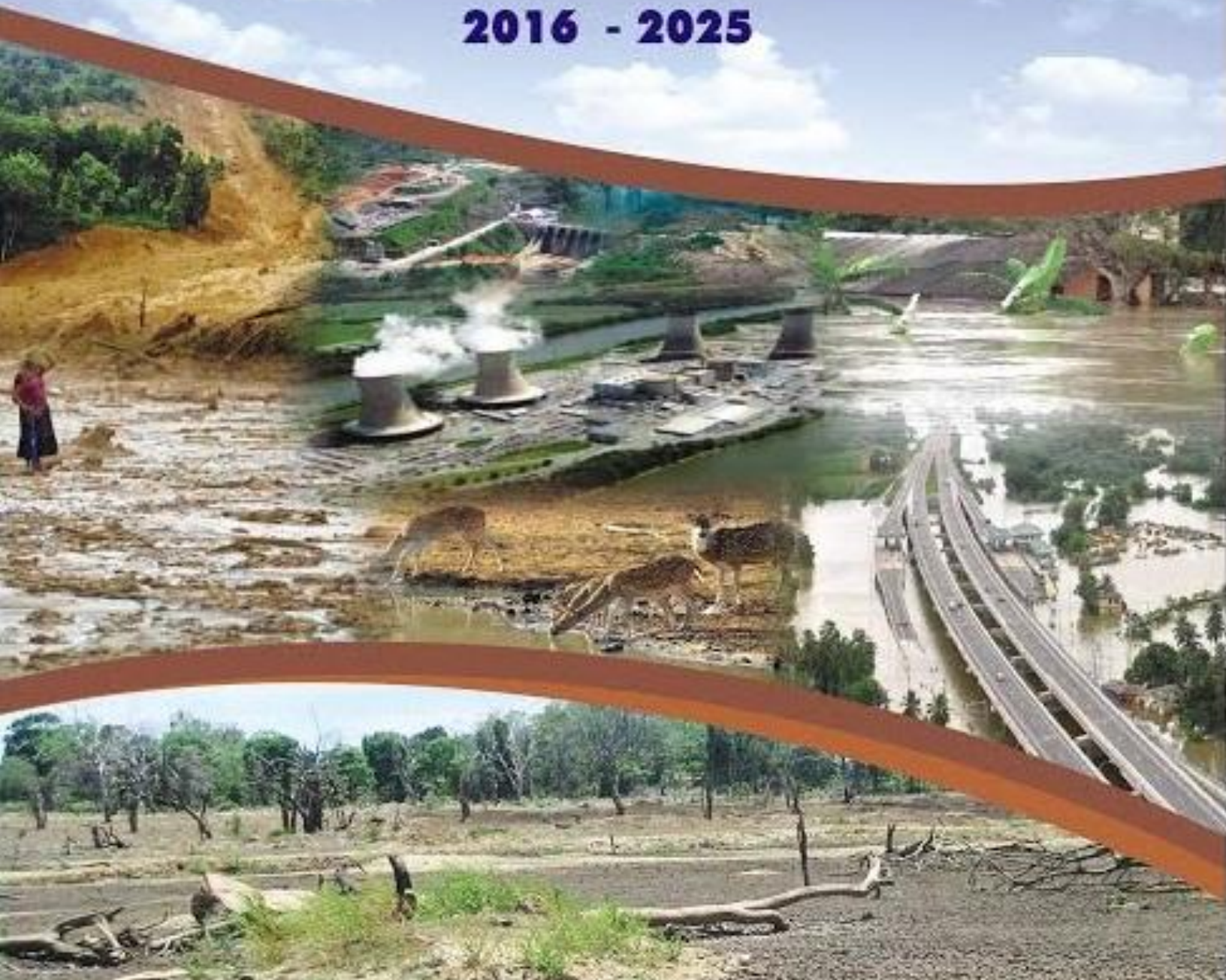
NATIONAL ADAPTATION PLAN FOR CLIMATE CHANGE IMPACTS IN SRI LANKA

2016 - 2025



Ministry of Mahaweli Development and Environment
Sri Lanka

National Adaptation Plan for Climate Change Impacts in Sri Lanka

2016 - 2025

Climate Change Secretariat
Ministry of Mahaweli Development and Environment
2016

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The Message of the National Focal Point to UNFCCC

As a small island and a developing nation, Sri Lanka is highly vulnerable to the adverse effects of climate change. Consequences of climate change such as temperature rise, rainfall variability and sea level rise are critically affecting almost all economic sectors of the country. Occurrences of natural disasters due to extreme weather conditions such as prolonged droughts, flash floods and landslides deprive lives and livelihoods of people.

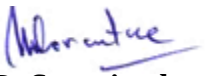
Ratification of the Paris Agreement further to the United Nations Framework Convention on Climate Change (UNFCCC) is one more step forward for committing Sri Lanka to address climate change and related issues. Although mitigation of greenhouse gases is the highlighted portion of the Paris Agreement, we still believe that building resilience of vulnerable communities and ecosystems over climate change effects within a broader framework of sustainable development should be our priority as a developing country.

Recognizing this responsibility, the Government of Sri Lanka has launched a national initiative for facing the threat of climate change. I am happy that the Ministry of Mahaweli Development and Environment has played the leadership role in this effort by developing the National Climate Change Adaptation Strategy for Sri Lanka in 2010 and developing the National Climate Change Policy adopted in 2012. The National Adaptation Plan (NAP) presented in this document, which is the next logical step of this initiative, is a country-driven, gender-sensitive and a fully transparent approach to deal with climate change impacts on Sri Lanka.

The National Adaptation Plan of Sri Lanka has identified agriculture, fisheries, water, human health, coastal and marine, ecosystems and biodiversity, infrastructure and human settlements as the most vulnerable sectors to the adverse effects of climate change. This Plan provides the opportunity for all the stakeholders for developing policies, strengthening cooperation, institutional setup, resources mobilization, technology development and transfer, awareness and capacity building to increase resilience of vulnerable communities, areas and sectors in the country.

In order to implement the NAP of Sri Lanka, we expect the external support for further strengthening the national adaptation planning process in the country, and technical and financial assistance to make these actions realistic at the ground level. It is my pleasure to take this opportunity to deliver a bouquet of appreciation for the partners and stakeholders who engage in developing the NAP of Sri Lanka.

This is one of our commitments to achieve the ultimate objective of the United Nations Framework Convention on Climate Change (UNFCCC), its COP decisions and the Paris Agreement.



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Executive Summary

Climate change impacts are looming over every conceivable level; global, regional, national and local that calls for multi-level action. Sri Lanka, a tropical nation, is highly vulnerable to adverse impacts of climate change. National level actions have to play a critical role while international cooperation is also important. Recognizing this responsibility, the Government of Sri Lanka (GOSL) has launched a national initiative to face the impacts of climate change. The Climate Change Secretariat of the Ministry of Mahaweli Development and Environment plays the leadership role in this activity which is the National Focal Point for the United Nations Framework Convention on Climate Change (UNFCCC), spearheads the process. Among the key national initiatives, the *National Climate Change Adaptation Strategy for Sri Lanka 2011-2016* prepared in 2010 and the *National Climate Change Policy* (NCCP) adopted in 2012 are the two major achievements. The *National Adaptation Plan* for *Climate Change Impacts in Sri Lanka* (NAP) is the next logical step of the National initiatives for meeting the adverse effects of climate change adaptation.

The *National Adaptation Plan* for *Climate Change Impacts in Sri Lanka* (NAP) was prepared in line with the broad set of guidelines set forth by the UNFCCC for the development of national adaptation plans. The NAP process of UNFCCC is a generalized process consisting of four stages that could be customized according to specific situations in respective countries. The NAP process in Sri Lanka started from the stage of preparatory elements, which is the real planning stage of the process, and a country-specific NAP methodology was developed and adopted based on the broader guidelines of the UNFCCC.

The importance of adaptation as a major strategy for facing the threat of climate change has been recognized by all parties to Paris Agreement and called for national actions for adaptation under Intended Nationally Determined Contributions (INDCs). The necessity of adaptive strategies has also been highlighted by number of Sustainable Development Goals (SDGs) adopted by the United Nations in 2015.

The NAP covers adaptation needs at two levels, namely; adaptation needs of key vulnerable sectors and cross-cutting national needs of adaptation. Nine vulnerable sectors were identified in the consultative process, i.e. food security, water, coastal sector, health, human settlements, bio-diversity, tourism and recreation, export development and industry- energy-transportation. Broader stakeholder consultation adopted in the preparation of the NAP has helped to identify adaptation needs of each vulnerable sector based on logical criteria involving projections, vulnerabilities, impacts and socio-economic outcomes. The NAP identifies adaptation options that can fulfill these needs and actions necessary to achieve these adaptation options with responsible agencies and key performance indicators. They together constitute the sectoral action plans for each vulnerable sector. The NAP also includes interventions necessary to fulfill cross-cutting national needs of adaptation identified on the basis of analyzing common sectoral needs and opinions of key stakeholders. The plan also proposes an institutional and coordination mechanism along with implementation and resource mobilization strategies for the successful implementation of the NAP based on a realistic timeframe.

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List of Abbreviations and Acronyms

AchFoU	Architecture Faculties of Universities
AFoU	Agriculture Faculties of Universities
AR5	The Fifth Assessment Report
CAC	Climate Adaptation Cells
CARP	Sri Lanka Council for Agricultural Research Policy
CC&CRMD	Coast Conservation and Coastal Resources Management Department
CCS	Climate Change Secretariat
CDA	Coconut Development Authority
CEA	Central Environmental Authority
CEB	Ceylon Electricity Board
CHPB	Centre for Housing Planning and Building
CIP	Climate Information Products
CRI	Coconut Research Institute
CSO	Civil Society Organization
DAD	Department of Agrarian Development
DAPH	Department of Animal Production and Health
DCD	Department of Cooperatives Development
DFAR	Department of Fisheries and Aquatic Resources
DFC	Food Commissioner's Department
DM	Department of Meteorology
DMC	Disaster Management Centre
DNBG	Department of National Botanical Gardens
DNZG	Department of National Zoological Gardens
DOA	Department of Agriculture
DOArch	Department of Archeology
DOI	Department of irrigation
DWLC	Department of Wild Life Conservation
EFoU	Engineering Faculties of Universities
FD	Forest Department
FIM	First Inter-Monsoon
GOSL	The Government of Sri Lanka
ICTAD	The Institute for Construction Training and Development
IDB	Industrial Development Board
IPCC	Inter-governmental Panel for Climate Change
ITI	Industrial Technology Institute

IUCN	International Union for Conservation of Nature
IWMI	International Water Management Institute
Las	Local Authorities
LEG	Least Developed Countries Expert Group
MASL	Mahaweli Authority of Sri Lanka
ME	Ministry of Environment
MENR	Ministry of Environment and Natural Resources
MEPA	Marine Environmental Protection Authority
MMDE	Ministry of Mahaweli Development and Environment
MODM	Ministry of Disaster Management
MOE	Ministry of Education
MOH	Ministry of Health
MOPI	Ministry of Plantation Industries
MOT	Ministry of Transport
MRI	Medical Research Institute
MSL	Mean Sea Level
NABRO	National Building Research Organization
NAF	National Adaptation Fund
NAP	National Adaptation Plan
NAQDA	National Aquatic Development Authority
NARA	National Aquatic Resources Research and Development Agency
NBRO	National Building Research Organization
NCCAS	National Climate Change Adaptation Strategy
NCCP	National Climate Change Policy
NCPC	National Cleaner Production Centre
NEM	Northeast monsoon
NERD	National Engineering Research and Development Center
NGOs	Non-Governmental Organization
NIPM	National Institute of Plantation Management
NLDB	National Livestock Development Board
NPPD	National Physical Planning Development
NRC	National Research Council of Sri Lanka
NSF	National Science Foundation
NWG	National Working Group
NWSDB	National Water Supply and Drainage Board
OFC	Other Food Crops
PCs	Provincial Councils
PMB	Paddy Marketing Board
RDA	Road Development Authority

RDD	Department of Rubber Development
RPTAs	Road Passenger Transport Authority
RRI	Rubber Research Institute
SD	Survey Department
SEA	Sri Lanka Sustainable Energy Authority
SFoU	Science Faculties of Universities
SIM	Second Inter-Monsoon
SLCC	Sri Lanka Cashew Corporation
SLR	Sri Lanka Railways
SLTDA	Sri Lanka Tourism Development Authority
SLTPB	Sri Lanka Tourism Promotion Bureau
SRI	Sugarcane Research Institute
SVP	Sector Vulnerability Profile
SWM	Southwest monsoon
TBSL	Tourism Board of Sri Lanka
TFoU	Tourism Faculties of Universities
THASL	The Hotel Association of Sri Lanka
TNA	Technology Needs Assessment
TRI	Tea Research Institute
UDA	Urban Development Authority
UNCCS	United Nations Climate Change Secretariat
UNFCCC	United Nations Framework Convention for Climate Change
VRI	The Veterinary Research Institute
WMO	World Meteorological Organization
WRB	Water Resources Board

1. Introduction

The Fifth Assessment Report (AR5) of Inter-governmental Panel on Climate Change (IPCC) emphasizes that the current as well as future generations will have to face multiple impacts of climate change with far reaching consequences. According to the World Meteorological Organization (WMO), 13 out of the 14 hottest years were reported since year 2000 and each successive decade since 1980 has been warmer than the previous one, having 2001-2010 recorded as the warmest decade ever (WMO, 2014). Scientific studies have shown that mean sea-level (MSL) has increased by 0.19 meters during the last century and it is projected to rise even faster during this century (IPCC, 2014). The thermal expansion of oceans and melting of glaciers due to global warming are mainly responsible for this. Reports also suggest that seasonal melting of major ice sheets and glaciers have accelerated during the recent past and significant areas of snow cover have permanently disappeared (IPCC, 2014). These changes in the global climate could lead to create impacts with negative physical and socio-economic outcomes around the world.

Sri Lanka, a tropical nation, is highly vulnerable to impacts of climate change. 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 (Ahmed and Supachalasai, 2014; ME, 2010 a; 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 Sri Lanka's 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 the 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 b and c). Overall, the impacts of climate change are widespread and they are likely to create negative socio-economic outcomes on many sectors in Sri Lanka.

Adaptation is the key strategy available for facing the impacts of climate change. Climate adaptation is widely defined as actions taken to moderate, cope or take advantage of experienced or anticipated changes in climate (IPCC, 2007). However, scholars who look from

the social perspective suggest that the essence of the concept of adaptation is adjustment of behaviour (Adger et al., 2009; Smit et al., 2000; Smith et al., 1996; Stakhiv, 1993). Hence, more precisely, climate adaptation can be defined as 'adjustments in behaviour of natural and social systems and their members in response to actual or expected variability or change in climate in order to moderate and cope with harmful impacts or to take advantage of opportunities.

2015 is a landmark year for global efforts on climate change and sustainable development. In this year, global community was successful in breaking the deadlock in international climate negotiations by reaching a historical agreement in Paris. Simultaneously, world leaders adopted Sustainable Development Goals (SDGs) in the United Nations General Assembly. As a responsible member of the global community, Sri Lanka is expected to make contributions towards both overcoming the challenges of climate change as well as achieving SDGs. The Paris Climate Agreement is based on Intended Nationally Determined Contributions (INDCs) for mitigation of and adaptation to climate change. Accordingly, Sri Lanka signed the Paris Climate Agreement in April 2016 and submitted Sri Lanka's INDCs covering national commitments to both mitigation and adaptation. The adaptation commitments in INDCs are largely based on the adaptation options and actions identified in the NAP process and hence this plan is fully consistent with Sri Lanka's commitments towards global efforts on adaptation. In the final count, adaptation is all about achieving the long-term goals of sustainable development in the face of rising risk of climate change. Hence, the NAP should invariably contribute to achieve SDGs. The SDGs have 17 goals and 169 targets of which Goal Number 13 is fully dedicated to climate change with 9 targets associated with it. In addition, number of other goals covers areas relevant to climate change adaptation with relevant targets attached to them. Sri Lanka's NAP is essentially contributing to number of SDGs and they are especially highlighted in the plan.

Being a phenomenon with impacts looming over every conceivable level, i.e. global, regional, national and local, climate change calls for multi-level actions for adaptation. The national level actions have to play a critical role while international cooperation is also important. At the national level, the government has the responsibility of coordinating adaptation decisions taken at international and provincial levels as well.

Recognizing this responsibility, the Government of Sri Lanka (GOSL) has launched a national initiative to face the threat of climate change (Jayathunga and Kumari, 2013; Marambe et al., 2015b). The Climate Change Secretariat of the Ministry of Mahaweli Development and Environment (MMDE) plays the leadership role here.

Sri Lanka's capacity for successful adaptation to climate change impacts depends on two major factors—vulnerability and adaptive capacity of its people. Sector vulnerability profiles prepared for agriculture, health, water, biodiversity and human settlements have identified many geographical locations and economic sectors that are vulnerable to impacts of climate change

(ME, 2010 a, b &c). Around 28 per cent of the country's population depends on livelihoods related to agriculture, which are highly dependent on climatic conditions. Impacts on agriculture will place not only the livelihoods of farmers, but the food security of the entire population under risk. Poverty is also a major vulnerability-enhancing factor. Even though Sri Lanka has been successful in reducing the poverty head count ratio to a single digit, studies on multi-dimensional poverty indicate that people who are marginally over the poverty line could fall below the line easily due to various livelihood shocks. Hence, climate change impacts have the potential to reverse the country's achievements in poverty alleviation unless countered through appropriate measures of adaptation.

Adaptive capacity implies the ability of people and socio-ecological systems to respond to the impacts of climate change with minimum negative outcomes. Adaptive capacity is determined by several factors that include livelihood assets, knowledge and skills, technology, institutions and information. Unlike in the case of vulnerability, assessments of adaptive capacity are rare in Sri Lanka. However, it is not hard to identify that currently there are many gaps in institutions, technology, knowledge and information concerning impacts of climate change concerned. Hence, successful adaptation requires assessing of the risk and vulnerability, accessing appropriate technologies and sound science, improved institutional mechanisms, multilateral corporations while enhancing the adaptive capacity of people.

1.1.NAP Process in Sri Lanka

The NAP was prepared in line with the broad set of guidelines set forth by UNFCCC's Least Developed Countries Expert Group (LEG) for development of national adaptation plans (NAPs) (LEG, 2012; UNFCCC, 2012). The UNFCCC guidelines identify preparing the NAPs as a process to develop the capacity and knowledge of all decision-makers at national, sub-national (e.g. sectoral, provincial) and supra-national levels. The NAP process of the UNFCCC is a generalized process consisting of four stages that could be customized according to specific situations in respective countries (Box 1). The four stages are: laying the groundwork and identifying gaps; making preparatory elements; implementation strategies, and; reporting, monitoring and reviewing. Of them, the third and fourth are post-plan stages. It is useful to review Sri Lanka's situation with respect to this four stage process.

> ***Initiating and launching the NAP process***: Sri Lanka has already started the NAP process and reached two important milestones, namely: the *National Climate Change Policy* (NCCP) and the *National Climate Change Adaptation Strategy for Sri Lanka* (NCCAS)*: 2011 to 2016* (NCCAS 2011-16). These important policy documents elaborate the national vision and strategic priorities with regard to facing the threat of climate change. They also provide a source of legitimacy and authority required for the NAP. In addition, CCS has established its position as the key national agency with specialized mandate for

addressing national issues on climate change. These factors can be considered as positive features which strengthen the process for developing, and implementing the NAP in Sri Lanka

Box 1: UNFCCC's Generalized Process for the Preparation of NAPs

UNFCCC identified a generalized process consisting of four stages that could be customized according to specific situations in respective countries. The four stages are: laying the groundwork and identifying gaps; making preparatory elements; implementation strategies, and; reporting, monitoring and reviewing.

Laying the groundwork: This is a pre-planning stage of the NAP process. It covers three major areas: initiating and launching the NAP process; stocktaking and synthesizing available information; identifying vulnerabilities and, analysis of major gaps and potential barriers.

Making preparatory elements: This is the real planning stage of the NAP process. UNFCCC has not identified a specific methodological procedure for the preparation of the Plan but only an overall framework (Figure 1). Planners have to identify the suitable methodological framework for respective countries considering the ground realities in the relevant countries. However, UNFCCC emphasizes the necessity of extensive consultation of relevant stakeholders in the planning stage.

Implementation strategy: The third stage of the NAP process is the implementation stage. This is a post-planning stage that deals with implementing selected interventions in the action plan. However, essential aspects of implementation strategy should be laid down in the Plan itself with the necessary flexibility to make adjustments based on changes in conditions that may come in the future.

Reporting monitoring and reviewing: The final stage of the NAP process is reporting, monitoring and reviewing. It deals with monitoring the implementation of the Plan. This is also a post-planning stage. However, like implementation strategies, there should be built-in mechanisms for reporting, monitoring and reviewing progress of the plan. These mechanisms should help review the progress and iteratively update the plan according to the changing conditions.

Stocktaking, synthesizing information and identifying vulnerabilities: The Ministry of Environment, with the initiatives taken by the CCS, has already published two *National Communications of Climate Change* in 2001 and 2011 that reviewed the existing information. In addition, Sector Vulnerability Profiles (SVPs) have been developed for 5 sectors. The Ministry has also completed the Technology Needs Assessment (TNA) for

adaptation and mitigation which identified priority technologies for five adaptation sectors and three mitigation sectors. Several national level conferences organized by various agencies have helped to exchange findings of research conducted by institutions and individual researchers. These developments have established a solid foundation for the NAP process.

Major gaps and barriers: Despite positive factors, however, there are also significant gaps in certain areas. Review of existing literature helped to identify a few major gaps that need to be addressed for successful adaptation in Sri Lanka. They are: information gaps, technological gaps, policy and governance gaps, institutional and coordination gaps and resource mobilization gaps.

Information gaps: Major improvements in generation of climate information products (CIPs) are necessary to provide effective guidance to adaptive actions of different stakeholders.

Technological gaps: Despite that the TNA has been conducted for five important sectors of adaptation, technological gaps in many areas remain largely unexplored.

Policy and governance gaps: Efforts initiated by the MMDE and CCS have helped to fulfill some policy gaps at the national level. The NCCP has established the national vision whereas the NCCAS: 2011-2016 identified strategic priorities. However, climate change is a complex problem that cannot be governed through efforts of a single ministry or a line agency. Hence, there are policy and governance issues that need to be addressed through the NAP process.

Institutional and coordination gaps: Currently, many activities pertaining to adaptation are undertaken in an ad-hoc manner without proper coordination. This cannot be considered a favorable situation and therefore an appropriate institutional mechanism for coordination of different actors is necessary.

Resource mobilization gaps: The government is burdened with numerous fiscal and monetary difficulties to find extra resources for climate adaptation interventions. Therefore, conventional channels of public finance cannot be relied upon to meet all resource needs of adaptation and innovative ways of resource mobilization should be identified.

These gaps act as barriers to successful adaptation thereby leading to reduce the adaptive capacity and increase the vulnerability of individual citizens as well as the nation as a whole.

The major aim of the NAP is overcoming these gaps so that the adaptive capacity of all stakeholders will be enhanced while the vulnerability will be reduced.

Given the situation that many groundwork requirements have already been fulfilled and the NAP process in Sri Lanka was started from the second stage—i.e. by making preparatory elements. This can be considered as the real planning stage of the NAP for Sri Lanka. Essential preparatory elements of the NAP process include: analysing current climate and future climate scenarios; assessing vulnerabilities; identifying, reviewing and appraising adaptation options and, compiling and communicating the NAP (Figure 1).

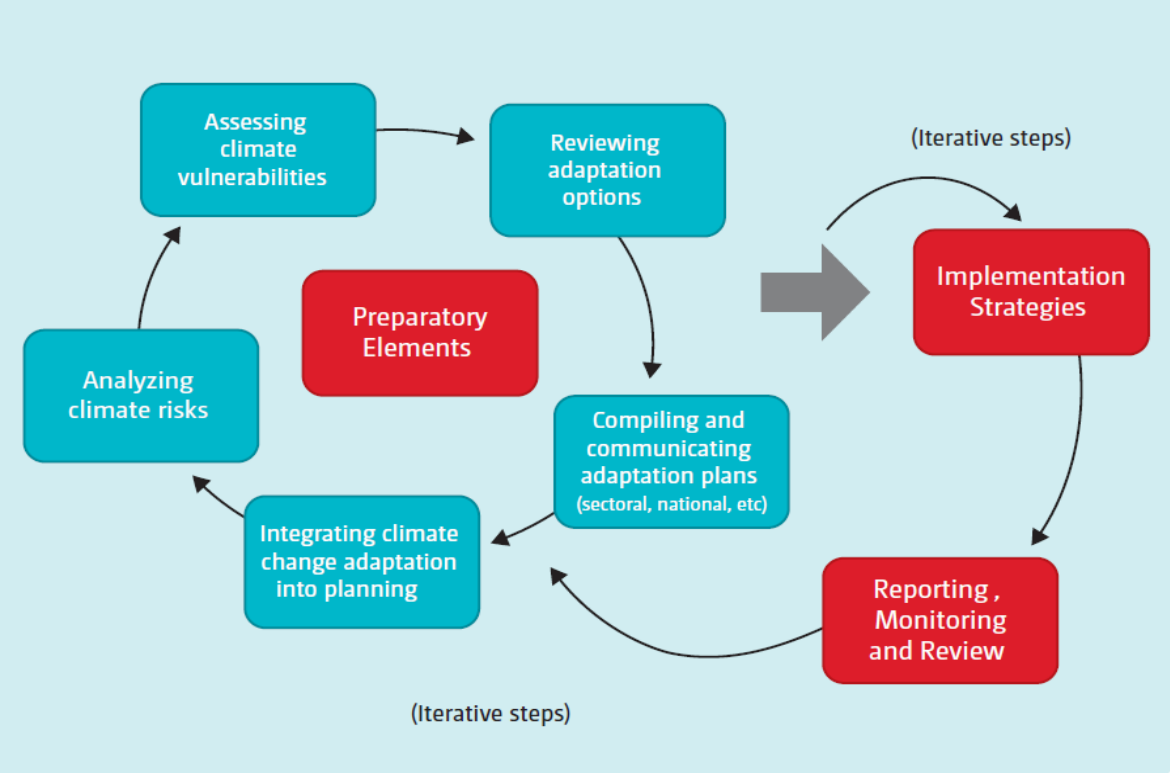

Figure 1: The NAP Process

The UNFCCC guidelines do not offer a detailed planning methodology other than the broad framework shown in Figure 1. It is understood that each country faces different circumstances and a rigid prescriptive methodology would not generate desired results. Instead it remains open for country-driven customized methodologies for the preparation of the NAP. The NAP methodology of Sri Lanka was developed according to these broad guidelines of the UNFCCC and is discussed in Chapter 5 of this Plan.

1.2. Organization of Chapters

Chapter 2 presents an overview of climate change in Sri Lanka. It discusses the average pattern of climate in Sri Lanka together with observed changes in the recent past and projected changes for the future. Chapter 3 describes the scope of the plan together with key stakeholders and the plan's connectivity to other relevant national policies and plans. Planning concepts and approaches that guided the plan are presented in Chapter 4. The detailed methodology of the plan is described in Chapter 5. The methodology of the plan has a logical structure that begins from the projections on changes in key climatic parameters. Physical effects of projected changes give rise to physical hazards and vulnerabilities on different sectors. The impacts of these hazards and vulnerabilities determine the adaptation needs of respective sectors and feasible adaptation options to cope with impacts that provided the basis of the action plan. This logical structure of the plan is explained in Chapter 6 before the presentation of The Plan in Chapter 7. Chapter 7 presents the plan in detail with summary of priority actions, followed by sector specific actions plans for 9 different sectors, and the plan for cross cutting adaptation needs. Chapter 8 presents the institutional and coordination mechanism while the implementation strategy and the resource mobilization mechanism of the plan are presented in Chapters 9 and 10 respectively.

2. Climate Change in Sri Lanka: An Overview

Successful adaptation against climate change is necessarily an information-driven process. Therefore, the logical starting point of preparing the NAP is reviewing information on the existing situation of climate change in Sri Lanka. This section provides a brief overview of the climate in Sri Lanka, major changes that have been observed in the system and changes projected to take place in future.

2.1. Climate in Sri Lanka

The review of general pattern of climate described in this section is based on Basnayake (2007), Chandrapala (2007 a) and Abhayasinghe (2007). Being a small tropical island, there is no significant annual variation in temperature in Sri Lanka due to latitude. However, significant regional variation in temperature could be observed due to altitude. In lowland areas, average annual temperature usually varies around 26.5 – 28.5 °C and it falls quickly as altitude increases (e.g. Nuwara Eliya – 15.9 °C at 1800 meters above mean sea level).

In the absence of high seasonal variation in temperature, the average pattern of climate in a given local area is determined mainly by the variations in precipitation. Sri Lanka's mean annual rainfall is around 1850 mm (ranging from 900 mm to 5000 mm). There are three major sources of rainfall in the country, namely; monsoonal, convectional and depressional. Based on the variation in precipitation, Sri Lanka's climate is generally divided into four seasons:

1. First inter-monsoon season (FIM): March –April (268 mm, 14%)
2. Southwest monsoon season (SWM): May –September (556 mm, 30%)
3. Second inter-monsoon season (SIM): October-November (558 mm, 30%)
4. Northeast monsoon season (NEM): December- February (479 mm, 26%)

The first inter-monsoon (FIM) rains are usually experienced around March-April period. During the FIM, southwestern quarter and certain parts of central highlands receive over 250 mm rainfall, with some localized areas on the Southwestern slopes experiencing rainfall in excess of 700 mm. Most other parts get rainfall around 100-250 mm. Hazardous lightning associated with thunderstorms is a frequent incident and sometimes intensive rainfall may give rise to flash floods.

The country experiences the Southwestern monsoon (SWM) around May-September. During the SWM season, mid-elevation western slopes of central highlands receive over 3000 mm rainfall and southwestern coastal belt around 1000-1600 mm. Higher elevations in central highlands get rainfall around 800 mm. Long lasting monsoon rains may result in floods in low-lying areas and landslides in hilly areas. Rains can be experienced at any time during the day and night.

Box 2: Observed Changes of Climate in Sri Lanka - Some Scientific Evidence

Temperature: Analysis of past data suggests that atmospheric temperature is gradually rising almost everywhere in the country (Chandrapala, 2007a; De Costa, 2008; Eriyagama et al., 2010; Nissanka et al., 2011; Sathischandra et al., 2014). Varied rates of increase in temperature have been reported from different locations and in recent years, the warming trend has become faster (Basnayake, 2007; Chandrapala, 2007a; De Costa, 2008; Sathischandra et al., 2014). Annual mean air temperature anomalies have shown significant increasing trends in all stations during the recent decades (Basnayake, 2007). It has been reported that mean daytime maximum and mean night time minimum air temperatures also have increased (Basnayake, 2007; Zubair et al., 2005). Data indicates that increase in night time minimum air temperature contributes more to average increase in annual temperature than day time maximum air temperature (Basnayake, 2007).

***Precipitation*:** Unlike in the case of temperature, no clear pattern or trend has been observed in precipitation. Some researchers, comparing the mean annual precipitation of recent and earlier periods, suggest that average rainfall is showing a decreasing trend (Basnayake, 2007; Chandrapala, 2007b; De Costa 2008; Jayatillake et al., 2005). However, there is no consensus on this fact among researchers and opposing trends can be observed in different locations. Punyawardena et al. (2013a) observed that heavy rainfall events have become more frequent in central highlands during the recent period. However, many researchers seem to agree that the variability of rainfall has increased over time, especially in *Yala* season (Chandrapala 2007b; Eriyagama et al. 2010; Punyawardena et al., 2013b). Moreover, the number of consecutive dry days has increased and the consecutive wet periods have decreased (Premalal, 2009; Ratnayake and Herath, 2005). Studies also indicate that spatial distribution of rainfall appears to be changing although a distinct pattern cannot be recognized yet (Basnayake, 2007; Marambe et al., 2013; Nissanka et al., 2011; Sathischandra et al., 2014). Some studies suggest changes in distribution can even lead to shifting of agro-ecological boundaries (Eriyagama et al., 2010; Mutuwatte and Liyanage, 2013).

***Extreme events*:** The intensity and the frequency of the extreme events such as floods and droughts have increased during recent times (Imbulana et al., 2006; Ratnayake and Herath 2005; Premalal and Punyawardena, 2013; Punyawadena and Premalal, 2013). Areas of high rainfall intensities and the locations of landslides show a strong correlation (Ratnayake and Herath, 2005).

***Sea level rise*:** Sea level rise of 1-3 mm/year is observed in the Asian region and is marginally higher than the global averages (Cruz et al., 2007). An accelerated level of sea level rise has been observed during the period of 1993-2001 (3.1 mm/year) for the Asian region. However, specific levels of sea level rise in areas around Sri Lanka are yet to be assessed.

Second inter-monsoon season (SIM) brings rainfall around October-November period. Unlike FIM, the influence of depressions is common during SIM, the whole country experiencing

strong winds with widespread rains, sometimes leading to floods and landslides. It is the season with most evenly distributed rainfall in Sri Lanka. Many areas receive over 400 mm. Slopes in southwestern quarter receive 750-1200 mm.

Usual period of northeast monsoon season (NEM) is December-February. During this season moist wind blowing from northeast Asian landmass produces seasonal rainfall in the northern, north central and eastern parts of the country. Highest rainfall figures are recorded in north-eastern slopes of the hill country and eastern slopes of the Knuckles/Rangala range.

This general pattern of annual rainfall results in an overall mean annual rainfall of around 1850 mm that range from 900 mm to 5000 mm. Southwestern quarter of the country, especially western slopes of central highlands receive the highest rainfall (e.g. Yatiyantota, Ginigathhena, Watawala > 5000 mm). On the other hand, southeastern (Yala, Palatupana < 1000 mm) and northwestern (Mannar < 1000 mm) coastal areas receive the lowest amount of rainfall.

Sri Lanka has traditionally been generalized into three climatic zones, namely, 'wet zone' in the Southwestern region including central hill country, 'dry zone' covering predominantly the Northern and Eastern parts of the country, and 'Intermediate Zone', skirting the central hills except in the South and the West. In differentiating these three climatic zones, annual rainfall, contribution of southwest monsoon rains, soil type, land use, and vegetation have been widely used (Punyawardena, 2007). The Wet Zone receives a relatively high mean annual rainfall over 2,500 mm without pronounced dry periods. The Dry Zone receives a mean annual rainfall of less than 1,750 mm with a distinct dry season from May to September. The Intermediate Zone receives a mean annual rainfall between 1,750 and 2,500 mm with a short and less prominent dry season. Sri Lanka has been further divided into 46 agroecological regions (Punyawardena, 2007) that take into account the monthly rainfall amount (at 75 % probability) and distribution in addition to the parameters considered for identifying climate zones. Figure 2 presents the map of agro-ecological zones in Sri Lanka.

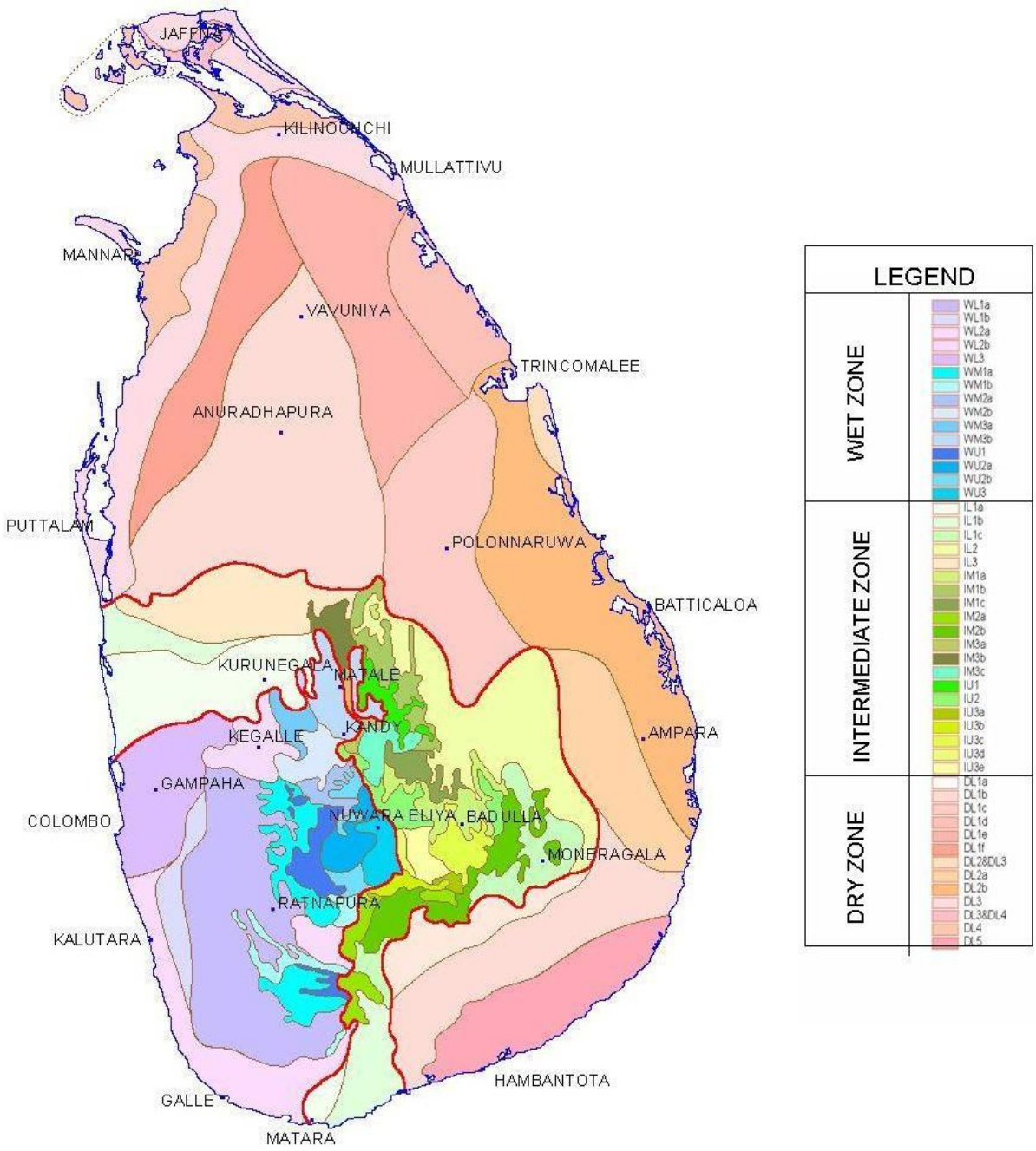

Figure 2: Agro-ecological regions of Sri Lanka

Source: Natural Resources Management Centre, Department of Agriculture (2003).

2.2. Observed and Projected Changes in Climate in Sri Lanka: An Overview

Recent studies on local, regional and global climate suggest that this general pattern of climate is undergoing changes. There are two major sources of information.

- *Observed changes of climate*: These are based on statistical analysis of historically recorded meteorological data over several years across a number of locations in the country
- *Projected changes on climate*: This refers to projections based on global, regional and downscaled climate models for future time periods

Academics and researchers have conducted a number of studies on trends that can be observed from analysis of past meteorological data and they indicate that Sri Lanka's climate is changing gradually. Areas that attracted researchers' attention most were trends in temperature, changes in precipitation patterns and observations on extreme events. Evidence suggests that atmospheric temperature is gradually rising almost everywhere in the country. A major feature of rainfall in Sri Lanka is the high year-to-year variability. However, no distinct pattern of change has been observed. Variation of rainfall is much smaller in lowlands than highlands. A summary of findings from analysis of past data is given in Box 2.

Projected changes are likely future trends of key meteorological parameters according to projections of climate models, which are complex mathematical models. Global climate models provide limited information on a smaller country like Sri Lanka and hence model information need to be downscaled. There were a few attempts on downscaling and a brief review of the projected changes in climate in Sri Lanka due to global warming is presented in Box 3.

2.3. An Overall Assessment

Overall, information on observed and projected changes suggests that the climate of Sri Lanka is undergoing three major types of changes.

- Gradual increase in ambient air temperature
- Changes in distribution pattern of rainfall
- Increase in frequency and severity of extreme weather events

In addition to the above changes in atmosphere, there are associated changes in oceanic environment too, especially sea level rise, that seem to create significant impacts over Sri Lanka. Adaptation is a response strategy for overcoming the impacts of observed and projected changes in climate. Therefore, the above observations and projections provide the essential scientific basis for NAP.

Box 3: Projected Changes in Climate in Sri Lanka: Some Scientific Evidence

Three modelling approaches have been used for projecting climate change in Sri Lanka: general circulation models (GCM), regional climatic models (RCM) and statistically downscaled GCM models (Eriyagama et al., 2010). Key global projections applicable to Sri Lanka are projections for Asia in fourth and fifth assessments reports (AR4 and AR5) of IPCC. The general agreement of these projections is that South Asia will increasingly become warmer (Cruz et al., 2007; Hijioka et al. 2014). The warming is projected to be stronger than global mean in South Asia. Some of the predictions with high confidence (very likely) applicable for South Asia are: mean annual temperature will increase by greater than 3 Celsius; increase in precipitation by mid-21st century; increased precipitation extremes related to monsoons, and; oceans getting warmer in tropical Asia (Hijioka et al., 2014). Ahmed and Supachalasai (2014), based on a RCM, predicted that temperature could rise by 3.6 C, 3.3 C and 2.3 C under A2, A1B and B1 scenarios, respectively by 2080 (Table B-1).

Table B-1: Temperature and Precipitation Projections under Different Scenarios

Climate parameter	2030			2050			2080		
	A2	A1B	B1	A2	A1B	B1	A2	A1B	B1
Precipitation (%)	7.4	11.0	3.6	15.8	25.0	16.5	39.6	35.5	31.3
Temperature (C)	1.0	1.1	1.0	1.8	1.5	1.3	3.6	3.3	2.3

Source: Ahmed and Supachalasai (2014).

Like in the case of observed changes, projections also are less certain about the changes in rainfall pattern. Ahmed and Supachalasai (2014) predict increases in precipitation level by 39.6, 35.5 and 31.3 per cent, respectively, under A2, A1B and B1 scenarios by 2080 (Table B-1). However, locally downscaled models have predictions on change in precipitation towards both directions—increasing as well as decreasing mean annual rainfall (MAR) (Eriyagama et al., 2010). According to one projection, MAR will increase by 14 percent for A2 and 5 percent for B2 by 2050s compared with 1960-1991 (De Silva, 2006 b). This overall increase is not uniform and it predicts a decrease of 34 percent for A2 and 26 percent for B2 in NEM while projecting increases of 38 percent for A2 and 16 percent for B2 for SWM rainfall. Some studies have projected increased rainfall in wet zone, intermediate zones and north and south-western dry zones and decreased rainfall in other areas of dry zone by 2050 (Basnayake and Vithanage, 2004). Studies have also suggested a 17 percent reduction of rainfall in the upper Mahaweli watershed in the central highlands by 2025 (Shantha and Jayasundara, 2005). Another recent projection has predicted that climate pattern in Sri Lanka is getting more polarized where the Dry zone becomes drier and Wet zone becomes wetter in years to come (Marambe et al., 2015; Punyawardena et al., 2013 a).

The IPCC studies have also projected an increased incidence of extreme weather events for the South Asian region that may include heat waves and intense precipitation events (Cruz et al., 2007). Coastal disasters have also been projected to rise with increased incidence of tropical cyclones by 10-20 percent (Cruz et al., 2007).

3. Scope of the Plan and Key Stakeholders

Climate change is a complex phenomenon with impacts spread over all sectors of the economy and every strata of the society. Therefore, some scoping is necessary to identify and organize adaptation actions against climate change impacts. According to the UNFCCC guidelines, there are no standard frameworks proposed for scoping of impacts and organizing adaptation actions. Scoping of NAP has to be done according to the situation of respective countries.

A broad categorization of adaptation needs based on current understanding on climate change impacts as they are applicable in the context of Sri Lanka can be given as below:

- Adaptation needs of key sectors
- Cross-cutting national needs of adaptation

The NAP is intended to address both types of adaptation needs within a realistic timeframe. This section presents a brief description of two types of adaptation needs and the list of sectors and cross-cutting national issues identified in the consultation process of the NAP preparation. In addition, the section also identifies the key stakeholders of NAP and presents a comparison of the scope of the plan with the scopes of the National Climate Change Policy (NCCP) of 2012 and the National Climate Change Strategy (NCCAS) 2011-2016.

3.1. Adaptation Needs of Key Sectors

This refers to adaptation needs that can be handled within boundaries of vulnerable sectors. Consultations with key stakeholders and experts at the preparatory stage of the plan helped to identify nine critically important sectors in Sri Lanka in terms of vulnerability to climate change impacts and necessity of adaptive actions (Table 1). Usually, these sectors are serviced by established line ministries and agencies (e.g. Food security sector: Ministries for Agriculture/Livestock/Fisheries/Food Security and associated line agencies; health sector: Ministry of Health and line agencies). Consultations also helped in identifying the priority areas within each sector that needs specific actions of adaptation. In the identification of sectors and priority areas within them, attention was also given to align them with organizational structure of line agencies responsible for catering needs of respective sectors as far as possible.

Table 1: Key Sectors and Priority Areas

Sector	Priority areas
Food security : agriculture, livestock and fisheries	• Rice • Other food crops (OFC) • Horticultural crops • Sugarcane • Livestock • Fisheries • Agriculture and land degradation
Water resources	• Water for agriculture • Water for human consumption • Water for industry and energy • Degradation of watersheds
Coastal and marine sector	• Coastal zone management • Beach stability • Coastal bio-diversity • Ocean acidification
Health	• Climate altering pollutants • Diseases: Spread and outbreaks • Hazardous events: Health impacts • Heat/thermal stress
Human settlements and infrastructure	• Urban settlements and infrastructure • Rural settlements and infrastructure • Estate settlements and infrastructure • Coastal settlements and infrastructure
Ecosystems and biodiversity:	• Forests • Wild life • Wetlands • Agro ecosystems: home gardens • Loss of ecosystem services
Tourism and recreation	• Coastal tourism • Tourism and bio-diversity • Cultural assets
Export agriculture sector	• Tea • Rubber • Coconut • Export agricultural crops
Industry, energy and transportation	• Industry • Energy • Transportation

Mainstreaming approach implies that the climate change issues of these sectors should be handled by the respective line ministries and agencies themselves rather than by specialized agencies mandated for climate change. Simultaneously, the integrated approach implies that sectoral issues should be addressed with connection to national level issues. The NAP takes a facilitative approach towards sectoral adaptation needs through an institutional mechanism that involves respective line ministries/agencies mandated to address the needs of the respective sectors.

3.2. Cross-cutting National Needs of Adaptation

Cross-cutting national needs of adaptation are issues that pervade boundaries of the sectors. Overcoming gaps concerning these issues will help to increase adaptive capacities and reduce vulnerabilities of stakeholders in all or many sectors. As in the case of key sectors, cross-cutting areas have also been identified through the consultation of stakeholders and experts. The list of cross-cutting national issues and key areas of interest coming under them are given Table 2.

Table 2: Cross-cutting National Issues and Areas of Interest

Sector	Areas of interest
Policy, legal, economic and governance issues	• Policies and programs • Laws and regulations • Governance procedures
Institutional development and coordination	• Institutions • Coordination
International cooperation and partnerships	• International cooperation: global & regional • Areas for cooperation • Regional partnerships
Resource mobilization	• Resource mobilization : national sources • Resource mobilization : international sources • Resource mobilization: local (private & community) • Market based instruments
Research and development	• Research & development • Critical research needs • Research facilities • Skills and training needs
Technology transfer and standards	• Technology transfer: International dimension • Technology transfer: National and local • Channels of transfer • Standards

Building of adaptive capacity of communities	• Assessing adaptive capacity and vulnerability • Enhancing community participation • Utilization of local knowledge • Involvement of CSO • Change in attitudes, lifestyles and behaviour
Education, training and awareness	• Education (formal & informal) • Training needs and skills • Increasing awareness
Climate-induced disaster risk management	• Climate-induced disaster risks • Risk management instruments • Establish Connectivity to existing disaster management plans
Climate information management	• Climate forecasting: short-term & seasonal • Long-term projections • Communication of climate information

Climate change is a relatively new area of government intervention and there are no mandated national stakeholders vested with the responsibility of adaptation in respective cross-cutting areas except the CCS. At present the CCS, as the national focal point for the subject, is expected to look after many areas in spite of the Secretariat's limited capacity of doing so. Hence, identification of suitable national stakeholders and enlisting their support for planned interventions is a major challenge in implementing the plan. Responsibility of certain areas is already vested with national stakeholders (e.g. climate information - Department of Meteorology; disaster risk management – Disaster Management Centre). In such cases, the action plan should identify necessary capacity building interventions for the existing stakeholders whereas in others, the plan may need to come up with innovative solutions (e.g. institutional development and coordination).

3.3. Connectivity to and Consistency with other National Policies and Plans

3.3.1. Connectivity to National Climate Change Policy and the Strategy

The NAPs are supposed to have a connection with national visions/goals and to derive their legitimacy through instruments such as national policies, Acts of parliament, national directives, decree or executive orders by the head of state. Hence, attention was given to maintain consistency with the *National Climate change Policy of 2012* (the *Policy*) and the *National Climate Change Adaptation Strategy 2011-2016* (the *Strategy*) to the extent possible. It is necessary to position the NAP with respect to the *Policy* and the *Strategy.* However, the scope of the plan is not necessarily restricted by the scope of the *Strategy*.

National Climate Change Policy of 2012: The *Policy* articulates the broad national policy statements which will guide decisions taken at national and sub-national levels against

the threat of climate change. It presents twenty five policy statements to cover a number of relevant areas of climate change in Sri Lanka including: vulnerability, adaptation, mitigation, sustainable consumption and production, knowledge management and general statements concerning institutional coordination, research and development, technology transfer, legal and regulatory framework, market and non-market based mechanisms and resource mobilization. Adaptation is only one component of the policy and there are other complementary areas that are linked to adaptation (e.g. vulnerability). Hence, the scope of the *Policy* is essentially broader than the scope of the NAP. However, the NAP expands and deepens the coverage of adaptation within the broader scope of statements adopted in the *Policy* and takes them into a level of practical implementation.

National Climate Change Adaptation Strategy (2011-16): The *Strategy* identifies strategic priorities required to be addressed when facing the threat of global climate change. The scope of the *Strategy* is restricted only to adaptation. Hence, it overlaps closely with the scope of NAP. Its scope covers five strategic thrusts, 25 thematic areas of action and 91 priority adaptation measures. Hence, it goes beyond identification of strategic priorities and suggests a broad selection of interventions to address these strategic priorities without specific plan of actions to implement them or to monitor the progress.

In relation to the *Policy* and *Strategy*, the role and function of NAP can be described as follows.

The NAP is a rolling plan with a set of implementable actions. It is not a statement of policies, strategies or principles, but a selection of practical interventions identified by relevant stakeholders to overcome anticipated threats due to impacts of climate change. It comprises a set of interventions selected by key stakeholders considered as desirable to overcome the perceived threats of climate change impacts in key sectors and cross-cutting national areas of interest. While the interventions of NAP are guided by broad principles laid down by the *Policy* and strategic priorities identified by the *Strategy,* it is not necessarily restricted by their scopes. Interventions identified in the NAP are focused actions with specific timelines, responsible stakeholders, implementation strategies and key performance indicators for monitoring and reviewing mechanisms compared with the broad interventions suggested by the *Strategy*. The interventions have been designed to mainstream climate change adaptation in the overall national effort for sustainable development, integrating decisions taken at supra- and sub-national levels as well. As in the case of *Policy* and *Strategy*, the NAP has also been developed through extensive consultation and participation of relevant stakeholders.

3.3.2. Connectivity to other National Policies and Plans

In addition to the *Policy* and the *Strategy* on climate change, the environment sector has a number of other national policies, strategies and action plans. Some of these policies have

recognized climate change as a key environmental challenge faced by the country. Even though their coverage of the subject is not comprehensive and focused as in the current plan, they propose certain strategies, actions, projects for overcoming threats posed by climate change impacts on respective areas of interest. In this section, a brief review of most relevant policy documents is presented.

National Action Plan for Haritha Lanka Programme: The *Haritha Lanka Programme* has identified climate change as the third mission and selected certain strategies/actions relating to both mitigation and adaptation (NCSD, 2009). While the climate change mission in *Haritha Lanka* has given more weight to strategies/actions targeting mitigation (i.e. reducing GHG emissions), it has adaptation actions in areas of infrastructure vulnerability, land use zoning, rain water harvesting, increase of vectors and food security.

Sri Lanka Comprehensive Disaster Management Programme 2014-2018 **(SLCDMP):** The SLCDMP is a policy document, which has a close connection to the National Adaptation Plan (NAP). It identifies climate change as a disaster and proposes actions to overcome its' consequences. In addition, other major types of disasters identified by the SLCDMP such as floods, droughts, landslides, high winds/cyclones are also closely associated with extreme weather events. As a result, there are overlapping areas in the SLCDMP and NAP, however, the NAP does not intend to duplicate the SLCDMP. While proposing adaptation actions for extreme events in all sectors, the disaster risk management has been identified separately as a cross–cutting need of adaptation so that all disaster related actions can be coordinated closely with the existing disaster management agencies such as the Ministry of Disaster Management and the Disaster Management Centre.

National Action Programme for Combating the Land Degradation of Sri Lanka **(NAP-CLD)**: The NAP-CLD has recognized climate change as a factor that can intensify the degradation of land resources in future (Ministry of Environment and Natural Resources, 2014). It highlighted issues such as soil erosion and landslides in up- and mid-country wet zone (upper watershed) areas as critical issues together with actions to overcome them. These actions can complement the climate change adaptation. Therefore, certain actions in the NAP-CLD and NAP can be jointly implemented through proper coordination.

Coastal Zone Management Plan **(CZMP)**: The CZMP has also recognized climate change as a factor that can intensify the degradation of coastal resources in future. Its main concerns include coastal erosion, coastal pollution and degradation of coastal habitats. The NAP identifies impacts of climate change on the coastal sector and proposes adaptation measures to overcome them. Hence, overlapping areas of the CZMP and NAP are complementary and better results can be achieved through proper coordination.

***National Physical Plan* 2011-2030 (NPP)**: The NPP has identified global warming as a concern that can affect physical development activities of the country. In addition, it covers some aspects of disaster risk management too. However, the major focus of the NPP is development of physical infrastructure facilities and no attention was given to climate adaptation. However, its proposal to conserve central and coastal regions as environmentally sensitive (fragile) areas, complements achieving the objectives of the NAP to a certain degree.

***Sri Lanka Water Development Report 2010* (SLWDP)**: The SLWDP has identified climate change as a major driver of change in the water resources sector. However, information in the report suggests that there is no current policy, plan or programme in the water sector that specifically cover climate change adaptation. Hence, proposed actions of the NAP would be highly beneficial for addressing adaptation needs in the water sector.

Draft National Agriculture Policy: The presently available draft framework of the National Agriculture Policy for public comments identified 'Assuring food security' and 'Ensuring environment sustainability' as two major pillars of the policy in making. It recognized 'Natural resource management & climate change adaptation' as a key strategic/intervention area that cover soil conservation, water management, agriculture climate forecast and disaster risk reduction. However, the policy is still at the preliminary stage of preparation and the NAP has a comprehensive portfolio of actions under food security and water resources sectors that can complement the objectives of the National Agriculture Policy.

Overall, none of the existing plans or policies covers climate change adaptation as a special focus area. There are a few policy documents that cover climate change within their scopes in limited manner. However, they are focused on addressing specific issues of respective sectors/resources and climate change has usually been identified as an overarching issue that could affect respective sectors/resources. When preparing the NAP, other policy documents such as *Haritha Lanka, SLCDMP, CZMP and NAP-CDL* and *CNMP* also were taken into consideration and experts from respective sectors were consulted. Hence, the NAP, while being specialized and focused specifically on the subject of climate change adaptation, adopted a complementary approach towards other plans that cover climate change within their scope.

3.4. Consistency with Sri Lanka's global commitments on climate change

3.4.1. Consistency with INDCs

With the signing of Paris Agreement in April 2016 and ratifying the same in September 2016 by Sri Lanka, its global commitments on climate change will mainly focus on the INDCs that have been already submitted. Sri Lanka's submitted INDCs are mainly covered the areas of mitigation, adaptation, loss and damage and means of implementation. In this contest INDCs related to adaptation cover the sectors of; human health, food security (agriculture, livestock and fisheries), water, irrigation, coastal and marine, biodiversity, urban city planning & human settlements, and tourism & recreation. Each of these sectors has separate sectoral INDCs.

All these sectors have been covered in the NAP. In addition, it also covers adaptation needs of export agriculture sector along with industry/transport/energy sectors which comprises main mitigation sectors in Sri Lanka's INDCs. Moreover, nearly all sectoral INDCs have been captured under different adaptation options and adaptive actions proposed to address respective sectoral needs of adaptation. The submission on INDCs acknowledges the NAP, all technical work of which had been completed by the time of submission (April 2016) and identifies it as a source document for identifying key sectors and sectoral INDCs. Hence, the connectivity between the NAP and Sri Lanka's INDCs is straightforward and there is high level of consistency between the two. In fact, even though official submission of INDCs came first, they are directly based on and guided by the NAP. This implies that implementation of the NAP will complement fulfilling Sri Lanka's global commitments on climate change and vice versa.

The NAP also contributes to SDGs and an assessment on the contribution of NAP to achieve SDGs is presented in Section 8.

3.5. Key Stakeholders of the Plan

Like many other national plans, the NAP has also been prepared to implement within the organizational structure of line ministries and line agencies of the Government of Sri Lanka. However, its target beneficiaries are not the government agencies, but the vulnerable sections of the society to climate change impacts. The ultimate goals of the plan are to enhance the adaptive capacity of these target groups and reduce the state of vulnerability they are currently in. These ultimate goals, however, have to be delivered through the joint efforts of key stakeholders that include:

- Government sector (Line ministries and line agencies and central government and

provincial councils)
- Private sector (Corporate sector and SMEs)
- Civil society organizations
- Academics, researchers and other knowledge makers
- Local community-based organizations

While these stakeholders bear implementation and monitoring responsibilities of the plan in their professional and occupational capacities, individually they are also part of vulnerable sections of the society to climate change impacts. Hence, they have vested interests of being a part of target beneficiaries as well that should give additional source of motivation for making the plan a success.

4. Planning Concepts and Approaches

The plan is guided by the principles adopted by the *Policy,* the *Strategy* as well as the NAP guidelines developed by UNFCCC. Being a more practically oriented document, it is more concerned with planning concepts and approaches that underline the preparatory elements of the plan. The key planning approaches and concepts used are:

- Mainstreaming adaptation to national development
- Integration of sectoral and cross-cutting national dimensions
- Adaptive policy and management
- Anticipatory adaptation

Mainstreaming adaptation to national development: The NAP aims to mainstream the climate change adaptation to sustainable development of the country. The term 'mainstreaming' implies fulfilling a few essential conditions as given below.

Prioritized: Adaptation to climate change impacts should be given due priority among other national issues at macro and sector levels that compete for policy makers' attention.

Comprehensive: Plan should cover a comprehensive scope to address key priority areas concerning climate change impacts in Sri Lanka

Informed: Decisions/actions should be taken with consultation of the best available information at the time of decision

Timely attended: Issues pertaining to climate change should be addressed on a regular basis taking required decisions/actions at the right time

Ensured with sufficient resources: Necessary resources for implementation of planned interventions should be provided in adequate amounts in a timely manner

Coordinated: All actions should be taken with appropriate level of coordination among relevant stakeholders

Success of mainstreaming climate change adaptation to national development process would be determined by how successfully the above conditions shall be fulfilled by the plan of actions.

Integration of sectoral and macro dimensions: Climate change is a complex phenomenon that gives rise to sectoral and cross-cutting adaptation needs among sectors. Therefore, planned

interventions should be integrated to address impacts and vulnerabilities that arise at different sectors as well as cross-cutting needs that may spread across boundaries of several sectors. It is the role of NAP to ensure that all necessary sectoral and macro dimensions of climate change impact are covered and arrangements are in place to integrate relevant sectors when impacts and adaptation options concerned are interconnected among sectors.

Adaptive policy and management*:* Uncertainty is the key challenge that has to be faced in making any form of planned intervention against climate change impacts. A policy dilemma arise here as no one can accurately predict future scenario(s) whereas decisions also cannot be delayed awaiting more information before it is too late. Therefore, adaptive policy making and management principles should be adopted here. This implies that: (a) selected interventions should be robust and resilient to a wide range of future scenarios and, (b) decision making process should be flexible to make adjustments according to emerging information.

Anticipatory adaptation: Climate change is an ongoing process. Policy makers can either take decisions in advance anticipating future impacts (anticipatory adaptation) or they can wait till impacts appear (reactive adaptation). Given the uncertainty involved in the whole process of climate change, reactive responses carry an immense risk. Therefore, the NAP adopts the principle of anticipatory adaptation.

5. Planning Methodology

The methodology of the plan was guided by the broad framework proposed by UNFCCC guidelines on the NAP process (Figure 1). Accordingly, the real planning activities of the NAP process are covered under the second stage on 'preparatory elements'. The essential preparatory elements identified in the NAP process include: analysing current climate and future climate scenarios; assessing vulnerabilities; identifying, reviewing and appraising adaptation options; and, compiling and communicating national adaptation plan.

The methodology of the plan was developed to cover these essential elements and the key steps of the methodology included the following:

- Assess the projections on major changes in atmospheric and oceanic systems that are important for Sri Lanka
- Determine different physical effects/dimensions of change associated with the major projections
- Identify key physical hazards and vulnerabilities on major sectors caused by physical effects of projected changes
- Recognize likely impacts and their socio-economic outcomes on respective sectors and stakeholders
- Recognize adaptation needs of sectors, determine appropriate adaptation options to fulfill these needs and identify necessary actions to achieve these options
- Figure out cross-cutting national adaptation needs through the analysis of sectoral information and consultation of stakeholder views
- Identify interventions necessary for fulfilling cross-cutting national adaptation needs

These key steps were followed through an extensive series of consultations and analysis of inputs collected in the process.

5.1. Methodology of the Plan

The following activities were carried out to cover the methodological steps of the plan.

Review of available information: Information available from various sources on climate change in Sri Lanka was reviewed. The review also covered similar plans (e.g. climate change action plans; adaptation plans, NAPAs) prepared by other countries. IPS has already developed a significant understanding on climate change policy issues in Sri Lanka through research studies conducted during the last few years. It has recently conducted a policy analysis on key sectors using expert elicitation method for which the staff of CCS also was regularly invited. Inputs from review of literature, IPS own research as well as knowledge

acquired from consultation of experts was used as background information for preparation of the plan.

Initial brainstorming sessions: Two brain storming workshop sessions were conducted for identifying the methodology and finalizing the scope of the plan. A UNFCCC expert was invited to the first workshop on methodology for better understanding on the UNFCCC guidelines on NAP process. These sessions were followed by discussions between consultants, CCS staff and UNDP staff helped to develop the seven step methodological framework given above.

Consultations: Consultants developed a structured discussion guide based the methodological framework developed and conducted nine consultation meetings participated by government officers, academics, CSO members and experts on each sector. These discussions were the main data collection activity involved in preparation of the plan. In the discussions, inputs of participants were systematically gathered on: projections on major changes in atmospheric and oceanic systems; different physical effects of those projections; key physical hazards and vulnerabilities affecting respective sectors; likely impacts and their socio-economic outcomes; adaptation needs of sectors and appropriate adaptation options, and; actions necessary to achieve the options. In addition, one workshop was conducted to gather stakeholders' opinions on the cross-cutting needs of adaptation.

Analysis and preparation of the draft plan: Information gathered in discussions was analysed using qualitative analytical tools. Based on the outcomes of analysis, the first complete draft of the plan was developed. This was submitted for comments and feedback of CCS staff. Revised draft was distributed to stakeholders for their comments.

Preparation of the final draft: The final draft of the plan was prepared by incorporating comments and suggestions offered by stakeholders in a final validation workshop.

6. Projections, Physical Effects, Impacts, Adaptation Needs and Adaptation Options

This section presents a detailed summary of projections, physical effects, impacts, adaptation needs and adaptation options identified for each sector. Adaptation action plans for each sector presented in the next chapter were developed based on these summaries.

Stakeholder consultations helped to identify projections on five major types of changes in atmosphere and oceanic systems that could create impacts on vulnerable sectors. They are:

- Increased atmospheric concentration of greenhouse gases
- Rising atmospheric temperature
- Changing pattern of precipitation
- Increased incidence and severity of rainfall
- Sea level rise

These projections have different physical effects (dimensions) that create impacts on respective sectors. These physical effects involve different time horizons and it seems many are already in effect or could take place in the short run. There are also physical effects that may take time to show their effects gradually. Table 3 presents the physical effects identified for each type of projections.

Table 3: Projections and their Physical Effects

Projections	Physical effects/dimensions	Time horizon
Increased concentration of GHG	Rising atmospheric CO_2 concentration	Short-term
	Increased concentration of climate altering pollutants (non-CO_2)	Short-term
	Progressive increase in acidity of rainfall	Long-term
	Ocean acidification	Long-term
Rising atmospheric temperature	Increased day and night air temperature	Short-term
	Increased evaporation and evapotranspiration	Short-term
	Alteration of optimal ranges of temperature for biological organisms (pests, pathogens, parasites, vectors)	Medium-term
	Increased concentration of dust/ soil particles in atmosphere	Short-term
	Heat island effect	Short-term
Rising oceanic temperature	Physio-chemical changes in oceanic environment	Long-term
Changing patterns of precipitation	Irregular/erratic changes in established patterns of rainfall	Short-term

	Regular incidents of intense rainfall with high cloud cover	Short-term
	Regular and extended dry spells	Short-term
	Boundary shift in climatic zones	Long-term
Increased incidence and severity of extreme events	Increased frequency and severity of floods	Short-term
	Increased frequency and severity of droughts	Short-term
	Increased frequency of cyclones and high winds	Short-term
	Increased incidence of lightening	Short-term
	Increased incidence of landslides	Short-term
	Increased wind and waves (Turbulent weather)	Short-term
Sea level rise	Salt water intrusion	Medium -term
	Inundation of low-lying areas	Long-term

These physical effects create hazards and vulnerabilities on different sectors. These physical hazards and vulnerabilities are the root causes of sectoral impacts. They could create multiple impacts on sectors with socio-economic outcomes. Experts suggested that the same physical effects could lead to create different impacts on different sectors. Similarly, physical effects could act in combination with each other on different sectors. For instance, rising temperature would lead to create pronounced impacts on crops and natural biodiversity together with periodic dry spells or droughts, generating losses to farmers and peripheral communities around forest. Likewise, the same combination of physical effects could affect urban communities negatively by decreasing their living comfort, causing them to spend more on domestic cooling facilities. Identification of potential impacts on different sectors was the most important step for selection of respective adaptive actions for different sectors. This was done through lengthy and exhaustive expert consultation sessions where available limited information was screened by experts applying their professional knowledge as groups to reach consensus on types of impacts.

Adaptation needs of different sectors are determined by the impacts and their socio-economic outcomes. Depending on the types of impacts, sectors could have a number of adaptation needs. Adaptation options are broad solutions available to fulfill those adaptation needs of different sectors. Each adaptation option may involve several actions which are practical measures of adaptation that help to build up the adaptive capacity and reduce vulnerability of stakeholders in each sector. Summary of physical effects, vulnerabilities/physical hazards, impacts, socio-economic outcomes, adaptation needs and adaptation options identified for nine sectors are presented in Appendix Tables A1-A9.

Overall analysis of summary tables helped to identify cross-cutting national needs of adaptation that help to build up the adaptive capacity of all or many sectors simultaneously. In the next chapter, adaptation action plans developed for each sector and the plan for cross-cutting adaptation actions are presented.

7. The Plan

The NAP is the country's road map to guide the national efforts for confronting challenges posed by global climate change and its impacts. It envisages moderating and coping up with harmful impacts of climate change while taking the advantage of any opportunities presented in the path. It offers a practical path of action to reduce the vulnerability and enhance the adaptive capacity of the nation as a whole.

The NAP consists of action plans for nine vulnerable sectors and a set of interventions proposed to fulfill cross-cutting national needs of adaptation. Among the key components covered in the NAP are: specific actions/interventions with time lines to fulfill sectoral and cross-cutting adaptation needs; an implementation strategy for selected interventions; institutional mechanisms for coordination of actions of stakeholders; key performance indicators (KPI) for each action; system for monitoring and evaluation KPIs.

7.1. Goals

The NAP aims at achieving Sri Lanka's objectives of sustainable development through appropriate, timely measures of adaptation so as to ensure a secure future for its citizens by minimizing the impacts of climate change on human life, ecosystems, national assets and the economy.

The major goals of the plan are to:

- Raise the adaptive capacity of individuals, communities and the society to cope with impacts of climate change effectively;
- Reduce the vulnerability to climate risks by enhancing the resilience of communities and ecosystems, and;
- Capture any opportunities that arise due to changes for maximum gain for the society and people.

7.2. Objectives

The plan intends to reach these broader goals through achieving the following objectives.

1. To increase the resilience of economic sectors and natural systems against the emerging and projected impacts of climate change by adopting appropriate coping strategies and system improvements
2. To minimize the risk of damage caused by short-, medium- and long-term impacts

associated with projected changes in climatic parameters through timely adaptive measures

3. To expand the current knowledge on observed and projected changes of climate and associated physical vulnerabilities and socio-economic impacts through scientific research
4. To build the capacity of communities, economic sectors and ecosystems to adjust more readily to unfolding changes of climate through supportive investments on adaptive actions and increased awareness
5. To improve the existing systems of disaster risk management to minimize the vulnerabilities and increase the risk preparedness for extreme events
6. To increase the preparedness to face the threats of climate change through establishment of advanced monitoring and surveillance systems, timely weather and climate forecasting systems and effective communication channels for information dissemination
7. To increase the skills and knowledge on successful practices of adaptation through well-designed education, training and awareness programmes

7.3. Time Plan of Actions

Time horizon of the plan is ten years extending from 2016 to 2015. This period is divided into three stages for periodic revision of the plan according to the following timeframe.

Table 4: Time Horizons of the Plan

Period	Stage of the Plan	Review
1-4 years (2016 -2019)	Foundation building stage	Progress of the first stage to be reviewed at the last quarter of 2018 and necessary adjustments be made
5-7 years (2020 -2022)	Development stage	Progress of the both stages since 2015 to be reviewed at the last quarter of 2021 and necessary adjustments to be made
8-10 years (2023- 2025)	Goal achieving stage	Progress of the whole plan to be reviewed at the first quarter of 2025 and gaps and lessons for future plans to be identified

7.4. Summary of the Overall Plan

Table 5 presents an overall summary of the plan. It presents a list of actions that were assigned the highest priority by stakeholders from respective sectors and the priority actions identified for overcoming the cross-cutting adaptation needs. Priority was determined by ranking offered by individual experts and working groups on respective sectors in the validation workshop. The detailed action plans for respective sectors and cross-cutting needs of adaptation are presented in Tables 6-15.

Table 5: An Overall Summary of the Plan - Priority Actions

Sector	Priority actions
Food security	• Develop tolerant varieties (paddy, OFC, horticulture) and breeds (livestock and poultry) to heat stress, drought and floods and resistant to diseases and pest attacks • Develop and promote water efficient farming methods • Adjust cropping calendars according to climate forecasts • Develop systems for timely issuing and communicating of climate information to farmers • Develop research institute capacity for conducting research on tolerant varieties/breeds and climate resilient farming methods
Water resources	• Develop and implement watershed management plans for critical watershed areas • Increase the efficiency of use and reduce losses of irrigation water • Assess the current practices of water management for climate resilience and identify ways to improve them • Identify and map areas vulnerable to droughts and flood hazards and prepare disaster risk management plans • Design rational intra-basin and trans-basin strategies to harness periodic surpluses of water in storage facilities
Coastal and marine sector	• Implement a continuous programme for monitoring shore line changes • Develop shore shoreline management plans including M&E programmes • Study impacts of sea level rise on costal habitats over short-, medium- and long-term horizons • Identify, declare, collect information and prepare maps on vulnerable areas to extreme events and inundation • Conduct awareness programmes on sea level rise and extreme events to coastal communities to empower them for facing the risks of climate change
Health	• Establish a surveillance programme for detection and monitoring of climate induced diseases • Conduct research studies on impact of climate change prevalence and spread of vector borne and pathogenic diseases • Develop research institutes' capacity conducting research on health impacts of climate change • Strengthen the mechanisms for sharing information between disaster management and health management agencies • Launch awareness programmes on climate and health risks for healthcare workers and the public

Human settlements and infrastructure	• Promote climate resilient building designs • Revise building approval systems to increase the climate resilience • Conduct research studies on climate resilient building designs, green building concepts and alternative materials • Conduct training programmes on climate resilient buildings for industry stakeholders • Prepare hazard preparedness plans for urban, rural and estate settlements
Ecosystems and biodiversity	• Conduct research studies on climate change impacts on ecosystems and biodiversity • Establish a comprehensive programme to monitor climate change impacts on key natural ecosystems and biodiversity • Prepare adaptive management programmes for climate sensitive ecosystems • Prepare recovery plans for highly threatened ecosystems and species • Develop research institutes' capacity for conducting research on climate change impacts on ecosystems and biodiversity
Tourism and recreation	• Increase the awareness of tour industry operators on climate change and its impacts • Establish emergency communication channels for tourists and operators • Identify tourism facilities in vulnerable areas and make arrangements to increase the climate resilience of them • Assess the current promotional strategies with connection to emerging scenarios of climate change and adjust them accordingly • Conduct research studies on climate change impacts on tourism and recreation
Export agriculture sector	• Introduce new cultivars/clones tolerant to heat, drought and flood and resistant to disease and pest attacks • Promote improved nursery and plant management practices and sustainable cropping systems to increase the climate resilience of plantations and crops • Conduct research studies on climate change impacts on export agriculture crops • Identify and collect information on areas most vulnerable to disasters and prepare hazard vulnerability maps for all crops • Develop research institutes' capacity for conducting research on climate change impacts on export agriculture crops

Industry, energy and transportation	• Minimize the fluctuation hydropower generation potential through improvements in system management • Diversify the energy mix with increased share of renewable energy • Diversify the supply sources of climate sensitive agro-based raw materials • Establish an early warning and hazard communication system for commuters and managers of energy, transport and industrial facilities • Conduct research studies on climate change impacts on industry, energy and transportation
Cross-cutting needs of adaptation	• Undertake a review of relevant macro and sectoral policies, ordinances, acts, statutes and procedures to identify options for mainstreaming climate change adaptation activities in Sri Lanka • Develop policy recommendations necessary for addressing vulnerability to impacts of climate change in all development /management projects
	• Restructure and strengthen the Climate Change Secretariat as the National Focal Point (NFP) for implementation of NAP
	• Develop an inventory of international climate donors, funding schemes, training providers, training programmes, research agencies/consortiums and events (conferences, seminars etc.) for the benefit of local stakeholders of adaptation
	• Create a *National Adaptation Fund* with the collaboration of the Ministry of Finance to support the implementation of NAP actions and supportive programmes
	• Establish a national network of research agencies and universities that are carrying out research on climate adaptation for promoting coordinated research and information dissemination • Develop a coordinated multi-disciplinary small research grant programme on thematic areas relating to climate change adaptation to be facilitated by the National Focal Point and managed by the national research support agencies (e.g. NSF, NRC, CARP) • Establish a common repository of scientific and awareness materials on climate change adaptation
	• Initiate a joint island wide programme for identification of religious, cultural and archaeological assets vulnerable to climate change impacts and conservation of threatened assets
	• Conduct training programmes for government officers, CSO members, and private sector employees on climate change adaptation • Establish a national research programme on climate modeling for long-term climate projections

7.5. Sectoral Adaptation Plans

Sectoral action plans contain adaptation actions/interventions proposed to fulfill adaptation needs of nine identified sectors. These sectors were identified for their high level of vulnerability to impacts of climate change. The actions of sectoral plans have been chosen to fulfill adaptation needs of the sectors which have been identified on a logical criteria based on projections, vulnerabilities and impacts on respective sectors. Details on identification of adaptation needs are presented in Appendix Tables A-1 to A-9. Action plans begin with adaptation needs and provide details on actions, responsible agencies and key performance indicators. The specific institutional and implementation mechanisms proposed for implementation of sectoral plans are presented in forthcoming sections of the plan. Tables 5-14 present the actions plans for each sector.

Food Security

Food security is one of the most critical areas that need special attention in climate adaptation in Sri Lanka. Key components that contribute to food security in Sri Lanka are rice, other food crops, fruits and vegetables (horticultural crops), animal production and fisheries. The country has achieved self-sufficiency in rice. However, the country depends on imports for a number of other food products. Hence, agriculture development efforts in the country are mainly targeted at achieving self-sufficiency or reducing the import dependency of at least main categories of food such as milk and milk products and sugar. Relative contribution of the agriculture sector to the national economy has reduced to around 10 per cent of GDP. However, agriculture still occupies around 30 per cent of the workforce and a significant share of farmers live under poverty. Of all the economic sectors, agriculture is the most climate sensitive sector and climate related hazards have significantly affected the agricultural production and farm assets during the recent past. Hence, high climate sensitivity and livelihood dependency of a large section of population makes food security a highly vulnerable sector to climate change impact that needs special attention in national adaptation plan.

Table 6: Sector Action Plan – Food Security

Adaptation needs	Adaptation options	Actions	Responsible agencies	Key performance indicators
Enhance the resilience of crops, animals, fish and agro-ecosystems against heat and water stress	A. Germplasm improvement	• Screen existing varieties/breeds for heat and water stress. • Develop tolerant varieties (paddy, OFC, horticulture) – Heat tolerant – Drought tolerant – Short age (early maturing) • Develop heat tolerant breeds (**Focus**: livestock and poultry)	**DOA** **DAPH** *AFoU* *VRI* *NLDB*	• Number of existing varieties/breeds gone through the screening process • Number of tolerant varieties developed • Number of heat tolerant breeds developed
	B. Improvement of farm water management	• Reduce field-level irrigation water losses • Promote micro-irrigation techniques • Develop water efficient farming methods • Promote on-farm rainwater harvesting • Promote reuse of wastewater	**DOA** *AFoU* *DI* *DAD* *MASL*	• % of reduction in irrigation water losses • Number of micro-irrigation initiatives • Number of water efficient farming methods developed • Number of on-farm rainwater harvesting initiatives
	C. Promotion of resource efficient farming systems	• Improve cropping systems and conservation farming practices • Improve nursery protection • Introduce flower induce techniques in fruits • Increase the use organic matter to improve soil quality (Integrated plan nutrient management) • Promote low-water demanding crops and varieties and crop diversification (**Focus**: Dry and intermediate zones) • Promote the intensive management of livestock	**DOA** **DAPH** *AFoU* *VRI*	• % increase in the yield due to improve cropping systems and conservation farming practices • % drop in the nursery plant losses • Number of flower induce techniques introduced • % increase in the use of organic matter
	D. Sectoral Capacity development	• Develop research institutes' capacity for conducting research on tolerant varieties and water efficient farming methods.	**NSF** *DOA* *VRI* *SLCARP* *AFoU*	• Number of training programme

Minimize the risk of crop and health damage due to biological agents	A.	Germplasm improvement	• Screen existing varieties/breeds for pest and disease resistance. • Develop pest resistant varieties (**Focus**: paddy, OFC, horticulture; insect pests and diseases) • Develop disease resistant breeds (**Focus**: livestock and poultry)	**DOA** **DAPH** *AFoU* *VRI* *NLDB*	• Number of existing varieties/breeds gone through the screening process • Number of pest resistance varieties developed • Number of disease resistant breeds developed
	B.	Strengthening of supporting facilities	• Strengthen vaccination programmes • Develop pest forecasting system • Conduct research on parasites and diseases • Promote crop clinics	**DOA** **DAPH** *VRI*	• Amount of money allocated for vaccination programme • Pest forecasting system developed • Number of research outputs o parasites and diseases
	C.	Promotion of best practices	• Promote integrated pest management	**DOA** *AFoU*	• Number of awareness programmes on integrated pest management
Minimize the impact on food security due to erratic changes in precipitation	A.	Establishment of an efficient climate information management and communication system	• Develop a system for timely issuing of seasonal and medium-term weather forecasts (**Focus**: mobile and internet alert systems) • Adjust cropping calendars according to the seasonal weather forecasts	**DM** *DOA* *DAPH*	• System is developed • Cropping calendars adjusted
	B.	Improvement of pasture and fodder management	• Diversify into livestock feeds other than naturally grown pasture • Promote silage and hey production • Promote techniques of fodder production and conservation	**DAPH** *VRI* *NLDB*	• Number of other types of livestock feeds adapted • Number of research carried out to suggest other livestock feed types • Number of awareness programmes on silage production • Number of techniques promoted • Amount of money allocated for promotion of fodder production and conservation techniques
Enhance the resilience of crops, animals, fish and agro-	A.	Germplasm improvement	• Screen existing varieties for tolerance to extreme events • Develop tolerant varieties (**Focus**: paddy) – Flood tolerant – Drought tolerant	**DOA** *AFoU*	• Number of existing varieties gone through the screening process • Develop flood and drought tolerant varieties

ecosystems to extreme weather events	B. Establishment of an efficient climate information management and communication system	• Develop a system for timely issuing of short-term weather forecasts • Strengthen the early warning systems • Strengthen fishing Vessel monitoring and tracking system (**Focus**: Coastal and deep sea fishing) • Develop mobile phone based communication systems • Develop safety plans and promote use of safety equipment	**DM** *DOA* *DFAR* *DAPH*	• Forecasting system developed • Money allocated for strengthening the early warning system • Fishing Vessel monitoring and tracking system established • Mobile phone based communication system developed • Safety plans are developed • Number of awareness programs on the use of safety equipments
	C. Improvement of disaster risk preparedness and management	• Identify and collect information on areas most vulnerable to flood and drought hazards • Identify food storage capacities in vulnerable areas • Develop buffer stocks and maintain them regularly	**DMC** **DFC** *DCD* *PMB*	• Number of areas where the Information collection is finalized • Number of food storage capacities are assessed identified • Number of vulnerable areas with established buffer stocks
Minimize the impacts of sea level rise on agriculture in coastal zone	A. Germplasm improvement	• Screen existing varieties for tolerance to salinity/alkalinity • Develop salinity/alkalinity tolerant varieties (**Focus**: paddy)	**DOA** *AFoU*	• Number of existing varieties gone through the screening process • Number of salinity tolerant varieties developed • Data base with quarterly salinity levels in the coastal areas • Money allocated for rehabilitation of the salinity exclusion structures • Number of the salinity exclusion structures rehabilitated • Number of paddy acres converted
	B. Strengthening the monitoring of climate impacts	• Monitor regularly the development of salinity /alkalinity levels • Strengthen the seawater defense structures to control sea water intrusions to coastal paddy lands	**CC&CRMD** **NARA** *DOA* *ID*	
	C. Exploring alternatives	• Convert severely affected paddy lands for other uses (e.g. brackish water aquaculture)	**NAQDA** *DOA* *DAD*	
Assess the changes in oceanic environment and impacts on livelihood	A. Initiating research studies to assess climate impacts	• Assess long-term structural changes oceanic habitats and composition of species • Assess climate change impacts on lagoon and coastal fisheries • Assess climate change impacts on reef fish stock	**NARA** *AFoU/SFoU* *NSF* *NRC* *CARP*	• Completion of the assessment (long-term structural changes oceanic habitats and composition of species) and report made available • Completion of the assessment (climate change impacts on lagoon and coastal

and food security	B. Strengthening the monitoring of climate impacts	• Initiate long-term monitoring of essential bio-physical parameters (National monitoring programme)	**NARA** *CC&CRMD*	fisheries) and report made available • Completion of the assessment (climate change impacts on reef fish stock) and report made available • A monitoring system for essential bio-physical parameters is established
Assess the impacts of rising atmospheric CO_2 on productivity crops and weed populations	A. Initiating research studies to assess climate impacts	• Conduct research studies on impact of increased CO_2 on agriculture – Productivity of crops – Weed populations (**Focus**: Invasive alien species)	**DOA** *AFoU/SFoU* *NSF* *NRC* *CARP*	• Number of research studies conducted • Amount of money spent on research

Water Resources

Availability, supply, distribution, use and conservation of water resources are directly dependent on climate conditions. The water resources sector in Sri Lanka has to cater to the domestic, agricultural and industrial needs of water. Besides fulfilling human needs, the survival of all ecosystems also relies heavily on the availability of water. Relationship between water and ecosystems is a complex one. Hence, in addition to fulfilling human needs, managers of water resources have to be mindful about ecosystems also. Only a limited segment of households in the country have access to safe drinking water. Sri Lanka has invested heavily on agricultural water supply and a significant share of the country's power generation capacity also is dependent on water resources. A growing number of industrial facilities also create demand for water resources and this has led to high level of extraction of groundwater as well as increased pollution of water resources. Overall, water is an important sector that has implications for all major economic sectors and human activities that need special attention in adaptation climate change.

Table 7: Sector Action Plan – Water Resources

Adaptation needs	Adaptation Options	Actions	Responsible agencies	Key performance indicators
Enhance the resilience of systems for water resources management and use to overcome the scarcities caused by climate change impacts	A. Improvement of watershed management	• Identify and map critical watersheds • Develop and implement watershed management plans for critical upper watersheds – Declare critical catchments as reserves – Incorporate water safety plans • Increase the canopy cover in catchment areas of – Irrigation reservoirs – Water supply reservoirs – Hydropower reservoirs • Promote conservation farming methods in reservoir catchments • Launch participatory cascade management programmes in selected village tank catchments • Incorporate climate impact assessment for the future water resources development plans	**ID** **MASL** **DAD** *CEB* *NWSDB* *WRB* *PCs*	• Number of watershed plans developed • % of canopy cover increased in the catchment areas of irrigation and water supply reservoirs • Number of conservation framing methods adopted • Amount of money allocated/spent on promotion of conservation farming methods • Number of workshops carried out in promotion • Number of villages covered by the participatory cascade management programmes • Amount of money allocated/spent on participatory cascade management programmes
	B. Capacity development of storage facilities	• Assess the current facilities and storage options in connection to future projections of climate change • Evaluate future options for enhancement of storage facilitates including groundwater • Develop a road map and investment plan for efficient utilization of existing and future storage options • Assess, regularize and preserve ground water resources at local level water resources for effective utilization	**ID** **MASL** **DAD** *AFoU* *NWSDB* *WRB* *IWMI*	• Number of current facilities and storage options assessed • An assessment report is finalized and made available on the current facilities and storage options • Number of options evaluated • A road map and an investment plan is developed.

C.	Initiating research studies to assess climate impacts	• Assess short-, medium- and long-term impacts of climate change on water resources management in the country • Screen current practices of water management for climate resilience and identify ways to improve them • Explore climate resilient indigenous practices of water management and identify ways to integrate them into modern practices	**ID** **MASL** **DAD** *DM* *IWMI* *AFoU/SFoU* *NSF* *NRC* *CARP*	• An assessment report completed and published • Number of screened water management practices for climate change resilience • Number of indigenous practices of water management identified and integrated
D.	Strengthening the monitoring of climate change impacts (changing pattern of variability)	• Initiate a long-term monitoring programme on essential bio-physical parameters of climate change on water resources – National monitoring programme	**CEA** *DM* *ID* *MASL* *DAD* *IWMI* *NWSDB*	• Monitoring programme is installed and functioning
E.	Promote efficient practices of water management and use	• Promote efficient domestic water use practices: – Domestic rain-water harvesting systems (e.g. ferro-cement tanks; roof top) – Domestic water treatment facilities • Increase the efficiency of use and reduce losses of irrigation water – Re-use of drainage (waste) water – Water saving irrigation applications: micro irrigation, drip irrigation – Efficient use of groundwater: Production wells , boreholes – Rainwater harvesting: *Pathaha* • Improve maintenance of existing reservoirs – Improve the water conveyance efficiency – Rehabilitation of village tanks to design capacity • Promote wastewater recycling for industrial and aquaculture water uses	**ID** **MASL** **DAD** *IWMI* *NWSDB* *DOA*	• Number of awareness campaigns launched to promote efficient domestic water use practices • Money allocated/spent on promoting efficient domestic water use practices • Number of awareness campaigns on promoting means of reducing wastage and losses in irrigation • Money allocated/spent on promoting means of reducing wastage and losses in irrigation • Money allocated/spent on improving the maintenance of existing reservoirs • Number of village tanks rehabilitated • Number of village tanks with improved conveyance efficiency

Ensure the safety of water management facilities and minimize disturbances to supply due to extreme weather events	A. Strengthening the monitoring of climate change impacts (extreme events)	• Assess the capacity of existing hydro-meteorological information facilities • Implement necessary capacity improvement measures (**Focus**: facilities in water management agencies)	**DM** *ID* *MASL* *DAD* *NWSDB* *DOA*	• Number of assessments completed out of existing hydro-meteorological information facilities • An assessment report is completed and published • Number of initiatives implemented
	B. Establishment of an efficient climate information and communication system	• Improve the existing system for timely issuing short term weather forecasts • Strengthen the early warning systems • Develop network based communication systems (**Focus**: mobile phones and internet) • Assess the traditional knowledge of weather forecasting and integrate them for better forecasts of water availability.	**DM** *ID* *MASL* *DAD* *NWSDB* *DOA*	• A system is developed • Money allocated/spent on strengthening the systems of short-term weather forecasts A mobile phone based communication is in place • Money allocated/spent on developing the mobile phone based communication system • An assessment study is completed and report published on traditional knowledge of weather forecasting • Number of training programmes/workshops conducted on integrating traditional knowledge of weather forecasting in to existing one
	C. Improvement of disaster risk preparedness and management	• Identify, map and collect information on areas most vulnerable to flood , drought and land slide hazards • Develop disaster risk management plans for vulnerable areas • Establish necessary facilities for improvement of drainage in susceptible areas • Develop dam safety plans and promote use of safety measures and equipment	**DMC** **NBRO** *ID* *MASL* *DAD* *NWSDB* *DM*	• Number of areas identified and completed with data collection • Number of areas completed with finalized flood risk management plans • Number of areas with established facilities for improvement of drainage • Number of dam safety plans developed

	D. Capacity development of storage facilities	• Design rational strategies to harness excess water in storage facilities (**Focus**: Intra-basin and trans-basin approaches)	**ID** **MASL** **DAD** *AFoU* *NWSDB* *DM*	• Number of strategies designed to harness the excess water in storage facilities. • Number of workshops/training programmes on designing strategies to harness the excess water in storage facilities	
Minimize the impacts of sea level rise on water supply and management in coastal zone	A. Strengthening the monitoring of climate change impacts (sea level rise)	• Monitor salinity levels regularly	**NARA** **CC&CRMD**	• Money allocated/spent on developing the monitoring system • Regular (quarterly) monitoring reports prepared and presented	
	B. Improve saltwater intrusion protection measures in coastal areas and wetlands	• Identify vulnerable areas for saltwater intrusion and develop maps • Strengthen the salinity exclusion structures to control sea water intrusions • Design and construct salinity barriers to protect fresh water resources and agricultural lands • Establish desalinization facilities in affected/vulnerable areas	**CC&CRMD** *ID* *DAD* *NWSDB* *DA* *NARA* *NAQDA*	• Number of vulnerable areas identified and plans developed • Number of salinity exclusion structures rehabilitated/repaired/newly built • Amount of money allocated/spent on rehabilitating/repairing the salinity exclusion structures • Number of salinity barriers designed • Number of desalination facilities established	

Coastal and Marine Sector

Sri Lanka is an island nation surrounded by a low-lying coastal belt. Around a third of the country's population is concentrated in the costal belt. There are several townships located in the coastal zone and relatively well developed infrastructure facilities are found in those areas. Fisheries and tourism are among the significant economic activities in the coastal zone and numerous fishing villages, harbours and anchorages are located around the country. Nearly a quarter of a million families make their living on coastal and offshore fishing. The coastal belt is rich with numerous coastal and marine ecosystems. Beyond the beach zone, fertile strips of rice and coconut lands are located that support the food security and export earnings of the country. Overall, coastal areas contribute the country's economy significantly and a large share of population is dependent on them. Sea level rise, a major physical effect associated with climate change, is likely to create significant impacts over the coastal zone. Tsunami in 2004 has indicated that Sri Lanka's low-lying coastal areas will be highly vulnerable to inundation. Besides, rising incidence of extreme and unpredictable weather events have created uncertainties over costal livelihoods sometimes even causing life and property damages. Hence, adaptation in coastal and marine sectors is critical for the country's sustainable development.

Table 8: Sector Action Plan – Coastal and Marine Sector

Adaptation needs	Adaptation options	Actions	Responsible agencies	Key performance indicators
Strengthen the coastal zone management to face the impacts of sea level rise	A. Initiating research studies to assess impacts of sea level rise	• Study impacts of sea level rise on coastal habitats over short-medium- and long-term horizons • Study erosion trends and identify appropriate protection measures • Conduct research studies on coastal water quality and hydrodynamics in relation to climate change • Establish regional collaborations on research and monitoring	**NARA** **CC&CRMD** *MEPA* *DFAR* *EFoU/SFoU*	• Number of studies completed/published • Amount of money allocated/spent on research studies • Number of regional collaborative studies undertaken/completed/published • Number of collaborative workshop conducted • Amount of money allocated/spent on regional collaborative studies
	B. Establishment of a sea level rise monitoring system	• Identify critical shore line parameters for regular monitoring • Implement continuous monitoring of shore line changes • Prepare maps on low-lying areas vulnerable to inundation • Prepare a data base on existing coastal habitats • Promote participation of coastal communities in monitoring sea level rise • Establish the mean sea level	**CC&CRMD** **NARA** *SD*	• Number of parameters identified • Regular (Quarterly) monitoring reports produced on shore line changes • Number of area maps developed/produced on inundation • A fully functioning data base is created • Number of participants from coastal communities who are enlisted

C.	Strengthening the coastal protection and management	• Develop shoreline management plan including M & E programme • Update CZMP to ensure greater concern over climate change impacts • Prepare SMA plans to vulnerable areas • Revise set back limits considering the sea level rise • Undertake physical protection measures in critical areas – Establish green belts and increase vegetation covers – Undertake sand nourishment – Build coastal defense structures in strategic locations (**Focus**: off-shore breaks, revetment, sea walls, break waters etc.)	**CC&CRMD**	• Number of shoreline management plans developed • CZMP is updated to ensure greater concern over climate change impacts • Number of vulnerable areas with completed SAM plants • % of the shoreline areas with established set back limits to take account of sea level rise • % shoreline with established of physical protection measures
D.	Participatory management of sensitive coastal habitats	• Conduct awareness programmes on sea level rise and extreme events to coastal communities to empower them for facing climate change impacts • Prepare and implement participatory management plans for the conservation and rehabilitation of sensitive coastal habitats with the collaboration of local communities and CSOs – Conservation of mangrove, salt marshes and sea grass beds – Sand dune rehabilitation – Restoration of mangroves – Restoration of coral reefs	**CC&CRMD** *NARA* *MEPA* *DWLC* *FD*	• Number of awareness programmes conducted on sea level rise to coastal communities • Number of coastal communities with fully developed participatory management plans for the conservation and rehabilitation of sensitive coastal habitats

Enhance the resilience of coastal systems against increased extreme events	A. Improvement of disaster risk preparedness and management	• Identify and declare vulnerable coastal areas to extreme events • Collect information and prepare maps on vulnerable areas to extreme events • Prepare emergency response/contingency plans and guidelines for vulnerable areas • Establish physical protection measures in critical areas – Establish green belts and increase vegetation covers	**CC&CRMD** **DMC** *NARA*	• Number of coastal areas identified that are vulnerable to extreme events • Number of vulnerable coastal areas where data collection has completed • Number of coastal areas where completed vulnerability maps are developed • Number of vulnerable coastal areas with completed emergency response/contingency plans • % of identified vulnerable shore line areas with completed physical protection measures	

Health

Health is another area that climate change can create significant impacts. Studies around the world have suggested the possibility of increased health hazards with changing climate patterns. Life cycles of biological agents associated with diseases are highly sensitive to weather and climate related parameters. On the other hand, several countries have reported a rising number of fatalities due to heat waves and disasters. Sri Lanka has reported relatively high achievements in the health sector compared with other developing nations. In spite of that, the country has recently experienced outbreak of diseases that are closely connected with environment and weather patterns. Seasonal outbreaks of dengue are a prime example of this. Spread of vector borne diseases into new areas with changing patterns of local climate is a potential health hazard that needs close attention. Sri Lanka has a history of such epidemics in the past such as periodic outbreaks of malaria. In addition, extreme weather conditions can lead to disasters causing injuries and fatalities. Besides, living and health comfort can directly be affected by gradual rise in temperature and sudden, uncharacteristic and extreme changes in weather parameters. Demographic information suggests that Sri Lanka has an ageing population which would particularly be vulnerable to climate related health hazards. Hence, serious effort towards adaptation against potential health hazards associated with climate change is a priority.

Table 9: Sector Action Plan – Health

Adaptation needs	Adaptation options	Actions	Responsible agencies	Key performance indicators
Assess and prepare for the increased health risks due to climate-induced vector bone and pathogenic diseases	A. Conducting research studies to assess the risk of climate-induced diseases	• Conduct research studies on impact of climate change on prevalence and spread of – Vector bone diseases – Pathogenic diseases • Assess critical factors for controlling climate-induced disease incidents • Identify plausible strategies for management of climate-induced disease incidents	**MOH** *MRI* *NSF* *NRC* *MFoU/SFoU*	• Number of research studies conducted • Amount of money allocated/utilized for doing research • Assessment on the critical factors for controlling climate-induced disease incidents finalized • Number of plausible strategies identified for management of climate-induced disease incidents
	B. Strengthening the surveillance and monitoring of climate-induced diseases	• Establish a surveillance program for detection and monitoring of climate-induced diseases • Prepare vulnerability maps on climate related health hazards • Establish a mechanism for sharing meteorological , clinical and entomological information (**Focus**: central and provincial data)	**MOH** *MRI*	• Surveillance programme established • Number of vulnerability maps produced • Money allocated for establishing a mechanism for sharing meteorological , clinical and entomological information
	C. Capacity development for managing climate-induced disease incidents	• Strengthen the alertness of health system against climate-induced disease incidents • Launch an awareness programme on climate and health risks for – Healthcare workers – Public • Develop/review guidelines for management of climate-induced disease incidents • Develop research institutes' capacity for conducting research on climate and health issues including multidisciplinary collaborative research	**MOH** *MRI* *NSF* *NRC* *MFoU/SFoU*	• Amount of money allocated/spent for Strengthening the alertness of health system against climate-induced disease incidents • Number of awareness programme conducted • Guidelines are developed and published • Amount of money allocated for the development • Number of training programme conducted • Amount of money spent on purchasing laboratory equipment

Minimize the health hazards associated with increased incidence of extreme events	A.	Establishing an efficient climate information and communication system	• Strengthen early warning systems of extreme events • Strengthen the mechanism for sharing information between disaster management and health management agencies	**DMC** *DM* *MOH* *MRI*	• Amount of money allocated/spent on the activities on the early warning system • Number of activities initiated to strengthen the early warning system • Amount of money allocated/spent on establishment of the mechanism • Number of information sharing workshops conducted
	B.	Improvement of disaster risk preparedness of health related agencies and workers	• Develop disaster risk preparedness guidelines for health workers in vulnerable areas • Increase the knowledge and awareness on health impacts of extreme events among healthcare workers (e.g. MOH, PHI) • Improve the coordination between disaster management and health management agencies	**DMC** *DM* *MOH* *MRI*	• Guidelines are developed and published • Number of awareness workshops conducted • Amount of money allocated/spent on awareness workshops • Amount of money allocated/spent on activities to strengthen the coordination • Number of coordination meetings/workshops between the agencies
Assess and prepare for health risks caused by concentration of climate altering pollutants	A.	Conducting research studies to assess health impacts of climate altering pollutants	• Conduct research studies on health impacts of climate altering pollutants (**Focus**: availability, temporal variation and health impacts) • Identify and assess treatment procedures and diagnostic tools	**MOH** *MRI* *NSF* *NRC* *MFoU/SFoU*	• Number of research studies conducted • Amount of money allocated/spent on research • Number of treatment procedures and diagnostic tools identified
	B.	Improvement of monitoring of climate altering pollutants	• Establish air quality monitoring facilities in strategic locations • Establish pollution dispersion and transport forecasting system (**Focus**: computer numerical modelling) • Review and improve monitoring standards of pollutants to keep up with world standards • Establish a mechanism for consulting health sector on matters concerning EPLs	**CEA** *MOH* *MRI* *NSF* *NRC* *MFoU/SFoU*	• Amount of money allocated/spent on establishing air quality monitoring facilities in strategic locations • Amount of money spent on establishment of pollution-free transport system • Number of locations where the monitoring systems are established • Amount of money allocated/spent on establishing mechanisms

	C.	Capacity development for managing health impacts of climate altering pollutants	• Strengthen respiratory disease control programme • Develop guidelines for controlling exposure • Increase public awareness on health impacts of pollution • Develop a mechanism for dissemination of air pollution levels to the general public in high risk areas • Train health workers on environmental health and safety	**MOH** *MRI* *CEA*	• Amount of money allocated/spent on strengthening the programme • Guidelines are developed • Number of awareness programmes conducted • Number of training programmes conducted
Assess the impact on health due to increased heat and thermal stress	A.	Conducting research studies to assess health impacts of heat/thermal stress	• Conduct research studies on heat/thermal stress on human health • Identify and assess – Diagnostic tools and treatment procedures • Increase public awareness on health risks of heat /thermal stress	**MOH** *MRI* *NSF* *NRC* *MFoU/SFoU*	• Number of research studies conducted • Amount of money allocated/spent on research studies • Assessments on the diagnostic tools and treatment procedures are completed • Number of awareness programmes conducted • Amount of money allocated/spent on awareness activities

Human Settlements and Infrastructure

Human settlements and infrastructure are two closely connected areas that come under the direct influence of climate change impacts. In Sri Lanka, they are likely to be impacted by several physical effects associated with climate change. Impacts on settlements and infrastructure have direct repercussions on basic living standards of the population. Broadly, human settlements and infrastructure in the country can be divided into three categories—urban, rural and estate. Types of impacts faced by these categories of settlements and infrastructure vary from each other and current levels of development of these three categories also are different. However, they share some common features that need the support of planned adaptation measures. Climate proof settlements and infrastructures have received the wide attention world over as innovative measures of adaptation to climate change. In Sri Lanka, human settlements and infrastructure are two areas that received limited attention despite their importance with connection to climate change adaptation.

Table 10: Sector Action Plan – Human Settlements and Infrastructure

Adaptation needs	Adaptation options	Actions	Responsible agencies	Key performance indicators
Enhance the resilience of human settlements and infrastructure against heat and water stress	A. Improvement and promotion of building designs for enhanced climate resilience	• Mainstream climate resilience in physical and urban planning and incorporate them for planning for development projects – Adopt green building concepts in planning – Encourage of wind corridors and open spaces – Promote planning the human settlement schemes so as to minimize the adverse effect – (and promote)on localized and regional water resources • Promote climate resilient building designs – Develop specifications, standards, guidelines, promotion of alternative building materials – Create public awareness – Provide training to industry stakeholders • Promote use of alternative materials – Identify and assess alternative materials – Assess the availability – Create public awareness – Provide training to industry stakeholders • Develop/review appropriate sector specific building standards and guidelines for urban, rural and estate sectors • Provide standardization of equipment such as A/C and refrigerators so they emit less GHG's	**UDA** **LAs** **NBRO** *NPPD* *ICTAD* *AchtFoU* *TCFoU* *PCs* *CHPB* *SLSI* *ITI*	• Number of workshops conducted in mainstreaming climate resilience in physical and urban planning • A document on contacting green building concepts are prepared and published • Number of workshops in promoting climate resilient building designs • Number of public awareness programmes conducted in promoting climate resilient building designs • Number of training workshops conducted for industry stakeholders in promoting climate resilient building designs • Number of workshops in promoting use of alternative materials • Number of public awareness programmes conducted in promoting use of alternative materials • Number of training workshop conducted for industry stakeholders in promoting use of alternative materials • A document contacting appropriate sector specific building standards for urban, rural and estate sectors are prepared and published

	B.	Revision of procedures and guidelines	• Revise building approval systems s to ensure climate resilience – Expand the coverage of the guidelines to ensure climate resilience and minimize health impacts – Strengthen the enforcement and implementation through local governments	**UDA** **PCs** **LAs**	• Number of workshops conducted in revising the building approval systems s to ensure climate resilience • Number of awareness programmes conducted at the local government levels to Strengthen the enforcement and implementation through local governments
	C.	Initiating research studies to assess climate impacts	• Conduct research studies on – Climate resilience building designs – Practical applications of green building concepts – Alternative materials	**NBRO** **ICTAD** **CHPB** *AchFoU* *TCFoU* *NSF* *NRC*	• Amount of money allocated/spent on research activities • Number of research activities conducted
	D.	Sectoral Capacity development	• Conduct training programmes for industry stakeholders – Public officers – Builders – Construction workers – Architects – Designers – Environmental design department of Universities, Ex: University of Moratuwa	**ICTAD** *AchFoU* *TCFoU*	• Number of training programmes conducted • Amount of money allocated/spent on training programmes
Minimize the impacts on human settlements and infrastructure due to erratic	A.	Enhance the capacity of infrastructure in urban settlements	• Extend the capacity of drainage and sewerage systems to avoid periodic overcrowding • Rationale use of drainage infrastructure to encourage recharging of ground water systems	**NWSDB** *UDA* *LAs* *PCs*	• Number of drainage and sewerage systems where the capacity is extended to avoid periodic overcrowding • Number of workshops conducted in rationalizing the use of drainage infrastructure to encourage recharging of ground water systems

changes in precipitation	B.	Promote water safety and efficient utilization of surplus water	• Promote measures to ensure safety of domestic water for settlements – Household water treatment and safe storage through point-of-use practices – Strengthening the drinking water surveillance systems – Domestic water recycling and re-using • Promote use of rainwater harvesting systems to collect water in surplus periods to be used in the dry periods	**NWSDB** *UDA* *LAs* *PCs*	• Number of workshops conducted in promoting measures to ensure safety of domestic water for settlements • Number of workshops conducted in promoting the of rainwater harvesting systems to collect water in surplus periods to be used in the dry periods
Enhance the resilience of human settlements and infrastructure to extreme weather events	A.	Promotion of disaster resilient buildings and construction	• Promote disaster resilient buildings (new constructions) – Promote NBRO prepared guidelines – Create public awareness – Provide training to industry stakeholders – Promote retrofitting of existing buildings • Promote practice of building codes including roofing standards specially in the public buildings	**NBRO** *NPPD* *UDA* *LAs* *PCs*	• Number of workshops conducted in promoting NBRO prepared guidelines for disaster resilient buildings • Number of public awareness programmes conducted in promoting disaster resilient buildings • Number of training programmes conducted for industry stakeholders for promoting disaster resilient buildings • Number of workshops conducted in promoting practice of building codes including roofing standards specially in the public buildings
	B.	Improvement of disaster risk preparedness and management	• Prepare hazard preparedness plans for urban, rural and estate settlements including – hazard mapping – disaster response planning – awareness creation – early warning • Revisit existing preparedness plans for climate change • Develop and enforce zoning system based on hazard vulnerability	**DMC** *NPPD* *UDA* *NBRO*	• Number of hazard preparedness plans prepared for urban, rural and estate settlements including • Number of awareness programmes conducted in developing and enforcing enforce zoning system based on hazard vulnerability

Minimize the impacts of sea level rise on coastal settlements and infrastructure	A.	Increase the resilience of coastal settlements	• Promote building standards which are specific to the coastal sector – Encourage practicing building codes and standards – Encourage use of proper materials in constructions – Make appropriate considerations in relation to impacts on winds – Create public awareness – Provide training to industry stakeholders	**CC&CRMD** *UDA* *NBRO* *DMC*	• Number of awareness workshops conducted in promoting building standards which are specific to the coastal sector • Number of training programmes provided for industry stakeholders
	B.	Strengthening the monitoring of sea level rise	• Regular monitoring of sea level rise • Prepare maps on low-lying areas vulnerable to inundation • Demarcate coastal zones vulnerable to inundation • Develop guidelines for human settlements and infrastructure in vulnerable zones	**NARA** **DMC** *CC&CRMD* *NPPD* *NBRO*	• Quarterly monitoring reports are prepared on sea level rise • Number of maps prepared on low-lying areas vulnerable to inundation • Total coastal areas demarcated as vulnerable to inundation • A guideline document is prepared and published for human settlements and infrastructure in vulnerable zones

Ecosystems and Biodiversity

Sri Lanka is one among 35 biodiversity hotspots in the world. The country was endowed with truly remarkable bequest of biodiversity and ecosystems. This includes both fauna and flora resources. Furthermore, Sri Lanka's endowments cover terrestrial, aquatic as well marine ecosystems. Benefits of biodiversity and various ecosystem services for human well-being have been well recognized by numerous studies. Simultaneously, climate is a primary factor that determines the geographical distribution of ecosystems and availability of biodiversity around the world. However, anthropogenic factors have caused the degradation of biodiversity and ecosystems within a relatively short period. Just over a century, country's forest cover has reduced to a third of what it used to be. Several species have been listed under endangered or threatened categories. Process of biodiversity and ecosystem losses are already in rise due to human activities. Climate change has a potential to top up this tendency. Impacts of climate change could be multifaceted with both negative and positive impacts. For instance, current predictions about gradual spread of the intermediate zone in to dry zone areas can bring in challenges as well as opportunities. Despite the potential impacts, we know very little about what changes have already taken place or where the ensuing changes would eventually lead. Hence, biodiversity and ecosystems are areas where Sri Lanka needs special attention when it comes to adaptation to climate change.

Table 11: Sector Action Plan – Ecosystems and Biodiversity

Adaptation needs	Adaptation options	Actions	Responsible agencies	Key performance indicators
Enhance the resilience of natural and agro ecosystems against the impacts of climate change impacts	A. Initiating research studies to assess climate impacts	• Conduct research studies on climate change impacts on ecosystems and biodiversity – Modelling impacts of climate change on bio-diversity – Changing patterns of precipitation and boundary shifts of climatic zones – Causal factors of forest die-back and degradation of ecosystems – Traditional methods of biodiversity management – Life cycle studies: e.g.in the sex ratios – Ex-situ conservation .	**FD** **DWLC** **DNBG** **DNZG** *SFoU/AFoU* *DM* *IUCN* *NARA* *NSF*	• Amount of money allocated/spent on research activities • Number of research studies completed and published

B.	Extension of existing biodiversity protection interventions to cover climate change impacts	• Prepare adaptive management programmes for climate sensitive ecosystems – Identify and map ecosystems that are highly sensitive to climate impacts ('hot spots') – Demarcate the vulnerable sites – Prepare adaptive management programmes • Protect marshes/flood retention areas vulnerable to thermal stress – Identify threatened areas and map – Restrict land conversion of wet lands – Develop special management plans – Enhance the enforcement of law • Develop a comprehensive plan for mitigating wild/forest fire incidents – Identify hazard prone areas and prepare maps – Training of staff – Acquire new equipment – Increase awareness. – Formation of CBOs • Prepare recovery plans for highly threatened ecosystems are and species – Ex-situ conservation of highly threatened species – Captive breeding and propagation – Reintroduction to natural systems	**FD** **DWLC** **DNBG** **DNZG** *CC&CRMD* *NARA* *IUCN*	• Number of adaptive management programmes prepared • Amount of money allocated/spent on preparing adaptive management programmes • Number of workshops conducted in preparing the adaptive management programmes • Number of special management plans developed for protecting marshes/flood retention areas vulnerable to thermal stress • Number of threatened areas identified for protecting marshes/flood retention areas vulnerable to thermal stress • % land area restricted to conserve wetlands • Amount of money allocated/spent on enforcement activates • Number of vulnerable areas with comprehensive plan for mitigating wild fire incidents • Number of recovery plans prepared for highly threatened ecosystems are and species
C.	Strengthening the monitoring of climate impacts	• Establish a comprehensive programme to monitor climate change impacts on key natural ecosystems and biodiversity (**Focus**: GIS mapping) • Establish permanent monitoring plots for research on natural bio-diversity	**FD** **DWLC** *CC&CRMD* *NARA* *IUCN*	• A comprehensive plan is established to monitor climate change impacts on key natural ecosystems and biodiversity • Number of monitoring plots established for research on natural bio-diversity

D.	Enhancing the participation of local communities in monitoring, conservation and management of biodiversity	• Conduct awareness programmes for local communities on impacts on climate change local biodiversity and ecosystems in vulnerable areas • Organize local CBOs for monitoring changes in local ecosystems and bio diversity • Increase the participation of local communities in adaptive management programmes – Increase employment opportunities for local communities in conservation activities	**DF** **DWLC** *CC&CRMD* *NGOs*	• Number of awareness programmes conducted for local communities on impacts on climate change local biodiversity and ecosystems in vulnerable areas • Number of workshops/meetings with CBO's to organize them for monitoring changes in local ecosystems and bio diversity • Ensure participation of local bodies • A monitoring system is established to ensure community participation in adaptive management programmes
E.	Promotion of traditional methods of biodiversity conservation for increased resilience in agro-ecosystems	• Study and Identify traditional methods of biodiversity management in agro ecosystems • Identify and promote different agro-biodiversity models suitable for different agro-climatic zones – Dry Zone: Cascade system – Wet and intermediate zones: Kandyan home garden systems, *Owita* systems	**FD** **DWLC** **DOA** *SFoU/AFoU* *NGOs*	• Number of studies conducted and published to Identify traditional methods of biodiversity management in agro ecosystems • Number of agro-biodiversity models identified suitable for different agro-climatic zones
F.	Sectoral Capacity development	• Develop research institutes' capacity for conducting research on climate change impacts on ecosystems and biodiversity • Strengthen the existing capacities for genetic preservation of fauna and flora.	**FD** **DWLC** **NSF** **DOA** *SFoU/AFoU* *IUCN*	• Amount of money allocated/spent on developing research institutes' capacity for conducting research on climate change impacts on ecosystems and biodiversity • Number of studies conducted on genetic preservation of fauna and flora • Amount of money allocated on purchasing technical equipment for genetic preservation of fauna and flora

Enhance the resilience of natural and agro ecosystems against extreme weather events	A.	Improvement of disaster risk preparedness and management	• Strengthen the early warning systems – Identify and collect information on ecosystems and geographical locations most vulnerable to flood and drought hazards – Prepare emergency response/contingency plans and guidelines for vulnerable areas	**DMC** *DF* *DWLC*	• Money allocated/spent on activities to strengthen the early warning systems • Number of geographical areas identified that are most vulnerable to flood and drought hazards • Number of emergency response/contingency plans and guidelines prepared for vulnerable areas
Minimize the impacts of sea level rise on coastal bio-diversity and ecosystem services	A.	Initiating research studies to assess climate impacts	• Conduct research studies on – sea level rise and salinity changes in coastal ecosystems – Impacts of salinity changes in coastal biodiversity and eco-system services	**NARA** **NSF** **CC&CRMD** *SFoU/AFoU* *IUCN*	• Number of research studies conducted on sea level rise and salinity changes in coastal ecosystems and - Impacts of salinity changes in coastal biodiversity and eco-system services • Amount of money allocated/spent on research studies on sea level rise and salinity changes in coastal ecosystems and - Impacts of salinity changes in coastal biodiversity and eco-system services
	B.	Strengthening the monitoring of climate impacts	• Monitor regularly the development of salinity levels	**CC&CRMD** **NARA**	• Quarterly monitoring reports produced on the development of salinity levels
Assess the changes in oceanic environment and impacts on livelihoods and food security	A.	Initiating research studies to assess climate impacts	• Assess changes in oceanic habitats and composition of species due to impacts of climate change on oceanic environment	**NARA** **CC&CRMD** *NSF* *SFoU/AFoU* *IUCN*	• Assessment report is finalized and published on oceanic habitats and composition of species due to impacts of climate change on oceanic environment • Quarterly monitoring reports published on essential bio-physical parameters (National monitoring programme)
	B.	Strengthening the monitoring of climate impacts	• Initiate long-term monitoring of essential bio-physical parameters (National monitoring programme)		

Assess the impacts of rising atmospheric CO_2 on biomass production of natural vegetation and spread of invasive species	A. Initiating research studies to assess climate impacts	• Conduct research studies on impact of increased CO_2 on natural ecosystems and biodiversity – Biomass production – Food chains – Invasive alien species	**DF** *NSF* *SFoU/AFoU* *IUCN* *NARA*	• Number of research studies conducted on impact of increased CO_2 on natural ecosystems and biodiversity • Amount of money allocated/spent on conducting research on impact of increased CO_2 on natural ecosystems and biodiversity	

Tourism and Recreation

Being a tropical island nation, Sri Lanka is an attractive destination for tourists. The protracted conflict since 1980s has discouraged the flow of tourists significantly over three decades. However, with the termination of war in 2009, arrival of tourists has increased steadily that reached new heights with further potential for development. Annual arrivals surpassed the one million mark recently and increasing steadily. Among the country's attractions are scenic and sunny beaches, cultural heritage, ecological endowments of rich biodiversity, opportunities for nature recreation (e.g. whale watching, beach surfing, wild life) as well as comfortable climate zones. Climate change can affect desirable characteristics associated with each of those attractions, simultaneously creating problems for operational undertaking of travelling and leisure activities. Besides, it can affect infrastructure facilities of tourism industry making them vulnerable to various hazards. Tourism industry, by its nature, is highly sensitive and susceptible to disturbing conditions such as disasters and violence. Hence, maintaining Sri Lanka's position as an attractive destination and ensuring efficient operation of the industry under rising incidence of climate hazards needs adopting carefully planned adaptation measures.

Table 12: Sector Action Plan – Tourism and Recreation

Adaptation needs	Adaptation options	Actions	Responsible agencies	Key performance indicators
Adjustment of tourism and recreation industry to altered conditions of the destination	A. Initiating research studies to assess climate impacts	• Conduct research studies on climate change impacts on tourism and recreation (**Focus**: nature based tourism, coastal zone) – Critical impacts of climate change on tourism and recreation – Ways to overcoming constraints on industry – Ways to harnessing opportunities	**SLTDA** *TFoU* *NSF*	• Number of research studies conducted and published on climate change impacts on tourism and recreation • Amount of money allocated/spent on climate change impacts on tourism and recreation
	B. Operational adjustments in the industry	• Diversify the tourism products to meet the changing conditions – Increase the portfolio of destinations and attractions – Embrace new tourism concepts – Identify new themes (e.g. adventure tourism) • Develop collaborative plans with key stakeholders to adjust tourism operations in different locations – Nature tourism: Wildlife Dept., Forest Dept. – Cultural tourism: Dept. Archeology • Increase the awareness of tour industry operators on climate change and its impacts – Prepare guidelines for operators and guides • Increase the climate preparedness in organizing and implementing tour operations – Identify comfort/discomfort zones – Prepare toolkits/guidelines for operators and guides	**SLTDA** **SLTPB** **TBSL** *FD* *DWLC* *CC&CRMD* *DArch* *THASL*	• Number of research/workshop conducted to identify new tourism concepts and themes • Number of collaborative plans developed to adjust tourism operations in different locations • Number of workshops conducted to developed collaborative plans developed to adjust tourism operations in different locations • Number of awareness programmes conducted to increase the awareness of tour industry operators on climate change and its impacts • Number of initiatives taken to Improve the climate preparedness element in organizing and executing tour operations • Number of tourism facilities identified in vulnerable areas (e.g. low-lying beaches; disaster prone areas) and make arrangements to improve the resilience

	C.	Changing of promotional strategies	• Assess the current promotional strategies with connection to emerging scenarios of climate change (**Focus**: beach tourism, nature destinations) • Adjust the promotions to suit the different climate scenarios – Promotions according to seasonal variations in climate – Rebranding attractions to match the changing conditions – Identification of alternative destinations	**SLTDA** **SLTPB** **TBSL** *FD* *DWLC* *CC&CRMD* *DArch* *THASL*	• Assessment report on current promotional strategies with connection to emerging scenarios of climate change is published • Number of initiatives taken to Adjust the promotions to suit the different climate scenarios
Increase the preparedness of tourism and recreation operations to extreme weather conditions	A.	Improvement of emergency risk preparedness and management	• Identify tourism facilities in vulnerable areas (e.g. low-lying beaches; disaster prone areas) and make arrangements to improve the resilience (**Focus**: vulnerability assessment, retrofitting, climate proofing) • Prepare guidelines on managing emergencies in tour operations • Train tour operators on emergency management strategies • Design tourism infrastructure to meet the safety needs of operations • Build system's capacity for smooth switching to alternate plans • Establish emergency communication channels for tourists and operators (**Focus**: mobile and internet based communication)	**DMC** **SLTDA** *SLTPB* *TBSL* *THASL*	• Guidelines on managing emergencies in tour operations are developed • Number of tour operators trained on emergency management strategies • Number of tourism infrastructures designed to meet the safety needs of operations • Amount of money allocated on developing system's capacity for smooth switching to alternate plans • Amount of money allocated on establishing emergency communication channels for tourists and operators
	B.	Establishment of an efficient climate information management and communication system	• Develop a system for timely issuing of short-term weather forecasts • Strengthen the early warning systems (**Focus**: mobile and internet based communication)	**DM** **SLTDA** *SLTPB* *TBSL* *THASL* *DMC*	• A system is developed for timely issuing of short-term weather forecasts • Number of initiatives taken to strengthen the early warning systems

Export Agriculture Sector

All governments of Sri Lanka have been striving to achieve an export-led growth for the economy. Until the final quarter of the last century, Sri Lanka remained highly dependent over three agricultural commodities—tea, rubber and coconut—for a major share of its export earnings. Liberal economic reforms introduced in 1977 has transformed the structure of the export sector significantly, apparel industry becoming the major source of foreign earnings. Despite the reduction of relative share of agricultural exports, however, they continued to grow and still contribute a significant share of foreign earnings. Besides, three major agricultural commodities, spice crops, floriculture, aquaculture products, and non-traditional exports such as herbal products have also grown recently. Sri Lanka's economy needs the continuous support of this sector and there is significant unrealized potential yet to explore. Unlike seasonal agricultural crops that supports the country's food security, majority of export agricultural commodities are perennial in nature and concentrated in wet zone areas of the country. However, being agricultural commodities, they are also sensitive to changing patterns of weather and climate. Unlike in the past when major export commodities had been produced in large estates run by companies, current production base of agricultural commodities is dominated by small-scale producers. Hence, climate change impacts on these commodities can create significant livelihood outcomes affecting a large section of population in the country. High climate sensitivity and dependence by a large segment of small producers for their livelihoods make export agricultural sector a vulnerable area that needs special measures of adaptation to cope with impending changes of climate.

Table 13: Sector Action Plan – Export Agriculture Sector

(Focus: tea, rubber, coconut, coffee, cocoa, spices, cashew and sugarcane[1])

Adaptation needs	Adaptation options	Actions	Responsible agencies	Key performance indicators
Enhance the resilience of export agricultural crops and agro-ecosystems against heat and water stress	A. Germplasm improvement	• Screen existing cultivars/clones for heat and water stress. • Introduce new cultivars /clones – Heat tolerant – Drought tolerant – Flood tolerant • Develop grafted/budded plants with drought resistance properties	**MOPI** *TRI* *RRI* *CRI* *DEA* *SLCC* *SRI* *AFoU*	• Number of existing cultivars/clones for heat and water stress • Number of new cultivars /clones introduced • Number of grafted/budded plants developed with drought resistance properties
	B. Improvement of farm and nursery management practices	• Improve the management of shade trees as a climate change adaptation measure – Conduct nursery and field trials – Develop recommendations and guidelines • Promote suitable operational and management techniques – Application of Anti-transpirents (rubber) – Drip irrigation (with the new expansions in dry zone) – Mulching – Intercropping with spices • Develop improved cropping system models for vulnerable areas/lands • Promote improved nursery and plant management practices – New soil mixtures – Use soil quality index – Use of machinery for replanting	**MOPI** *TRI* *TBSL* *TSHDA* *RRI* *RDD* *CRI* *CDA* *CCB* *DEA* *SLCC* *SRI* *AFoU* *NIPM*	• Number of nursery and field trials conducted to Improve the management of shade trees as a climate change adaptation measure • Number of guidelines developed to Improve the management of shade trees as a climate change adaptation measure • Number of promotional workshops completed for promoting suitable operational and management techniques • Number of improved cropping system models developed for vulnerable areas/land • Number of improved nursery and plant management practices promoted • Number of promotional workshops to promote improved nursery and plant management practices

[1] Sugar cane is not an export crop in Sri Lanka. However it is managed as a plantation crop. Therefore adaptation of sugarcane is taken into consideration under this section.

			– Improvements in irrigation: nursery and new plantings – New planting techniques: root trainers – Improve soil organic matter: Bio-fertilizer development:		
	C.	Initiating research studies to assess climate impacts	• Conduct research studies on – Crop physiology: heat and drought resistance – Physiology of flowering: Synchronizing of flower irregularities – Resistance cultivars – Inter cropping: banana, cocoa, cash crops such as maize – Deep planting: at nursery and replanting levels – Cropping systems for climate resilience	**MOPI** *TRI* *RRI* *CRI* *DEA* *SLCC* *SRI* *AFoU*	• Number of research studies conducted and published • Amount of money allocated/spent on research studies
	D.	Sector capacity development	• Develop research institutes' capacity for conducting research on tolerant cultivars/clones • Develop facilities necessary to undertake controlled environment research	**MOPI** *TRI* *RRI* *CRI* *DEA* *SLCC* *SRI* *AFoU* *NSF*	• Amount of money allocated/spent on developing research institutes' capacity for conducting research on tolerant cultivars/clones • Amount of money allocated/spent on developing facilities necessary to undertake controlled environment research
Minimize the risk of crop damage due to biological agents	A.	Germplasm improvement	• Screen existing cultivars/clones for pest and disease resistance. • Develop pest and diseases resistant varieties	**MOPI** *TRI* *RRI* *CRI* *DEA* *SLCC* *SRI* *AFoU*	• Number of existing cultivars/clones screened for pest and disease resistance • Number of pest and diseases resistant varieties

	B. Improvement of farm and nursery management practices	• Develop recommendations on best practices of pest and disease management through improvements in: – Shade tree management – Nursery management – Crop sanitation	**MOPI** *TRI* *RRI* *CRI* *DEA* *SLCC* *SRI* *AFoU*	• Number of recommendations developed on best practices of pest and disease management through improvements	
	C. Monitoring and surveillance of pests and diseases	• Establish a surveillance programme for early detection of new diseases and pests • Develop a system forecasting risks of pest and diseases	**MOPI** *TRI* *RRI* *CRI* *DEA* *SLCC* *SRI*	• A surveillance programme established for early detection of new diseases and pests • A system forecasting risks of pest and diseases developed	
Minimize the impact on export earnings due to erratic changes in precipitation	A. Establishment of an efficient climate information management and communication system	• Develop a system for timely issuing of seasonal and short-term weather forecasts • Adjust calendar of operations with seasonal weather forecasts	**DM** *TRI* *RRI* *CRI* *DEA* *SLCC* *SRI*	• A system is developed for timely issuing of seasonal and short-term weather forecasts • A calendar of operations is adjusted with seasonal weather forecasts	
	B. Improvements in cropping systems	• Promote sustainable cropping system practices for increasing the resilience of plantations and trees – Rainwater harvesting – Shade tree management – Agro-forestry and timber plantations – Cover crops – Contour drains – Land suitability assessment (e.g. 60% slope) – Soil and moisture conservation practices	**MOPI** *TRI* *TBSL* *TSHDA* *RRI* *RDD* *CRI* *CDA* *CCB* *DEA* *SLCC* *SRI* *AFoU* *NIPM*	• Number of money allocated/spent on promoting sustainable cropping system practices for increasing the resilience of plantations and trees • Number of sustainable cropping system practices promoted for increasing the resilience of plantations and trees • Number of promotional workshops conducted to promote sustainable cropping system practices for increasing the resilience of plantations and trees	

Enhance the resilience of export crops and agro-ecosystems to extreme weather events	A. Establishment of an efficient climate information management and communication system	• Develop a system for timely issuing of short-term weather forecasts • Strengthen the early warning systems	**DM** *TRI* *RRI* *CRI* *DEA* *SLCC* *SRI*	• A system is developed for timely issuing of short-term weather forecasts • Money allocated/spent on strengthening the early warning systems
	B. Improvement of disaster risk preparedness and management	• Identify and collect information on areas most vulnerable to flood and drought hazards • Prepare hazard vulnerability maps for all crops • Develop guidelines for management of extreme events in vulnerable areas	**DMC** *TRI* *RRI* *CRI* *DEA* *SLCC* *SRI*	• Number of areas identified and data collected on most vulnerable to flood and drought hazards • Number of plans developed for areas that are most vulnerable to flood and drought hazards • Number of guidelines developed for areas most vulnerable to flood and drought hazards (extreme events)
Minimize the impacts of sea level rise on export crops in coastal zone	A. Strengthening the monitoring of climate impacts	• Monitor regularly the development of salinity levels	**NARA** **CC&CRMD** *CRI* *SLCC* *DEA*	• Quarterly monitoring reports on development of salinity levels are published • Number of money allocated/spent on constructing salinity exclusion structures and salinity barriers to control sea water intrusions to agricultural lands • Number of salinity exclusion structures and salinity barriers to control sea water intrusions to agricultural lands constructed
	B. Development of protection structures	• construct salinity exclusion structures and salinity barriers to control sea water intrusions to agricultural lands		

Industry, Energy and Transportation

Energy, industry and transportation are generally considered as sectors that are relevant in the case of mitigation rather than adaptation to climate change. However, stakeholders and experts suggested these sectors also need the support of certain adaptation measures to cope up with projected climate impacts. Hence, these sectors are considered here not for their contribution to mitigation of climate change but for identifying and implementing essential adaptation measures to enhance the climate resilience of them. Sri Lanka's power generation is still dependent on hydro power facilities to a significant extent and changing patterns of rainfall have would have an impact on them. Rainfall patterns are crucial for supply of raw materials for agro-based industries. Besides, rising scarcity of water and high extraction of groundwater would likely to create difficulties in industrial water supply in the future. Extreme events have the potential to affect transportation. Hence, despite usual affiliation of these sectors with mitigation efforts, they need the support of appropriately designed adaptation measures, too.

Table 14: Sector Action Plan – Industry, Energy and Transportation

Adaptation needs	Adaptation options	Actions	Responsible agencies	Key performance indicators
Minimize the impacts of rising temperature and periodic scarcity of water on energy, industry and transportation	A. System improvements and diversification of energy and power generation	• Minimize the fluctuation of hydro power generation potential through improvements in system management – Prepare and implement watershed management plans in major-hydro and mini-hydro reservoirs – Plan the generation using short-term and seasonal forecast of weather • Explore alternatives for maximizing the use of hydro power facilities: e.g. pumped-storage hydroelectricity • Improve the efficiency of transmission and distribution systems to minimize losses • Diversify the energy mix with increased share of renewable energy (**Focus**: recommendations on TNA-Energy Sector) • Factor in climate change into long-term generation plans	**CEB** **SEA** *DM* *EFoU*	• Amount of money allocated/spent on minimizing the fluctuation of hydro power generation potential through improvements in system management • Number of alternatives for maximizing the use of hydro facilities: e.g. pump storage explored and identified • Number of workshops conducted on improving the efficiency of transmission and distribution systems to minimize losses, diversifying the energy mix with increased share of renewable energy (TNA recommendations) and factoring climate change into long-term generation plans
	B. Supply chain improvements in agro-based raw materials	• Diversify the supply sources: – Identify climate sensitive raw materials – Assess the specific vulnerabilities – Promote the production in wider range of locations • Develop forward contract markets for agro-based raw materials • Introduce innovative risk transfer instruments	**IDB** *ITI* *DOA* *NCPC*	• Number of workshops conducted on identifying climate sensitive raw materials, assessing the specific vulnerabilities and promoting the production in wider range of locations • Number of forward contracts developed for markets for agro-based raw materials • Number of innovative risk transfer instruments introduced

	C.	Initiating research studies to assess climate change impacts	• Conduct research studies on impacts of climate change on energy, transportation and industry – Explore and assess the potential for establishing pumped-storage hydroelectricity (PSH) plants and conversion/ retrofitting of existing facilities to PSH plants – Identify climate sensitive agro-based raw materials and assess alternatives to ensure stable supply – Assess the impacts of climate change impacts on transport systems and road infrastructure	**CEB** **SEA** **ITI** **NERD** **RDA** *EFoU*	• An assessment report on the potential for developing (and retrofitting) pumped-storage hydroelectricity facilities is completed and published • Number of research studies conducted
Minimize the impacts of extreme weather events on energy, industry and transportation	A.	Improvement of the climate resilience and disaster risk preparedness of transportation	• Assess the impacts of projected changes and extreme weather scenarios on transportation systems • Assess vulnerable and hazard prone areas/roads and prepare maps • Identification of climate resilient improvements in – Transport planning – Infrastructure development – Implementation of plans • Develop guidelines for improve the resilience of transportation system for extreme weather situations • Create awareness on climate risks in transportation to commuters, drivers and transport operators • Establish an early warning and hazard communication systems for commuters and drivers (**Focus**: mobile phones, navigation systems, radio channels)	**DMC** **MOT** *DMT* *SLR* *SLTB* *RPTAs (PC)* *RDA*	• An assessment report on the impacts of projected changes and extreme weather scenarios on transportation systems I completed and published • Number of areas with hazard prone areas/roads maps • A guideline report to improve the resilience of transportation system for extreme weather situations is completed and published • Number of awareness programmes conducted on climate risks in transportation to commuters, drivers and transport operators • An early warning and hazard communication system is established for commuters and drivers

	B. Development of climate resilient infrastructure and production facilities	• Promote climate proof infrastructure and building design practices – identify design improvements for transport, energy and industry sector – Develop guidelines – Create awareness among planners, builders and operators of facilities – Develop and conduct training programs • Assess suitable interventions to strengthen climate resilience of energy sector and industrial facilities to extreme events – Introduce 'climate proofing' improvements – Retrofitting – Relocation of facilitates (if necessary)	**NBRO** **NERD** **ITI** *EFoU/AFoU*	• Number of awareness programmes on promoting climate proof infrastructure and building design practices • Guideline report on promoting climate proof infrastructure and building design practices is prepared and published • Number of critically vulnerable energy and industrial facilities in hazard prone areas identified • An assessment report on suitable interventions to strengthen climate resilience is prepared and published
	C. Improvement of disaster risk preparedness and management	• Identify vulnerable areas for climate-induced disaster risks on energy, transportation and industrial facilities and prepare maps • Develop a system for timely issuing of short-term weather forecasts • Establish an early warning system of disasters to energy, transport and industry managers	**DMC** **DM**	• Number of vulnerable areas identified and maps prepared for climate-induced disaster risks • A system is developed for timely issuing of short-term weather forecasts • An early warning system is established for energy, transportation and industrial managers
Minimize the impacts of sea level rise on energy, transportation and industrial facilities	A. Strengthening the monitoring of sea level rise	• Regular monitoring of sea level rise • Prepare maps on low-lying areas vulnerable to inundation • Demarcate coastal zones vulnerable to inundation • Develop guidelines for economic activities in vulnerable areas	**CC&CRMD** **NARA**	• Quarterly monitoring reports on of sea level rise is prepared and published • Number of maps prepared on low-lying areas vulnerable to inundation • Total coastal areas demarcated with vulnerability to inundation • Guideline are prepared for economic activities in vulnerable zones and published

B.	Increase the preparedness for sea level rise	• Identify critically vulnerable energy, transportation and industrial facilities in vulnerable areas to inundation • Develop contingency plans to gradual relocation and development of alternatives	**MOI** **MOE** **MOT** *DMC* *CC&CRMD*	• Number of critically vulnerable energy, transportation and industrial facilities in vulnerable zones to inundation identified • Number of contingency plans developed to gradual relocation and development of alternatives
C.	Initiating research studies to assess climate change impacts	• Conduct research studies on impact of climate change on industries located in coastal areas (**Focus**: salt, coir and coconut-based industries, mineral sands, boat building industries) • Identify adaptation actions suitable for respective industries	**MOI** *ITI* *IDB* *NERD*	• Number of research studies conducted to assess the vulnerability of industries based on coastal areas • Number of adaptation actions identified that are suitable for respective industries

7.6. Plan for Cross-cutting National Needs of Adaptation

Action plan for cross-cutting needs contain actions/interventions proposed to fulfill adaptation needs of ten interest areas. These areas were identified through analysis of common sectoral needs and opinions of stakeholders. The actions of cross-cutting plan have been selected to fulfil national level adaptation needs. Action plan on cross-cutting adaptation needs begin with specific interest areas followed by details on actions, responsible agencies and key performance indicators. The specific institutional and implementation mechanisms proposed for implementation of cross-cutting plan are presented in forthcoming sections of the plan. Table 15 presents the action plans for cross-cutting adaptation needs.

Table 15: Action Plan – Cross-cutting Needs of Adaptation

Cross cutting area	Action	Responsibility	Key performance indicators
Policy, legal economics and governance	Undertake a review of relevant macro and sectoral policies, ordinances, acts, statutes and procedures to identify options for mainstreaming climate change adaptation activities in Sri Lanka	**MOEnv** *CCS*	• A review report is prepared and published on relevant macro and sectoral policies, acts and procedures to identify options for mainstreaming climate change adaptation activities in Sri Lanka
	Develop policy recommendations necessary for addressing vulnerability to impacts of climate change in all development /management projects in terms of : • Assessing the climate vulnerability and sensitivity of projects (climate impact assessment); • Ensuring the inclusion of adaptive responses to overcomer climate vulnerabilities; • Implementation and monitoring of proposed adaptive actions	**MOEnv** *CCS*	• Number of policy recommendation developed for ensuring climate vulnerability issues are addressed in all development /management projects • An assessment report on the the climate vulnerability and sensitivity of projects (climate impact assessment) is prepared and published
	Carry out a policy study to explore the possibilities for: • Application of market-based instruments to motivate adaptive actions • Assessing feasibility of introducing innovative risk transfer tools (**Focus**: climate insurance schemes)	**MOEnv** *CCS*	• A policy study is finished and published to explore the possibilities for application of market-based instruments to motivate adaptive actions and identify and assess feasibility of introducing innovative risk transfer tools (e.g. index insurance schemes)
Institutional and coordination	Restructure and strengthen the Climate Change Secretariat as the National Focal Point (NFP) for implementation of NAP: • Increase the strength of staff • Provide training for professional staff • Provide necessary capacity building support for NAP implementation • Allocate sufficient budgetary provisions	**MOEnv** **MOF** *CCS*	• Number of staff increased • Number of training provided for professional staff • Number of capacity building workshops conducted • Amount of money allocated to restructure and strengthen the Climate Change Secretariat as the National Focal Point (NFP) for implementation of NAP

	Establish a suitable institutional mechanism for implementation of sectoral and cross-cutting actions of NAP. • *Climate Adaptation Cells (CAC)* for implementation of sectoral adaptation plans. To be represented by relevant sectoral agencies • *National Working Group (NWG)* for implementation of cross-cutting adaptation interventions. To be represented by national lead agencies • *Provincial Adaptation Cells (PAC)* for implementation of actions to be undertaken in provincial areas. To be represented by provincial agencies		• Climate action cells are established for implementation of sectoral adaptation plans. To be represented by relevant sectoral agencies • National Working Group (NWG) is established for implementation of cross-cutting adaptation interventions. To be represented by national lead agencies
	Organize a *Forum of Civil Society Organizations* (FCSO), a group of partner agencies, to support the implementation and coordination of community-based sectoral and cross-cutting interventions proposed by NAP	**MOEnv** *CCS*	• A Forum of Civil Society Organizations (FCSO) is organized
International cooperation and partnerships	Develop an inventory of international climate donors, funding schemes, training providers, training programmes, research agencies/consortiums and events (conferences, seminars etc.) for the benefit of local stakeholders of adaptation.	**CCS** *MOFA* *ERD*	• An inventory of international climate donors, funding schemes, training providers, training programmes, research agencies/consortiums and events (conferences, seminars etc.) is developed
	Establish a network of sectoral and national agencies, CSO partners, research institutes, think tanks and academics to approach international service providers through the facilitation support of the National Focal Point for funding support, technical assistance or training necessary for adaptation actions identified in NAP or supportive programmes developed to achieve the NAP objectives	**MOEnv** *CCS* *NSF* *CSOs*	• A network of sectoral and national agencies, CSO partners, research institutes, think tanks and academics is established
	Identify a group of sectoral and national level representatives from government organizations, CSOs and private sector to create a pool of climate negotiators • Develop the negotiation skills through training • Establish a facilitative mechanism for enlisting their services according to the requirement s through the National Focal Point	**MOEnv** **MOFA** *CCS* *SLIDA*	• Number of training programme conducted in developing the negotiation skills • A facilitative mechanism is established for enlisting services of trained negotiators according to the requirement s of the NAP programs

Resource mobilization	Create a *National Adaptation Fund* with the collaboration of the Ministry of Finance to support the implementation of NAP actions and supportive programmes	**MOF** **MOEnv** *CCS*	• A National Adaptation Fund is created • Amount of money allocated • Number activities/programmes funded
	Develop a 'fast track' mechanism for approving requests for donor funding for climate adaptation projects through the collaboration of the National Focal Point and the External Resources Department	**MOF** **MOEnv** *CCS* *ERD*	• A fast track mechanism is developed for approving requests for donor funding for climate adaptation projects
	Negotiate and establish a state-private partnership trust fund for attracting and channeling corporate social responsibility (CSR) funding for climate adaptation projects with the support of the Finance Ministry and corporate sector members	**MOF** **MOEnv** *CCS* *NCC* *FCCISL*	• A partnership trust fund with the corporate sector for channeling CSR funding for climate adaptation projects is negotiated and established
Research and development	Establish national level controlled environment research facilities in selected institutes for facilitation of multi-disciplinary research	**NSF** *NRC*	• Number of national level controlled environment research facilities established • Amount of money allocated for controlled environment research
	Establish a national network of research agencies and universities that are carrying out research on climate adaptation for promoting coordinated research and information dissemination	**NSF** *NRC* *CARP*	• A national network of research agencies and individual researchers on climate adaptation is established
	Organize an annual multi-disciplinary research symposium on climate change adaptation with international participation.	**CCS** **NSF**	• Number of annual multi-disciplinary research symposiums on climate change adaptation with international participation are conducted
	Develop a coordinated multi-disciplinary small research grant programme on thematic areas relating to climate change adaptation to be facilitated by the National Focal Point and managed by the national research support agencies (e.g. NSF, NRC, CARP)	**CCS** **NSF** *CARP* *NRC*	• A coordinated multi-disciplinary small research grant programme is developed
	Undertake advanced multidisciplinary studies on selected core areas of nationally important climate change adaptation issues supported by national and international donor funding (**Focu**s: germplasm improvement; climate modelling; stress physiology; climate information products)	**NSF** *NRC* *CCS*	• A funding facility for advanced studies on selected core areas of nationally important research is created
	Establish a common repository of scientific and awareness materials on climate change adaptation	**CCS** *NSF*	• A common repository of scientific and awareness materials on climate change adaptation is established

Technology transfer and standards	Identify international technology transfer service providers and technology developers and negotiate with them to establish technology and skills transfer opportunities for local researchers, trainers, experts, technology users and students	**CCS**	• Number of international technology transfer service providers and technology developers identified • Number of negotiations completed
	Organize national level technology transfer events and programmes (e.g. dissemination programmes, exhibitions, training programmes and demonstrations) to transfer technology/knowledge from developers and experts to technology users	**CCS** **NSF**	• Number of national level technology transfer events and programmes organized
Building adaptive capacity of communities	Develop a small grant facility jointly coordinated by *CSO Forum* and the National Focal Point to provide seed funding for community-based adaptation programmes to be financed through the *National Climate Adaptation Fund*	**CCS** *CSOs*	• A small grant facility to provide seed funding for community-based programmes helpful for achieving NAP objectives is developed
	Launch a partnership programme of academics, CSO members and researchers for gathering, compiling, documentation and analyzing of traditional local knowledge systems on climate and indigenous forecasting to be used in developing participatory community-based adaptation programmes.	**CCS** *CSOs* *AFoU*	• A programme for gathering, compiling and documentation of traditional local knowledge is completed
	Initiate a joint island wide programme for identification of religious, cultural and archaeological assets vulnerable to climate change impacts with the participation of experts (on archaeology, culture, religious affairs), CSO members and local communities for conservation of threatened assets.	**MOCA** *DOArch* *PGIArch* *DCA* *ROs* *CSOs*	• An island wide program is initiated for identification and vulnerability assessment of religious, cultural and archaeological assets threatened by climate change
Education, training and awareness	Conduct training programmes for government officers, CSO members, and private sector employees on climate change adaptation	**CCS** *AFoU* SLIDA	• Number of training programmes developed and conducted for government officers, CSO members, and private sector employees on climate change adaptation
	Incorporate and further strengthen climate change knowledge in formal education—school and university curricula	**CCS** **MOE** DE NIE UGC	• An assessment report on the current contents of school and university curricula to improve them further is completed and published

	Establish a media space including social media for climate change impacts and adaptation to enhance public awareness	**MOEnv** **MOMMI** CSOs	• A media space is created for climate change adaptation to enhance public awareness • Number of awareness initiatives taken by the established media space
Climate information management	Establish a *National Task Force on Climate Information Products* to strengthen current efforts for developing seasonal and sub-season climate forecasts: • Identify climate and weather forecast needs of different stakeholders • Identify a set of essential short-term and seasonal weather forecasting products • Launch a national programme for producing selected weather forecasting products with international technical support • Identify a suitable communication strategy for ensuring timely reach of information to end users and implement it	**DM** *CCS* *DMC* *DOA*	• A National Task Force on Climate Information Products to strengthen current efforts for developing weather forecasts is organized • Number of workshops conducted in identifying climate and weather forecast needs of different stakeholders and set of essential short-term and seasonal weather forecasting products • A national programme is launched for producing selected weather forecasting products with international technical support • A suitable communication strategy for ensuring timely reach of information to end users is identified and implemented
	Identify capacity development needs of the Department of Meteorology and provide necessary support to strengthen the capacity for offering reliable weather and seasonal and sub-season climate forecasts. • Increase the strength of staff • Provide training for professional staff • Provide necessary capacity building support for NAP implementation • Strengthen the network of meteorological data collection centres • Allocate sufficient budgetary provisions	**DM** *MOF*	• Number of staff increased and number of training programmes conducted for professional staff. • Number money allocated/spent on capacity building support for NAP implementation and strengthening the network of meteorological data collection centres
	Undertake a study on indigenous short- and medium-range weather forecasting knowledge and identify ways to incorporate it into a national climate risk surveillance programme. • Explore the modalities developed in other countries • Recruit trained local weather observers	**DM** *CCS* *DOA* *AFoU/SFoU/EF oU* *NSF*	• A study is undertaken and completed on indigenous weather forecasting knowledge and ways are identified to incorporate it into a national climate risk surveillance programme

	Establish a national research programme on climate modelling for long-term climate projections	**DM** **DOA** AFoU/SFoU/EFoU NSF NRC	• A national research programme is established on climate modelling for long-term projections • Number of research studies conducted and published under the established research programme
Climate-induced disaster risk reduction	Assess the disaster risk reduction needs of sectoral Climate Adaptation Cells (identified in NAP) and mainstream the implementation of them with ongoing programmes of disaster risk management	**MODM** **DMC** CCS	• A coordination committee is established • An assessment report is prepared and published by the established committee on disaster risk needs of sectoral Climate Adaptation Cells

8. Adaptation and Sustainable Development: The Potential Contribution of NAP towards Achieving SDGs

Since the official adoption by the UN in 2015, Sustainable Development Goals (SDGs) are going to play a dominant role in the global development agenda till 2030. All UN member nations are expected to make their contributions towards achieving the global development scenario envisioned by SDGs to the extent they are relevant to their national development goals. In practical sense, this would have important repercussions on many areas such as development planning and policy, poverty alleviation, environmental management, trade and international development cooperation. Hence, it is necessary to assume the primacy of SDGs in the global agenda by practitioners of development in all areas and climate change is not an exception. In the final count, adaptation is all about adjusting the discourse of development in the face of rising climate risk and it does not possess significant meaning without its contribution to the sustainable development. This implies that the NAP should assist the nation to achieve the broader goals of SDGs and vice versa. The SDGs have 17 goals and 169 targets of which Goal Number 13 is fully dedicated to climate change with 9 targets associated with it. In addition, number of other goals covers areas relevant to climate change adaptation with relevant targets attached to them. The NAP is essentially contributing to number of SDGs and how the specific goals are addressed by the relevant adaptation options and actions are shown in Table 16.

Table 16: Links between SDGs and NAP

SDG Goal and Target	Sector in NAP	Adaptation need	Adaptation Action
Goal 1: End poverty in all its forms everywhere			
1.5 by 2030 build the resilience of the poor and those in vulnerable situations, and reduce their exposure and vulnerability to climate-related extreme events and other economic, social and environmental shocks and disasters	Coastal sector	Enhance the resilience of coastal ecosystems against increased extreme events	▪ Improvement of disaster risk preparedness and management
	Cross cutting needs of adaptation	Climate-induced disaster risk reduction	▪ Assess the disaster risk reduction needs ▪ Mainstream the implementation with ongoing programs of disaster risk management
Goal 2: End hunger, achieve food security and improved nutrition, and promote sustainable agriculture			
2.4 by 2030 ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters, and that progressively improve land and soil quality	Food security	Enhance the resilience of crops, animals, fish and agro-ecosystems against heat and water stress	▪ Germ plasm improvements ▪ Improvement of farm water management ▪ Promotion of resource efficient farming systems ▪ Sectoral Capacity development
		Minimize the risk of crop and health damage due to biological agents	▪ Germ plasm improvements, ▪ Strengthening of supporting facilities,
		Minimize the impact on food security due to erratic changes in precipitation	▪ Establishment of an efficient climate information management and communication system, ▪ Improvement of pasture and fodder management
		Enhance the resilience of crops, animals, fish and agro-ecosystems to extreme weather events	▪ Germ plasm improvements ▪ Improvement of disaster risk preparedness and management

		Minimize the impacts of sea level rise on agriculture in coastal zone	▪ Germ plasm improvements ▪ Strengthening the monitoring of climate impacts
		Assess the changes in oceanic environment and impacts on livelihoods and food security	▪ Initiating research studies to assess climate impacts Strengthening the monitoring of climate impacts
		Assess the impacts of rising atmospheric CO_2 on productivity crops and weed populations	▪ Initiating research studies to assess climate impacts
Goal 3: Ensure healthy lives and promote well-being for all at all ages			
3.d strengthen the capacity of all countries, particularly developing countries, for early warning, risk reduction, and management of national and global health risks	Health	Assess and prepare for the increased health risks due to climate-induced vector bone and pathogenic diseases	▪ Conducting relevant research studies ▪ Strengthening the surveillance and monitoring ▪ Capacity development
		Minimize the health hazards associated with increased incidence of extreme events	▪ Improvement of disaster risk preparedness of health related agencies and workers
		Assess and prepare for health risks caused by concentration of climate altering pollutants	▪ Conducting relevant research studies • Improvement of monitoring of climate altering pollutants and capacity development
		Assess the impact on health due to increased heat and thermal stress	▪ Conducting relevant research studies
Goal 6: Ensure availability and sustainable management of water and sanitation for all			
6.4 by 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water	Water resources	Enhance the resilience of systems for water resources, management and use to overcome the scarcities caused by climate change impacts	▪ Improvement of watershed management ▪ Capacity development ▪ Promote efficient practices of water management and use

scarcity, and substantially reduce the number of people suffering from water scarcity **6.6** by 2020 protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes		Ensure the safety of water management facilities and minimize disturbances to supply due to extreme weather events	▪ Improvement of disaster risk preparedness and management ▪ Capacity development of storage facilities
		Minimize the impacts of sea level rise on water resources and management of coastal areas and wet lands	▪ Strengthening the monitoring of sea level rise, ▪ Improve salt water intrusion protection measures in coastal areas and wetland
Goal 11: Make cities and human settlements inclusive, safe, resilient and sustainable			
11.5 by 2030 significantly reduce the number of deaths and the number of affected people and decrease by y% the economic losses relative to GDP caused by disasters, including water-related disasters, with the focus on protecting the poor and people in vulnerable situations	Human settlements	Minimize the impacts on human settlements and infrastructure due to erratic changes in precipitation	Enhance the capacity of infrastructure in urban settlements, Promote water safety and efficient utilization of surplus water
11.b by 2020, increase by x% the number of cities and human settlements adopting and implementing integrated policies and plans towards inclusion, resource efficiency, mitigation and adaptation to climate change, resilience to disasters, develop and implement in line with the forthcoming Hyogo Framework holistic disaster risk management at all levels		Enhance the resilience of human settlements and infrastructure to extreme weather events Minimize the impacts of sea level rise on coastal settlements and infrastructure	Promotion of disaster resilient buildings and construction, Improvement of disaster risk preparedness and management Increase the resilience of coastal settlements, Strengthening the monitoring of sea level rise
Goal 13: Take urgent action to combat climate change and its impacts			

13.1 strengthen resilience and adaptive capacity to climate related hazards and natural disasters in all countries	Cross-cutting needs of adaptation	Building adaptive capacity of communities	▪ Develop a small grant facility ▪ Initiatives to promote traditional local knowledge on climate adaptation
13.2 integrate climate change measures into national policies, strategies, and planning	Cross-cutting needs of adaptation	Policy, legal and governance	▪ Identification of options for mainstreaming climate change adaptation ▪ Policy study on market-based instruments ▪ Promote suitable risk transfer tools
13.3 improve education, awareness raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction, and early warning	Cross-cutting needs of adaptation	Education, training and awareness	▪ Conduct training programs for stakeholders ▪ Incorporate and further strengthen climate change knowledge in formal education, ▪ Establish a media space for climate change impacts and adaptation
Goal 14: Conserve and sustainably use the oceans, seas and marine resources for sustainable development			
14.3 minimize and address the impacts of ocean acidification, including through enhanced scientific cooperation at all levels	Coastal and marine sector	Strengthen the coastal zone management to face the impacts of sea level rise	▪ Initiating relevant research studies
Goal 15: Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss			
15.3 by 2020, combat desertification, and restore degraded land and soil, including land affected by desertification, drought and floods, and strive to achieve a land-degradation neutral world	Ecosystems and Biodiversity	Enhance the resilience of natural and agro ecosystems against the impacts of climate change impacts	▪ Extend the existing biodiversity protection interventions to cover climate change impacts, ▪ Enhance the participation of local communities ▪ Research and Sectoral Capacity development

		Enhance the resilience of natural and agro ecosystems against extreme weather events	▪ Improvement of disaster risk preparedness and management
15.5 take urgent and significant action to reduce degradation of natural habitat, halt the loss of biodiversity, and by 2020 protect and prevent the extinction of threatened species		Minimize the impacts of sea level rise on coastal bio-diversity and ecosystem services	▪ Initiating research studies to assess climate impacts, Strengthening the monitoring of climate impacts
		Assess the changes in oceanic environment and impacts on livelihoods and food security	▪ Initiating research studies to assess climate impacts, Strengthening the monitoring of climate impact

9. Institutional and Coordination Mechanism

Given the comprehensive nature of the plan, it should be coordinated properly at both levels of implementation, namely, sector level and national level. Therefore, a suitable institutional and coordination mechanism is an indispensable component of the plan. Essential elements of the coordination mechanism are:

- National Focal Point
- Climate Adaptation Cells for Sectors
- National Working Group for Cross-cutting National Adaptation Needs
- CSO Forum

9.1. National Focal Point (NFP)

The National Focal Point (NFP) takes the responsibility of overall coordination of the plan. According to the current institutional set-up, CCS is the most suitable agency to undertake this task. It is necessary to strengthen the capacity of CCS through providing necessary resources and enhancing its staff skills through training.

9.2. Sectoral Climate Cells (SCC) for Sectors

Sectoral Climate Cells (SCC) will be established for vulnerable sectors to coordinate activities within respective sectors. It shall be represented by members of state agencies, private sector, community organizations and NGOs who are key stakeholders of a given sector. For instance, climate cell of the coastal sector should be represented by state agencies such as Coastal Conservation Department, Fisheries Department, NARA and private, community and non-government organizations involved in the coastal sector. Climate cell of a given sector/area should coordinate all activities pertaining to implementation and monitoring of activities of that entity.

Nine vulnerable sectors shall be organized under six SCCs as follows.

1. Climate Cell 1: Food security and water
2. Climate Cell 2: Bio-diversity and coastal resources
3. Climate Cell 3: Health
4. Climate Cell 4: Human settlements and infrastructure
5. Climate Cell 5: Tourism, energy, industry and infrastructure
6. Climate Cell 6: Export agriculture

A climate cell will always be coordinated by a representative of CCS. Other government representatives will be nominated by the heads of those agencies upon the request of the

Secretary of the Ministry of Environment. Non-governmental representatives will be invited by the Ministry of Environment. SCCs shall have the full responsibility of implementation of sector action plans with the coordination support from CCS.

9.3. National Working Group for Cross-cutting National Adaptation Needs (NWG)

National Working Group (NWG) will be a consortium of national lead agencies and non-state representatives, again coordinated by staff members of CCS. The NWG has the responsibility of implementation of adaptation actions relating to cross-cutting national issues. National lead agencies are the organizations that look after subjects with cross-cutting mandate. Some examples are Department of Meteorology (climate information), National Science Foundation (research) and Disaster Management Centre (disaster risk management). Cross-cutting issues are national level issues. As in the case of SCCs, government representatives shall be ex-officio members nominated by heads of lead agencies upon the request of Secretary, Environment whereas non-governmental members shall be appointed on invitation. Some lead agencies responsible for cross-cutting issues are:

- *Policy legislations and governance*: Ministry of Mahaweli Development and Environment, Climate Change Secretariat, Ministry of Policy Planning
- *Institutional development*: Ministry of Mahaweli Development and Environment, Climate Change Secretariat
- *International co-operation and partnerships*: External Resources Department, Ministry of Foreign Affairs
- *Resource mobilization*: Ministry of Finance, External Resources Department
- *Research and development*: Ministry of Science and Technology, National Science Foundation, National Research Council, National Science and Technology Commission
- *Technology transfer*: Ministry of Science and Technology, National Science Foundation, National Research Council, National Science and Technology Commission
- *Education, Training and awareness*: Ministry of Mass Media and Information, Ministry of Education, government media agencies, private media agencies, local and international non-governmental organizations, community based organizations
- *Extreme events management*: Ministry of Disaster Management, Disaster Management Centre, National Building Research Organization, Sri Lanka Land Reclamation and Development Corporation
- *Climate information management*: Department of Meteorology, Ministry of Disaster Management, Department of Agriculture, government media agencies, private media agencies
- *Building adaptive capacity*: Ministry of Local governments and Provincial Councils, local and international non-governmental organizations, community-based organizations, Ministry of Disaster Management

9.4. Regional Climate Cells (RCCs)

Regional Climate Cells (RCCs) will be set up according to the requirement for implementation of actions that are specific to a given regional area. These will be represented by the representatives of Provincial Councils, local government bodies, District and Divisional Secretariats in relevant areas upon the request of the Ministry of Mahaweli Development and Environment.

9.5. Civil Society Organizations (CSO) Forum

Forum of Civil Society Organizations (CSO), a group of partner agencies, will be a coordination body established to support actions that have grass root level operations. It will be established to support the implementation and coordination of community-based interventions involved with sectoral and cross-cutting levels proposed by NAP. It will function as a supporting body for both CACs and the NWG.

9.6. National Experts Committee on Climate Change Adaptation (NECCCA)

The National Experts Committee on Climate Change Adaptation (NECCCA) is an already appointed body of technical experts functioning in the advisory capacity to the Ministry of Mahaweli Development and Environment. The NECCCA will continue to function in the same advisory capacity and expected to fulfill an extended role with the launching of NAP. All other institutional bodies will be provided the opportunity for benefiting from the technical advices of the NECCCA through NFP and NSC. Technical Issues arising from implementation of the Plan will be forwarded to NECCCA that will be taken up in periodic meetings of the NECCCA or individual experts according to the technical subjects involved.

9.7. National Steering Committee (NSC)

National Steering Committee (NSC) will be the overall supervisory body of the plan implementation. It will be represented by the selected members of SCCs, RCCs, the NWG and CSOs appointed by the Ministry of Mahaweli Development and Environment. Members will be appointed to represent all sectors and regions as far as possible. The main roles of the NSC will be providing the overall leadership for implementation of the Plan, monitoring the progress of implementation, guiding the periodic review of the Plan according to the schedule and making decisions on necessary course correction adjustments.

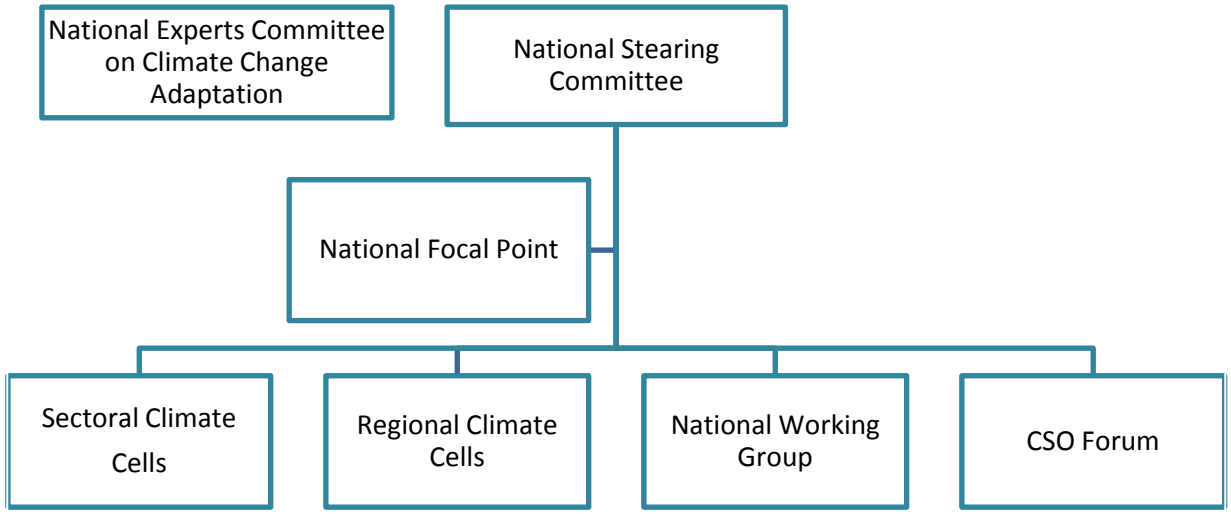

Figure 3: Structure of Institute and Coordination Mechanism

10.Implementation Strategy

The key objectives of the implementation strategy are efficient implementation of planned actions of adaptation on a realistic timeframe and ensuring the participation of all stakeholders from government, private sector, academia, civil society organizations and local communities to achieve the maximum level of cooperation.

The NAP identifies adaptation actions at three levels.

- Sector level actions: These actions are focused on individual sectors or joint sectoral actions
- National level actions: These actions are focused on cross-cutting issues
- Community level actions: Actions that are targeted at the grass-root level

10.1. Implementation of Sector Level Actions

Sector level actions will be implemented by SCCs. The role of CCS within a climate cell is facilitation and coordination. Climate cells will function as working groups on sectoral adaptation actions. Adaptation actions within a cell may involve interventions confined to individual sectors as well actions that need joint implementation with other cells (e.g. drinking water (water) and housing (human settlements). For actions confined to individual sectors, the responsible line agency (or agencies) may directly coordinate with CCS to implement the action within the purview of the cell. CCS may facilitate by helping to attract necessary financial opportunities and other resources. In case of actions that need joint implementation by agencies coming under different SCCs, the CCS, as the common coordinator of all cells, may facilitate creating inter-cell linkages. Hence, CCS is supposed fulfill intra-cell as well inter-cell coordination.

10.2. Implementation of National Level (cross-cutting) Actions

National level adaptation actions that deal with cross-cutting issues will be handled by the NWG. The convener of the working group is CCS and other members are national lead agencies. National level actions may require coordination among lead agencies within the NWG as well as coordination between lead agencies (of NWG) and sectoral line agencies (SCCs). Again the CCS shall act as the common facilitator within the NWG as well as between NWG and SCCs. This is critical for integrated actions and could help forging 'fast track' channels for fundraising from national and international sources.

10.3. Implementation of Regional Level Actions

Sector level actions will be implemented by SCCs. The role of CCS within a climate cell is

facilitation and coordination. Climate cells will function as working groups on sectoral adaptation actions. Adaptation actions within a cell may involve interventions confined to individual sectors as well actions that need joint implementation with other cells (e.g. drinking water (water) and housing (human settlements).

10.4. Implementation of Community Level Actions

Membership of the NWG as well as SCCs shall include representatives from CSOs and community organizations. Besides, there is CSO Forum. Both, sectoral and national level actions may need working at the grass-root level with local communities and CSOs. Actions that need to be focused at the community level could use the help of community organizations and CSOs that include both national and international NGOs. These organizations can act as mobilizers for community level actions. The CSO forum provides an additional platform for coordination among such organizations.

10.5. Monitoring and Evaluation

The NAP is a rolling plan with a 10 year time horizon. Hence, setting up of a viable mechanism for monitoring the progress of implementation should be an essential component of the Plan. Moreover, given the uncertainties involved with climate change impacts and rapidly increasing knowledge on the subject, updating the Plan periodically to match the changing conditions, increased understanding of issues and new information acquired also is mandatory.

Progress monitoring of the Plan: Progress of the plan to be monitored against the time plan of actions presented in Tables A10-A19. Progress of the each sectoral plan and the cross-cutting plan are to be reviewed bi-annually by the respective SCCs and the NWG. Similarly, progress of regional and community-based actions is to be monitored every six months by RCCs and the CSO Forum. At the end of each year, progress of all sectors and the cross-cutting action plan shall be reviewed by the NSC at an Annual Progress Meeting where necessary path correction decisions will be taken. The progress reports will be submitted to the NECCCA for further advice and comments on the corrective course of action. To undertake the monitoring in an objective manner, all SCCs, RCCs, NWG and the CSO forum will have to prepare suitable log frame structures for each sector and cross-cutting area.

Periodic revision and updating of the Plan: The NAP as a rolling plan shall undergo two periodic revisions for updating the overall plan as follows.

***First periodic revision*:** The first three years of the Plan will be the *Foundation Building Stage.* At the end of this phase plan will have to undergo and periodic revision and updating. This will take place in the final quarter of the third year and the updated plan will be submitted for approval of the Annual Progress

Meeting of the third year. The revision has to be undertaken through an extensive consultation of stakeholders at decision-making as well as field level.

***Second periodic revision*:** The Plan enters the *Development Stage* after the first periodic revision. At the end of this stage, the second periodic revision will be conducted. The second periodic revision of the NAP shall be carried out in the final quarter of the third year and the updated plan will be submitted for approval of the 6th Annual Progress Meeting.

***The post-plan review*:** The last four years of the plan will be the *Goal Achieving Stage*. After the completion of the 10th year of the Plan, a post-Plan review shall be undertaken to assess the overall achievements of the Plan and identify the lessons for future plans.

11. Resource Mobilization Mechanism

Resource mobilization is a major issue to be faced in all adaptation interventions in Sri Lanka. Therefore success of achieving the goals of the plan depends heavily on devising an effective mechanism for resource mobilization. It should be a proactive programme for acquiring resources necessary for implementation of the plan.

11.1. Types of Resources Needed

Implementation of NAP requires many resources in the form of financial, technical and human resources. Almost all the activities require financial resources while some may need technical and human resources also. Quite often, sourcing of the technical and human resources are conditional upon the access to financial resources. Therefore among resources, financial resources are the most critical for implementation of the adaptation actions both at national and sector levels. Following main sources are proposed in securing the necessary resources for adaptation actions.

11.2. Sources of Financing

National Adaptation Fund (NAF): The plan proposes to establish a National Adaptation Fund (NAF). The NAF will have seed funding from the government budget as an annual allocation for a specified period. In addition, the government shall seek co-financing from donor community to develop an endowment for supporting all types of adaptation actions in Sri Lanka. This fund will provide opportunities for fully funded initiatives and co-funded opportunities. For example, NAF will share a part of the cost of certain adaptation actions and the rest would come from local or an international funding source. The management of NAF will be a joint responsibility of the Ministry of Finance and Ministry of Environment. For both national and sectoral actions of NAP, allocation of money from NAF will be made upon the recommendation of CCS.

International adaptation funding opportunities: There are several international organizations that offer funding for adaptation interventions. Some examples are Asian Development Bank (ADB), World Bank (WB), GEF (UNDP), other United Nations organizations such as UNHABITAT, UNESCAP and Green Climate Fund (GCF). Both national adaptation actions and sectoral adaptation actions can be funded through these initiatives. Proposed national adaptation actions can be formulated in to project proposals and submitted for donor funding by the NWG or CACs. The CCS might not be able to approach these funding organizations directly, but through the External Resources Department (ERD), which is again a representative of the NWG. The same procedure can be followed for any adaptation actions to be implemented thorough CACs.

Funds for specialized adaptation related research and development: The National Science Foundation (NSF) and the National Research Council (NRC) are the two main government

institutions that facilitate small and large grants for scientific research in Sri Lanka. These two institutes fall under the Ministry of Science and Technology and will be member institutions of the NWG. These organizations may help developing dedicated funding facilities for thematic research on climate change adaptation.

Private sector funding opportunities: Another source of funding is the corporate sector. Private sector organizations usually allocate funds for Cooperate Social Responsibility (CSR). Climate change adaptation projects can be a recipient of such CSR funding. However, this is not a fully explored channel and therefore creation of awareness would matter most. Approaching these institutions can be facilitated by CCS.

Funding through Community Service Organizations: While the size of support expected from these sources may be low in terms of cash, there is plenty of human resources that can be used through this channel. These types of funding opportunities are ideal for adaptation measures that are targeting community level actions.

Tentative budget estimates are given in Tables A10-A19 with the time plan of actions. The figures given in the tables are gross estimates validated by the stakeholders in the workshops. However, these figures cannot be entirely relied upon and they only offer comparative first estimates that should provide the foundation for working out detailed budgets for respective actions.

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13. Appendices

Table A-1: Physical effects, impacts, adaptation needs and adaptation options – Food security

Physical effects	Physical hazards/vulnerabilities	Impacts	Socio-economic outcomes	Adaptation need	Adaptation options
• **Increased day and night air temperature** • **Increased evaporation and evapo-transpiration** • **Regular and extended dry spells** • **Increased frequency and severity of droughts**	• Increased thermal/heat stress on crops • Increased thermal/heat stress on animals • Increase water stress on crops • Regular shortages of water • Decrease in water availability in reservoirs • Reduction of soil moisture • Increased soil salinity • Decreased soil quality	• Decline of crop productivity • Decline of animal productivity • Decline of fish productivity in reservoir fisheries • Regular Crop losses	• Loss income to farmers • Loss of income to livestock producers • Loss of income to inland fishermen • Loss of livelihood opportunities	1. Enhance the resilience of crops, animals, fish and agro-ecosystems against heat and water stress	A. Germplasm improvement B. Improvement of farm water management C. Promotion of resource efficient farming systems D. Sectoral Capacity development
• **Alteration of thermal ranges for biological organisms (pests, pathogens, parasites, vectors)**	• Increased risk of pest and disease attacks on crops • Increased risk of parasite and disease attacks on livestock	• Increased crop damage due to pests and diseases • Increased health risks of farm animals	• Increased cost of plant protection • Increased cost of animal health management	2. Minimize the risk of crop and health damage due to biological agents	A. Germplasm improvement B. Strengthening of supporting facilities C. Promotion of best practices

• **Irregular/erratic changes in established rainfall patterns**	• Impacts on flowering of crops • Changing pasture availability for livestock	• Decline of crop productivity • Crop losses • Fluctuation in animal production	• Loss income to farmers • Loss of income to livestock producers	3. Minimize the impact on food security due to erratic changes in precipitation	A. Climate information management B. Improvement of pasture and fodder management	
• **Regular incidents of intense rainfall with high cloud cover** • **Increased frequency and severity of floods** • **Increased frequency and severity of droughts** • **Cyclones and high winds**	• Increased drainage and water logging problems • Increased soil erosion • Increased susceptibility of crops and livestock to floods hazards • Increased susceptibility of crops and livestock to droughts • Landslides • Turbulent conditions in the sea	• Decline of crop productivity • Crop losses • Decline of animal productivity • Decline of fish productivity in reservoir fisheries • Loss of livestock assets • Depletion of fish stock in reservoirs	• Life and property damages • Loss income to farmers • Loss of income to livestock producers • Disturbance to livelihood of fishermen • Loss income to fishermen	4. Enhance the resilience of crops, animals, fish and agro-ecosystems to extreme weather events	A. Germplasm improvement B. Establishment of an efficient climate information management and communication system C. Improvement of disaster risk preparedness and management	
• **Salt water intrusion** • **Inundation of low-lying areas**	• Increased soil salinity in coastal areas • Increased water salinity in coastal areas • Increased coastal erosion • Damage to coastal habitats	• Decline in agricultural productivity • Salinity development in agricultural lands • Damage to livelihoods based on coastal habitats	• Loss income to farmers • Loss of agricultural lands • impacts on livelihoods of coastal and lagoon fishermen	5. Minimize the impacts of sea level rise on agriculture in coastal zone	A. Germplasm improvement B. Strengthening the monitoring of climate impacts C. Exploring alternatives	

• **Ocean acidification** • **Physiochemical changes in oceanic environment**	• Damage to coral reefs • Structural changes oceanic habitats and composition of species	• Changes in reef fish stocks • Stock changes in economically important species	• Impacts on livelihoods to fishermen	6. Assess the changes in oceanic environment and impacts on livelihoods and food security	C. Initiating research studies to assess climate impacts D. Strengthening the monitoring of climate impacts
• **Rising atmospheric CO_2 concentration**	• Increased photosynthesis in certain plant categories	• Increased productivity in certain crops • Increased weed populations	• Income gains for farmers • Increased cost of plant protection	7. Assess the impacts of rising atmospheric CO_2 on productivity crops and weed populations	A. Initiating research studies to assess climate impacts

Table A-2: Physical effects, impacts, adaptation needs and adaptation options – Water resources

Physical effects	Physical hazards/vulnerabilities	Impacts	Socio-economic outcomes	Adaptation need	Adaptation options
• **Increased day and night air temperature** • **Increased evaporation and evapo-transpiration** • **Regular and extended dry spells** • **Increased frequency and severity of droughts** • **Irregular/erratic changes in established rainfall patterns**	• Regular fluctuation of water availability in major/medium reservoirs • Rapid dry out of minor irrigation facilities • Poor and disturbed flow in streams • Decreased quality of water due to high salinity • Depletion of ground water sources	• Decreased availability of safe water for human consumption • Decreased availability of water for irrigation • Decreased availability of water for industrial supply • Decreased water quality and safety	• Supply constraints of safe water for domestic use • Loss of income for farmers • Loss of livelihood opportunities • Increased cost of industrial water supply	1. Enhance the resilience of systems for water supply, management and use to overcome the scarcities caused by climate change impacts	A. Improvement of watershed management B. Capacity development of storage facilities C. Initiating research studies to assess climate impacts D. Strengthening the monitoring of climate impacts E. Promote efficient practices of water management and use

• **Regular incidents of intense rainfall** • **Increased frequency and severity of floods** • **Increased frequency cyclones and high winds**	• Problems of drainage and water logging conditions. • Rapid siltation of reservoirs • Damage to irrigation structures • Damage to domestic and industrial water supply structures • Decrease in quality of water due to – sediment wash off – Pollution of drinking water	• Wastage (unutilized) of water in periods of excess rainfall • Disturbances domestic water supply • Disturbances to irrigation • Disturbance to industrial water supply • Loss of storage capacity of reservoirs	• Problems of water quality and safety for human consumption • Increased cost of rehabilitation and maintenance • Increased cost of drainage • Life and property damages	2. Ensure the safety of water management facilities and minimize disturbances to supply due to extreme weather events	A. Strengthening the monitoring of climate impacts B. Establishment of an efficient climate information and communication system C. Improvement of disaster risk preparedness and management D. Capacity development of storage facilities
• **Salt water intrusion** • **Inundation of low-lying areas**	• Decline of water quality due to increased salinity • Damage to irrigation structures • Damage to domestic and industrial water supply facilities	• Decreased availability of fresh water for human consumption • Decreased availability of water for irrigation due to high salinity • Decreased quality of water for industrial supply	• Supply constraints of safe water for domestic use • Loss of income for farmers • Increased cost of industrial water supply	3. Minimize the impacts of sea level rise on water supply and management in coastal zone	A. Strengthening the monitoring of climate impacts B. Improve salinity protection measures in coastal areas

Table A-3: Physical effects, impacts, adaptation needs and adaptation options – Coastal and marine sector

Physical effects	Physical hazards/vulnerabilities	Impacts	Socio-economic outcomes	Adaptation need	Adaptation options
• **Inundation of low-lying areas (sea level rise)**	• Shoreline retreat • Increased coastal erosion • Damage to coastal habitats (estuaries& lagoons, mangroves, salt marshes, beaches, sand dunes, coral reefs, sea grass beds, deltas, islands, barrier beaches and spits) • Effects on estuaries and river mouths	• Damages to coastal protection structures • Decline in beach stability • Loss of eco-system services • Loss of lands	• Impacts on livelihoods of local communities • Increased cost of coastal protection • Increased scarcity of lands	1. Strengthen the coastal zone management to face the impacts of sea level rise	A. Initiating research studies to assess impacts of sea level rise B. Establishment of a sea level rise monitoring system C. Strengthening the coastal protection and management D. Participatory management of sensitive coastal habitats
• **Irregular/erratic changes in established rainfall patterns** • **Regular incidents of intense rainfall** • **Increased incidence of cyclones and high winds**	• Increased incidence of storm surges, tidal waves and turbulent conditions. • Damage to coastal habitats (estuaries& lagoons, mangroves, salt marshes, beaches, sand dunes, coral reefs, sea grass beds, deltas, islands, barrier beaches and spits)	• Damages to coastal protection structures • Decline in beach stability • Loss of eco-system services	• Loss of livelihoods/income to extractors of coastal resources • Increased cost of coastal protection	2. Enhance the resilience of coastal systems against increased extreme events	A. Improvement of disaster risk preparedness and management

Table A-4: Physical effects, impacts, adaptation needs and adaptation options – Health

Physical effects	Physical hazards/vulnerabilities	Impacts	Socio-economic outcomes	Adaptation need	Adaptation options
• **Irregular/erratic changes in precipitation pattern** • **Alteration of thermal ranges for biological organisms (pests, pathogens, parasites, vectors)** • **Boundary shift in climatic zones**	• Increased risk of spreading of existing vector borne-diseases (e.g. Dengue, malaria) • Increased risk spreading of pathogenic diseases • Risk of new areas becoming susceptible to vector bone and pathogenic diseases • Increased risk of new vector bone disease outbreaks (e.g. leishmaniasis)	• Increased mortality due to vector borne and pathogenic diseases • Increased morbidity due to vector borne and pathogenic diseases • Reduced capacity of victims for productive work	• Increased cost of prevention and treatment • Loss of value and income due to reduced number of workdays • Psychological trauma and stress due to victimization	1. Assess and prepare for the health risks due to increased vector bone and pathogenic diseases	A. Conducting research studies to assess the risk of climate-induced diseases B. Strengthening the surveillance and monitoring of climate- induced diseases C. Capacity development for managing climate-induced disease incidents
• **Increased frequency and severity of floods** • **Cyclones and high winds** • **Lightening** • **Landslides**	• Increased risk of outbreaks of food and water borne diseases • Increased number of injuries and mortalities due to victimization to hazard events • Health and sanitation problems due to poor access to water	• Increased susceptibility to health hazards among disaster victims	• Increased cost of health care management and treatment of victims • Psychological trauma and stress due to victimization	2. Minimize the health hazards associated with increased incidence of extreme events	A. Establishing an efficient climate information and communication system B. Improvement of disaster risk preparedness of health related agencies and workers

• **Increased concentration of climate altering pollutants**	• Increased risk of diseases and ill-health conditions (e.g. respiratory, cardio-vascular, skin diseases, neurological, carcinogenic)	• Increased mortality due to diseases and ill-health conditions • Increased morbidity due to diseases and ill-health conditions • Reduced capacity of victims for productive work	• Increased cost of prevention and treatment • Loss of value and income due to reduced number of workdays • Psychological trauma and stress due to victimization	3.	Assess and prepare for health risks caused by concentration of climate altering pollutants	A. Conducting research studies to assess health impacts of climate altering pollutants B. Improvement of monitoring of climate altering pollutants C. Capacity development for managing health impacts of climate altering pollutants
• **Increased day and night air temperature** • **Increased concentration of dust/ soil particles in atmosphere** • **Heat island effect**	• Increased risk of ill-health conditions due to heat stress • Probability for decline in cold related diseases, (e.g. influenza, common cold) • Increased risk of respiratory and eye diseases	• high rate of morbidity • Reduced capacity of victims for productive work	• Increased cost of prevention and treatment • Loss of value and income due to reduced number of workdays • Psychological trauma and stress due to victimization	4.	Assess the impact on health due to increased heat and thermal stress	A. Conducting research studies to assess health impacts of heat/thermal stresses and to protect the victims

Table A-5: Physical effects, impacts, adaptation needs and adaptation options – Human settlements and infrastructure

Physical effects	Physical hazards/vulnerabilities	Impacts	Socio-economic outcomes	Adaptation need	Adaptation options
• **Increased day and night air temperature** • **Increased evaporation and evapo-transpiration** • **Regular and extended dry spells** • **Increased frequency and severity of droughts** • **Increased concentration of dust/ soil particles in atmosphere** • **Heat island effect**	• Increased thermal stress on residents • Accelerated deterioration of infrastructure facilities: e.g. thermal cracks • Increased thermal stress on domestic animals • Increased exposure to pollutants • Increased exposure to air pollution due to poor wind movements	• Decrease in living comfort • Increased dependence on indoor living environments • Reduction in walkability and cyclability • Increased demand for energy and water supply	• Increased cost on indoor environment controlling facilities • Increased maintenance costs of infrastructure • Increased cost of sanitation and healthcare of domestic animals • Increased cost on energy and water supply • Increased cost of protection from pollution	1. Enhance the resilience of human settlements and infrastructure against heat and water stress	A. Improvement and promotion of building designs and the environment (landscaping etc.) for climate resilience B. Revision of procedures and guidelines C. Initiating research studies to assess climate impacts D. Sectoral Capacity development
• **Irregular/erratic changes in established rainfall patterns** • **Regular incidents of intense rainfall with high cloud cover**	• Impacts on drainage and sewerage systems • Accelerated deterioration of infrastructure facilities	• Decrease in living comfort • Increased dependence on indoor living environments • Reduction in walkability and cyclability • Periodic overcrowding of the capacity of Infrastructure facilities. E.g. Drainage system	• Increased maintenance costs of infrastructure facilities • Disturbance to livelihoods of rural, estate and urban poor	2. Minimize the impacts on human settlements and infrastructure due to erratic changes in precipitation	A. Enhance the capacity of infrastructure in urban settlements B. Promote water safety and efficient utilization of surplus water

• **Increased frequency and severity of floods** • **Increased frequency and severity of droughts** • **Cyclones and high winds** • **Land slides**	• Damage to housing and settlements • Damage to infrastructure facilities • Decline of water quality • Damages to critical social facilities: health, security, education, communication	• Increased incidences of diseases and injury • Increased demand for health and sanitation facilities • Problems of supply/distribution of water	• Life damages • Displacement of people • Damage to property and livelihood assets • Loss of livelihoods and income • Increased rehabilitation and maintenance cost	3. Enhance the resilience of human settlements and infrastructure to extreme weather events	A. Promotion of disaster resilient buildings and construction B. Improvement of disaster risk preparedness and management
• **Salt water intrusion** • **Inundation of low-lying areas**	• Damage to housing and settlements • Damage to near-shore infrastructure • Impacts on sea outfalls • Increased salinity of water sources • Accelerated deterioration of structures – concrete, steel materials	• Impacts on settlements – fishers, tourism • Problems of water supply – both pipe borne and well water	• Damage to property and livelihood assets • Loss of lands • Displacement of people and unplanned settlements • Increased maintenance costs of structures	4. Minimize the impacts of sea level rise on coastal settlements and infrastructure	A. Increase the resilience of coastal settlements B. Strengthening the monitoring of sea level rise

Table A-6: Physical effects, impacts, adaptation needs and adaptation options – Ecosystems and biodiversity

Physical effects	Physical hazards/vulnerabilities	Impacts	Socio-economic outcomes	Adaptation need	Adaptation options
• **Increased day and night air temperature** • **Increased evaporation and evapo-transpiration** • **Alteration of thermal ranges for biological organisms** • **Regular and extended dry spells** • **Increased frequency and severity of droughts** • **Irregular/erratic changes in established rainfall patterns** • **Boundary shift in climatic zones**	• Increased thermal/heat stress on flora • Increased thermal/heat stress on fauna • Changes in structure and composition of natural ecosystems • Changes in spatial distribution of natural vegetation • Drying out of wetlands due to increased evaporation • Eutrophication of water bodies and wetlands • Coral bleaching • Migration of species • Forest die-back • Migration of species due to water stress • Drying out of streams	• Decline of ecosystem services • Increased risk of wild fires • Loss of aesthetic value • Risk of extinction of species • Decreased availability of water to surrounding areas • Increased risk of human wildlife conflicts	• Impacts on livelihoods of local communities • Problems of water scarcity for local communities • Increase cost of managing wild fires • Life and property damages • Crop and livestock losses	1. Enhance the resilience of natural ecosystems and biodiversity against climate change impacts	A. Initiating research studies to assess climate impacts B. Extend the existing biodiversity protection interventions to cover climate change impacts C. Strengthening the monitoring of climate impacts D. Enhance the participation of local communities in monitoring, conservation and management of biodiversity E. Promotion of traditional methods of biodiversity conservation for increased resilience in agro-ecosystems F. Sectoral Capacity development

• **Regular incidents of intense rainfall with high cloud cover** • **Increased frequency and severity of floods** • **Increased frequency and severity of droughts** • **Cyclones and high winds**	• Physical damages to natural ecosystems • Increased mortality and stress on fauna • Migration of species	• Decline of ecosystem services • Negative externalities on local communities	• Impacts on livelihoods of local communities	2. Enhance the resilience of natural ecosystems against extreme weather events	G. Improvement of disaster risk preparedness and management
• **Salt water intrusion** • **Inundation of low-lying areas**	• Increased salinity levels in coastal ecosystems • Structural changes in coastal habitats and composition of species	• Changes in coastal biodiversity • Loss of eco-system services	• impacts on livelihoods of coastal resource extractors	3. Minimize the impacts of sea level rise on coastal bio-diversity and ecosystem services	A. Initiating research studies to assess climate impacts B. Strengthening the monitoring of climate impacts
• **Physiochemical changes in oceanic environment**	• Structural changes oceanic habitats and composition of species	• Changes in oceanic biodiversity and food chains	• Impacts on livelihoods to fishermen	4. Assess the impact of thermal changes in oceanic bio-diversity and food chains	A. Initiating research studies to assess climate impacts B. Strengthening the monitoring of climate impacts

• **Rising atmospheric CO_2 concentration**	• Increased photosynthesis in certain plant categories	• Increased biomass production of natural vegetation • Spread of invasive alien species (C3 species)	• Increased harvest from economically useful species • Income gains for local communities • Increase cost of controlling invasive alien species	5. Assess the impacts of rising atmospheric CO_2 on biomass production of natural vegetation and spread of invasive alien species	A. Initiating research studies to assess climate impacts

Table A-7: Physical effects, impacts, adaptation needs and adaptation options – Tourism and recreation

Physical effects	Physical hazards/vulnerabilities	Impacts	Socio-economic outcomes	Adaptation need	Adaptation options
• **Increased day and night air temperature** • **Regular and extended dry spells** • **Increased frequency and severity of droughts** • **Inundation of low-lying coastal areas Ocean acidification** • **Progressive increase in acidity of rainfall**	• Degradation of natural ecosystems and biodiversity • Drying out of wetlands • Eutrophication of water bodies and wetlands • Forest die-back • Drying out of streams • Destruction of coastal ecosystems • Loss of beaches and recreational areas • Destruction of coral reefs • Damages to monuments and archeological assets	• Decline of scenic attractions and aesthetic value • Decline of cultural assets • Loss of recreation opportunities • Damages to tourism infrastructure	• Decline of attractiveness as a tourism destination • Losses in tourism operations • Livelihoods impacts on local communities involved in tourism • Reduced earnings from tourism	1. Adjustment of tourism and recreation industry to altered conditions of the destination	A. Initiating research studies to assess climate impacts B. Operational adjustments in the industry C. Changing of promotional strategies
• **Irregular/erratic changes in established rainfall patterns** • **Increased frequency and severity of floods** • **Cyclones and high winds** • **Land slides**	• Creation of unsuitable conditions for travelling • Creation of unsuitable conditions for recreation • Increased incidents of disaster situations	• Restrictions on aviation • Restrictions on local travelling • Restrictions on undertaking recreational activities • Increased of emergencies in travelling	• Disturbances to tourism operations • Impacts on livelihoods of local communities	2. Increase the preparedness of tourism and recreation operations to extreme weather conditions	A. Improvement of disaster risk preparedness and management B. Establishment of an efficient climate information management and communication system

Table A-8: Physical effects, impacts, adaptation needs and adaptation options – Export development sector

Physical effects	Physical hazards/vulnerabilities	Impacts	Socio-economic outcomes	Adaptation need	Adaptation options
• **Increased day and night air temperature** • **Increased evaporation and evapo-transpiration** • **Regular and extended dry spells** • **Increased frequency and severity of droughts**	• Increased thermal/heat stress on crops • Increase water stress on crops • Regular shortages of water for extended periods • Reduction of soil moisture • Increased soil salinity • Decreased soil quality	• Decline of crop productivity (tea, rubber, coconut, spices, sugar and cashew) • Decline of the quality of products • High mortality and low survival in nursery and replanting operations • Potential increases in productivity of up country tea (WU)	• Loss of income for plantation workers and small scale producers • Decrease in export earnings • Increased cost of production • Potential Increase in earnings of up country tea (WU)	1. Enhance the resilience of export agricultural crops against the impacts of heat and water stress	A. Germplasm improvement B. Improvement of farm and nursery management practices C. Initiating research studies to assess climate impacts D. Sectoral Capacity development
• **Alteration of thermal ranges for biological organisms (pests, pathogens, weeds)**	• Increased risk of pest and disease attacks on crops	• Increased crop damage due to pests and diseases	• Increased cost of plant protection	2. Minimize the risk of crop damage due to biological agents	A. Germplasm improvement B. Improvement of farm and nursery management practices C. Monitoring and surveillance of pest and disease

• **Irregular/erratic changes in established rainfall patterns** • **Regular incidents of intense rainfall with high cloud cover**	• Low solar radiation • Drainage problems • High soil erosion • High number days with intense rainfall: increased vulnerability to rainfall shocks • High humidity and moisture • Disturbance to cultural operations • Problems of pollination • Increased vulnerability of new plantations in non-traditional areas	• Decline of crop productivity (tea, rubber, coconut, spices, sugar and cashew) • Decline of the quality of products • High mortality and low survival in nursery and replanting operations • Increased risk of diseases • Loss of number of harvesting days	• Loss of income for plantation workers and small scale producers • Decrease in export earnings • Increased cost of production	3. Minimize the impact on export earnings from agriculture due to erratic changes in precipitation patterns	A. Establishment of an efficient climate information management and communication system B. Improvements in cropping systems
• **Increased frequency and severity of floods** • **Increased frequency and severity of droughts** • **Cyclones and high winds**	• Increased drainage and water logging problems • Increased soil erosion • Increased susceptibility of crops to flood hazards • Increased susceptibility of crops to droughts • Landslides	• Physical damage to plantations and trees • Crop losses due to floods • Crop losses due to drought • Chronic declining of the vigor of plants • Fire damage on crops • Decline in Quality of products • High mortality and low survival in nursery and replanting operations • Loss of agricultural lands hilly areas	• Damage to plantations Properties • Loss of income for plantation workers and small scale producers • Decrease in export earnings • Increased cost of production	4. Enhance the resilience of export agricultural crops to extreme weather events	A. Establishment of an efficient climate information management and communication system B. Improvement of disaster risk preparedness and management

• **Salt water intrusion** • **Inundation of low-lying areas**	• Increased soil salinity in coastal areas • Increased water salinity in coastal areas • Inundation of agricultural lands	• Decline in agricultural productivity • Salinity development in agricultural lands • Loss of agricultural lands (coconut, cinnamon, cashew)	• Loss of income for producers and plantation workers in coastal areas	5. Minimize the impacts of sea level rise on export agricultural crops in coastal zone	A. Strengthening the monitoring of climate impacts B. Development of protection structures

Table A-9: Physical effects, impacts, adaptation needs and adaptation options – Industry, energy and transportation

Physical effects	Physical hazards/vulnerabilities	Impacts	Socio-economic outcomes	Adaptation need	Adaptation options
• **Increased day and night air temperature** • **Increased evaporation and evapo-transpiration** • **Regular and extended dry spells** • **Increased frequency and severity of droughts** • **Irregular/erratic changes in established rainfall patterns**	• Regular fluctuation of water availability in hydro power reservoirs • Increased thermal/heat and water stress on crops and animals • Increased thermal/heat stress in industrial facilities	• Fluctuation in hydro power generation potential • Supply irregularities in agro-based raw materials	• Reduction in low cost hydro power generation • Decline in agro-based industrial production • Increased cost on environment controlling facilities	1. Minimize the impacts of rising temperature and periodic scarcity of water on energy, industry and transportation	A. Improvement of watershed management B. Capacity development of storage facilities C. Initiating research studies to assess climate impacts D. Strengthening the monitoring of climate impacts E. Promote efficient practices of water management and use

• **Regular incidents of intense rainfall** • **Increased frequency and severity of floods** • **Increased frequency cyclones and high winds**	• Rapid siltation of hydro power reservoirs • Unfavorable conditions for transportation • Damage to transport infrastructure • Damage to energy and industrial facilities	• Rapid decrease in the capacity of hydropower reservoirs • Disturbances to road, sea and air transportation • Increased congestion and travel time in transportation • Increased risk of accidents • Damages to energy and industrial facilities	• Decline in hydro power generation capacity • Increased cost of transportation • Increased maintenance and rehabilitation cost of transportation infrastructure	2.	Minimize the impacts of extreme weather events on energy, industry and transportation	A. Strengthening the monitoring of climate impacts B. Establishment of an efficient climate information and communication system C. Improvement of disaster risk preparedness and management D. Capacity development of storage facilities
• **Inundation of low-lying areas**	• Vulnerability of industries based on coastal areas: e.g. salt, coir and coconut-based industries, mineral sands, boat building industries • Risk of damage on coastal infrastructure: e.g. roads, railways, transmission lines • Long-term risk of submergence of infrastructure and production facilities: energy, transportation and industry	• Decline of coastal industries • Damage to transport infrastructure in coastal areas • Damage to energy infrastructure: transmission • Loss of infrastructure, production and generation facilities	• Loss of income from coastal industries • Increased cost of rehabilitation and maintenance • Cost of new infrastructure • Cost of relocation of industries	3.	Minimize the impacts of sea level rise on energy, transportation and industrial facilities	A. Strengthening the monitoring of climate impacts B. Improve salinity protection measures in coastal areas

Table A-10: Time plan and budget – Food Security

Adaptation need	Adaptation option	Action	Time (years)										Proposed budget (Rs. Millions)
			1	2	3	4	5	6	7	8	9	10	
Enhance the resilience of crops, animals, fish and agro-ecosystems against heat and water stress	Germplasm improvement	Screen existing varieties/breeds for heat and water stress.											20
		Develop tolerant varieties (paddy, OFC, horticulture)											20
		Develop heat tolerant breeds (livestock)											20
	Improvement of farm water management	Reduce field-level irrigation water losses											15
		Promote micro-irrigation techniques											15
		Develop water efficient farming methods											15
		Promote on-farm rainwater harvesting											15
	Promotion of resource efficient farming systems	Improve cropping systems and conservation farming practices											8
		Improve nursery protection											8
		Introduce flower induce techniques in fruits											10
		Increase the use organic matter to improve soil quality(Integrated plan nutrient management)											8
		Promote low-water demanding crops and varieties and crop diversifications											8
		Promote the intensive management of livestock											8
	Sectoral Capacity development	Develop research institutes' capacity for conducting research on tolerant varieties and water efficient farming methods.											100
Minimize the risk of crop and health damage due to biological agents	Germplasm improvement	Screen existing varieties/breeds for pest and disease resistance.											20
		Develop pest resistant varieties (paddy, OFC, horticulture)											20
		Develop disease resistant breeds (livestock and poultry)											20

	Strengthening of supporting facilities	Strengthen vaccination programmes										15
		Develop pest forecasting system										20
		Conduct research on parasites and diseases										20
		Promote crop clinics										10
	Promotion of best practices	Promote integrated pest management										10
Minimize the impact on food security due to erratic changes in precipitation	Establishment of an efficient climate information management and communication system	Develop a system for timely issuing of seasonal and medium -term weather forecasts										30
		Adjust cropping calendars according to the seasonal climate forecasts										5
	Improvement of pasture and fodder management	Diversify into livestock feeds other than naturally grown pasture										5
		Promote silage and hey production										5
		Promote techniques of fodder production and conservation										5
Enhance the resilience of crops, animals, fish and agro-ecosystems to extreme weather events	Germplasm improvement	Screen existing varieties for tolerance to extreme events										20
		Develop tolerant varieties (paddy) – drought, flood										20
		Develop tolerant verities (OFC and horticulture) for moisture stress (deficit and excess)										10
	Establishment of an efficient climate information management and communication system	Develop a system for timely issuing of short-term weather forecasts										30
		Strengthen the early warning systems										20
		Strengthen fishing Vessel monitoring and tracking system										100
		Develop mobile phone based communication systems										30
		Develop safety plans and promote use of safety equipment										15
	Improvement of disaster risk	Identify and collect information on areas most vulnerable to flood and drought hazards										20

	preparedness and management	Identify food storage capacities in vulnerable areas										8
		Develop buffer stocks and maintain them regularly										30
Minimize the impacts of sea level rise on agriculture in coastal zone	Germplasm improvement	Screen existing varieties for tolerance to salinity										20
		Develop salinity/alkalinity tolerant varieties (paddy)										20
	Strengthening the monitoring of climate impacts	Monitor regularly the development of salinity/ alkalinity levels										15
		Strengthen the sea water depends structures to control sea water intrusions to coastal paddy lands										30
	Exploring alternatives	Convert severely affected paddy lands for other uses (e.g. brackish water aquaculture)										10
Assess the changes in oceanic environment and impacts on livelihoods and food security	Initiating research studies to assess climate impacts	Assess long-term structural changes oceanic habitats and composition of species										5
		Assess climate change impacts on lagoon and coastal fisheries										20
		Assess climate change impacts on reef fish stock										20
	Strengthening the monitoring of climate impacts	Initiate long term monitoring of essential bio-physical parameters (National monitoring programme)										20
Assess the impacts of rising atmospheric CO_2 on productivity crops and weed populations	Initiating research studies to assess climate impacts	Conduct research studies on impact of increased CO_2 on agriculture Productivity of crops Weed populations										50

Table A-11: Time plan and budget – Water resources

Adaptation need	Adaptation option	Action	Time (years)										Proposed budget (Rs. Millions)
			1	2	3	4	5	6	7	8	9	10	
Enhance the resilience of systems for water resources, management and use to overcome the scarcities caused by climate change impacts	Improvement of watershed management	Identify and map critical watersheds	■	■	■	■							20
		Develop and implement watershed management plans for critical upper watersheds	■	■	■	■	■	■	■	■	■	■	100
		Incorporate water safety plans to all watershed areas	■	■	■	■	■	■	■	■	■	■	20
		Increase the canopy cover in catchment areas	■	■	■	■	■	■	■	■	■	■	30
		Promote conservation farming methods in reservoir catchments	■	■	■	■							10
		Launch participatory cascade management programmes in selected village tank catchments	■	■	■	■	■	■	■	■	■	■	20
		Incorporate effect of climate change for the future water resources development plans	■	■	■	■	■	■	■	■	■	■	20
	Capacity development of water storage facilities	Assess the current facilities and storage options in connection to future projections of climate change	■	■	■	■							50
		Evaluate future options for enhancement of storage facilitates including ground water	■	■	■	■							50
		Develop a road map and investment plan for efficient utilization of existing and future storage options	■	■	■	■							5
		Assess, regularize and preserve ground water resources at local level and utilize effectively	■	■	■	■							15
	Initiating research studies to assess climate change impacts	Assess, short-, medium- and long-term impacts of climate change on water resources and management systems in the country	■	■	■	■							10
		Screen current practices of water management for climate resilience and identify ways to improve them	■	■	■	■							5
		Explore climate resilient indigenous practices of water sector operation management and identify ways to integrate them into modern practices	■	■	■	■							~~10~~

	Strengthening the monitoring of climate change impacts	Initiate a long term monitoring program on essential bio-physical parameters (National monitoring programme)										30
	Promote efficient practices of water management and use	Promote efficient domestic water use practices										20
		Increase the efficiency of irrigation water use and reduce losses										40
		Improve maintenance of existing reservoirs										20
		Promote wastewater recycling for industrial and aqua culture water uses										20
Ensure the safety of water management facilities and minimize disturbances to supply due to extreme weather events	Strengthening the monitoring of climate change impacts	Assess the capacity of existing hydro-meteorological information facilities										5
		Implement necessary improvements ~~to~~ and strengthen accordingly										20
	Establishment of an efficient climate information and communication system	Develop a system for timely issuing of short-term weather forecasts										30
		Strengthen the early warning systems										30
		Assess the traditional knowledge of weather forecasting and integrate them for better forecasts of water availability.										10
		Develop network based (mobile phone or GSM) communication systems										50
		Improve the existing system for timely issuing short term weather forecast and long term (climate) forecast										25
	Improvement of disaster risk preparedness and management	Identify,map and collect other information on areas most vulnerable to flood , droughts and landslides hazards										50
		Develop disaster (flood, drought, landslides) risk management plans for vulnerable areas										10
		Establish necessary facilities for improvement of drainage in susceptible areas										20
		Develop dam safety plans and promote use of safety measures and equipment										10

	Capacity development of storage facilities	Design rational strategies to harness excess water in storage facilities (interbrain, intra-basins and trans-basin approaches).										20
Minimize the impacts of sea level rise on water resources and management of coastal areas and wet lands	Strengthening the monitoring of sea level rise	Monitor the development of salinity levels regularly										20
	Improve salt water intrusion protection measures in coastal areas and wetland	Identify vulnerable areas for saltwater intrusion and develop maps										10
		Strengthen the salinity exclusion structures to control sea water intrusions										50
		Design and construct salinity barriers to protect fresh water resources and agriculture lands										50
		Establish desalinization facilities in affected/vulnerable areas										50

Table A-12: Time plan and budget – Coastal and marine sector

Adaptation need	Adaptation option	Actions	Time (years)										Proposed budget (Rs. Millions)
			1	2	3	4	5	6	7	8	9	10	
Strengthen the coastal zone management to face the impacts of sea level rise	Initiating research studies to assess impacts of sea level rise	Study impacts of sea level rise on coastal habitats over short-medium- and long-term horizons											50
		Study erosion trends and identify appropriate protection measures											20
		Conduct research studies on coastal water quality and hydro dynamics in relation to climate change impacts											50
		Establish regional collaborations on research and monitoring											8
	Establishment of a sea level rise monitoring system	Identify critical shore line parameters for regular monitoring											8
		Implement continuous monitoring of shore line changes											100
		Prepare maps on low-lying areas vulnerable to inundation											20
		Prepare a data base on existing coastal habitats											15
		Promote participation of coastal communities in monitoring sea level rise											10
		Establishment of the mean sea level											50
	Strengthening the coastal protection and management	Develop shoreline management plan including M & E programme											10
		Update CZMP to ensure greater concern over climate change impacts											50
		Prepare SMA (Special Management Area) plans for critical & vulnerable areas											20
		Revise set back limits considering sea level rise											10

		Undertake physical protection measures in critical areas										2000
	Participatory management of sensitive coastal habitats	Conduct awareness programs on sea level rise and to empower coastal communities to face climate change impacts										15
		Prepare and implement participatory management plans for the conservation and rehabilitation of sensitive coastal habitats with the collaboration of local communities and CSOs										200
Enhance the resilience of coastal ecosystems against increased extreme events	Improvement of disaster risk preparedness and management	Identify, collect information and prepare maps on coastal areas vulnerable to extreme events										20
		Prepare emergency response/contingency plans and guidelines for vulnerable areas										20
		Establish physical protection measures in critical areas										50
		declaration of affected areas										10

Table A-13: Time plan and budget – Health

Adaptation need	Adaptation option	Actions	Time (years)										Proposed budget (Rs. Millions)
			1	2	3	4	5	6	7	8	9	10	
Assess and prepare for the increased health risks due to climate-induced vector bone and pathogenic diseases	Conducting research studies to assess the risk of climate-induced diseases	Conduct research studies on impact of climate change on prevalence and spread of diseases											30
		Assess critical factors for controlling climate-induced disease incidents											10
		Identify plausible strategies for management of climate-induced disease incidents											10
	Strengthening the surveillance and monitoring of climate- induced diseases	Establish a surveillance program for detection and monitoring of climate-induced diseases											15
		Prepare vulnerability maps on climate related health hazards											8
		Establish a mechanism for sharing meteorological , clinical and entomological information											10
	Capacity development for managing climate-induced disease incidents	Strengthen the alertness of health system against climate-induced disease incidents											20
		Launch an awareness programme on climate and health risks for Health care workers and public											5
		Develop/review guidelines for management of climate-induced disease incidents											5
		Develop research institutes' capacity for conducting research on climate change and health issues-including multidisciplinary collaborative researches											30
Minimize the health hazards associated with increased incidence of extreme events	Establishing an information and communication system on extreme events	Strengthen early warning systems of extreme events											30
		Strengthen the mechanism for sharing information between disaster management and health management agencies											15
	Improvement of disaster risk	Develop disaster risk preparedness guidelines for health care workers in vulnerable areas											10

	preparedness of health related agencies and workers	Increase the knowledge and awareness on health impacts of extreme events among health care workers (e.g. MOH, PHI)	■	■	■	■							10
		Improve the coordination between disaster management and health management agencies	■	■	■	■							15
Assess and prepare for health risks caused by concentration of climate altering pollutants	Conducting research studies to assess health impacts of climate altering pollutants	Conduct research studies on climate altering pollutants / O2 availability , their temporal variations and health impacts	■	■	■	■	■	■	■	■	■	■	30
		Update and assess treatment procedures and diagnostic tools	■	■	■	■							10
	Improvement of monitoring of climate altering pollutants	Establish air quality monitoring facilities in strategic locations	■	■	■	■	■	■	■				20
		Review and improve monitoring standards of pollutants to keep up with world standards	■	■	■	■							20
		Establish a mechanism for consulting health sector on matters concerning EPLs	■	■	■	■							20
		Establish pollutions/dispersion transport forecasting system (computer numerical modeling)	■	■	■	■							10
	Capacity development for managing health impacts of climate altering pollutants	Strengthen respiratory disease control programme	■	■	■	■							15
		Develop guidelines for controlling exposure	■	■	■	■							10
		Increase public awareness on health impacts of air pollution	■	■	■	■							10
		Train health workers on environmental health and safety	■	■	■	■							8
		Develop a mechanism to disseminate air pollution level online to the general public, high risk areas	■	■	■	■							10
Assess the impact on health due to increased heat and thermal stress	Conducting research studies to assess health impacts of heat/thermal stress	Conduct research studies on heat/thermal stress on human health	■	■	■	■	■	■	■	■	■	■	20
		Identify and assess Diagnostic tools and treatment procedures	■	■	■	■							15
		Increase public awareness on health risks of heat /thermal stress	■	■	■	■							10

Table A-14: Time plan and budget – Human settlements and infrastructure

Adaptation need	Adaptation option	Actions	Time (years)										Proposed budget (Rs. Millions)
			1	2	3	4	5	6	7	8	9	10	
Enhance the resilience of human settlements and infrastructure against heat and water stress	Improvement and promotion of building designs for enhanced climate resilience	Mainstream climate resilience in physical and urban planning											8
		Promote climate resilient building designs											10
		Promote use of alternative materials											10
		Develop/review appropriate sector specific building standards and guidelines for urban, rural and estate sectors											8
		Promote planning the human settlement schemes so as to minimize the adverse effect (and promote) on localized and regional water resources											10
		Provide standardization of equipment such as A/C and refrigerators so they emit less GHG's											15
	Revision of procedures and guidelines	Revise building approval systems to ensure climate resilience											5
	Initiating research studies to assess climate impacts	Conduct research studies on climate resilient building designs, green buildings and alternative materials											25
	Sectoral Capacity development	Conduct training programs for industry stakeholders											15
Minimize the impacts on human settlements and infrastructure due to erratic changes in precipitation	Enhance the capacity of infrastructure in urban settlements	Extend the capacity of drainage and sewerage systems to avoid periodic overcrowding											15
		Rationale use of drainage infrastructure to encourage recharging of ground water systems											15
	Promote water safety and	Promote measures to ensure safety of domestic water for settlements											30

	efficient utilization of surplus water	Promote use of rainwater harvesting systems to collect water in surplus periods to be used in the dry periods										10
Enhance the resilience of human settlements and infrastructure to extreme weather events	Promotion of disaster resilient buildings and construction	Promote disaster resilient buildings (new constructions)										10
		Promote practice of building codes including roofing standards specially in the public buildings										10
	Improvement of disaster risk preparedness and management	Prepare hazard preparedness plans for urban, rural and estate settlements										8
		Revisit existing preparedness plans for climate change										8
		Develop and enforce zoning system based on hazard vulnerability										8
Minimize the impacts of sea level rise on coastal settlements and infrastructure	Increase the resilience of coastal settlements	Promote buildings standards which are specific to the coastal sector										10
	Strengthening the monitoring of sea level rise	Regular monitoring of sea level rise										20
		Prepare maps on low-lying areas vulnerable to inundation										8
		Demarcate coastal zones vulnerable to inundation										10
		Develop guidelines for human settlements and infrastructure in vulnerable zones										10

Table A-15: Time plan and budget – Ecosystems and biodiversity

Adaptation need	Adaptation option	Actions	Time (years)										Proposed budget (Rs. Millions)
			1	2	3	4	5	6	7	8	9	10	
Enhance the resilience of natural and agro ecosystems against the impacts of climate change impacts	Initiating research studies to assess climate impacts	Conduct research studies on climate change impacts on ecosystems and biodiversity											100
		Life cycle studies: this should cover things such as changes in the sex ratios											50
	Extend the existing biodiversity protection interventions to cover climate change impacts	Prepare adaptive management programmes for climate sensitive ecosystems											50
		Protect marshes/flood retention areas vulnerable to thermal stress											20
		Develop a comprehensive plan for mitigating wild/forest fire incidents											20
		Prepare recovery plans for highly threatened ecosystems are and species											50
	Strengthening the monitoring of climate impacts	Establish a comprehensive programme (GIS mapping) to monitor climate change impacts on key natural ecosystems and biodiversity											50
		Establish permanent monitoring plots for research on natural bio-diversity											30
	Enhance the participation of local communities in monitoring, conservation and management of biodiversity	Conduct awareness programs for local communities on impacts on climate change local biodiversity and ecosystems in vulnerable areas											20
		Organize local CBOs for monitoring changes in local ecosystems and bio diversity											10
		Ensure participation of local communities in adaptive management programmes											10
		Increase employment opportunities in local communities for conservation activities											

	Promotion of traditional methods of biodiversity conservation for increased resilience in agro-ecosystems	Study and Identify traditional methods of biodiversity management in agro ecosystems	■	■	■	■						10
		Identify and promote different agro-biodiversity models suitable for different agro-climatic zones	■	■	■	■	■	■	■			20
	Sectoral Capacity development	Develop research institutes' capacity for conducting research on climate change impacts on ecosystems and biodiversity	■	■	■	■	■	■	■	■	■	50
		Strengthen the existing capacities for genetic preservation of fauna and flora.	■	■	■	■	■	■	■	■	■	50
Enhance the resilience of natural and agro ecosystems against extreme weather events	Improvement of disaster risk preparedness and management	Strengthen the early warning systems	■	■	■	■	■	■	■	■	■	50
		Identify and collect information on ecosystems and geographical locations most vulnerable to flood and drought hazards	■	■	■	■	■	■	■			20
		Prepare emergency response/contingency plans and guidelines for vulnerable areas	■	■	■	■						10
Minimize the impacts of sea level rise on coastal bio-diversity and ecosystem services	Initiating research studies to assess climate impacts	Conduct research studies on	■	■	■	■	■	■	■	■	■	30
	Strengthening the monitoring of climate impacts	Monitor regularly the development of salinity levels	■	■	■	■	■	■	■	■	■	20
Assess the changes in oceanic environment and impacts on livelihoods and food security	Initiating research studies to assess climate impacts	Assess changes in oceanic habitats and composition of species due to impacts of climate change on oceanic environment	■	■	■	■	■	■	■	■	■	20
	Strengthening the monitoring of climate impacts	Initiate long term monitoring of essential bio-physical parameters (National monitoring programme)	■	■	■	■	■	■	■	■	■	20

Assess the impacts of rising atmospheric CO_2 on biomass production of natural vegetation and spread of invasive alien species	Initiating research studies to assess climate impacts	Conduct research studies on impact of increased CO_2 on natural ecosystems and biodiversity										50

Table A-16: Time plan and budget – Tourism and recreation

Adaptation need	Adaptation option	Actions	Time (years)										Proposed budget (Rs. Millions)
			1	2	3	4	5	6	7	8	9	10	
Adjustment of tourism and recreation industry to altered conditions of the destination	Initiating research studies to assess climate impacts	Conduct research studies on climate change impacts on tourism and recreation											30
	Operational adjustments in the industry	Diversify the tourism products to meet the changing conditions											15
		Develop collaborative plans with key stakeholders to adjust tourism operations in different locations											10
		Increase the awareness of tour industry operators on climate change and its impacts											8
		Improve the climate preparedness element in organizing and executing tour operations											8
		Identify tourism facilities in vulnerable areas (e.g. low-lying beaches; disaster prone areas) and make arrangements to improve the resilience											10
	Changing of promotional strategies	Assess the current promotional strategies with connection to emerging scenarios of climate change											5
		Adjust the promotions to suit the different climate scenarios											10
Increase the preparedness of tourism and recreation operations to extreme weather conditions	Improvement of emergency risk preparedness and management	Prepare guidelines on managing emergencies in tour operations											8
		Train tour operators on emergency management strategies											10
		Design tourism infrastructure to meet the safety needs of operations											50
		Develop system's capacity for smooth switching to alternate plans											20
		Establish emergency communication channels for tourists and operators											20

	Establishment of an efficient climate information management and communication system	Develop a system for timely issuing of short-term weather forecasts										30
		Strengthen the early warning systems										50

Table A-17: Time plan and budget – Export agriculture sector

Adaptation need	Adaptation option	Actions	Time (years)										Proposed budget (Rs. Millions)
			1	2	3	4	5	6	7	8	9	10	
Enhance the resilience of crops, animals, fish and agro-ecosystems against heat and water stress	Germplasm improvement	Screen existing cultivars/clones for heat, water stress, flooding and resistance for biotic stress (pests and diseases).											25
		Introduce new cultivars /clones tolerant to heat and drought											85
		Develop grafted/budded plants with drought resistance properties											50
	Improvement of farm and nursery management practices	Improve the management of shade trees as a climate change adaptation measure											60
		Promote suitable operational and management techniques											30
		Develop improved cropping system models for vulnerable areas/lands											30
		Promote improved nursery and plant management practices											50
	Initiating research studies to assess climate impacts	Conduct research studies on climate impacts on crop physiology, resistant cultivars and cropping systems											150
	Sector capacity development	Develop research institutes' capacity for conducting research on tolerant cultivars/clones											150
		Develop facilities necessary to undertake controlled environment research											200
Minimize the risk of crop and health damage due to biological agents	Germplasm improvement	Screen existing cultivars/clones for pest and disease resistance.											50
		Develop pest and diseases-resistant varieties											50
	Improvement of farm and nursery management practices	Develop recommendations on best practices of pest and disease management											10
	Monitoring and surveillance of	Establish a surveillance programme for early detection of new diseases and pests											10

	pest and disease	Develop a system forecasting risks of pest and diseases										30
Minimize the impact on food security due to erratic changes in precipitation	Establishment of an efficient climate information management and communication system	Develop a system for timely issuing of seasonal and short-term weather forecasts										30
		Adjust calendar of operations with seasonal weather forecasts										10
	Improvements in cropping systems	Promote sustainable cropping system practices for increasing the resilience of plantations and trees										15
Enhance the resilience of crops, animals, fish and agro-ecosystems to extreme weather events	Establishment of an efficient climate information management and communication system	Develop a system for timely issuing of short-term weather forecasts										30
		Strengthen the early warning systems										30
	Improvement of disaster risk preparedness and management	Identify and collect information on areas most vulnerable to flood and drought hazards										15
		Prepare hazard vulnerability maps for all crops										10
		Develop guidelines for management of extreme events in vulnerable areas										10
Minimize the impacts of sea level rise on agriculture in coastal zone	Strengthening the monitoring of climate impacts	Monitor regularly the development of salinity levels										15
	Development of protection structures	construct salinity exclusion structures and salinity barriers to control sea water intrusions to agricultural lands										30

Table A-18: Time plan and budget – Industry, energy and transportation

Adaptation need	Adaptation option	Actions	Time (years)										Proposed budget (Rs. Millions)
			1	2	3	4	5	6	7	8	9	10	
Minimize the impacts of rising temperature and periodic scarcity of water on energy, industry and transportation	System improvements and diversification of energy generation industry and transportation	Minimize the fluctuation of hydro power generation potential through improvements in system management											50
		Explore alternatives for maximizing the use of hydro power facilities: e.g. pump storage											20
		Improve the efficiency of transmission and distribution systems to minimize losses											100
		Diversify the energy mix with increased share of renewable energy (TNA recommendations)											100
		Factor in climate change into long-term generation plans											30
	Supply chain improvements in agro-based raw materials	Diversify the supply sources of climate sensitive raw materials											30
		Develop forward contract markets for agro-based raw materials											50
		Introduce innovative risk transfer instruments											100
	Initiating research studies to assess climate change impacts	Explore and assess the potential for developing (or retrofitting) pump storage options for hydro power generation facilities											30
		Conduct research studies on climate sensitive agro-based raw materials and options to ensure stable supply											30
Minimize the impacts of extreme weather events on energy, industry and transportation	Improvement of the climate resilience and disaster risk preparedness of industry, energy and transportation	Assess the impacts of projected changes and extreme weather scenarios on transportation systems											10
		Assess vulnerable and hazard prone areas/roads and prepare maps											10
		Identification of climate resilient improvements in transport planning, infrastructure development and implementation of plans											10
		Develop guidelines for improve the resilience of transportation system for extreme weather situations											10
		Create awareness on climate risks in transportation to commuters, drivers and transport operators											10

		Establish an early warning and hazard communication systems for commuters and drivers (mobile phones, navigation systems, radio channels)										50
	Development of climate change resilient infrastructure and production facilities	Promote climate change proof infrastructure and building design practices										50
		Identify critically vulnerable energy sources and industrial facilities in hazard prone areas										10
		Assess suitable interventions to strengthen climate resilience										10
	Improvement of disaster risk preparedness and management	Identify vulnerable areas for climate-induced disaster risks and prepare maps										10
		Develop a system for timely issuing of short-term weather forecasts										8
		Establish an early warning system of disasters to managers of energy, transport and industry										20
Minimize the impacts of sea level rise on energy, transportation and industrial facilities	Strengthening the monitoring of sea level rise	Regular monitoring of sea level rise										10
		Prepare maps on low-lying areas vulnerable to inundation										10
		Demarcate coastal zones vulnerable to inundation										10
		Develop guidelines for economic activities in vulnerable areas										10
	Increasing the preparedness for sea level rise	Identify critically vulnerable energy, transportation and industrial facilities in vulnerable areas due to inundation										10
		Develop contingency plans to gradual relocation and development of alternatives										10
	Initiating research studies to assess climate change impacts	Conduct research studies and assess the vulnerability of industries located in coastal areas (e.g. salt, coir and coconut-based industries, mineral sands, boat building industries)										30

Table A-19: Time plan and budget – Cross-cutting needs of adaptation

Cross-cutting area	Action	Time (years)										Proposed budget (Rs. Millions)
		1	2	3	4	5	6	7	8	9	10	
Policy, legal and governance	Undertake a review of relevant macro and sectoral policies, ordinances acts and statutory procedures to identify options for mainstreaming climate change adaptation activities in Sri Lanka											8
	Develop policy recommendations necessary for ensuring climate change vulnerability issues are addressed in all development /management projects											15
	Carry out a policy study to explore the possibilities for application of market-based instruments to motivate adaptive actions and identify and assess feasibility of introducing innovative risk transfer tools (e.g. insurance schemes)											10
Institutional and coordination	Restructure and strengthen the Climate Change Secretariat as the National Focal Point (NFP) for implementation of NAP											100
	Establish an sustain a suitable institutional mechanism for implementation of sectoral and cross-cutting actions of NAP											60
	Organize a *Forum of Civil Society Organizations* (FCSO), a group of partner agencies, at national, provincial and district levels to support the implementation and coordination of community-based sectoral and cross-cutting interventions proposed by NAP											45
International cooperation and partnerships	Develop an inventory of international climate donors, funding schemes, training providers, training programs, research agencies/consortiums and events (conferences, seminars etc.) for the benefit of local stakeholders of adaptation.											5
	Establish a network of sectoral and national agencies, CSO partners, research institutes, think tanks and academics to approach international service providers through the facilitation support of the National Focal Point for funding support, technical assistance or training necessary for adaptation actions identified in NAP or supportive programs developed to achieve NAP objectives											10
	Identify a group of sectoral and national level representatives from government organizations, CSOs and private sector to create a pool of climate negotiators											10

Resource mobilization	Create a *National Adaptation Fund* with the collaboration of the Ministry of Finance to support the implementation of NAP actions and supportive programs										20
	Develop a 'fast track' mechanism for approving requests for donor funding for climate adaptation projects through the collaboration of the National Focal Point and the External Resources Department										2
	Negotiate a private channel of funding with the corporate sector for directing a share of CSR allocations for climate adaptation projects. If possible create a trust fund for channeling and pooling of funds partnered by the Finance Ministry and corporate sector members										2
Research and development	Establish national level controlled environment research facilities in selected institutes for facilitation of multi-disciplinary research										100
	Establish a national network of agencies and universities for carrying out research & development on climate adaptation, promotion of coordination among research institutes and information dissemination.										20
	Organize an annual multi-disciplinary research symposium on climate change adaptation with international participation										30
	Develop a coordinated multi-disciplinary small research grant program on thematic areas relating to climate change adaptation facilitated by the National Focal Point and managed by the national research support agencies (e.g. NSF, NRC, CARP)										100
	Establish a funding facility to undertake advanced studies on selected core areas of nationally important research										1000
	Establish a common repository of scientific and awareness materials on climate change adaptation.										30
Technology transfer and standards	Identify international technology transfer service providers and technology developers, and negotiate with them to establish technology and skills transfer opportunities for local researchers, trainers, experts, technology users and students.										10
	Organize national level technology transfer events and programs (e.g. Dissemination programs, exhibitions, training programs and demonstrations) to transfer technology/knowledge from developers and experts to technology users.										20

Building adaptive capacity of communities	Develop a small grant facility to provide seed funding for community-level programs helpful for achieving NAP objectives to be supported by the National Climate Adaptation Fund and jointly coordinated by *CSO Forum* and the National Focal Point										100
	Launch a program for gathering, compiling and documentation of traditional local knowledge on climate adaptation and indigenous forecasting as a partnership program of academics, CSO members and researchers.										50
	Initiate an island wide program for identification and vulnerability assessment of religious, cultural and archaeological assets threatened by climate change implemented by experts on archaeology and culture, religious organizations, CSO members and local communities.										50
Education, training and awareness	Conduct training programs for government officers, CSO members, and private sector employees on climate change adaptation which includes integrating climate change components to existing training programmes										30
	Incorporate and further strengthen climate change knowledge in formal education										25
	Establish a media space (including social media) for climate change impacts and adaptation to enhance public awareness										15
Climate information management	Establish a *National Task Force on Climate Information Products* to strengthen current efforts for developing seasonal and sub-season climate forecasts										50
	Identify capacity development needs of the Department of Meteorology and provide necessary support to strengthen the capacity for offering reliable weather, sub-seasonal and seasonal forecasts										100
	Undertake a study on short and medium range indigenous weather forecasting knowledge and identify ways to incorporate it into a national climate risk surveillance program										20
	Establish a national research program on climate modeling for long-term climate projections										50
Climate-induced disaster risk reduction	Assess the disaster risk reduction needs of sectoral Climate Adaptation Cells (identified in NAP) and mainstream the implementation of them with ongoing programs of disaster risk management										10

List of Participants in the Stakeholder Consultation Workshops

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13	Ms. Pradeepa Ranaweera	Program Assistant, Bio Diversity Secretariat	Ministry of Mahaweli Development and Environment
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15	Dr. R.D.S. Jayathunga	Director (Climate Change)	Ministry of Mahaweli Development and Environment
16	Ms. H.N.K.T. Dulani	Assistant Director, Climate Change Secretariat	Ministry of Mahaweli Development and Environment
17	Mr. Ranjith Rajapaksha	Environment Management Officer, Climate Change Secretariat	Ministry of Mahaweli Development and Environment
18	Ms. Shyamali Priyanthi	Environment Management Officer, Climate Change Secretariat	Ministry of Mahaweli Development and Environment
19	Ms. R.M.N.P. Ranasinghe	Environment Management Officer, Climate Change Secretariat	Ministry of Mahaweli Development and Environment
20	Ms. Iresha Rajapakasa	Environment Management Officer, Climate Change Secretariat	Ministry of Mahaweli Development and Environment
21	Ms. Hasula Wickramasinghe	Programme Assistant, Climate Change Secretariat	Ministry of Mahaweli Development and Environment

Export Agriculture Sector			
	Name	**Designation**	**Institute**
1	Dr. A. P. Heenkenda	Additional Director General	Departmentt of Export Agriculture
2	Dr. H.A. Sumanasena	Director	Department of Export Agriculture
3	Mr. Darshana Perera	Deputy Director	Sri Lanka Export Development Board
4	Ms. Gayani Wijayathilaka	Assistant Director	Sri Lanka Export Development Board
5	Mr. L.M.J.R. Wijayawardane	Research Officer	Sugarcane Research Institute
6	Dr. C.S. Ranasinghe	Head/ Plant Physiology Division	Coconut Research Institute
7	Ms. D.N. Ambepitiya	Additional Director (Planning)	Ministry of Irrigation and Agriculture
8	Mr. N.S. Jayalath	Assistant General Manager	Coconut Cultivation Board
9	Mr. G.R. Bandula Kumara	Deputy General Manager	Coconut Cultivation Board
10	Mr. S.S.B. Rathnayake	Assistant General Manager	Sri Lanka Cashew Crop

11	Dr. V.H.L. Rodrigo	Additional Director	Rubber Research and Development Institute
12	Mr. E.S. Munasinghe	Senior Research Officer	Rubber Research and Development Institute
13	Ms. T.L. Wijerathne	Research Officer	Tea Research Institute
14	Mr. H.I.C. Jayasooriya	Research Officer	Hector Kobbekaduwa Agrarian Research and training Institute (HARTI)
15	Dr. R.D.S. Jayathunga	Director (Climate Change)	Ministry of Mahaweli Development and Environment
16	Ms. H.N.K.T. Dulani	Assistant Director, Climate Change Secretariat	Ministry of Mahaweli Development and Environment
17	Mr. Ranjith Rajapaksha	Environment Management Officer, Climate Change Secretariat	Ministry of Mahaweli Development and Environment
18	Ms. K.K.S. Priyanthi	Environment Management Officer	Ministry of Mahaweli Development and Environment
19	Ms. Nilmini Ranasinghe	Environment Management Officer, Climate Change Secretariat	Ministry of Mahaweli Development and Environment
20	Ms. Ambika Tennakoon	Environment Management Officer, Climate Change Secretariat	Ministry of Mahaweli Development and Environment
21	Mr. Upul Premalal	Research Assistant, Climate Change Secretariat	Ministry of Mahaweli Development and Environment
22	Mr. Dasun Hewapathirana	Research Assistant, Climate Change Secretariat	Ministry of Mahaweli Development and Environment

Industry , Energy and Transport			
	Name	**Designation**	**Institute**
1	Mr. Asitha K Senaviratna	Additional Secretary	Ministry of Industry & Commerce
2	Mr. A.H.S. Wijesinghe	Additional Secretary (Development)	Ministry of Power and Energy
3	Mr. Sena Peiris	Chief executive Officer	National Cleaner Production Centre
4	Mr. S.A.L. Subasinghe	Assistant Director (planning)	Ministry of Transport
5	Mr. S.N. Bentotage	Senior Lecture	University of Moratuwa
6	Mr. Susantha Udugedara	RECP Technologist	National Cleaner Production Centre
7	Mr. S.H.U. De Silva	Director (ESD)	Road Development Authority
8	Mr. Ronald Comebe	Deputy General Manager	Ceylon Electricity Board
9	Mr. P.G. Joseph	Consultant	Sri Lanka Carbon Fund

10	Dr. R.D.S. Jayathunga	Director (Climate Change)	Ministry of Mahaweli Development and Environment
11	Mr. Ranjith Rajapaksha	Environment Management Officer, Climate Change Secretariat	Ministry of Mahaweli Development and Environment
12	Ms .K.K.S. Priyanthi	Environment Management Officer, Climate Change Secretariat	Ministry of Mahaweli Development and Environment
13	Ms. Nilmini Ranasinghe	Environment Management Officer, Climate Change Secretariat	Ministry of Mahaweli Development and Environment
14	Ms. Ambika Tennakoon	Environment Management Officer, Climate Change Secretariat	Ministry of Mahaweli Development and Environment
15	Mr. Upul Premalal	Research Assistant, Climate Change Secretariat	Ministry of Mahaweli Development and Environment
16	Mr. Dasun Hewapathirana	Research Assistant, Climate Change Secretariat	Ministry of Mahaweli Development and Environment

Cross Cutting National Issues of Adaptation			
	Name	**Designation**	**Institute**
1	Mr. Anura Sathurusinghe	Conservator General of Forests	Forest Department
2	Dr. Terney Predeep Kumara	Director General	Marine Environment Protection Authority
3	Mr. S.G.R. Rajkumar	Deputy General Manager (Development)	National Water Supply and Drainage Board
4	Mr. S.A.M. Azmy	Head / ESD	National Aquatic Resources Research and Development Agency (NARA)
5	Ms. Janaki Migastenna	Deputy Director (Irrigation & Water Mgt.)	Department of Irrigation
6	Dr. D.H.P. Peramunagama	Director (Development)	Department of National Botanic Gardens
7	Mr. Nuwan Maduwan Arachchi	Additional Director (PP)	Disaster Management Centre
8	Ms. D.N. Ambepitiya	Additional Director (Planning)	Ministry of Irrigation and Agriculture
9	Ms. T.L. Wijerathne	Research Officer	Tea Research Institute
10	Mr. Darshana Perera	Deputy Director	Sri Lanka Export Development Board
11	Mr. M.A. Mohomed Piyas	Town Planner	Dept. of National Physical Planning
12	Dr. C.S. Ranasinghe	Head/ Plant Physiology Division	Coconut Research Institute

13	Ms. Manjula Wimalasena	Legal Officer	Central Environmental Authority
14	Ms. A.L.S. Nazeema	Director	Ministry of Highways, Higher Education and Investment Promotion
15	Ms. Anoja Herath	Director	Ministry of Irrigation and Agriculture
16	Mr. Sena Peiris	Chief Executive Officer	National Cleaner Production Center
17	Mr. P.G. Joseph	Consultant	Sri Lanka Carbon Fund
18	Dr. (Mrs) S. M. Wijesundara	Food Sector Expert	No. 35B, Second Lane, Gamunupura, Kotalawala, Kaduwela
19	Prof. Buddhi Marambe	Professor, Faculty of Agriculture	University of Peradeniya
20	Mr. Ranga Pallawela	Director	Janathakshan
21	Mr. Hemantha Withanage	Executive Director	Center for Environment Justice
22	Mr. U.R. Wickramaarachchi	Fisheries Inspector	Department of Fisheries and Aquatic Resources
23	Ms. A.K.R. Dilshani	Fisheries Inspector	Department of Fisheries and Aquatic Resources
24	Ms. S.A. Mahaarachchi	Engineer (Research and Design)	Coast Conservation and Coastal Resources Management Department
25	Mr. J.A.V.S. Jayakody	Deputy Director	Road Development Authority
26	Ms. Sukanthy Vairamuthu	Development Officer	Ministry of Social Services, Welfare and Livestock Development
27	Dr. Niroshan Gamage	Deputy Director	Ministry of Social Services, Welfare and Livestock Development
28	Mr. Roshan Salinda	Programme Manager	Green Movement of Sri Lanka

Validation and **Finalization Workshop**			
	Name	**Designation**	**Institute**
1	Mr. J.K.M. Chandrasiri	Additional Director	Hector Kobbekaduwa Agrarian Research and Training Institute (HARTI)
2	Ms. L.U.N. Sumanasekara	Director Agriculture Technology	Ministry of Agriculture
3	Mr. R.P. Smarakkody	Additional Director General	Disaster Management Center
4	Mr. A.H.S. Wijesinghe	Additional Secretary (Development)	Ministry of Power and Energy
5	Dr. A. P. Heenkenda	Additional Director General	Department of Export Agriculture
6	Ms. Janaki Migastenna	Director (Water Management)	Department of Irrigation

7	Mr. B.A.P. Kapila	Additional Director	Ministry of Fisheries and Aquatic Resources
8	Mr. S.H.U. De Silva	Director (ESD)	Road Development Authority
9	Mr. S.G.R. Rajkumar	Deputy General Manager (Development)	National Water Supply and Drainage Board
10	Mr. Bharatha Ramanayake	Director (Planning)	Ministry of Fisheries and Aquatic Resources Development
11	Dr. Terney Predeep Kumara	General Manager	Marine Environmental Protection Authority
12	Mr. Madduma Bandara	Director (Environment)	Mahaweli Authority of Sri Lanka
13	Mr. A.Z.J. Singarayer	Senior Engineering Assistant	Agrarian Development Department
14	Mr. K. Nanayakkara	Director (Development)	Department of National Botanic Gardens
15	Dr. Inoka Suraeera	Consultant Community Physician	Ministry of Health and Indigenous Medicine
16	Ms. Sujeewa Fernando	Environmental Management Officer	Ministry of Health and Indigenous Medicine
17	Pro. W.L. Sumathipala	Consultant	Ministry of Mahaweli Development and Environment
18	Mr. M.M.M. Aheeyer	Management Officer	International Water Management Institute (IWMI)
19	Mr. A.L. Chandrajith De Silva	Senior Research Officer	Sugarcane Research Institute
20	Mr. S.S.B. Rathnayake	Assistant General Manager	Sri Lanka Cashew Corporation
21	Mr. T.L. Wijerathna	Research Officer	Tea Research Institute
22	Ms. Anusha Maduwanthi	Town Planner	Department of National Physical Planning
23	Dr. H.A. Sumanasena	Director	Department of Export Agriculture
24	Mr. R.A.S. Ranawaka	Senior Engineering	Coast Conservation and Coastal Resources Management Department
25	Mr. Piripaharan	Senior Environment Officer	Central Environmental Authority
26	Prof. Buddhi Marambe	Professor, Faculty of Agriculture	University of Peradeniya
27	Dr. B.V.R. Punyawardena	Head/ Climatology Division	Department of Agriculture
28	Mr. M.S.P. Jayawardena	Deputy Director	Meteorology Department
29	Mr. S. Shivatharsan	Fisheries Inspector	Department of Fisheries and AR
30	Mr. Laksiri Nanayakkara	Project Specialist	World Food Programme
31	Mr. Wijendran Paramasami	Project Coordinator	World Food Programme

32	Dr. Athula Senaratne	Research Fellow	Institute of Policy Management (IPS)
33	Ms. Kanchana Wikramasinghe	Research Economist	Institute of Policy Management (IPS)
34	Mr. Chathura Rodrigo	Research Economist	Institute of Policy Management (IPS)
35	Mr. Vajira Bandara	Project Officer	Institute of Policy Management (IPS)
36	Dr. R.D.S. Jayathunga	Director (Climate Change)	Ministry of Mahaweli Development and Environment
37	Mr. Ajith Silva	Director (Policy and Planning)	Ministry of Mahaweli Development and Environment
38	Ms. H.N.K. Dulani	Assistant Director, Climate Change Secretariat	Ministry of Mahaweli Development and Environment
39	Mr. Ranjith Rajapaksha	Environment Management Officer, Climate Change Secretariat	Ministry of Mahaweli Development and Environment
40	Ms. K.K.S. Priyanthi	Environment Management Officer, Climate Change Secretariat	Ministry of Mahaweli Development and Environment
41	Ms. Iresha Rajapaksha	Environment Management Officer Climate Change Secretariat,	Ministry of Mahaweli Development and Environment
42	Ms. Ambika Tennakoon	Environment Management Officer, Climate Change Secretariat	Ministry of Mahaweli Development and Environment
43	Mr. Upul Premalal	Research Assistant, Climate Change Secretariat	Ministry of Mahaweli Development and Environment
44	Ms. Hasula Wikramasinghe	Programme Assistant, Climate Change Secretariat	Ministry of Mahaweli Development and Environment
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