pure and Applied Research** Conducting relevant geophysical surveys (gravity, gravity radiometric, magnetic, seismic)	H	This activity/intervention is not among the ones proposed by the Energy Group. Further, how the priority "H" is obtained is ambiguous. So, it is not right for me to complete this.		
Sub Area – **2) RE technology development for electricity**	**Innovation** a) Establish small hydropower systems	H	This activity/intervention is not among the ones proposed by the Energy Group. Further, how the priority "H" is obtained is ambiguous. So, it is not right for me to complete this.		

generation **Issues/Problems-** Lack of technology developments for optimum exploitation of indigenous resources for electricity generation	**Innovations** a) Establishing wind energy systems locally	H	This activity/intervention is not among the ones proposed by the Energy Group. Further, how the priority "H" is obtained is ambiguous. So, it is not right for me to complete this.		
Sub Area – **2) RE technology development for electricity generation** **Issues/Problems-** I) Very limited local value addition, design & manufacture, leading to less socio-economic impacts	**Pure and Applied Research** a) Local design & manufacture of low-head small hydro power (SHP) system components including turbines and inverters; b) Local design & manufacture of wind turbine blades and other system components including inverters; c) Local design manufacture & fabrication of Solar PV system components; d) Local design & manufacture of biomass power systems including Gasifiers, Micro-turbines, Co-firing (with coal)	M	Review technology advancements in RE for power generation (covering low-head SHP, Solar PV, Wind power and biomass power - Gasifiers, Micro-turbines, Co-firing); Explore opportunities and potential for local value addition, design and manufacture of RE systems for power generation (covering the areas listed above);	SLSEA, CEB, NERDC Universities, Private Sector	GoSL, Multilateral Donor Agencies (ADB; UNIDO; UNDP; JICA; KOICA)

	Testing, standardization & Accreditation a) Establish Standards, Testing Protocols and facilities RE systems including low-head SHP, Solar PV, Wind turbine and Biomass power	M	Develop design guideline and standards for RE systems; Formulate standards and testing protocols for RE system components; Establish testing facilities for RE systems	SLSEA, Universities, NERDC, Sri Lanka Standard Institute (SLSI)	GoSL, Multilateral Donor Agencies (ADB; UNIDO; UNDP)
II) Limited emphasis on optimum exploitation of indigenous resources through technology developments	**Pure and Applied Research** a) Improvements of system performance of RE technologies;	M	Review optimum performances and best available technologies of SHP, wind turbines, Solar PV and Biomass power plants; Characterize the performance of RE power plants in operation; Identify opportunities and potentials for performance / efficiency enhancements.	SLSEA, CEB, NERDC Universities, Private Sector	GoSL, Multilateral Donor Agencies (ADB; UNIDO; UNDP; JICA; KOICA)
	Testing, standardization & Accreditation a) Establish Minimum performance Standards for RE power plants covering SHP, Solar PV, Wind and Biomass power.	M	Develop minimum performance standards for RE power plants; Establish monitoring, reporting & verification (MRV) systems for RE power plants; Implement a rewarding scheme for best performing RE power	SLSEA, Universities, NERDC, SLSI, Private power producers	GoSL, Multilateral Donor Agencies (ADB; UNIDO; UNDP, JAICA, KOICA)

			plants.		
III) Very little progress in waste to energy conversion technology solutions in the power sector	**Policy Studies** a) Policy interventions for implementation of waste to energy (WtE) systems	H	Review best practices in policy interventions globally, related to waste management in general and WtE in particular; Review the National Waste Management Policy and other local policies having link to the waste sector; Review current status of waste management in the country; Propose policy revisions for utilization of WtE option as a part of holistic waste management.	Central Environment Authority (CEA), SLSEA, Universities, IPS; Provincial Councils and Local Authorities	GoSL, Provincial Councils & Local Authorities; Donor Agencies (ADB; UNDP, UNEP, JAICA, KOICA)
	Pure and Applied Research a) Quantification and Characterization waste;	H	Estimate the special / temporal distribution of present and future generation and collection of different types of waste; Identify the physical, chemical and thermal properties of different types of waste; Establish criteria and indicators for selection of appropriate WtE technology options;	CEA, SLSEA, Universities; Provincial Councils and Local Authorities	GoSL, Provincial Councils & Local Authorities; Donor Agencies (ADB; UNDP, UNEP, JAICA, KOICA)

			Implement pilot WtE plants in selected locations for selected waste categories.		
	Biotechnology a) Application of biotechnology for optimum biogas generation in WtE plants	H	Review progression of application of biotechnology on the enhancing of biogas production from waste; Identify potential biotechnologies for optimum biogas production; Implement pilot biogas plants to test the effectiveness of biotechnologies.	CEA, SLSEA, Universities; Provincial Councils and Local Authorities	GoSL, Provincial Councils & Local Authorities; Donor Agencies (ADB; UNDP, UNEP, JAICA, KOICA)
	Capacity Building a) Capacity development on WtE technology options and their roles within holistic waste management.	H	Conduct capacity need assessment related to holistic waste management in general and WtE in particular; Develop capacity development programmes for key stakeholders; Implement awareness and capacity development programmes on WtE options.	CEA, SLSEA, Universities; Technical colleges; Provincial Councils and Local Authorities	GoSL, Provincial Councils & Local Authorities; Donor Agencies (ADB; UNDP, UNEP, JAICA, KOICA)
	Popularization a) Awareness on the role of WtE within holistic waste management.	H	Develop strategy for education and effective awareness creation	CEA, SLSEA, National Institute of Education (NIE), Universities, NGOs, Mass	GoSL; Private sector; Donor Agencies (ADB;

			among all the stakeholders on holistic waste management and role of WtE; Introduce the concepts of holistic waste management and WtE options into related curricula in formal education systems; Conduct awareness programmes through mass media.	media, social media.	UNDP)
Sub Area – **3) RE technology development for Thermal Energy applications** **Issues/Problems-** I) Heavy dependency on biomass without resorting to efficient technologies such as gasifiers and cleaner sources such as liquid biofuels and biogas in domestic cooking.	**Pure and Applied Research** a) Design and development of efficient biomass cook stoves (both direct combustion and gasification); b) Development of cleaner bio-fuels including woody biomass (pellets), biogas and liquid biofuels for cooking applications.	H	Appraise development of cleaner fuels and improved cookstoves worldwide and characterize their properties and performances; Review improved cookstove and cleaner fuel programmes conducted locally; Establish performance characteristics of conventional and improved cookstoves developed locally; Develop improved cookstoves to suit local requirements;	NERDC, IDB, Universities, Technical/vocational institutes, Integrated Development Agency (IDEA)	GoSL; Private sector; Donor Agencies (UNDP, UNIDO, UNEP, GEF); Global Alliance for Clean Cookstoves

			Develop cleaner fuels; Conduct pilot demonstration and dissemination programmes.		
	Innovation a) Promote innovation and technology transfer/ commercialization of cleaner cooking fuels and efficient cook-stove technologies	H	Identify innovative concepts related to Cleaner fuels and Efficient technologies developed locally and support their commercialization; Conduct competitions on innovative processes and technologies and reward them; Support innovation driven startup/spinoff companies for effective technology transfer and commercialization.	NERDC; Sri Lanka Inventors Commotion (SLIC); Universities, Institute of Engineers Sri Lanka (IESL).	GoSL; Private sector; Global Alliance for Clean Cookstoves
	Testing, standardization & Accreditation a) Establish testing protocols and minimum performance standards for cleaner cooking fuels and efficient cookstove technologies .	M	Develop minimum performance standards for cleaner cooking fuels and efficient cookstoves; Establish facilities for testing of cooking fuels and cooktoves.	SLSI, SLSEA, Universities, NERDC	GoSL, Multilateral Donor Agencies (ADB; UNIDO; UNDP, UNEP); Global Alliance for Clean Cookstoves

	Capacity Building a) Train cookstove manufacturers and cooking fuel producers/ suppliers	H	Conduct awareness and training programmes for manufacturers of cookstoves (potters) on efficient cookstoves; Conduct awareness and training programmes for cooking fuel suppliers on cleaner fuels.	SLSI, SLSEA, Universities, Technical/vocational institutes, NERDC.	GoSL, Multilateral Donor Agencies (ADB; UNIDO; UNDP, UNEP); Global Alliance for Clean Cookstoves
	Popularization a) Promote the use of cleaner cooking fuels and efficient cookstoves	H	Develop educational and promotional materials on the benefits of the use of cleaner cooking fuels and improved cookstoves; Conduct awareness programmes through mass media.	CEA, SLSEA, National Institute of Education (NIE), Universities, NGOs, Mass media, social media.	GoSL; Private sector; Donor Agencies (ADB; UNDP)
II) Slow transfer and adaptation of internationally available renewable resource based thermal energy systems, particularly biomass, in industrial /commercial sectors	**Pure and Applied Research** a) Development of technologies for preprocessing/pretreatment of biomass (such as drying, chipping, briquetting, pelletizing) and bio-fuels; b) Design and development of technologies for the conversion of fossil fuel based industrial thermal systems to biomass, including emission control technologies; c) Design and development of improved biomass energy conversion systems for industrial	H	Appraise development of preprocessing/ pretreatment of biomass and biofuels worldwide; Identify and characterize the improved biomass energy technologies worldwide; Review the fossil fuel based technologies in-use to identify potential for conversion to biomass; Review the biomass energy technologies in-	NERDC, SLSEA, IDB, Universities, Technical/vocational institutes, Private sector organizations.	GoSL; Private sector; Donor Agencies (ADB, UNDP, UNEP),

	thermal applications.		use to identify potential areas for improvements; Design/Adopt and develop improved biomass energy technologies / bio-fuels for industrial thermal applications.		
	Innovation a) Promote innovation and technology transfer/ commercialization of cleaner biomass and biofuel processes and products, b) Promote innovation and technology transfer/ commercialization of cleaner biomass energy technologies.	H	Identify innovative concepts related to cleaner biomass/biofuels and efficient biomass energy technologies developed locally for industrial thermal energy applications, and support their commercialization; Conduct competitions on innovative processes and technologies and reward them; Support innovation driven startup/spinoff companies for effective technology transfer and commercialization.	NERDC; SLIC; Universities, IESL, Private sector.	GoSL; Private sector.
	Testing, standardization & Accreditation a) Establish fuel quality standards for biomass fuels (particularly briquettes and pellets);	M	Review biomass fuel quality standards and improved biomass energy conversion technologies related to industrial	SLSI, SLSEA, Universities, NERDC	GoSL, Multilateral Donor Agencies (ADB; UNIDO; UNDP, UNEP).

	b) Establish testing protocols and minimum performance standards for biomass energy conversion technologies for industrial thermal applications.		thermal energy applications; Develop minimum performance standards for biomass energy conversion technologies for industrial thermal applications ; Establish facilities for testing of biomass fuels and for biomass energy conversion technologies.		
	Capacity Building a) Train technical persons on design, operation and maintenance of modern/improved biomass energy conversion technologies including preprocessing/ pretreatment technologies.	M	Conduct awareness and training programmes for technical persons on modern/improved biomass energy conversion technologies; Conduct awareness and training programmes for biomass fuel suppliers.	SLSI, SLSEA, Universities, Technical/vocational institutes, NERDC.	GoSL, Multilateral Donor Agencies (ADB; UNIDO; UNDP, UNEP).
	Popularization a) Promote the use of cleaner biomass fuels and modern/ improved biomass energy conversion technologies for industrial thermal energy applications	M	Develop educational and promotional materials on the performance and benefits of cleaner biomass fuels and modern/ improved biomass energy conversion technologies; Conduct awareness programmes through mass media.	SLSEA, National Institute of Education (NIE), Universities, NGOs, Mass media, social media.	GoSL; Private sector; Donor Agencies (ADB; UNDP).

III) Inadequate exploration of RE resources and technologies for processing of agricultural and food products	**Pure and Applied Research** a) Design and Optimization of solar air heaters for different products b) Design & optimization of biomass driers for different products	H H	Appraise development of efficient renewable energy technologies (RETs) such as solar air heaters and biomass driers for processing of agricultural and food products worldwide and characterize their properties and performances; Review the RETs (solar air heaters and biomass driers) used locally for processing of agricultural and food products locally and identify the areas for improvements; Establish configurations and design parameters for solar air heaters and biomass driers for processing of different agricultural and food products. Develop modeling and simulation tools for performance characterization and optimization of different solar air heaters and biomass driers and conduct field-testing for	NERDC, SLSEA, IDB, Universities, Technical/ vocational institutes, The Institute of Post Harvest Technology (IPHT).	GoSL; Private sector; Multilateral Donor Agencies (ADB; UNIDO; UNDP, UNEP).

			validation. Conduct pilot testing programmes to establish design guidelines and operational parameters different solar air heaters and biomass driers.		
	Innovation a) Introduction of innovative concepts / configurations for better performances of solar dryers b) Introduction of innovative concepts / configurations for better performances of biomass dryers	H H	Identify innovative concepts related to improved solar air heaters and biomass driers for processing of agricultural and food products developed locally and support their commercialization; Conduct competitions on innovative processes and technologies related to use of solar and biomass for processing of agricultural and food products and reward them; Support innovation driven startup/spinoff companies for effective technology transfer and commercialization.	NERDC; IDB; SLIC; Universities, IESL, IPHT, Private sector.	GoSL; Multilateral Donor Agencies (ADB; UNIDO; UNDP, UNEP); Private sector.
	Indigenous knowledge and Intellectual Property Rights a) Study on traditional knowledge /	M	Identify indigenous processes and technologies employed	NERDC; IDB; SLIC; Universities, IESL, IPHT, Private sector.	GoSL; Multilateral Donor Agencies

	best practices on solar drying technologies b) Study on traditional knowledge / best practices on biomass based drying technologies.	 M	in agricultural and food products drying using solar and biomass as energy sources together with associated traditional knowledge / best practices. Characterize the indigenous processes and technologies identified above. Establish innovative concepts of indigenous processes and technologies identified above. Secure IPR for the innovative concepts identified above, where possible. Support development and commercialization of indigenous processes and technologies used in in agricultural and food products drying.		(ADB; UNIDO; UNDP, UNEP); Private sector.
	Testing, standardization and Accreditation a) Development of code of practice for solar dryers b) Development of code of practice	 M M	Identify the system configuration, processes/ technologies of solar and biomass dryers for agricultural and food product processing.	NERDC, SLSI, SLSEA, Universities, IDB, IPHT, Private sector.	GoSL; Multilateral Donor Agencies (ADB; UNIDO; UNDP, UNEP); Private sector.

	for biomass dryers		Develop design guideline and standards for the dryers identified/selected. Formulate standards and testing protocols for the system components of solar/biomass dryers identified/selected. Establish testing facilities for the key system components of selected solar/ biomass dryers.		
	Capacity Building a) Training on design, fabrication and operation of solar dryers. b) Training on design, fabrication and operation of biomass dryers.	M M	Conduct awareness and training programmes on modeling and design solar and biomass dryers; Conduct awareness and training programmes for on fabrication and operation of solar and biomass dryers.	SLSI, SLSEA, Universities, Technical/vocational institutes, NERDC, IDB, IPHT.	GoSL, Multilateral Donor Agencies (ADB; UNIDO; UNDP, UNEP).
	Popularization a) Dissemination of information / technology demonstrations on solar dryers. b) Dissemination of information / technology demonstrations on biomass dryers,	M M	Develop educational and promotional materials on the performance and benefits of cleaner biomass fuels and modern/ improved biomass energy conversion technologies; Conduct awareness programmes through mass media.	SLSEA, National Institute of Education (NIE), Universities, NGOs, Mass media, social media.	GoSL; Private sector; Donor Agencies (ADB; UNDP).

Sub Area- **4) RE technology development for Transport Applications** **Issues/Problems-** I) Heavy dependency on imported fossil fuels in the transport sector	**Innovations** Develop biofuels for transport applications: biodiesel and ethanol	H	This activity/ intervention was ranked as "Low" by the Energy Group. The priority "H" here is obtained is ambiguous. So, it is not right for me to complete this	University of Colombo ,University of Moratuwa, Other universities, NIFS	
II) Inadequate emphasis on alternative transport fuels / technologies in transport planning	**Innovations** a) Develop biofuels for transport applications: Biogas	H	This activity/ intervention was ranked as "Low" by the Energy Group. The priority "H" here is obtained is ambiguous. So, it is not right for me to complete this		
III) Lack of technology road map / targets in the transport sector IV) lack of integration of research outputs for policy making	**Pure and Applied Research** a) Development of solar, wind, small-hydroelectricity based charging stations and networks	M	Review the development of solar, wind, small-hydroelectricity based charging stations and networks worldwide. Study the technical and economic potential of using solar, wind and small-hydro based charging stations for different modes of	Universities, SLSEA, CEB, LECO	GoSL, Multilateral Donor Agencies (ADB; UNDP; UNEP); JAICA; KOICA.

			transports/vehicles.		
	Policy Studies a) Policy interventions for the development of transport sector road map b) Formulation of policies incorporating relevant research outputs	M M	Review policy interventions related to the use of solar, wind, small-hydroelectricity sources for battery charging stations and networks in the transport sector worldwide. Review the transport and electric sector policies in the country to identify opportunities and gaps for the promotion of solar, wind, small-hydroelectricity based charging stations. Develop policy elements for the introduction of solar, wind, small-hydroelectricity sources for battery charging stations and networks in the transport sector.	Universities, SLSEA, CEB, LECO, National Institute of Fundamental Studies (NIFS).	GoSL, Multilateral Donor Agencies (ADB; UNDP; UNEP); JAICA; KOICA.
Sub Area- **5) RE for other energy uses and non-energy services** **Issues/Problems** Overlooking the	**Pure and Applied Research** a) Research on modern high efficient biomass energy conversion technologies for commercial and industrial applications	H	Review development of modern high efficient biomass energy conversion technologies (co-generation, tri-generation) for commercial and	SLSEA, NERDC, Universities, Biomass Energy Association of Sri Lanka (BEASL).	GoSL, Multilateral Donor Agencies (ADB; UNDP; UNEP); JAICA; KOICA.

Potential of advanced energy systems (e.g. co-generation, tri-generation, thermo-electric generation)			industrial applications worldwide. Study technical and economic potential of introducing high efficient biomass energy conversion technologies in Sri Lanka. Implement pilot projects for selected commercial and industrial applications.		
Sub Area- **6) Indigenous resource development** **Issues/Problems** Lack of sustainable supply of resources for RE	**Policy Studies** a) Policy interventions on land-use planning for promotion of biomass	H	Review of national policies and regulations affecting biomass plantation, harvesting and transport. Explore the potential lands for biomass plantation (including dedicated, intercropping, under-cropping). Develop and introduce policy and regulatory interventions for promotion of biomass for energy applications.	SLSEA, Department of Forestry, BEASL, Universities, Timber Corporation, National Planning Department.	GoSL, Multilateral Donor Agencies (FAO, GEF, UNDP, ADB).
	Pure and Applied Research a) Development of sustainable plantation management techniques with high productivity for sustainable supply of biomass for	H	Identify potential species for biomass plantation suitable for different agro climatic zones. Identify potential	SLSEA, Department of Forestry, BEASL, Universities.	GoSL, Multilateral Donor Agencies (FAO, GEF, UNDP, ADB).

	generation of RE		sustainable plantation management techniques used locally and globally. Study the productivity of different species in each agro climate zones under different sustainable plantation management techniques. Establish sustainable plantation management techniques with high productivity in each agro climate zones.		
	Innovations a) Innovations in plantation management for optimum economic output	H	Identify innovation concepts in sustainable plantation management techniques practiced. Promote introduction of innovative concepts in plantation management for optimum economic output, while preserving sustainability.	SLSEA, Department of Forestry, BEASL, Universities.	GoSL, Multilateral Donor Agencies (FAO, GEF, UNDP, ADB).
	Biotechnology a) Application of biotechnology for fuel-wood plantations	M	Explore potential biotechnology concepts for the application in fuel-wood plantation in ensuring sustainability with optimum productivity. Undertake pilot	SLSEA, Department of Forestry, BEASL, Universities.	GoSL, Multilateral Donor Agencies (FAO, GEF, UNDP, ADB).

			plantation programmes to ascertain the productivity improvements.		
	Indigenous knowledge and Intellectual Property Rights a) Exploration and adaptation of indigenous plantation management techniques	M	Identify indigenous management techniques employed in biomass plantations together with associated traditional knowledge / best practices. Establish innovative concepts of indigenous plantation management techniques identified above. Secure IPR for the innovative concepts identified above, where possible. Support further development and adaptation of indigenous plantation management techniques for biomass.	SLSEA, Department of Forestry; SLIC; Universities, Private sector.	GoSL; Multilateral Donor Agencies (FAO, GEF, UNDP, ADB); Private sector.
	Testing, standardization and Accreditation a) Development of standards for sustainability criteria for bioenergy	M	Review international standards on sustainability criteria for bioenergy. Develop and adopt standards on sustainability criteria for	SLSEA, SLSI, Forestry Department, Universities.	GoSL; Multilateral Donor Agencies (FAO, GEF, UNDP, ADB); Private sector.

			bioenergy suitable for local context.		
	Capacity Building a) Training on sustainable plantation management techniques	M	Develop training materials on sustainable plantation management techniques for biomass/fuel-woods. Conduct training programmes on sustainable plantation management techniques.	SLSEA, SLSI, Forestry Department, Universities.	GoSL; Multilateral Donor Agencies (FAO, GEF, UNDP, ADB); Private sector.
	Popularization a) Popularization of sustainable fuel wood plantation techniques	H	Develop awareness materials on sustainable plantation management techniques for biomass/fuel-woods. Conduct awareness programmes on sustainable plantation management techniques.	SLSEA, SLSI, Forestry Department, Universities, Media.	GoSL; Multilateral Donor Agencies (FAO, GEF, UNDP, ADB); Private sector.
Sub Area- **7) Effective energy storage systems** **Issues/Problems** **I)** Difficulties in absorbing renewable energy resources (wind and solar) due to the electricity demand pattern of the national grid (with evening peak	**Pure and Applied Research** Conduct a feasibility study and design of pump storage systems for large-scale grid electricity storage	H	Review the progression on pump storage systems for large-scale grid electricity storage globally. Identify potential sites for the installation of pump storage systems. Establish technical and economic potential of pump storage systems.	SLSEA, CEB, Universities.	GoSL; Multilateral Donor Agencies (ADB, World Bank).

and late-night valley)					
II) Lack of low cost and efficient options for storing electricity when production exceeds demand and using it during peak-demand periods	**Innovations** Develop advanced battery technologies for medium and small scale grid energy storage	H	Review the progression on advanced battery technologies for medium and small scale grid energy storage globally. Identify the innovative concepts in R&D programmes on advanced battery technologies for medium and small scale grid energy storage applications conducted locally. Support commercialization of advanced battery technologies.	SLSEA, CEB, Universities, Coordinating Secretariat for Science, Technology and Innovation (COSTI).	GoSL; Multilateral Donor Agencies (ADB; UNDP; UNEP); JAICA; KOICA.
Sub Area- **8) National Electricity Infrastructure / Grid Architectures** **Issues/Problems** I) Intermittency, partial unpredictability, location dependency, demand fluctuations in wind and solar electricity generation	**Pure and Applied Research** a) Conduct research on Design and optimization of national grid with mix of central and distributed generation system for grid integration of REs. b) Advanced supply and demand forecasting tools for optimum grid integration of RE c) Development of dynamic modelling tools for optimum electricity dispatch for grid	H H H	Review the progression on RE integration to central and distributed grids globally. Review advanced demand and supply forecasting tools related to grid integration of REs. Study the performance characteristics of grid-integrated RE systems already in operation.	SLSEA, CEB, LECO, Universities, Private power producers	GoSL; Multilateral Donor Agencies (ADB; UNDP; UNEP); JAICA; KOICA; Private power producers.

	integration of RE		Develop modeling tools to simulate the performance of grid integrated RE systems. Develop design criteria for grid integration of REs for optimum performances. Conduct pilot programmes on selected REs for grid integration.		
	Innovations a) Introduction of innovative concepts for optimum electricity dispatch in grid-integration of RE	H	Identify innovative concepts that could be introduced to optimize the electricity dispatch performances of grid-integrated RE systems. Conduct pilot programmes on REs for grid integration to test the innovative concepts.	SLSEA, CEB, LECO, NIFS, Universities, Private power producers	GoSL; Multilateral Donor Agencies (ADB; UNDP; UNEP); JAICA; KOICA; Private power producers.
	Information and Communication Technologies a) Effective use of ICT for optimum electricity dispatch in grid-integration of RE	M	Review progression of ICT applications in grid integrated RE systems globally. Identify potential ICT tools that could be used for optimum electricity dispatch in grid-integration of REs. Conduct pilot programmes on use of	SLSEA, CEB, LECO, NIFS, Universities, Private power producers	GoSL; Multilateral Donor Agencies (ADB; UNDP; UNEP); JAICA; KOICA; Private power producers.

			ICT for optimum electricity dispatch in grid-integration of REs.		
	Capacity Building a) Training on dynamic modelling and optimum electricity dispatch	M	Develop training materials on dynamic modelling of demand and supply and optimum electricity dispatch related to grid integration of REs. Conduct training programmes on dynamic modelling and optimum electricity dispatch.	SLSEA, CEB, LECO, Universities.	GoSL; Multilateral Donor Agencies (ADB; UNDP; UNEP); JAICA; KOICA; Private power producers.
(B) Energy efficiency improvements, conservation & management					
Sub Area- **9) Energy conservation in the Domestic sector** **Issues/Problems** I) Lack of local development of energy efficient appliances	**Pure and Applied Research** a) Design and Develop energy efficient lighting products and appliances locally b) Design and develop energy efficient LPG stoves and burners	H H	Review the progression of energy efficient lighting products & appliances and LPG stoves & burners globally. Establish the performance characteristics of lighting products & appliances and LPG stoves & burners marketed and manufactured locally. Develop design guideline for energy efficient lighting products & appliances and LPG	SLSEA, NERDC, Universities, SLEMA, Private sector.	GoSL; Multilateral Donor Agencies (ADB; UNDP; UNEP; UNIDO); JAICA; KOICA; Private sector.

			stoves & burners. Support local development and manufacture of energy efficient lighting products & appliances and LPG stoves & burners.		
II) Inability to control marketing of energy inefficient household appliances	**Policy Studies** a) Development of energy labelling regulations	H	Identify and prioritize household appliances for energy labelling programme. Appoint national expert committee to develop criteria for energy labelling for each appliance selected. Develop and introduce energy labels for appliances.	SLSEA, SLSI, CEB, LECO, Universities, NERDC, Private sector	GoSL; Multilateral Donor Agencies (ADB; UNDP; UNEP); JAICA; KOICA; Private sector.
	Pure and Applied Research a) Formulation of criteria for the estimation of energy performance of appliances	H	Establish energy performance characteristics of household appliances marketed/manufactured locally. Identify parameters related to energy performances of each appliances selected. Formulate criteria for energy efficiency	SLSEA, SLSI, CEB, LECO, Universities, NERDC, Private sector	GoSL; Multilateral Donor Agencies (ADB; UNDP; UNEP); JAICA; KOICA; Private sector.

			performances.		
	Testing, Standardization and Accreditation a) Development of testing standards and accreditation of testing facilities	M	Develop testing standards for energy labeling of household appliances. Establish facilities for testing of appliances for energy performances. Develop conformity assessment schemes for accreditation of testing facilities. Implement accreditation programme for energy labelling testing facilities.	Sri Lanka Accreditation Board (SLAB), SLSEA, SLSI, CEB, LECO, Universities, NERDC, Private sector	GoSL; Multilateral Donor Agencies (ADB; UNDP; UNEP); JAICA; KOICA; Private sector.
	Popularization a) Popularization of energy efficient appliances	H	Develop media strategy for the promotion of energy efficient household appliances. Develop promotional tools / awareness materials on energy efficient appliances. Implement promotional programmes for popularization of energy efficient appliances.	SLSEA, SLSI, CEB, LECO, Universities, Media, Private sector	GoSL; Multilateral Donor Agencies (ADB; UNDP; UNEP); JAICA; KOICA; Private sector.
Sub Area- **10) Energy conservation in the Commercial and Industrial sectors**	**Policy Studies** a) Policy formulation and introduction of mechanisms for the promotion of low energy-intensive processes, plants and machineries	H	Review the progress of national energy management programme of SLSEA, Ministry of Power & Renewable	SLSEA, SLEMA, Universities	GoSL; Multilateral Donor Agencies (ADB; UNDP; UNEP); JAICA;

Issues/Problems I) Lack of due consideration of energy efficiency of processes, plants & machinery, (e.g. life-cycle-analysis) in the development of businesses, industries and commercial establishments that use energy intensive processes			Energy. Review the global status of the policy interventions in promotion of low energy-intensive processes, plants and machineries. Identify and introduce policy interventions for the promotion of low energy-intensive processes, plants and machineries. Revise and update the national energy management programme to accommodate the promotion of low energy-intensive processes, plants and machineries.		KOICA.
II) Lack of systems for waste energy/material recovery and reuse	**Pure and Applied Research** a) Development and commercialization of waste heat recovery and utilization systems b) Introduction of Cleaner production techniques (waste as a resource)	H H	Review the progression of waste heat recovery & utilization systems and cleaner production techniques globally. Study the status of waste heat sector locally and identify the opportunities for recovery and utilization.	SLSEA, National Cleaner Production Center (NCPC), Ministry of Environment, SLEMA, Ministry of Industries.	GoSL; Multilateral Donor Agencies (UNDP; UNEP); JAICA; KOICA.

			Study the progression of cleaner production in local industrial and commercial sectors and identify the potential areas for interventions. Develop design guideline for waste heat recovery and utilization systems. Develop cleaner production techniques for local industry.		
III) Limited use of passive techniques and in situ renewable energy generation in buildings	**Policy Studies** a) Development of regulations for EE building envelops (both existing and new)	H	Revise the EE building code for commercial buildings (to cover both existing and new facilities). Develop EE building code for residential buildings. Develop enforcement mechanism of building codes.	SLSEA, SLSI, SLEMA, UDA, Local Authorities.	GoSL; Multilateral Donor Agencies (UNDP; UNEP); JAICA; KOICA.
	Pure and Applied Research a) Development of energy performance rating schemes for buildings	H	Review energy performance rating schemes practiced globally. Establish energy performances of typical building envelopes in the country. Formulate energy performance rating	SLSEA, SLSI, SLEMA, UDA, Local Authorities.	GoSL; Multilateral Donor Agencies (UNDP; UNEP); JAICA; KOICA.

			schemes for building envelopes (for both commercial and residential).		
	Innovations a) Exploration of innovative concepts for enhancement of energy performance of buildings	M	Identify innovative concepts that could be introduced to enhance the energy performance of buildings. Conduct pilot testing programmes for validation of innovative concepts.	SLSEA, SLEMA, NERDC, Universities.	GoSL; Multilateral Donor Agencies (ADB; UNDP; UNEP).
	Indigenous Knowledge and Intellectual Property Rights a) Exploration of EE building concepts used in traditional buildings	M	Identify EE building concepts used in traditional buildings with associated knowledge / best practices. Establish innovative concepts used in traditional buildings and their performance characteristics . Secure IPR for the innovative concepts identified above, where possible. Support further development and adaptation of EE building concepts used in traditional buildings.	SLSEA, SLEMA, NERDC, IESL, Universities.	GoSL; Multilateral Donor Agencies (ADB; UNDP; UNEP).

	Testing, Standardization and Accreditation a) Certification and accreditation of EE / green building consultants	M	Review schemes available for certification and accreditation of EE / Green building consultants globally. Develop eligibility requirements for accreditation of EE / Green building consultants. Formulate and implement certification and accreditation of EE / green building consultants programmes.	SLSEA, SLEMA, IESL, Universities.	GoSL; Multilateral Donor Agencies (ADB; UNDP; UNEP).
	Capacity Building a) Training programmes on EE building designs	M	Develop training materials on EE building designs. Conduct training programmes on EE building designs.	SLSEA, SLEMA, IESL, Construction Industry Development Authority (CIDA), Universities.	GoSL; Multilateral Donor Agencies (ADB; UNDP; UNEP).
	Popularization a) Awareness and popularization of EE buildings	H	Develop media strategy for the promotion of EE buildings. Develop promotional tools / awareness materials on EE buildings . Implement promotional programmes for popularization of EE buildings.	SLSEA, SLEMA, IESL, CIDA, Universities, Media.	GoSL; Multilateral Donor Agencies (ADB; UNDP; UNEP); JAICA; KOICA.

Sub Area- **11) Energy conservation in the Power sector** **Issues/Problems** Inadequate energy efficiency improvement interventions in power generation facilities	**Pure and Applied Research** a) Conduct research on Design, optimization and introduction of waste-heat recovery and utilization systems for power plants	H	Review the progression of waste heat recovery & utilization systems and concepts in power plants globally. Study the status of waste heat recovery in local power plants and identify the opportunities for improvements. Develop design guideline for waste heat recovery and utilization systems for power plants.	CEB, SLSEA, SLEMA, Universities, Private power producers	GoSL; Multilateral Donor Agencies (ADB; UNDP; UNEP); Private power producers.
Sub Area **12) Energy conservation in the Transport sector** **Issues/Problems** I) Inadequate attention to energy efficiency / fuel economy aspects of the transport sector	**Policy Studies** a) Development of regulations on fuel economy standards for road vehicles	H	Review fuel economy standards for road vehicles implemented globally. Formulate and implement regulations on fuel economy standards for road vehicles	Universities, SLSEA, SLSI, Department of Motor Traffic (DMT), National Transport Commission (NTC),	GoSL; Multilateral Donor Agencies (ADB; UNDP; UNEP).
	Pure and Applied Research a) Development of representative driving cycles covering strategic regions	H	Review methodologies available for development of driving cycles. Formulate procedures for the development of driving cycles. Establish driving cycles	Universities, SLSEA, SLSI, DMT, NTC.	GoSL; Multilateral Donor Agencies (ADB; UNDP; UNEP).

			for different vehicle categories in different regions. Establish overall driving cycle.		
	Innovations a) Development of innovative approaches for formulation of driving cycles	H	Review the parameters and concepts used for the development of driving cycles globally. Identify innovative concepts that could be introduced to develop driving cycles best suit to actual behaviour locally.	Universities, SLSEA, SLSI, DMT, NTC.	GoSL; Multilateral Donor Agencies (ADB; UNDP; UNEP).
	Testing, standardization and Accreditation a) Development of testing procedures and accreditation of chassis dynamometer testing facilities	M	Review equipment and resources required for setting-up of chassis dynamometer testing facilities. Establish chassis dynamometer testing facilities. Develop operational procedure for chassis dynamometer testing facilities. Develop conformity assessment schemes for accreditation of testing facilities. Implement accreditation programme for chassis	Universities, SLSEA, SLSI, SLAB, DMT, NTC,	GoSL; Multilateral Donor Agencies (ADB; UNDP; UNEP).

			dynamometer testing facilities.		
	Popularization a) Popularization of fuel efficient vehicles	H	Develop media strategy for the promotion of fuel-efficient vehicles. Develop promotional tools / awareness materials on fuel-efficient vehicles. Implement promotional programmes for popularization of fuel-efficient vehicles.	Universities, SLSEA, SLSI, SLAB, DMT, NTC, Media.	GoSL; Multilateral Donor Agencies (ADB; UNDP; UNEP); JAICA; KOICA.
II) Deterioration of public transport systems and services (rail / bus)	**Policy Studies** a) Development of transport sector master plan promoting public transport systems	H	Review transport policy and transport master plan to identify the gaps in promoting public transport. Update transport policy and transport master plan to promote public transport.	NTC, Ministry of Transport, Universities.	GoSL; Multilateral Donor Agencies (ADB; UNDP; UNEP); JAICA; KOICA.
	Pure and Applied Research Impact assessments of public transport modes on fuel economy and other socio-economic aspects	H	Identify criteria and indicators for the evaluation of performance of transport modes covering technical, environmental, economic and social (including fuel economy and GHG emissions). Identify major public	NTC, Ministry of Transport, SLSEA, CEA, Universities.	GoSL; Multilateral Donor Agencies (ADB; UNDP; UNEP); JAICA; KOICA.

			transport modes. Conduct impact assessments of selected /prioritized public transport modes.		
	Innovations a) Development of innovative approaches in integrating mass transport systems to present infrastructure	H	Review the innovative approaches / best practices used in integrating mass transport systems to present infrastructure globally. Identify/develop the innovative concepts that could be adopted locally.	NTC, Ministry of Transport, SLSEA, CEA, Universities.	GoSL; Multilateral Donor Agencies (ADB; UNDP; UNEP); JAICA; KOICA.
	Information and Communication Technologies a) Use of ICT for optimum utilization of public/ mass transports	M	Review progression of use of ICT in public/ mass transport systems globally. Identify potential ICT tools that could be used for optimum utilization of public/ mass transports. Conduct pilot programmes on use of ICT for optimum utilization of public/ mass transports.	NTC, Ministry of Transport, SLSEA, CEA, Universities.	GoSL; Multilateral Donor Agencies (ADB; UNDP; UNEP); JAICA; KOICA.
II) Inadequate attention on Non-technical options for energy efficient	**Pure and Applied Research** a) Impact assessments of supply /demand management	H	Develop models for simulation and characterization of	NTC, Ministry of Transport, SLSEA, CEA, Universities.	GoSL; Multilateral Donor Agencies

transport systems	interventions on fuel economy and other socio-economic aspects		supply and demand management scenarios in transport sector. Identify criteria and indicators covering technical, environmental, economic and social (including fuel economy and GHG emissions) areas for the impact assessments. Identify potential supply / demand management scenarios. Conduct impact assessments of selected supply / demand management scenarios.		(ADB; UNDP; UNEP); JAICA; KOICA.
	Innovations a) Development of innovative approaches for supply/ demand management in the transport sector.	H	Review the innovative approaches / best practices used in innovative approaches for supply/ demand management in transport globally. Identify/develop the innovative concepts that could be adopted locally.	NTC, Ministry of Transport, SLSEA, CEA, Universities.	GoSL; Multilateral Donor Agencies (ADB; UNDP; UNEP); JAICA; KOICA.
	Information and Communication Technologies a) Use of ICT for supply and demand management in the	H	Review progression of use of ICT for supply and demand management in the transport sector	NTC, Ministry of Transport, SLSEA, CEA, Universities.	GoSL; Multilateral Donor Agencies (ADB; UNDP;

	transport sector		globally. Identify potential ICT tools that could be used for supply and demand management in transports. Conduct pilot programmes on use of ICT for for supply and demand management in transports.		UNEP); JAICA; KOICA.
III) Lack of systems to promote inter-modal transport and non-motorized transport (NMT) modes	**Policy Studies** a) Development of policy interventions for promotion of NMT	H	Review policies, regulations and best practices related to NMT globally. Formulate and implement policy and regulations for the promotion of NMT.	NTC, Ministry of Transport, SLSEA, CEA, Universities.	GoSL; Multilateral Donor Agencies (ADB; UNDP; UNEP); JAICA; KOICA.
	Pure and Applied Research a) Impact assessments of NMT on fuel economy and other socio-economic aspects	H	Develop models for simulation and characterization of NMT. Identify criteria and indicators covering technical, environmental, economic and social (including fuel economy and GHG emissions) areas for the impact assessments. Identify potential NMT options.	NTC, Ministry of Transport, SLSEA, CEA, Universities.	GoSL; Multilateral Donor Agencies (ADB; UNDP; UNEP); JAICA; KOICA.

			Conduct impact assessments of selected NMT options.		
	Innovations a) Introduction of innovative concepts for best integration of NMT in present transport sector	H	Review the innovative approaches / best practices used in integration of NMT in the transport sector globally. Identify/develop the innovative concepts that could be adopted locally.	NTC, Ministry of Transport, SLSEA, CEA, Universities.	GoSL; Multilateral Donor Agencies (ADB; UNDP; UNEP); JAICA; KOICA.
	Popularization a) Promotion of NMT modes	H	Develop media strategy for the promotion of NMT. Develop promotional tools / awareness materials on NMT modes. Implement promotional programmes for popularization of NMT.	NTC, Ministry of Transport, SLSEA, CEA, Universities, Media.	GoSL; Multilateral Donor Agencies (ADB; UNDP; UNEP); JAICA; KOICA.
Sub Area- **13) Energy Efficient Zones / Communities** **Issues/Problems** I) Inadequate attention to the development of energy efficient townships/urban communities	**Policy Studies** Develop mechanisms, guidelines and planning tools to establish energy efficient townships /urban communities	M	Review policies, standards, regulations, guidelines and best practices related to energy efficient townships /urban communities globally. Study the programmes implemented locally on establish energy efficient townships /urban	Ministry of Megapolis and Western Development, UDA, SLSEA, Universities.	GoSL; Multilateral Donor Agencies (ADB; UNDP; UNEP); JAICA; KOICA.

			communities. Formulate mechanisms, guidelines and planning tools to establish energy efficient townships /urban communities.		
Sub Area- **14) Smart Metering** **Issues/Problems** I) Failure to implement end-user electricity conservation and management through advanced concepts such as smart metering and dynamic pricing	**Pure and Applied Research** Conduct survey for introduction of pricing mechanisms / incentive schemes for demand peak clipping and valley filling, EV charging and other DSM initiatives	M	Review the progression of the concepts of smart metering for end-user electricity conservation and management globally. Study the local scenario on the concepts such as demand peak clipping and valley filling, EV charging and other DSM initiatives. Propose suitable interventions on pricing mechanisms / incentive schemes for DSM.	CEB, LECO, SLSEA, Universities.	GoSL; Multilateral Donor Agencies (ADB; UNDP; UNEP); JAICA; KOICA.

			Priority					
Sub Area and Issues/Problems	**Pure and Applied Research**	**Recommendations**	**H-High, M-Medium,**	**Actions**		**Implementing Agency/Agencies**	**Funding Agency / Agencies**	
14) Smart metering								
Issues/Problems I) Failure to implement end-user electricity conservation and management through advanced concepts such as smart metering and dynamic pricing	Conduct a survey for introduction of pricing mechanisms / incentive schemes for demand peak clipping and valley filling, EV charging and other DSM initiatives.							

		L-Low			
Sub Area – **1) Mineral Exploration- Ocean** **Issues/Problems-** I) Lack of information on availability of mineral resources including oil and gas in the EEZ	**Pure and Applied Research** a) Geophysical (gravity, magnetic, radiometric and seismic) and geochemical surveying and modeling of shallow subsurface of the continental shelf	H	A systematic survey covering the continental shelf	NARA, GSMB	State funds, Foreign Funds
	b) Preparation of bathymetry, marine geological and geophysical maps	H	Development of a model for shallow subsurface of the EEZ, Based on the survey results development of following maps for EEZ a) bathymetry map b) Geological map c) Geophysical map	NARA, GSMB,	State funds, Foreign Funds
Sub Area – **2) Mineral Exploration - Land** **Issues/Problems-** I) Increase in demand for mineral resources II) Lack of information on available resources	**Pure and Applied Research** a) Airborne geophysical survey and compilation of maps b) Geochemical surveys	H	An airborne survey covering the whole island Geochemical survey covering the whole island	GSMB, Survey Department , SLAF NIFS, GSMB,	State funds, Foreign Funds State funds, Foreign Funds
Sub Area – **3) Product Development**	**Pure and Applied Research** a)Synthesis of graphene and nanomaterials as a value addition to graphite	H	Laboratory studies, Pilot scale studies, Patenting the procedures	ITI, Ministry of S&T, SLINTEC,	State funds Through MoSTR, Private

Issues/Problems- I) Lack of research and development in product development using minerals available in Sri Lanka.					sector, Foreign Funds
	b)Thorium-fuelled liquid fluoride reactor	H	Extraction of Thorium and other REE at of laboratory scale, Reactor establishment	Atomic Energy Authority, SLINTEC	State funds Through MoSTR, Private sector
	c) Montmorillonite purification pilot plant	H	Pilot scale work, Laboratory studies, Plant Establishment	GSMB, SLINTEC	State funds Through MoSTR
	a) Synthesis of precipitated calcium carbonate	H	Laboratory scale process, Pilot scale studies, Patenting the process	University of Peradeniya	State funds Through MoSTR
	e) Li, Na and iron intercalation to Sri Lankan natural vein graphite	H	Research work at laboratory scale, Pilot scale research, Patenting the process	NIFS, SEU	State funds through MoSTR
	f) Nano tourmaline	H	Laboratory scale process, Pilot scale research, Patenting the process	Gem & Jewellery Research and Training Institute (GJRTI)	State funds

Focus Area 08: Textile and Apparel

Sub Area and Issues/Problems	Relevant Interventions	Priority H-High, M-Medium	Actions	Implementing Agency/Agencies	Funding Agency / Agencies
	g) Newly added Vein Quartz purification	H	Laboratory scale process, Pilot scale research, Patenting the process	SLINTEC, IPTs	State funds
	h)TiO_2 pigment preparation	H	Laboratory scale process, Pilot scale research, Patenting the process	SLINTEC	State funds
II) Lack of long-term stable comprehensive policy for mineral sector development, and implementation	**Policy Studies** a) Formulation of a national policy for mineral resource exploitation and product development	H	Development of the policy, Publishing for private comments, Validation of the policy, Approval of Cabinet of Ministers	MoSTR/ NASTEC GSMB	State funds

		L-Low			
Sub Area – **1) Institutional collaborations** **Issues/Problems-** I) National level R&D institutes, universities, etc. work in scattered way and no proper link among themselves. II) No proper procedure to nurture ideas / innovations. III) Lack of research partnerships with international institutions	**Capacity Building** a) Establish a R&D and innovation coordination center	H	Convening a stakeholder meeting , Appointment of a steering committee, Identifying the members, Identifying the objectives, Identifying the actions of the centre, Establishing the textile R.D, Coordinating Centre (TRDCC)	University of Moratuwa, OUSL, Sri Lanka Institute of Textile and Apparel (SLITA), Private Sector	The line Ministry (Ministry of Industry and Commerce), UGC, Relevant Universities, ERD, Private Sector
	Capacity Building a) Introduce subjects on key strategic R&D fields in undergraduate and postgraduate studies and research related to textile and apparel industry	H	Promote and facilitate establishing research centres in all the relevant Universities, R&D institutes, to be coordinated by the centre of excellence, Promote PPP, Increase HR capacities, Facilitating and attracting PG students with a rewarding system	UOM, TRDCC, SLITA, OUSL, Other Universities	The line Ministry , UGC, ERD, NSF, UGC, Relevant Universities
	Policy Studies a) Develop an IP policy & strategy	H	Adopt the existing IP policies to meet the specific T&A industry requirements	TRDCC, SLITA, NIPO, U of M, OUSL	Line Ministry, UGC, Relevant universities
	Policy Studies a) Develop a policy document to support funding for research	L	Appointing a steering committee, Developing the policy	TRDCC	Line Ministry

	Capacity Building a) Develop partnerships with foreign universities	H	Promote signing MOUs with relevant foreign universities	TRDCC, Relevant University Faculties/ departments	Line Ministry, UGC, Relevant Universities
Sub Area – **2) Apparel Marketing / Branding** **Issues/Problems-** I) Sri Lanka loosing competitiveness in traditional markets II) Lack of branding and consumer awareness	**Information and Communication Technologies** a) Develop new business models using ICT	H	Developing new business models using ICT	TRDCC, U of M, OUSL, Industry	Line Ministry, Private sector, Relevant universities
	Pure and Applied Research a) Research on emerging markets and branding **Popularization** a) Exploration of new markets	H H	Facilitate research on emerging markets and branding, Facilitate research	TRDCC, IPS, SLITA, Universities SLITA, SLIM	Line Ministry, IPS, ERD , UGC Line Ministry, ERD
	Information and Communication Technologies a) Setting up data portal to provide information to the stakeholders	M	Setting up data portal to provide information to the stakeholders	TRDCC, ICTA	Line Ministry
	Pure and Applied Research a) Market research on suitable branding strategy based on Sri Lankan identity and its core strengths	H	Facilitate research	TRDCC, Relevant Universities, SLITA, IPS, SLIM, Private sector	Line Ministry, Relevant Universities, Private sector
	Popularization a) Find new Sri Lankan brands for	H	promote new Sri Lankan brands for the identified	Industry	Private Sector

	the identified international markets		international markets		
Sub Area- **3) Fashion Design** **Issues/Problems-** I) Lack of commercializatio n in fashion developments	**Pure and Applied research** a) Research on fashion trends and forecasting	H	Facilitate research	TRDCC, Industry, Universities, SLIM, SLITA, Private sector	UGC, Line Ministry, Private Sector, Relevant Universities
II) High lead time for design realization	**Information and Communication Technologies** a) Develop personalized product using CAD / virtual prototyping	H	Facilitate research	TRDCC, OUSL, SLITA, U of M	Industry, UGC, Relevant Universities
III) Lack of value addition using textile and surface design	**Nanotechnology** a) Develop textile and surface design techniques	H	Facilitate research	TRDCC, SLITA, U of M, OUSL, Private sector, SLINTEC	Industry, MoSTR, ERD, Line Ministry, Private Sector
IV) Lack of emerging design entrepreneurs	**Popularization** a) Develop design- incubators and promote new Sri Lankan brands	H	Facilitate establishing an incubation system	TRDCC, U of M, Private Sector	Line Ministry, UGC, Private Sector
V) Opportunity for new embellishment techniques.	**Information and Communication Technologies** a) Develop design software to enhance embellishment techniques and capability	H	Facilitate research	TRDCC, U of M, OUSL, SLITA	Line Ministry, UGC, Private Sector

Sub Area- **4) Apparel Product Innovation** **Issues/Problems-** I) Low efficiency and low material utilization in traditional cut and sewing	**Innovations** a) Develop efficient alternative methods to traditional cut and sew method	H	Develop efficient alternative methods to traditional cut and sew method	TRDCC, U of M, OUSL, SLITA	Line Ministry, UGC, Private Sector, MoSTR
II) Consumers demand individual fit or customized garments	**Information and Communication Technologies** a) Develop software for 3D modelling	M	Develop software for 3D modelling	TRDCC, U of M, OUSL, SLITA	Line Ministry, UGC
III) Increase functionality of wearing apparel.	**Nanotechnology** a) Develop new mechanisms to the textile development	M	Conduct research in the area, Develop new mechanisms	TRDCC, U of M, OUSL, SLITA, SLINTEC, Private Sector	Line Ministry, UGC, Relevant Universities, Private Sector, MoSTR
IV)Research on consumer trends towards wellbeing and increase energy levels	**Innovations** a) Utilize biomechanical knowledge when developing active wear	H	Conduct research in the area, Gather existing knowledge, Utilize biomechanical knowledge when developing active wear	TRDCC, U of M, OUSL, SLITA, SLINTEC, Private Sector	Line Ministry, UGC, Relevant Universities, Private Sector, MoSTR

V) Less usage due to wearing / tearing some of the apparel parts	**Innovations** a) Develop efficient detachable methods	L	Conduct research in the area, Gather existing knowledge, Develop efficient detachable methods	TRDCC, U of M, OUSL, SLITA, SLINTEC, Private Sector	Line Ministry, UGC, Relevant Universities, Private Sector, MoSTR
VI) Longer product development process	**Innovations** a) Develop efficient product development methods	H	Conduct research in the area, Gather existing knowledge, Develop efficient product development methods	TRDCC, U of M, OUSL, SLITA, SLINTEC, Private Sector	Line Ministry, UGC, Relevant Universities, Private Sector, MoSTR
VII) Delay in sampling process	Innovations a) Develop efficient sampling processes	L	Conduct research, Develop efficient sampling process	TRDCC, U of M, OUSL, SLITA, Private sector, SLIM	Line Ministry, UGC, Relevant Universities, Private Sector
Sub Area- **5) Apparel Process Innovation** **Issues/Problems-** I) Difficulty in attracting manpower for production II) Higher labour cost	**Information and Communication Technologies** a) Adapt/ Develop automated production and material handling mechanisms	H	Conduct research on automation, Gather existing information on automation, Develop automated production and material handling mechanisms	TRDCC, U of M, OUSL, SLITA, Private sector	Line Ministry, UGC, Relevant Universities, Private Sector
	Information and Communication	H	Conduct research on	NERD Centre,	Line Ministry,

	Technologies a) Develop automated sewing mechanisms		automated sewing mechanisms	TRDCC, SLITA, Faculties of Engineering of Universities, Private Sector	UGC, MoSTR, Relevant Universities, Private Sector
	Innovations a) Develop radio frequency identification systems for cost effective inventory tracking and defect identification	H	Conduct research on the radio frequency identification systems for cost effective inventory tracking and defect identification	TRDCC, SLITA, Engineering Faculties of Universities, Private Sector	UGC, Relevant Universities
	Information and Communication Technologies a) Develop models to simulate the garment manufacturing process and seam engineering	H	Conduct research on simulating the garments manufacturing process & seam engineering, Develop models to simulate the garment manufacturing process and seam engineering	TRDCC, Relevant University Departments where research on radio frequency identification system are carried out	Line Ministry, UGC, Relevant Universities, NSF, Private Sector
	Pure and Applied Research **a)** Enhance anthropometric knowledge to identify variations in anthropometric dimensions in designing apparels	H	Conduct research on anthropometric knowledge	TRDCC, SLITA, Relevant Universities	Line Ministry, UGC, Relevant Universities, NSF, Private Sector
	Indigenous knowledge & Intellectual Property Rights	H	Conduct research on the subject	TRDCC, SLITA,	Line ministry, UGC,

	a) Promote usage of lean technologies based on indigenous knowledge and such other knowledge streams			Relevant University/ Faculties/ Departments, Private sector	Relevant Universities, Private sector
Sub Area- **6) Textile material innovation (fiber, Yarn & accessories)** **Issues/Problems-** I) Non availability of natural and man-made fiber base. II) Customer concern on environmentally friendly textiles and apparel III) Demand for sustainable fibres in the high end markets	**Pure and Applied Research** a) Conduct research on value added materials such as Cosmeto Textiles using local raw materials	H	Conduct research on the subject	TRDCC, SLITA, Relevant University/ Faculties/ Departments, Private sector	Line ministry, UGC, Relevant Universities, Private sector
	Indigenous knowledge & Intellectual Property Rights a)Promote Indigenous knowledge in production of eco-friendly and bio-based fibre	H	Conduct research on the Indigenous knowledge on the subject, Application on research funding	TRDCC, SLITA, Relevant University/ Faculties/ Departments, Private sector	Line ministry, UGC, Relevant Universities, Private sector
	Pure and Applied research a)Conduct research into sustainable/renewable fibres/materials	H	Conduct research on the subject	TRDCC, SLITA, Relevant University/ Faculties/ Departments, Private sector	Line ministry, UGC, Relevant Universities, Private sector
	Innovations a)Develop new methods of recycling and regenerating textile materials	H	Conduct research on the subject, Developing raw materials using research findings	TRDCC, SLITA, Relevant University/	Line ministry, UGC, Relevant Universities,

				Faculties/ Departments, Private sector	Private sector
IV) Demand for innovative textile materials	**Innovations** a)Develop new methods of re-cycling polyester fibre / fabric waste & blended materials	H	Conduct research on the subject, Developing raw materials using research findings	TRDCC, SLITA, Relevant University/ Faculties/ Departments, Private sector	Line ministry, UGC, Relevant Universities, Private sector
	Innovations a)Develop new methods of production Sustainable natural fibres and regenerated fibres based on agricultural waste such as banana, pineapple, plant materials	H	Conduct research on the subject, Developing raw materials using research findings	TRDCC, SLITA, Relevant University/ Faculties/ Departments, Private sector	Line ministry, UGC, Relevant Universities, Private sector
	Pure and Applied Research a)Conduct research on emerging fibres such as bamboo, banana etc.	H	Conduct research on subject	SLITA, Relevant University/ Faculties/ Departments, Private sector	Line ministry, UGC, Relevant Universities, Private sector
	Nanotechnology a)Promote Nano technological knowledge in production of Nano materials and in processing technologies.	H	Conduct research on subject, Apply the existing knowledge and new knowledge generated through research in the production and nano material and in processing knowledge	TRDCC, SLITA, SLINTEC, Relevant University/ Faculties/ Departments,	MoSTR, UGC, Relevant Universities, Private sector-

				Private sector	
	Nanotechnology a)Promote Nano technological knowledge in production of Functional Fibres and Polymers	H	Conduct research on the subject, Apply existing knowledge and new knowledge developed through research	TRDCC, SLITA, SLINTEC, Relevant University/ Faculties/ Departments, Private sector	MoSTR, UGC, Relevant Universities, Private sector
Sub Area- **7) Handloom** **Issues/Problems-** I) High investment requirement with regards to textile machinery II) High energy cost	**Indigenous knowledge & Intellectual Property Rights** a)Initiation of modifying existing machinery to suit varied & diverse needs	L	Initiation of modifying existing machinery to suit varied & diverse needs	Relevant Universities/ Departments, SLITA, TRDCC, Private Sector	Line ministry, UGC, Relevant Universities, Private sector
	Pure and Applied Research a)Conduct research on attachments or computerized programmable rigs to assist machine set up	L	Conduct research on attachments or computerized programmable rigs to assist machine set up	Relevant Universities/ Departments, SLITA, TRDCC, Private Sector	Line ministry, UGC, Relevant Universities, Private sector

III) Increased set up time and labor cost and skill IV) Weaving not supporting technical textiles Higher production cost and low productivity in handloom sector V) Lack of Design and marketing capability VI) Not having access to markets VII) Lack of awareness on suitable raw materials and techniques					
	Pure and Applied Research a)Conduct research on redesign of equipment to produce value added materials	M	Conduct research on redesign of equipment to produce value added materials	Relevant Universities/ Departments, SLITA, TRDCC, Private Sector	Line ministry, UGC, Relevant Universities, Private sector
	Information and Communication Technologies a)Develop a database for the handloom industry	L	Collect data, Developed data base	TRDCC	Line ministry

	Pure and Applied Research a)Conduct research on methods for improving machine efficiency and productivity	M	Conduct research on methods for improving machine efficiency and productivity	Relevant Universities Faculties/ Departments, SLITA, Private sector	Line ministry, UGC, Relevant Universities, Private sector
	Capacity Building a)Conduct training programs on 3D weaving to achieve conformable shapes for technical textiles	L	Conduct training programs on 3D weaving to achieve conformable shapes for technical textiles	TRDCC, SLITA, Relevant Universities Faculties/ Departments, Private sector	Line ministry, UGC, Relevant Universities, Private sector
	Pure and Applied Research a)Conduct research on Machine modifications specifically aiming energy cost reduction	H	Conduct research on machine modifications specifically aiming energy cost reduction	SLITA, Relevant Universities Faculties/ Departments, Private sector	Line ministry, UGC, Relevant Universities, Private sector
	Innovations a)Find out solutions for development of alternative natural and sustainable raw materials, dyes & finishes specially for handloom use	H	Conduct research on natural and sustainable raw materials, dyes & finishes specially for handloom use	TRDCC, SLITA, Relevant Universities Faculties/ Departments, Private sector	Line ministry, UGC, Relevant Universities, Private sector
	Pure and Applied Research a)Use alternative energy sources to operate looms	H	Conduct research on the use of alternative energy sources to operate looms, Apply research funding & existing knowledge to operate looms	TRDCC, SLITA, Relevant Universities Faculties/ Departments, Private sector	Line ministry, UGC, Relevant Universities, Private sector

Sub Area- **8) Knitting /seamless garments** **Issues/Problems-** I) Not explored the compression possibilities with seamless garments. II) Not fully explored the value addition through vertical Integration	**Pure and Applied Research** a)Develop machinery and structures with ability to pre-stress for compression characteristics	H	Do research on machinery and structures with ability to pre-stress for compression characteristics, Apply the new knowledge generated through research and existing knowledge to develop machinery and structures with ability to pre-stress for compression characteristics	Relevant Universities, Faculties/ Departments, SLITA, NERD centre, Private sector	MoSTR
	Innovations a)Initiation of knitting technology and 3D shapes for technical textile applications such as medical and smart textiles	H	Do research on knitting technology and 3D shapes for technical textile applications such as medical and smart textiles, Apply existing knowledge and new knowledge and new knowledge generated through research to initiate knitting technology and 3D shapes for technical textile applications such as medical and smart textiles	Relevant Universities Faculties/ Departments, SLITA, NERD centre, Private sector	MoSTR
	Information and Communication Technologies a)Develop computerized systems for controlled knitting, designing and shaping	H	Develop computerized systems for controlled knitting, designing and shaping	SLITA, Relevant Universities, Faculties/ Departments, Private sector	Line Ministry, UGC, Relevant Universities, Private sector

	Innovations a)Develop information portal to cater fabric and garment formation through seamless knitting	H	Do research on this subject, Develop information portal to cater fabric and garment formation through seamless knitting, Using existing knowledge and/or new knowledge generated through research	SLITA, Relevant Universities, Faculties/ Departments, Private sector	Line Ministry, UGC, Relevant Universities, Private sector
	Pure and Applied Research a)Conduct research on cost effective complete garment with seamless knitting using pre-dyed and finished yarn	H	Conduct research on cost effective complete garment with seamless knitting using pre-dyed and finished yarn	SLITA, Relevant Universities, Faculties/ Departments, Private sector	Line Ministry, UGC, Relevant Universities, Private sector
Sub Area- **9)Colouration, finishing & surface treatments** **Issues/Problems-** I) High water and energy usage II) Environment issues & sustainability III) Unable to access high efficient new dyeing techniques due to high	**Capacity Building** a)Conduct training programs on reducing water consumption in pre-treatment and dyeing and finishing	H	Conduct training programs on reducing water consumption in pre-treatment and dyeing and finishing	SLITA, Relevant Universities, Faculties/ Departments, Private sector	Line Ministry, UGC, Relevant Universities, Private sector
	Capacity Building a)Conduct training programs on pre-treatment and dyeing techniques aiming low water and energy consumption	H	Conduct training programs on pre-treatment and dyeing techniques aiming low water and energy consumption	SLITA, Relevant Universities, Faculties/ Departments, Private sector	Line Ministry, UGC, Relevant Universities, Private sector
	Innovations a)Develop water-less Dyeing techniques	H	Do research on this subject, Develop water-less dyeing techniques using existing knowledge and/or new knowledge generated through research	SLITA, Relevant Universities, Faculties/ Departments, Private sector	Line Ministry, UGC, Relevant Universities, Private sector

investment IV) Longer time for colour matching and dyeing V) High shade variation due to dependence of human skills for colour matching.	**Indigenous knowledge & Intellectual Property Rights** a)Develop finishes using locally available indigenous/herbal materials	H	Do research on the indigenous knowledge on locally available indigenous/ herbal material need for finishes, Develop finishes using locally available indigenous/herbal materials using existing knowledge and new knowledge generated through research	SLITA, Relevant Universities, Faculties/ Departments, Private sector	Line Ministry, UGC, Relevant Universities, Private sector
	Pure and Applied research a)Conduct research on new fast dyeing techniques to reduce dyeing cycle time	H	Conduct research on new fast dyeing techniques to reduce dyeing cycle time	SLITA, Relevant Universities, Faculties/ Departments, Private sector	Line Ministry, UGC, Relevant Universities, Private sector
	Information and Communication Technologies a)Develop computer aided techniques for colour matching and dyeing	L	Develop computer aided techniques for colour matching and dyeing	SLITA, Relevant Universities, Faculties/ Departments, Private sector	Line Ministry, UGC, Relevant Universities, Private sector
	Information and Communication Technologies a)Develop computerized systems to reduce colour variations and methods to detect and rectify such variations on-line	M	Develop computerized systems to reduce colour variations and methods to detect and rectify such variations on-line	SLITA, Relevant Universities, Faculties/ Departments, Private sector	Line Ministry, UGC, Relevant Universities, Private sector

	Information and Communication Technologies a)Develop information system or portal for on-line inspection of fabric quality	H	Develop information system or portal for on-line inspection of fabric quality	SLITA, Relevant Universities, Faculties/ Departments, Private sector	Line Ministry, UGC, Relevant Universities, Private sector
	Pure and Applied Research a)Development of natural dyeing and finishing	H	Development of natural dyeing and finishing	SLITA, Relevant Universities, Faculties/ Departments, Private sector	Line Ministry, UGC, Relevant Universities, Private sector
Sub Area- **10)Technical Textiles** **Issues/Problems-** I) Technical textiles are expected to continue to grow at a higher rate than any other segment of the textile market.	**Pure and Applied Research** a)Conduct research on different applications of textile structures	H	Conduct research on different applications of textile structures	SLITA, Relevant Universities, Faculties/ Departments, Private sector	Line Ministry, UGC, Relevant Universities, Private sector
	Pure and Applied Research a)Conduct research on protective textile and apparel	H	Conduct research on protective textile and apparel	SLITA, Relevant Universities, Faculties/ Departments, Private sector	Line Ministry, UGC, Relevant Universities, Private sector
	Pure and Applied Research a)Conduct research on functionalization of textile structures	H	Conduct research on functionalization of textile structures	SLITA, Relevant Universities, Faculties/ Departments, Private sector	Line Ministry, UGC, Relevant Universities, Private sector

	Information and Communication Technologies a)Develop information system as 'assistant' for clothing that have a memory to store information and carry out complex calculations	M	Develop information system as 'assistant' for clothing that have a memory to store information and carry out complex calculations	SLITA, Relevant Universities, Faculties/ Departments, Private sector	Line Ministry, UGC, Relevant Universities, Private sector
	Information and Communication Technology a)Develop information system to monitor clothing that record the behaviour or the health of the person	H	Do research on information system to monitor clothing that record the behaviour or the health of the person, Develop information system to monitor clothing that record the behaviour or the health of the person using existing knowledge and knowledge generated through research	SLITA, Relevant Universities, Faculties/ Departments, Private sector	Line Ministry, UGC, Relevant Universities, Private sector
	Testing, Standardization & Accreditation a)Testing standards of regulative clothing that adjusts certain parameters, such as temperature or ventilation	H	Develop testing standards of regulative clothing that adjusts certain parameters, such as temperature or ventilation	SLSI	MoSTR, SLSI
	Information and Communication Technologies a)Develop electronic components that are washable and durable and safe for on-body application	H	Do research on electronic components that are washable and durable and safe for on-body application, Develop electronic components that are washable and durable and safe for on-body application using existing	SLITA, Relevant Universities, Faculties/ Departments, Private sector	Line Ministry, UGC, Relevant Universities, Private sector

			knowledge and knowledge generated through research		
	Innovations a)Integrate the existing electronic components into apparel	H	Integrate the existing electronic components into apparel	SLITA, Relevant Universities, Faculties/ Departments, Private sector	Line Ministry, UGC, Relevant Universities, Private sector
	Information and Communication Technologies a)Develop smart fibre based monitoring systems	H	Develop smart fibre based monitoring systems	SLITA, Relevant Universities, Faculties/ Departments, Private sector	Line Ministry, UGC, Relevant Universities, Private sector
	Nanotechnology a)Develop cost effective production methods of nano fibres for technical textile applications	H	Do research on production of nanotechnology fibres for technical textile applications, Develop cost effective production methods of nano fibres for technical textile applications using existing knowledge and knowledge generated through research	SLITA, Relevant Universities, Faculties/ Departments, Private sector	Line Ministry, UGC, Relevant Universities, Private sector, NSF, MoSTR
	Nanotechnology a)Develop nano coating for fibrous surfaces	H	Do research on developing nano coating for fibrous surfaces, Develop nano coating for fibrous surfaces using existing knowledge and knowledge generated through research	SLITA, Relevant Universities, Faculties/ Departments, Private sector	Line Ministry, UGC, Relevant Universities, Private sector, NSF, MoSTR

	Nanotechnology a)Develop nano conductive materials for medical & smart textiles	H	Do research on developing nano conductive materials for medical & smart textiles, Develop nano conductive materials for medical & smart textiles using existing knowledge and knowledge generated through research	SLITA, Relevant Universities, Faculties/ Departments, Private sector	Line Ministry, UGC, Relevant Universities, Private sector, NSF, MoSTR
Sub Area- **11)Supply Chain** **Issues/Problems-** Longer lead-times	**Information and Communication Technologies** a) Develop information portal to cater to seamless fabric and garment making	M	Develop information portal to cater to seamless fabric and garment making	TRDCC	Line Ministry
Sub Area- **12) Energy** **Issues/Problems-** I) High energy cost II) lack of sustainable energy sources	**Pure and Applied Research** a)Conduct research on low cost / sustainable energy sources optimized for Textile and Apparel industry	H	Conduct research on low cost / sustainable energy sources optimized for textile and Apparel industry	SLITA, Relevant Universities, Faculties/ Departments, Private sector	Line Ministry, UGC, Relevant Universities, Private sector
	Pure and Applied Research a)Conduct research on machine improvements to reduce energy consumptions	H	Conduct research on machine improvements to reduce energy consumptions	SLITA, Relevant Universities, Faculties/ Departments, Private sector	Line Ministry, UGC, Relevant Universities, Private sector
	Pure and Applied Research a)Conduct research on low energy manufacturing models	H	Conduct research on low energy manufacturing models	SLITA, Relevant Universities, Faculties/ Departments, Private sector	Line Ministry, UGC, Relevant Universities, Private sector

	Popularization a)Adapt green technology for textile & apparel industry	H	Identify relevant green technologies Apply the identified technologies in the industry	TRDCC, Private sector, SLITA, Relevant Universities, Faculties/ Departments,	Line Ministry, UGC, Relevant Universities, Private sector

Focus Area 09: ICT and Knowledge Services

Sub Area and Issues/Problems	Relevant Interventions	Priority H-High, M-Medium, L-Low	Proposed Actions	Proposed Implementing Agency/Agencies	Funding Agency / Agencies
Sub Area – **1) Information Technology & Business Process Outsourcing (IT & BPO)** **Issues/Problems-** I) Lack of skilled labour force in relation to anticipated future development plans	**Policy Studies** a) Develop a policy document to encourage the IT/BPO sector	H	Formulation of a study group, Developing the policy, Publishing for public comments, Validation workshop, Approval by the Cabinet of Ministers	SLASSCOM, Information and Technology Agency of Sri Lanka (ICTA), NASTEC, Ministry of Telecommunication and Digital Infrastructure (MoTDI)	GoSL, Private sector

II) Lack of encouragement from the state (Tax concessions, making critical infra-structure cost effective, Establishment of IT parks etc.)	**Capacity building** a) Bridge the gap between industry needs and University education	H	Promote self-learning through online learning to fulfil to industry needs , Introduce entrepreneurship thinking into all streams of all University education , Establishing Universities-Industry interactions and allowing there financially independent as liability companies, Funding for visiting faculty from industry, Provide more opportunities for University academics to spend their sabbatical leave at ICT related world reputed organization and short term vacation leave with the industry, Provide opportunities for industry personal to engage in research and teaching in Universities, Provide opportunities to all students following ICT degree programme, to get at least 6 month of Industrial training at reputed ICT companies	Universities , UGC, Private sector, ICT skill council	GoSL, UGC, Universities, Private sector

Sub Area – **2) Datafication** **Issues/Problems-** I) Lack of relevant Policies II) Lack of knowledge on datafication and its applications	**Policy Studies** a) Develop policies for datafication		Formulation of a study group, Developing the policy, Publishing for public comments, Validation workshop, Approval by the Cabinet of Ministers	ICTA, NASTEC, MoTDI, SLASSCOM, Professional bodies of ICT, CSSL	GoSL
	Capacity Building a) Training on datafication		Introduce courses on datafication at the relevant University Faculties/ Departments/ SLIATE/Private Higher Education Institutes (HEIs), Promote STEM education at school level, Promote mathematics, statistics and Artificial Intelligence education at the University level	Universities, SLIATE, Private sector, NIE, MoHE, UGC	GoSL, Private sector
	Popularization a) Implement strategies identified for awareness building		Use games animation in education, Use of mass media, social media and mobile platforms, Promote kids programming	ICTA, Mass media, Telecommunication Service Providers	GoSL, Private sector

Sub Area – **3) Big Data Analysis** **Issues/Problems-** I) Lack of awareness of benefits of big data analysis as a source of income generation and provision of employment	**Policy Studies** a) Develop incentive policies to encourage and enhance Big Data Analysis as business ventures		Formulation of a study group, Developing the policy, Publishing for public comments, Validation workshop, Approval by the Cabinet of Ministers	ICTA, NASTEC, MoTDI, SLASSCOM, Professional bodies on ICT	GoSL
	Popularization a) Implement strategies identified for awareness building among target groups		Seminars and workshop for target groups, Use of mass media, social media and mobile platforms, Promote kids programming	ICTA, Mass media, Telecommunication service providers, Professional associates, Universities	GoSL, Private sector
Sub Area – **4) Emerging Trends in ICT (Cloud Computing, The Internet of Thing (IoT) and Smart Systems, 3D Printing)** **Issues/Problems-**	**Popularization** a) Implement strategies identified for awareness building among target groups	H	Develop relevant strategies, Implement the strategies, Promote start-up companies by fresh graduates	ICTA, Mass media, Telecommunication service providers, Professional associates, Universities	GoSL, Private sector

I) Lack of knowledge of emerging trends in ICT	**Promote Innovations** Strengthen University industry cells as fully fledged business units	H	Provide relevant card to give business leadership, Student competition at National level, Provincial level, District level, Zonal level, school level and University level, Promote kids programming, Promote start-up companies by fresh graduates, Provide training in business academic staff, Provide financial autonomy under University Council, Promote kids programming	University Faculties and Departments, Private sector	GoSL, UGC, Universities, Private sector

	Application in ICT Promote high value addition, high tech industries	H	Promote 3D modelling, Provide adequate training on 3D modelling, Promote 3D printing cottage industry for IoT, Form collaboration with nano technology for IoT manufacturing SDGs, Database on problems, Access to industry, Develop technology adding to problem, Scale up the technology	SLASSCOM, FITIS, Chambers, SLINTEC, Relevant University Faculties/ Departments	Private sector, GoSL, SLINTEC
	Policy Studies Formulate a policy for research commercialization	H	Develop a clear IP policy to promote industry relevant research	NASTEC, MoSTR	MoSTR
Sub Area – **5) Portfolio Analysis** **Issues/Problems-** 1)Lack of sufficient awareness and encouragement to expand the industry	**Policy Studies** a) Formulate a policy to create awareness, encourage and expand the Portfolio Analysis as a business		Formulation of a study group, Developing the policy, Publishing for public comments, Validation workshop, Approval by the Cabinet of Ministers	ICTA, NASTEC	GoSL

Sub Area – **6) Bioinformatics** **Issues/Problems-** I) Lack of sufficient awareness and encouragement to expand the industry	**Policy Studies** Formulate a policy to create awareness, encourage and expand the bioinformatics as a business	L	Formulation of a study group, Developing the policy, Publishing for public comments, Validation workshop, Approval by the Cabinet of Ministers	ICTA, NASTEC	GoSL
	Capacity Building Promote Biotechnology education	M	Include biotechnology modules into GCE ordinary level and Advanced level curricula, Promote certificate, diploma and degree programmes in Biotechnology	NIE, MoE, Universities, UGC, Private sector, HEIs	UGC, Private sector, MoE
	Pure and Applied research Prioritise Bioinformatics research	M	Encourage interdisciplinary research between Biology and computing and in bio information	Universities, Private sector	NRC, NSF, Universities, Private sector
	Applications of Biotechnology Export bioinformatics capacity as a BPM industry	M	Identify and develop applications that can be taken to market, Get IP rights and apply them in industry	ICTA, Universities, Private sectors	GoSL, UGC, Universities

Sub Area – **7) Mathematical Solutions, Geophysical Data Processing and Architectural CAD Designing** **Issues/Problems-** I) Lack of sufficient awareness & encouragement to expand the industry	**Policy Studies** a) Formulate policies to create awareness, encourage and expand Mathematical modelling, Geophysical Data Processing and Architectural CAD Designing as business ventures	M	Formulation of a study group, Developing the policy, Publishing for public comments, Validation workshop, Approval by the Cabinet of Ministers	ICTA, MoTDI, NASTEC	GoSL
	Capacity Building a) Conduct training programs on Mathematical modelling, Geophysical Data Processing and Architectural CAD Designing	H	Conduct training programs on mathematical modelling, geophysical, data processing and Architectural CAD designing, Provide training on audio editing, video editing and preparation of and other interactive learning material to teachers	ICTA, Universities, Private sector	GoSL, UGC, Universities, Private sector
Sub Area- **8) On-line-Legal Services and On-line-Tutoring** **Issues/Problems-** I) Lack of sufficient awareness &	**Policy Studies** a) Formulate a policy to create awareness, encourage and expand On-line Legal Services and On-line-Tutoring	M	Formulation of a study group, Developing the policy, Publishing for public comments, Validation workshop, Approval by the Cabinet of Ministers	NASTEC, ICTA	GoSL

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

Sub Area and Issues/Problems	Relevant Interventions	Priority H-High, M-Medium, L-Low	Proposed Actions	Proposed Implementing Agency/Agencies	Funding Agency / Agencies
encouragement to expand the industry	**Capacity Building** a) Conduct training programs on On-line-Legal Services and On-line-Tutoring	H	Conduct training programs on On-line-Legal Services and On-line-Tutoring	ICTA	GoSL

Sub Area- **I) Basic Sciences** **Issues/Problems** I) Research in basic sciences are not developed up to satisfactory levels compared to neighbouring countries II) Lack of trained personnel in basic sciences III) Lack of collaboration with centres of excellence for fundamental research (in other countries) IV) Interest of students to follow science degree programs is decreasing V) Unavailability of essential state-of -the –art equipment for	**Policy Studies** a) Recognize the importance of research on basic sciences and allocate funds	H	Out of the amount allocated for research a significant percentage should be allocated for purely basic science (no immediate commercial applicability) e.g - particle physics, mathematics, astronomy	Universities, NIFS, and other relevant R&D institutes	NRC, NSF, UGC, Universities
	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	H	When funds are allocated for basic research allow to have a budget line for foreign collaboration	Universities, NIFS, and other relevant R&D institutes	NRC, NSF, UGC, Universities
	c) Establish special scholarship programs for promising young students to study science up to postgraduate level at recognized universities and world class Research Institutes	H	Establish link programmes with reputed International Universities and Research Institute, Establish special scholarship programme for students	MoSTR, MoHE, Foreign Donor Agencies	GoSL, Foreign Donor Agencies
	d) Create postdoctoral positions in Universities and Research Institutes	H	Create postdoctoral tenure track positions at Universities and Research Institutes	Universities, Relevant Research Institutes	UGC, Ministry of STR

scientific research	e) Encourage industries to fund basic research providing tax benefits	M	Encourage funding from Industries and other donors, Providing tax benefits and recognition through national awards	Ministry of Finance, Presidential Secretariat	Ministry of Finance , Presidential Secretariat
	Capacity Building a) Strengthen existing research institutes to carry out fundamental research	H	Allocate a significant percentage of total funding for basic research which have no immediate commercial applicability, Enhance the human resources and laboratory facilities	NIFS, Universities	NSF, NRC, Universities
	b) Establish state-of-the-art national equipment Centre(s)	H	State-of the- art Equipment in basic sciences in one or more centres, Develop a mechanism to access the facilities in these centres at affordable cost by scientists for basic research	MoSTR	MoSTR
Sub Area- **2) Emerging Technologies** **Issues/Problems** I) Lack of expertise II) Transfer of knowledge to	**Policy Studies** a) Promote industries for producing new materials utilizing local minerals b) Promote foreign direct	H H	Promote establishing of industries (local or in collaboration with reputed foreign partners) to produce value added products utilizing local minerals such as limonite, graphite, phosphate etc.	MoSTR, Ministry of Industries, Minitry of Trade, BOI	MoSTR, MoI, MoT, BOI

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	investments to produce high-tech products such as silicon chips				
	Pure and Applied Research Utilizing emerging technologies efficiently for economic development and welfare of people. For eg., identifying fishing grounds, weather forecasting, microelectronics, mechatronics & robotics, nanotechnology, biotechnology	H	Establishing a national hub for receiving and redistribution of earth observation satellite data	Department of Meteorology, MTDI	Department of Meteorology, MTDI
			Promote collaborative research in emerging technologies such as microelectronics, mechatronics, robotics and use of satellite data for Fisheries and agricultural development	M of Fisheries, MoI, Relevant R:D institution including NARA, R:T institute of Ministry of Agriculture, Department of Meteorology, Universities, Private sector, NERD Centre	MoSTR, M of Agriculture, M of Fisheries, Private sector, M of Industries
			Enhance support for research on new material for nanotechnology and biotechnology	MoSTR, Universities, SLINTEC, ITI, ACCIMT, Private sector	MoSTR, UGC, Universities, Private sector, Donor by Agencies

satellite data are not properly utilized	**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	H	Acquiring development of national capabilities in emerging technologies especially in under developed areas like space technology, mechatronics, electronics by (i) Providing advanced overseas training in these areas (ii) Providing enhanced funding in these areas and in other emerging technologies, nano technology, biotechnology (iii) Encouraging private sector collaboration through tax and other benefits	MoSTR, Universities, SLINTEC, ACCIMT, Ministry of Finance, BOI, Private sector, MoHE	Ministry of Finance, MoSTR, UGC, Universities, BOI, Private sector
	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	H	Encourage establishment of a technology transfer unit to promote commercialization	MoSTR	MoSTR
	c) Establish a central station for training technicians/ instrumentation experts	H	Have state-of the- art equipment in emerging technologies in one or more centres,	MoSTR, SLINTEC	MoSTR

	to handle and repair equipment		Promote the training for technicians/instrumentation experts at these centres and ensure such trained technicians provide with enumeration to retain them		
	Information on the Science and Technology Personal a) Develop an on-line database on S&T personnel in the country	H	Improve already available database at the NSF	NSF	MoSTR
Sub Area- **3) Indigenous Knowledge(IK)** **Issues/Problems** 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	**Policy Studies** a) Formulation of a policy to preserve and use IK	H	Establishing a committee to develop a policy guideline to preserve and use IK, including the relevant aspects of IK creation, transfer and epistemology	NASTEC	MoSTR
	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	H	Referred to the above committee Enhance funding for research on IK , Promote prehistoric knowledge research in IK	NASTEC, Legal Draftment office Universities, M of Agriculture, M of Health, M of Irrigation	MoSTR, M of Justice GoSL, Private sector

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	**Innovations** Innovations to incorporate IK in agriculture	M	Encouraging research to study incorporation of IK in agriculture	IIK, DoA, BMARI, Relevant University/ Faculties/ Departments, Private sector	NSF, NRC, Universities, UGC, M of Agriculture, Private sector
	Documentation, Testing, Standardization and Accreditation a) Standardization of Indigenous medicinal products	H	Use existing literature on IK to provide formulae for the manufacture of indigenous standardized medicinal products, Establish a proper "knowledge management system" to facilitate acquisition, validation, dissemination and management	BMARI, SLSI, Universities	NSF, NRC, M of Health
	b) Develop standards to practice indigenous medicine	H	Establish accredited testing laboratories for indigenous medicine, Develop standard protocols for practicing indigenous medicine, Establish certification procedures for practicing indigenous medicine	BMARI, SLSI, MoH	MoH, MoSTR
	Popularization Popularize IK	M	Popularization through workshops, seminars and print and electronic media and establish a mechanism to prevent propagation of purported forms of Ik	IIK, DoA, BMARI, SLAAS, NSF, Universities, Mass media, Telecommunicate service providers	NSF, NRC, M of Information, M of Telecommunication, D.I, Private sector