



NATIONAL
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**National Thematic Research Programme on
Climate Change and Natural Disasters**
Theme Paper



**Prepared by
The National Science Foundation**

2016



**NATIONAL THEMATIC RESEARCH PROGRAMME ON CLIMATE
CHANGE AND NATURAL DISASTERS**

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Table of Contents

Introduction	4
Background	4
Why a National Climate Change Research Program is needed	7
The focus of the Climate Change & Natural Disasters Thematic Research Programme	8
Programme strategy and implementation framework	10
Component A: Major Research Projects	10
Component B: Dissemination	11
Coordinating Mechanism	13
References	14
Annex A: National Climate Change Adaptation Strategy	17
Annex B: Research Requirements Identified in the NCCAS	18
Annex C: Research Project Concept Notes	21

Introduction

The climate change research programme of the National Science Foundation (NSF) described below has been developed considering the national development priorities while being in line with the key global agendas such as Paris Climate Agreement to which Sri Lanka became a signatory in April 2016, Sustainable Development Goals (SDGs) for people and planet for 2030 that were unveiled in September 2015; and Sendai Framework for Action on Disaster Risk Reduction till 2030, which also include climate adaptation.

Sri Lanka has launched into an unprecedented development drive, the success of which is critical for the nation. The current policy environment in Sri Lanka is focused primarily on the intention of establishing a clean administration, restoration of democracy and upgrading the country towards ‘Upper Middle Income’ status. The thrust of the economic strategy of the Government is based on a “Competitive Social Market Economic Model” where policies aim at promoting competition and economic efficiency while promoting social equity. Public Investment Programme (PIP) has been prepared to present an account of how the Government of Sri Lanka (GOSL) proposes to allocate funds for capital expenditure during the next three years. It also describes the development goals and objectives and explains how the development process will be carried forward over the medium-term. Public Investments of amounting to Rs. 2.4445 trillion are planned under this framework for the 2017-2019 period (Ministry of Finance and Planning, 2016).

Some of these investments are at risk due to climate change—a global phenomenon, which we cannot avoid and must prepare, as a nation, to face. Urgent and constructive actions are needed to address the challenges climate change will pose to Sri Lanka’s development trajectory. The National Science Foundation’s Climate Change and Natural Disasters Thematic Research Programme (CC&NDTRP) is formulated to be a key part of this process. It will provide policy and decision makers with the research-based recommendations they will need to address the challenges ahead.

Background

Human-induced climate change has emerged as a major concern of our times. Having initially emerged as an environmental issue, it is now globally regarded as an overarching development challenge that can seriously affect economic growth, food-water-energy security, public health, and social stability. Developing countries are especially vulnerable (MoMD&E, 2016; MoE, 2011; MoE/ADB, 2010a; MoNR& UNEP, 2009).

The full extent of climate change impacts on Sri Lanka is still being studied, but there is growing recognition that climate change may threaten the significant achievements the country has made in the last 20 years in increasing incomes and reducing poverty (MoE/ADB, 2010a; NCS&D and Presidential Secretariat, 2009; MoENR, 2008). All of the key thrusts of Sri Lanka’s development framework show vulnerabilities to climate change, and adaptive measures will be necessary to ensure their long term resilience and sustainability. Research and projections indicate that Sri Lanka is highly vulnerable to effects of climate change and could be affected in different ways. For example:

- Raised temperatures and unpredictable monsoon rains are already affecting the country's food production and water resources (Marambeet *al.* 2015; Nissankaet *al.* (2013); MoE/ADB, 2010b; MoE/ADB, 2010c; Eriyagamaet *al.* 2010; MaddumaBandara, 2002; MoE, 2011).
- Hydro-meteorological hazards like floods and droughts can disrupt public life and damage property and crop harvests (Abeysekera et al. 2015; Punyawardenat *al.*; 2013; MoE/ADB, 2010c; MoE/ADB, 2010d; MoE/ADB, 2010e,f).
- In the longer term, rising sea levels can impact the island's highly populated coastal areas, threatening human settlements, infrastructure and coastal/marine ecosystems (MoMD&E 2016; MDM, 2014; MoENR, 2014), MoE, 2011; MoE/ADB, 2010d; MoE/ADB, 2010f).

In general, there is a high spatial variation among different administrative districts of Sri Lanka to climate change at varying degrees depending on socio-economic conditions, environmental factors and institutional development among districts, in ways that do not correspond directly to exposure (to climatic hazards) or geography (Punyawardenat *al.*, 2013).

Addressing the adverse impacts of climate change is highlighted in the Government's updated version of the 'Haritha (Green) Lanka Strategy and Action Plan 2016', 'Caring for the Environment: Path to Sustainable Development Action Plan 2008-2012' (Presidential Secretariat, 2009; MoENR, 2008) and Sri Lanka NEXT – Blue-green-era, Program as priority areas requiring action. Several government departments and research institutions are engaged in studies to understand and manage climate change impacts, and to discern the optimal policy, technical and grassroot level interventions.

Sri Lanka is an active participant in international initiatives addressing both:

- **Mitigation**, which involves reducing the emission of greenhouse gases that cause manmade global warming; and
 - Actions to reduce the sources or increase the sinks of greenhouse gases that cause human-induced global warming
- **Adaptation**, or living with the climate change impacts that are inevitable in the coming years.
 - Actions taken to reduce the vulnerability and increase the resilience to actual or expected changes in climate

As part of its obligations in accordance with the UNFCCC, Sri Lanka submitted its Initial National Communication in 2000, the Second National Communication in 2011. The TNC is in preparation. Sri Lanka has voluntarily taken measures to engage in climate change mitigation activities, including involvement in carbon trading through the Clean Development Mechanism (CDM) and submitting Intended Nationally Determined contribution (INDCs). As for climate change adaptation, Sri Lanka has already prepared the National Adaptation Plan (NAP) considering ten thrust area, including cross-cutting issues.

In addition to ongoing global mitigation initiatives, the Government of Sri Lanka (GOSL) has recognized that working towards mitigation alone will not protect Sri Lanka's national interests. Given the scale of the threat Sri Lanka faces, a strengthened **focus on adaptation is imperative**. With this in mind, the Ministry

responsible for the subject of Environment launched an ambitious planning process in 2011, involving a cross section of sector agencies, to develop Sri Lanka's first National Climate Change Adaptation Strategy and Action Plan (NCCAS&AP). The NCCAS&AP has laid out a framework that is specific for Sri Lanka for moving stakeholders across the economy systematically towards building climate resilience.

Both climate mitigation and adaptation have been incorporated to the National Climate Change Policy (NCCP) of 2012, which was developed by the Ministry of Mahaweli Development and Environment.

Why a National Climate Change Research Program is needed

Currently, research on climate change adaptation and mitigation is being carried out with little coordination. While the risks Sri Lanka faces as a result of climate change (such as the increased floods, droughts, and landslides) are becoming increasingly evident, visible and concerted action in response to the climate change threats Sri Lanka faces have still been limited. The following is an extract of the National Adaptation Plan (MoMD&E, 2016), which also spells out future research needs in terms of climate adaptation, on research carried out in Sri Lanka identifying the magnitude of the climate change impacts.

“As a small island in the Indian Ocean, the coastal region of Sri Lanka is susceptible to changes in sea level. The 2004 tsunami has indicated that low-lying plains in the coastal zone will be vulnerable to any future rise in sea level. Important sectors of the economy such as tourism and fisheries could be affected due to impacts of sea level rise (ADB, 2014; ME, 2011; Senaratne et al., 2009). A significant population of the country is dependent on livelihoods connected to agriculture. Studies show that food security of the nation can be adversely affected due to impacts of climate change (De Costa, 2008; De Silva, 2008 and 2013; Marambe et al., 2013, 2015a; Punyawardena, 2007). Besides, a substantial share of foreign income is earned through export crops which are highly sensitive to fluctuations of weather (Nissanka et al., 2013; Ranasinghe, 2013; Wijeratne et al., 2007). Emerging evidence from various sources suggest that climate change could alter natural systems connected to water cycle, eco systems and bio-diversity of the country (Eriyagama et al., 2010; Marambe et al., 2012; ME, 2011; Weerahewa et al., 2012). This could lead to decline of various ecosystem services that are indispensable for the welfare of human population. Impacts of climate change appear to have significant repercussions on health of the citizens and human settlements of the country too (ME, 2010 a & b). Overall, the impacts of climate change are widespread and they are likely to create negative socio-economic outcomes on many sectors in Sri Lanka.”

All these recent information suggest that an improved and more effective platform for planning, coordinating, sharing and disseminating of climate change related knowledge is thus, needed. A centrally coordinated multidisciplinary research program considering both Carbon and non-carbon benefits, is urgently needed in order to systematically address the challenges caused by CC. Therefore, the intended research programmes should be focused on generating information, technologies and best practices towards minimizing impacts and strengthening sustainable response strategies. By establishing a coordinated multidisciplinary research programme with a focus on effective information dissemination, the National Science Foundation (NSF) aims at being a credible hub for national climate change research in line with global efforts and the national development agenda.

The NSF will also structure the research programme in line with the NCCP, NCCAS, NAPs and Sri Lanka NEXT to conduct prioritized research projects under each of the thrust areas discussed later.

The focus of the Climate Change & Natural Disasters Thematic Research Programme

Climate change impacts will be far reaching, affecting many sectors of the Sri Lankan economy and touching every segment of its population. While impacts are potentially immense in both degree and scale, resources and capacity to deal with such challenges are not sufficient in the present context.

Success of the theme CC&ND will depend on how the research can lead to tangible outputs that can in turn be operationalized to help the country. The NSF has established a Climate Change & Natural Disasters Steering Committee (CC&NDSC) to facilitate development of the CC&NDTRP based on two basic principles as given below, support in research proposal evaluation and subsequent monitoring.

Focus on National priorities and complementarities with national development agenda

Thrust Area 1: Mainstream Climate Change Concerns into National Planning and Development Processes –

Includes understanding the strengths and weaknesses of the current policies, scenario analysis to support the National Budgetary processes targeting optimum use of resources for development, prioritization of potential adaptation and mitigation interventions, and socio-economic impacts of CC across the key sectors.

Thrust Area 2: Climate change resilience on Settlements, Human Health and infrastructure

Includes climate proofing of housing, urban development, public health, drinking water, wetlands, and coastal environments

Thrust Area 3: Minimize Climate Change Impacts on Food Security

Includes agriculture (crops, livestock and fisheries) and human nutrition

Thrust Area 4: Safeguard Natural Resources and Biodiversity from Climate Change Impacts

includes land and water resources management and ecosystem conservation focusing on environmentally-friendly initiatives

Thrust Area 5: Future Climate, Climate Scenarios and Natural Disasters and Early Warning

Includes novel approaches for short, medium and long range weather and climate forecasting, climate projections, hazard and risk assessment and early warning.

Thrust Area 6: Climate Change Mitigation and Environmental sustainability

Thrust Area 7: Data management

Includes data gathering, gap identification, standardization, archiving, and accessibility to stakeholders

Under each of its strategic thrusts, the NCCAS has identified a wide array of research gaps (see Annex B) which need to be explored over the medium term. NSF, under the guidance of the CC&NDSC, evaluated these research needs and identified the key projects which are of high national priority and require urgent attention. These projects have been included as the initial projects to be managed under the CC&NDTRP.

Programme strategy and implementation framework

The CC&NDTRP is designed for an initial period of five years and will have three major components as follows:

1. Major research projects
2. Capacity building, awareness creation, Information dissemination

Component A: Major Research Projects

These will form a pipeline of relatively large, commissioned research projects of high national priority, developed and structured directly by NSF. After initial development and structuring, the final research will be outsourced to competent researchers and/or organizations through a competitive selection process, which will also be managed by NSF.

All the research projects will include tangible outputs of national importance. The major research projects to be pursued under each Strategic Thrust area are outlined below, and further detailed in Annex C.

Research Area	Research Projects
Mainstream Climate Change Concerns into National Planning and Development Processes	Project 1: Valuation and socio-economic assessment of climate change impacts in key sectors (agriculture, water, health, energy, transport) Project 2: Vulnerability and risk assessment of key economic sectors including scenario analysis
Climate change resilience on Settlements, Human Health and Infrastructure	Project 1: Controlling water and vector-borne diseases (covering urban, suburban and rural habitats) Project 2: Assessment of climate change impacts on plantation and Export Agriculture Sectors in Sri Lanka and development of adaptation strategies
Minimize Climate Change Impacts on Food Security	Project 1: Assessment of food security in Sri Lanka under a changing climate: An approach using bio-physical, socio-economic and GCM models Project 2: Enabling community level seed banks programs in building climate resilience

Safeguard Natural Resources and Biodiversity from Climate Change Impacts

Project 1: Safeguard biodiversity (inland and marine) from the impacts of climate change and natural disasters through the resilience of biodiversity.

Project 2: Promoting home gardens as a means to improve climate resilient communities and biodiversity

Project 3: Improve climate resilience in Industry Sector (Manufacturing, Transportation and Energy)

Future Climate, Climate Scenarios and Natural Disasters and Early Warning

Project 1: Future climate scenarios and seasonal climate forecasting

Project 2: Hazard, vulnerability and risk assessment

Project 1: Assessing Socio economics benefits of investments on projects for mitigating Disaster Impacts

Project 2: Sustainable Development Initiatives to Minimize Climate Change Impacts by Reducing GHG Emissions in the Areas of Energy Generation & Supply, Transportation, Waste

Climate Change Mitigation and Environmental sustainability

Project 1: Collection of data available in all sectors and gap identification

Data Management

Project 2: Standardizing, processing to a useable format and archiving

Component B: Dissemination

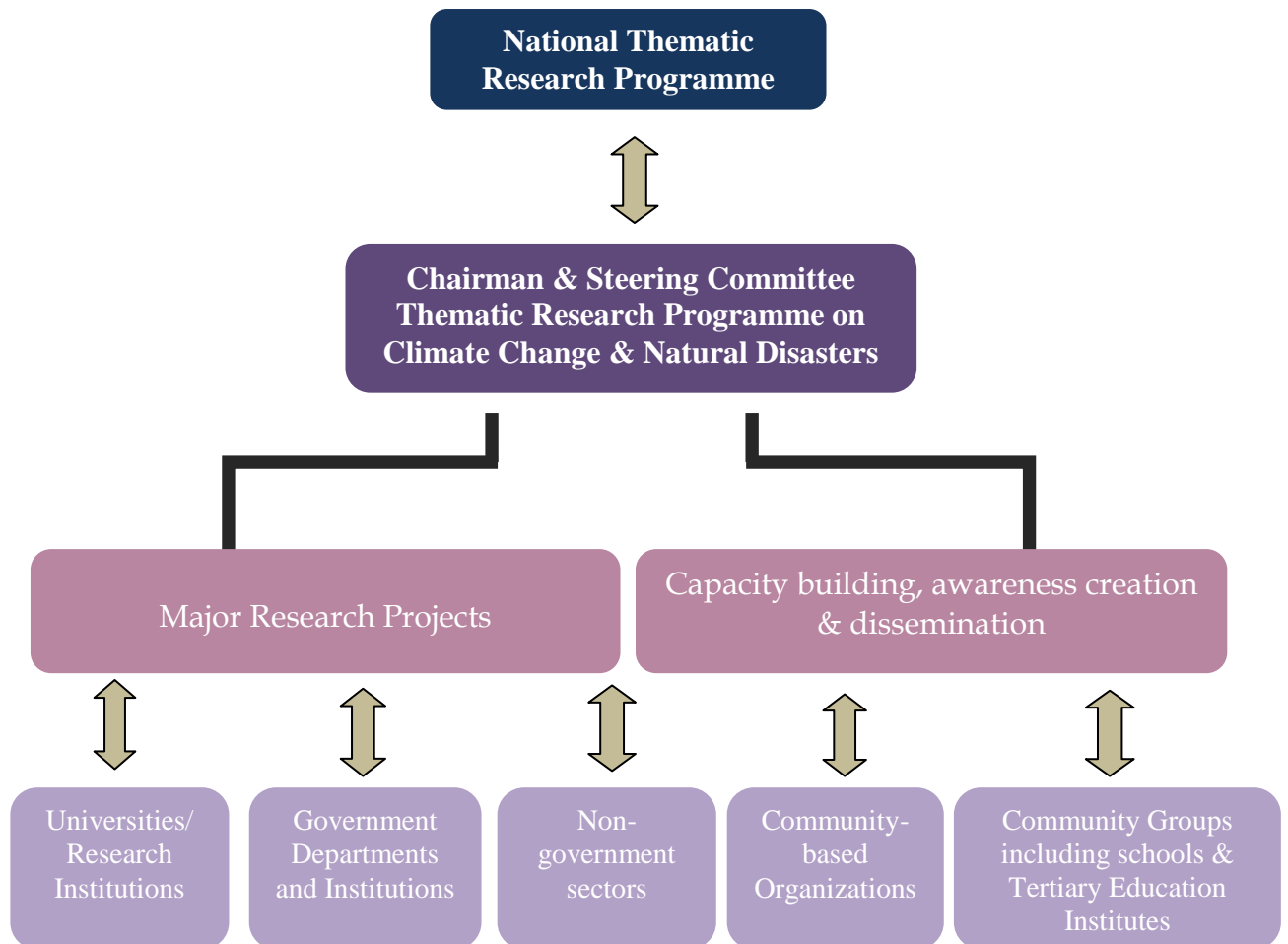
Climate change research is meaningless unless effectively disseminated, and findings incorporated into national plans and initiatives. Mechanisms to widely disseminate the outputs of both the major research projects, as well as the small grants driven research projects, is needed to complete the CC&NDTRP. Therefore, the NSF proposes to disseminate the findings and recommendations of its work through a multipronged communication initiative, with messaging tailored to reach specific target audiences¹.

¹ The dissemination component of the CCTRP is formulated based on recommendations in *the Information, Education, and Communications Strategy for Climate Change Adaptation*—a supplement to the NCCAS developed by the Ministry of Environment.

Target Audience	Mode of dissemination
Senior officials and decision makers	High-level discussions with the concerned authorities in the Government, the National Planning Department, and elsewhere to keep them abreast with any key research outputs and their applicability to national initiatives.
The research/academic community	Annual national symposium on climate change, and through the release of a series of publications to showcase the outputs of the CC&NDTRP.
Communities at the grassroots level	Findings/recommendations arising through the CC&NDTRP will be disseminated through carefully designed and simply articulated informational material to message multipliers such as the media and civil society groups, for onward communication through their respective networks.
Students, particularly at secondary school level	Succinct and simple educational materials/brochures/posters highlighting key findings of relevance at household level. Briefings/training for science teachers will also be organized in collaboration with relevant agencies in the Government.

Coordinating Mechanism

The NSF will continuously monitor and guide the projects through a dedicated coordination unit, and funding will be released to researchers in trenches based on completion of targets and milestones.



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Annex A: National Climate Change Adaptations Strategy

STRATEGIC THRUSTS AND LINKAGES TO NATIONAL DEVELOPMENT AGENDA

The NCCAS planning process engaged over 500 stakeholders through a year-long planning process, first through development of sector based “vulnerability profiles” and then establishment of 5 strategic thrusts which are more integrated.

Such integrated strategic thrusts were established because:

- Climate change-related risks cannot be considered in isolation. They are often linked to, and will likely aggravate existing development disparities and problems.
- Problems are rarely isolated clearly within one sector, and cross sectoral linkages are common
- A multidisciplinary approach is critical in order to effectively understand and address climate change concerns
- Integrated solutions and adaptation measures straddling multiple sectors are necessary to address risks to key national development initiatives

Sri Lanka’s development framework as articulated in the MCBF and the MC10YP outlines the overarching development strategy Sri Lanka is pursuing. Several key pillars of the national development strategy are apparent upon evaluation of the approximately Rs. 2.445 trillion investment framework planned for the 2017-2019 period (MF 2016).

- Human resource development (Rs 733 billion)
- Infrastructure development (Rs 1,246 billion).
- Agriculture and Industries (Rs 127 billion)
- Environment (Rs 32 billion)
- Regional development (Rs 216 billion)
- Governance (Rs 49 billion)
- Social protection (Rs 35 billion)

All of the above key thrusts of Sri Lanka’s development framework also show vulnerabilities to climate change, and adaptive measures will be necessary to ensure their long term resilience and sustainability. In order to effectively bolster Sri Lanka’s national development framework, and support the initiative to ensure the success and sustainability of the country’s development effort the NCCAS development process aggregates findings across sectors, and addresses them in an integrated manner in line with the same national framework.

Annex B: Research Requirements Identified in the NCCAS

Research necessary to enable climate resilient and healthy human settlements

Climate change impacts on human settlements:

A concerted body of applied research to better understand climate vulnerabilities specific to Sri Lanka's settlements and to develop pragmatic recommendations and scaleable adaptation measures needs to be adopted and launched. Such research needs to have a well implemented, defined feedback loop into planning processes and agencies. Strengthening this link is vital, as is the commissioning of specific new research that helps monitor human settlements related trends and conditions. This is essential to improve planning to include climate change considerations.

Climate impacts on water availability and develop scalable adaptation models:

The body of research on climate change impacts on water availability for Sri Lanka's growing settlements is needed--with a clear view towards developing a range of scaleable adaptation measures. Projects that can be deployed at household and community level, as well as at a larger scale are suggested. This type of work is necessary to ensure adequate quality and quantity of water for settlements.

Health impacts of climate change in the Sri Lankan context:

A wider body of research into the extent and nature of climate change impacts on Sri Lanka's health sector needs to be pursued to combat climate change-related health concerns in settlements.

Improve coordination/dissemination through existing institutional mechanisms

Improving the currently scattered information gathering and researching processes on human settlements needs to be accompanied by similar measures to enhance the access to resulting information in the public domain. War-time restrictions on geo-spatial data and other information need to be reviewed and removed to enable informed decision making at all levels. This will assist in increasing awareness on vulnerabilities and adaptation of settlements.

Research to minimize climate change impacts on food security

Climate change impacts/adaptive measures for agriculture, livestock and fisheries sectors:

The impacts of climate change on agriculture are yet not fully understood, especially in fisheries and livestock sectors. This knowledge is vital for us to adapt to climate change. It will facilitate the identification of adaptive measures suitable to scale up. Negative aspects on species as well as potential opportunities that climate change may provide should be explored. Impacts on pests, diseases, and IAS need to be better understood and managed. Traditional practices and community level adaptation interventions should also be explored. This will contribute towards ensuring the ability to meet food production and nutrition demand.

Climate change impacts on long term food security and on the potential adaptive measures:

Impacts of climate change on long term food security should be studied along with how identified agricultural value chains are affected. This should study the impacts on all activities and processes developed to address that lead to a product or service that reaches the various final consumers. Dimensions on impacts on the components in the products pathway to reach the final consumer value chain structure, economic relationships between players in the chain, anticipated changes in the structure, the key threats to the entire value chain, should be well understood in order to determine adaptation interventions necessary. This research would help fill the gaps to help mitigate food security related socio economic impacts.

Pilot test and scale up community level agriculture/livestock/fisheries adaptation models:

A key lesson from the Green Revolution was the value of demonstrating new methods and practices. This can now be replicated with climate adaptation measures by starting with pilot projects which are then promoted and eventually scaled up. This work will contribute to increased awareness and mobilization of communities for climate change adaptation.

Research to improve climate resilience of key economic drivers

Climate impacts and adaptive measures in plantation sub-sectors:

A wider body of applied research into the extent and nature of climate change impacts on Sri Lanka's plantation subsector, their productivity, and their competitiveness needs to be defined and pursued. This research is necessary to minimize impacts of climate change on plantations sector.

Pilot test and scale up sub-sector specific adaptation measures:

Climate change adaptive measures in the plantations sector need to be developed where vulnerabilities are significant, pilot tested, and findings made available to industry groups.

Potential climate change impacts/adaptive measures for key industries:

The current limited body of research on climate change impacts on Sri Lanka's key industries needs to be expanded to identify and address risks, and exploit potential opportunities as well. This will help identify necessary new knowledge to help key industries cope with climate change impacts.

Research to safeguard natural resources and biodiversity from climate change impacts

Research and monitoring programs to strengthen knowledge base on climate change and terrestrial biodiversity:

Research on and monitoring of the impacts of climate change on terrestrial biodiversity is needed to understand where adaptation interventions are most needed. Vitrally important are establishing interventions needed phenological studies on forest tree species, tailored to ecosystem/monitoring critical habitats and fauna most liable species type to be affected examining climate change impacts on different types of forest flora. Indicator species such as amphibians, freshwater crabs etc. should be given special attention. Capacity should be built for monitoring climate change impacts through training programmes on species identification, biodiversity monitoring, behavioural

ecology, principles of conservation biology, phenological sampling and maintenance of accurate data base on rainfall and ambient temperature.

Research and monitoring programs to strengthen knowledge base on climate change and aquatic biodiversity:

Research and monitoring are required continually identify threats to freshwater and coastal biodiversity that would be exacerbated by climate change and to understand where adaptation interventions are needed. Monitoring changes in coastal water quality parameters – i.e. acidity, temperature, salinity, is essential. Monitoring of salinity intrusion into surface water is particularly important to enable fishermen to adapt accordingly by selecting appropriate species for aquaculture, and to adapt to changed distribution of species in fishing grounds. Likewise research and dissemination of results are necessary to enable fishermen to change fishing methods and areas, seasons, fishing depths and catch species accordingly. Monitoring freshwater bodies and threatened aquatic species should be encouraged to minimise negative impacts on biodiversity and ecosystem services. Periodic monitoring of ecosystem health in all climatic zones is also vital for early identification of climate change impacts on freshwater species and ecosystems.

Minimize entry, establishment and spread of IAS:

There is a need to step up preventive measures to prevent entry of new IAS; monitor natural and modified ecosystems to detect establishment of IAS and the further spread of existing IAS; promote and inculcate skills for monitoring of natural and modified ecosystems to detect climate change impacts in forests (e.g. forest die-back can promote spread of invasive species), coastal areas (e.g. coral bleaching and death has lead to *Halimeda* invasions, etc), and wetlands that may promote spread of IAS, with the support of universities and researchers with appropriate skills and experience. Capacity building is also needed to promote research to expand the understanding of behaviour and physiology of selected IAS, and to enhance skills for adaptive management of IAS within institutions responsible for conservation of national biodiversity.

Promote research partnerships on good practices for varied water uses:

It is necessary to form and implement research partnerships among multiple stakeholders having various skills and technological facilities that will result in good practices for effective multiple use of ground and surface waters and an uninterrupted flow of ecosystem services in wetlands and watersheds.

Annex C: Research Project Concept Notes

Strategic Thrust 1

Thrust Area: Mainstream Climate Change Concerns into National Planning and Development Processes

Project 1

Valuation and socio-economic assessment of climate change impacts in key sectors (agriculture, water, health, energy, transport)

Justification: (Addressing the national issues)

In Sri Lanka, many ad hoc initiatives have been carried out on climate change; however, almost all of these have been qualitative. To date, there has not been a rigorous, comprehensive and comparative economic analysis of climate change for the country. This analysis is urgently required to support policy and investment decision making.

Objective: To improve understanding of the degree and scale of climate change impacts in key sectors (agriculture, water, health, energy, transport) and to enable effective targeting and prioritizing adaptation-related investments.

Scope:

1. Review and identify existing economic strategies and plans across sectors that may be vulnerable to climate change impacts.
2. Identify, review and analyze the key national and sector-specific policies and strategies, to identify how climate change issues have been, or could be addressed.
3. Valuation of sector-specific financial and socioeconomic impact of climate change on critical sectors.
4. Perform cost benefit analysis on adaptation interventions.

Expected tangible output:

1. Increased understanding of the strengths and weaknesses of the current policies and strategies in adopting climate change initiatives.
2. Clearer understanding (quantitative and qualitative) of the specific socioeconomic impacts of climate change across key sectors
3. Prioritization of potential adaptation interventions

Project 2:

Vulnerability and risk assessment of key economic sectors including scenario analysis

2a. Floods:

Justification

Water is inherently sensitive to climate conditions, and is among the most vulnerable sectors to the risks and impacts of climate change in Sri Lanka. The

situation will be further aggravated due to multiple competitions for water by different stakeholders in a single river basin. It is likely to result in more and more conflicting issues due to increasing demand and decreasing supply of water under a changing climate.

Note: Similar project is being carried out by the Irrigation Department. Integration or upgrading of the existing programme will be considered.

Objectives

- To identify the vulnerable river basins of Sri Lanka for climate change and to measure the pace of change in both supply and demand in those basins
- To identify and recommend appropriate adaptation strategies including governance mechanisms for collective actions to minimize the vulnerability to climate change

Scope

1. Strengthen the monitoring capacity of hydrological changes in sensitive river basins
2. Hydrological modelling to identify the pace of change in hydrology in basins
3. Identify and map out the most sensitive river basins that need immediate attention
4. Develop basin-based early warning mechanisms for extreme anomalies (i.e, drought and flood)
5. Recommend appropriate adaptation initiatives at farm-level, village level and watershed level to meet the demand for water by multiple stakeholders in a basin

2b. Drought

Justification:

In Sri Lanka, many *ad hoc* initiatives have been carried out on drought situations but there is no proper plan to avoid the drought situations before the onset of drought. This analysis is required for areas to cope with water scarcity situations for agricultural activities such as paddy and other field crop cultivation. This analysis is urgently required to support policy and investment decision making.

Objective:

To identify the vulnerability of drought prone areas for water scarcity in order to develop adaptation strategies for farmers. For example areas such as Anuradhapura, for inadequate rainfall for paddy and other field crops cultivation.

Scope:

1. Identify the water balance components for the selected catchment areas to assess the available water for irrigation.
2. Identify the possible risk assessment methods to recommend remedial measures.
3. Perform cost benefit analysis on adaptation interventions.

Expected outputs (2a and 2b):

1. Increased understanding of the availability of water in drought prone areas.
2. Understanding of availability of water for cultivation before the season starts.
3. Clear adaptation measures to cope with situation for farmers
4. Tangible incentives for adverse situations through policy interventions

Strategic Thrust 2

Thrust Area: Climate change resilience on Settlements, Human Health and Infrastructure

Project 1: Controlling water and vector borne diseases (covering urban, suburban and rural habitats)

Justification:

Vector borne diseases have emerged as a serious public health problem in Sri Lanka, particularly dengue fever. Dengue is spreading rapidly to newer areas, with outbreaks occurring more frequently and explosively (1,420 cases per 100,000 population in 2009). The prevailing climatic conditions, environmental pollution, rapid urbanization, over-crowding of cities and careless human practices are proving conducive for the rapid breeding of the mosquito vector and the spread of this infection. Dengue transmission simulations have also shown high sensitivity to relative humidity and temperature and therefore are expected to exacerbate with climate change. Furthermore, increases in the frequency and intensity of disaster events, as well as changed rainfall patterns have led to higher levels of vulnerability. Further, in-depth research on climate-impacts on vectors is also needed, and would be of benefit at a regional level as well.

In addition to dengue, Chronic Kidney Disease of Uncertain Etiology (CKDu) is also likely to be affected as a result of climate change as water has been identified as the major culprit. An effective, nationwide, and systematic programme to monitor and control the diseases which are on the rise with climate change is an urgent need for Sri Lanka.

Objective:

To control the spread of vector borne diseases especially in highly populated areas.

Scope:

1. Set up program for assessment and regular monitoring of vector densities and distribution across the country at a pilot scale.
2. Research the impacts of climate change (temperature increase, humidity variations, rainfall changes) together with interactions of other population dynamics on vector densities and distribution;
3. Refine methodology and design scaleable vector monitoring programme.
4. Develop mathematical models for early predictability of disease incidence.
5. Identify scaleable adaptation and vector control methods

Expected output:

The ultimate expected outcome of the proposed initiative is to enable predictability of potential epidemics of vector borne diseases and non-communicable diseases based on a clearer understanding of vector densities and causal factors and interactions with climate. Specific outputs include:

1. Identification of causal factors and early detection techniques for CKDu
2. Improved Vector monitoring program at a national level
3. Forecasting potential of outbreaks of vector borne and non-communicable diseases
4. Integrated network with the Ministry of Health for long term monitoring of vector borne and non-communicable diseases
5. Knowledge base for the training and awareness for control of vector borne and non-communicable diseases

Project 2:

Assessment of climate change impacts on plantation and Export Agriculture Sectors in Sri Lanka and development of adaptation strategies

Justification: (Addressing the national issues)

Recent studies have confirmed that the country's climate is changing and impact negatively on crop production in general. Since, plantation sector in the country comprises of mainly perennial crops of tea, rubber, coconut and export agricultural crops, and also cultivating under wider range of agro-climatic and management conditions, climate change will cause an additional burden to the existing numerous eco-physiological, social etc. problems, results severe production losses and quality variations causing massive economic losses and badly impacting on the sustainability of the industry as a whole. Climate predictions and analyses trends indicate that plantation sector is very vulnerable to climate change and implementation of urgent measures to enhance adaptation capacity is essential. National policies and strategies already developed and are being formulated geared to promote agriculture and plantation sector to ensure sustainable crop production and income generation in the country. Challenges faced by plantation industry under changing climate can only be addressed and solved through a multidisciplinary approach, keeping in line with the national policies and agenda. Plantation and Export Agriculture Sectors sector are having well established Research Institutes. Scientists in these institutes have already initiated to investigate climate change impact on plantation industry in collaboration with Universities and other related Institutes. Proposed project may help to strengthen inter-institutional collaborations and activities carried out in achieving climate change challengers successfully with the participation of the Stakeholders in the sector.

The project is in line with National Policies elaborated by the Ministry of Policy and Economic Affairs, Haritha Lanka Action Plan (Mission 3 – Climate Change), National Agriculture Policy of 2007 (Policy Statement 1 – Promoting Agricultural Production), Science, Technology and Innovation Strategy of Sri Lanka 2011-2015 (Objectives 1.2, 3.1, 4.2, 4.3), and the Millennium Development Goals (Goal 1 – Eradicate extreme hunger and poverty, and Goal 7 – Ensure environmental sustainability) and the Intended Nationally Determined Contributions for Climate Change Mitigation and the National Adaptation Plan.

Objectives:

Ensure sustainability in the Plantation Industry in Sri Lanka by addressing climate change challenges through broad-based adaptation strategies and policies enabling resilience enhancement

1. Identification of most vulnerable growing regions, tolerant plantation crop species/varieties/clones, and management practices to climate variability (extremes) of mainly rainfall and temperature and associated other conditions
2. Develop short, medium and long-term plantation crop/region specific adaptation measures to climate variability

3. Introduce good agricultural practices (soil conservation, fertilizer use etc.) to enhance crop production and resource use efficiency while minimizing GHG from the sector as mitigation measures
4. Strengthen the related government Institutes, Plantation Sector, and associated Communities involved in, on knowledge and capacity in decision making, planning and implementing adaptation strategies.

Scope: The scope of the proposed project is to assess the threat of changing climate on plantation industry of Sri Lanka, and provide recommendations to formulate relevant policies and strategies to gear the plantation crop production programs aiming a sustainable industry.

Expected output:

1. Identification of vulnerability profiles for plantation and Export Agricultural crops
2. Develop specific short, medium and long-term adaptation strategies and management protocols to above sectors based on the vulnerability rating of least to the most (Identification of resilient crop varieties, management practices etc.)
3. Increase resilience to climate change variability and increase crop productivity and resource use efficiency
4. Reduced emission from the sector through the application of good agricultural practices
5. Establish avenues of income generation through CDM mechanism from plantation and export agricultural crops that fixed large stock of carbon- Rubber, Tea with timber trees (inter cropping) and coconut
6. Stakeholders in the sectors are aware of climate change impacts and capable of identifying possible solutions to address climate change impacts
7. Introduced appropriate polices to meet climate change challenges effectively and efficiently
8. Establish vulnerability (economic and agronomic) of intercropping system in major cropping systems.
9. Introduce crop insurance scheme to safeguard famers from extreme climate variability conditions.

Strategic Thrust 3

Minimize Climate Change Impacts on Food Security

Project 1

Assessment of food security in Sri Lanka under a changing climate: An approach using bio-physical, socio-economic and GCM models

Justification:

The demand for food will continue to grow placing an additional strain on sustainable food production systems of the country. Climate change adds a further challenge as changes in extreme weather events and inter-annual variability. The mean climate parameters will negatively affect the production and productivity of crops and animals, and agro-ecosystem resilience, thereby decreasing the capacity to feed the country's ever increasing population. Climate predictions and analyses of past and current trends indicate that small-scale farming households will be exposed to increased climate risks and will become more vulnerable to these risks, unless drastic measures are implemented to increase their capacity to adapt to climate change. The proposed research projects will use existing mathematical models (bio-physical models, socio-economic and GCM models involving a combination of scenarios) to assess and address the threats on food security resulting from potential population and economic growth and climate change. Based on the information generated and collected, the project will revise the existing food security maps of Sri Lanka, taking climate change risks into consideration, in order to support national level development planning and poverty alleviation initiatives.

The project is in line with National Development Policy of the ministry of Policy Planning and Economic Development, National Climate Change Policy, Adaptation – food production, food security, Mitigation – Agriculture and Livestock, National livestock development policy, 2007, national fisheries and aquatic resources development policy, 2006 (Eradication of hardcore poverty and Malnutrition), *Haritha Lanka* Action Plan (Mission 3 – Climate Change), National Agriculture Policy of 2007 (Policy Statement 1 – Promoting Agricultural Production), Science, Technology and Innovation Strategy of Sri Lanka 2011-2015 (Objectives 1.2, 3.1, 4.2, 4.3), and the Millennium Development Goals (Goal 1 – Eradicate extreme hunger and poverty, and Goal 7 – Ensure environmental sustainability) and National Adaptation Plans. The proposed project involves a team-effort of scientists who are conversant in crop growth modeling under different abiotic and biotic stresses, population growth, economic growth and hydrological changes. The inter-institutional collaboration will help smooth implementation of project activities.

Objective:

To offset the possible food shortages due to climate change through broad-based economic policies and strategies based on sound scientific outputs,

enabling robust decision-making and resilient development planning to ensure national level food security.

Scope:

The scope of the proposed project is to assess the threat of changing climate on national level food security of Sri Lanka, and provide recommendations to formulate relevant policies to gear the national agriculture production programs aiming at a food-secured nation.

Expected outputs:

1. Recommendation on region-specific productivity enhancement packages for different farming systems to cope up with changing climate
2. Policy brief on incentive schemes such as micro-financing, for climate change adaptation in agriculture for relevant productivity enhancement packages stated in (a) above.
3. Revised national level food security map depicting climate change vulnerable areas

Project 2

Enabling community level seed banks programs in building climate resilience

Justification:

Variability in rainfall patterns and the resulting swings in production are a significant nationwide concern for Sri Lanka's food security and nutrition. Poor subsistence farmers are directly vulnerable, while the supply and price shifts in the value chain also impact the poor and vulnerable country-wide. Adaptation measures are needed to mitigate the impacts of these adverse weather conditions to maintain food production and livelihood security. Maintaining paddy seed stock of varieties with different yield periods has been identified as one way of adapting to these situations. Maintaining seed stocks of other food crops such as maize, pulses, vegetable, etc. are another adaptive measure. However, maintaining adequate seed stocks centrally and distributing efficiently in emergency situations poses logistical challenges. This project, targets the development of community level programmes for quality seed production and storage to be tested on a pilot scale. If successful, this work can be up scaled to a national level.

Objective:

To ensure livelihood security in farming communities vulnerable to climate change.

Scope:

1. Carry out an assessment and identify the most vulnerable communities to climate change
2. Provide training and awareness on quality seed production and storage technologies.

3. Stimulate development of community level seed storage infrastructure through incentives on a pilot scale.

Expected output:

The ultimate expected outcome of the proposed initiative is to increase the resilience of the farming communities vulnerable to climate change to adapt quickly. Specific outputs include:

1. Knowledge on the key vulnerable farming communities in the country
2. Increased knowledge on quality seed production and storage technologies.
3. Tested and proven seed stock with appropriate infrastructure at the community level – a model for up scaling.

Strategic Thrust 4

Thrust Area: Safeguard Natural Resources and Biodiversity from Climate Change Impacts

Project 1

Safeguard biodiversity (inland and marine) from the impacts of climate change and natural disasters through the resilience of biodiversity.

Justification:

In Sri Lanka, the main biodiversity issues already existing are habitat fragmentation, forest, sensitive coastal habitats and wetland degradation and spread of invasive alien species. All these factors can exacerbate the impacts of climate change on biodiversity and ecosystem services. Healthy coastal ecosystems provide many services to humans such as food, livelihoods, etc. Ecosystem functions such as preventing flood, soil erosion, coastal erosion and landslides etc. and services are directly linked to human wellbeing. Coastal Biodiversity and ecosystem are crucial in supporting Sri Lanka's food supply, livelihoods of communities and provide a source of recreation. At present the ecosystems in Sri Lanka are being degraded due to heavy anthropogenic pressures. To combat climate change impacts which threaten human wellbeing, it is necessary to understand and identify how these ecosystems and biodiversity can be conserved to help safeguard against climate change impacts. Hazard maps are available for Sri Lanka and hazard prone areas have been identified. Therefore, large amount of background work has been completed. Hence there is a possibility to link these research programmes with existing programmes.

Objective:

To increase resilience of biodiversity to climate change using ecological interventions and to help safeguard communities as a result.

Scope:

1. Value ecosystems in terms of its function as a disaster shield for climate change induced hazards in selected disaster prone areas.
2. To study the impact of climate change on ecosystem function and services including food chains, which underpin human wellbeing
3. Identify and test effectiveness of possible interventions to improve human wellbeing

Expected output:

1. Valuation of selected ecosystems – methodology to replicate elsewhere
2. Increased knowledge on ecosystem function and services
3. Tested interventions to replicate

Project 2

Promoting home gardens as a means to improve climate resilient communities and biodiversity

Justification:

In Sri Lanka, some of the major biodiversity issues are habitat fragmentation, habitat degradation and the spread of alien invasive species. These three factors seriously jeopardize the country's biodiversity which is essential in supporting human wellbeing. Understanding the threat of habitat fragmentation for biodiversity in the light of climate change is an important move in increasing the resilience of the biodiversity of the country. The development of home garden/village models to improve connectivity of fragmented natural forest/ecosystems will contribute to reducing the vulnerability of biodiversity. Studies on pollinator community changes with climate change are also important as they may have negative impact on the productivity of agriculture. Studying the changes in migratory patterns, home ranges and behavioural responses of insect pollinators to climate change, will also help to improve the home garden model. Since it is now acknowledged that the spread of IAS is accelerated by climate change, understanding its negative effects on the economy at different levels (home garden, village) could facilitate actions to manage to below economic threshold.

Objective:

To understand the threat of habitat fragmentation and the implications for biodiversity with predicted climate change and to develop home garden/village models to improve connectivity of fragmented ecosystems aimed at increasing the resilience biodiversity.

Scope:

1. Study of the impact of climate change on home garden biodiversity, which underpins human wellbeing
2. Assess and Promote home garden/village farming models to improve connectivity of fragmented natural forest/ecosystems
3. Identify pest species and assess economic damage caused by them under changing climate
4. Study the changes in migratory patterns, home ranges and behavioral responses of insect pollinators related to climate change
5. Identify pest resurgence and assess their economic damages and economic impact by them under changing climate

Expected tangible output:

1. Identified areas for home garden conservation
2. Increased knowledge on the impacts of climate change on the biodiversity of home gardens
3. Tested models to improve connectivity of habitats to increase the resilience of biodiversity.

Project 3

Improve climate resilience in Industry Sector (Manufacturing, Transport and Energy)

Justification:

Major Investments are stipulated for coming years in the sectors of transport, power, housing, tourism and shipping industries, etc. A major transformation of the country in both physical and economic terms is widely anticipated as a result of these investments.

While these major investments are being rolled out, adequate consideration of potential climate change induced risks is critical to ensure that our investments and economic growth are sustainable over the long term. Some investments and sectors may be substantially vulnerable to climate change.

For example Sri Lanka's tourism industry is underpinned by its natural resources, including beaches and biodiversity, which could be negatively impacted by climate change impacts such as temperature rise, sea level rise and increased natural hazards.

An integrated approach is needed to improve the climate resilience of key economic drivers involving tourism, transport, commercial agriculture and several other sectors to minimize risks to Sri Lanka's development trajectory.

Objective:

Ensure sustainability in the Industry sector in Sri Lanka by minimizing the long term impacts on the natural resources base

Scope:

1. Identify, quantify and value of the industrial impact on critical natural resources (Eg. Water, Land etc.).
2. Investigation into increase of natural resource use efficiency of industrial sector. (Reducing Carbon and water footprint).
3. Development of mechanisms/ technologies (cleaner production technologies) to reduce the pollution impacts/emissions of industrial sector on natural resources specially on water resources while integrating indigenous, traditional, innovative technologies)
4. Investigate avenues of carbon trading by Hotel and Manufacturing industry, Transport and Energy
5. Identify the existing inefficiencies in the current transport modes (passenger and freight).
6. Performing cost benefit analysis for the different non-conventional energy options (wind, solar.) with emphasis on equity and environmental considerations

Expected output:

1. Efficient Natural resources used in industrial sector
2. Mechanisms/ technologies to reduce the pollution impacts/emissions of industrial sector on natural resources
3. New avenues of carbon trading by Hotel and Manufacturing industry, Transport and Energy
4. Use of non-conventional energy options (wind, solar.)

Strategic Thrust 5

Thrust Area: Future Climate, Climate Scenarios and Natural Disasters and Early Warning

Project 1

Future climate scenarios and seasonal climate forecasting

Justification:

Scientific evidences clearly reveal that climate change is taking place. There is a whole body of knowledge in the world published in scientific journals, and synthesis report published by the Intergovernmental Panel on Climate Change (IPCC) at regular intervals. These give projections of future changes in climate for the entire world as well as different geographical regions. However, when a small country like Sri Lanka is considered, these predictions cannot be used with sufficient reliability and thus, make important decisions for the country without wide margin of errors. It is mainly due to the fact that weather and climate are not affected only by global parameters but, local bio-physical parameters such as terrain and vegetation. Therefore, it is necessary to downscale those coarse resolution GCMs using appropriate downscaling tools to produce output at a finer resolution. In order to make correct decisions at every stage including at the highest political level, it is very important to make those forecasts and projections as accurate as possible. As there is large number of GCMs developed by different agencies in the world, it is likely to produce different outputs from each one and some may not even represent our situation correctly. Therefore, it is necessary to evaluate all those GCMs to be used in our environment in order to ensure reliable future projections of climate in Sri Lanka. It is also need to run appropriate models and produce an ensemble output so that a correct picture of the future climate can be captured.

Objective:

To produce reliable long range weather and climate forecasts and projections in order to help policy makers and other stake holders to plan and take appropriate actions to avoid disasters and minimize the impacts.

Scope:

1. Research and identify suitable Global Circulation Models (GCM) to project the future climate of Sri Lanka and down scale them in order to produce appropriate results at a finer resolution.
2. Test the model skills for temperature, rainfall, wind and if possible, dynamics of the ocean around the island.
3. Develop appropriate medium-term, long-term and seasonal weather/climate prediction methods using dynamical and statistical tools.

4. Build Human Capital and infrastructure capacity on Seasonal Climate Forecasting

Expected output:

1. Methods or models that will be able to forecast and project weather and future climate in Sri Lanka could be used for planning process in all sectors of the economy such as agriculture, water resources, energy, health, fishery etc. in order to ensure a climate resilient nation.
2. Trained Human capital on future climate scenarios, seasonal and long range forecasting
3. Enhancing institutional capacities to tackle future climate change and natural disasters

Project 2

Hazard, vulnerability and risk assessment

Justification:

The DMC has prepared hazard maps for coastal hazards, floods, drought, lightning, cyclones and high winds. However vulnerability and risk assessments are yet to be done. One of the main reasons hindering the development of vulnerability is the non-availability of a methodology to undertake the vulnerability and risk assessments. There are global and regional models to carry out these risk assessments, however, considering the limited availability of data suitable methodology needs to be developed which can be applied with available data in Sri Lanka. Moreover, existing methods as well as tools employed in hazard assessments need to be further enhanced.

Objective:

To develop a methodology to undertake the vulnerability and risk assessment for major hazards in Sri Lanka and to improve methods and tools available for hazard assessments

Scope:

1. Review the hazard maps developed by DMC with the assistance of technical agencies for all major hazards
2. Update and improve existing methods and tools available for hazard assessments
3. Develop a model for assessing vulnerability of people and infrastructure in hazard prone areas.
4. Conduct a National workshop with technical agencies and academia to agree upon the methodology for assessing the vulnerability of each disaster separately.
5. Collect information on the vulnerable elements from Survey Department, Department of Statistics, etc.
6. Prepare vulnerability maps for coastal hazards, land-slides and floods
7. Propose criteria for assessing disaster risk on coastal hazards, landslides and floods

Expected Outputs:

1. A methodology agreed by technical agencies to conduct vulnerability and risk assessment is available
2. Vulnerability and risk assessment completed for major hazards
3. National level workshop conducted to present the vulnerability and risk maps
4. Improved methodologies for hazard assessments

Strategic Thrust 6

Thrust Area: Climate Change Mitigation and Environmental Sustainability

Project 1

Assessing Socio economic benefits of investments on projects for mitigating Disaster Impacts

Justification

Though there are clear methodologies for carrying out Economic Rate of Return for economic development projects no such calculations are undertaken for investments on DRR projects. As per the assessment made by the National Planning Dept. in 2011 it was observed that the damages and losses in several important sectors due to floods have exceeded Rs 77 billion. Failure of large no of dams of village level tanks creating cascade effect on medium scale dams is one the main reason for causing severe floods and damage to infrastructure. A methodology to assess the benefit of investment to ensure the safety of the dams could have been used to justify the investment related to DR measures on small dams. Such an assessment would be useful to economic planners to decide on the priority areas of investment.

Objective:

To develop a methodology to prioritize investment on projects to mitigate disaster impacts based on socio-economic benefits.

Scope:

1. Undertake loss, damage and risk assessment of disasters on various sectors during last three years
2. Review the economic models used in the region and in the country to assess the economic rate of return on development projects and study the possibility of incorporating socio economic benefit assessment into the methodology used.
3. Develop a methodology to carry out the assessment on disaster risk reduction projects
4. Develop a case study based on ongoing DRR project
5. Train the development planners to undertake social economic benefit analysis for new development projects on DRR
6. Develop hazard and vulnerability maps for DRR

Expected outputs:

1. A methodology available to undertake socio economic cost benefit analysis for DRR investment.
2. Trained officers in development and Disaster Management agencies on the use of cost benefit analysis for DRR investment.

3. Results of a case study undertaken to justify the methodology proposed available.

Project 02

Sustainable Development Initiatives to Minimize Climate Change Impacts by Reducing GHG Emissions in the Areas of Energy Generation & Supply, Transportation, Waste

Justification

Based on the sustainable initiatives of the government and Nationally Determined Contributions (NDCs) of Sri Lanka, energy (electricity generation), transport, industry, forests and waste sectors have been identified under mitigation to reduce the GHG emissions. It is important to address the issues in these sectors and implement relevant actions to mitigate the issues.

Objective

To reduce GHG Emissions in the Areas of Energy Generation & Supply, Transportation, Waste Management, Industry, Agriculture & Livestock

Scope

1. Develop environmentally friendly technologies in electricity generation.
2. Develop energy efficient and environmentally sustainable transport systems.
3. Modify industrial systems towards minimizing GHG emissions.
4. Implement appropriate waste management technologies to reduce GHG emissions.
5. Apply environmentally friendly technologies in Agriculture & Livestock sectors.

Expected Outputs

1. Sustainable and environmental friendly energy generation technologies
2. Methods to minimize the loss of energy during transmission
3. Appropriate management of Solid waste as a resource
4. Strategic transport management plan to ensure high efficiency and green environment
5. Initiatives for green technologies in industrial services
6. Technologies to Minimize GHG emissions from agriculture and livestock sectors

Strategic Thrust 7

Thrust Area :Data Management

Project 1

Collection of data available in all sectors and gap identification

Project 2

Standardizing, processing to a useable format and archiving

Justification: Even though data are available with government institutions, private establishment and individuals, most of them are not available for public for use and research purpose. There will be gaps in these data and certainly some of these data will not be compatible. As it is necessary for future research work, these will have to be collected, gaps identified, standardize and presented in a suitable format. Further there will be new and specific data that will be necessary for climate change and natural disaster sector and these need to be identified and arrangements have to be made to collect these.

Objective:

1. To develop a methodology to collect data in each sector such as Meteorology, energy, agriculture, water, health, natural disasters and gaps identified
2. To develop a methodology to standardize data available to come up with a easy to use format
3. To identify an authority or a place to archive data in order for researcher and others to access these without hindrance

Scope: Providing accurate and reliable data for research purposes and decision making in the relevant fields

Expected outputs: Useable and reliable data sets in all fields especially needed for climate change and natural disasters research and decision making.