The WHO Regional Office of South-East Asia together with WHO Sri Lanka carried out a review (through desk and in country visit) of the work on climate change and health in 2015. The review explored awareness levels of the impact of climate change on health among key stakeholders and capacity of health sector to respond and adapt. The review as detailed in this report identified short, medium and long term strategic directions for strengthening health adaptation to climate change.
Review of
CLIMATE CHANGE and
HEALTH ACTIVITIES
in SRI LANKA

World Health Organization
Regional Office for South-East Asia
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1.1 Overview of physical geography, demographics, economy and health status

Sri Lanka is a small island nation located 80 kilometres (km) off the southeast coast of India in the Indian Ocean [1]. It shares maritime borders with India and the Maldives. Mainland Sri Lanka is 65,610 km², with a maximum length of 437 km and a maximum width of 225 km [2].

Physical geography varies across the country, from mountainous in the central region to flat in the north [1]. Topography can be divided into three main zones: coastal lowlands, between sea level and 270 metres (m); uplands, between 270 m and 1060 m (30% of island); and highlands, between 1060 m and 2420 m [3]. Sri Lanka has a tropical climate; average temperatures range from 27° C in the lowlands to 15°C in the highlands [1]. Precipitation varies from up to 5000 mm/year in the wetter southern zone to under 1750 in the dryer northern zone. Monsoons occur twice yearly [1].

The population of Sri Lanka is 20.48 million, with an annual growth rate of 0.8%. The country is divided into urban, rural and estate sectors from a larger macroeconomic standpoint. The urban population is about 18.3% while rural and estate populations are 77.3% and 4.4% respectively [4]. The country is divided into nine provinces and 25 districts.
administratively. According to the 2013 Census of Population and Housing, the population density was 327 people per km\(^2\) [5].

The service industry accounts for 59% of Sri Lanka’s GDP, and tourism is a driving force of the service economy. This is followed by industry at 29%; apparel accounts for 65% of industrial exports. Finally, agriculture comprises 12% of GDP and employs one third of the workforce [1]. The GDP growth rate was 7.8% in 2014 [6].

Sri Lanka is classified as a lower middle-income country by the World Bank, with a GNI per capita of US$ 3170 in 2013 [6]. It has a high Human Development Index of 0.750, ranking 73 out of 187 countries. The literacy rate is more than 90% [7].

Sri Lanka has a fairly strong health system and is on track to meet most Millennium Development Goals. The infant mortality rate was 6 deaths per 1000 live births in 2012, and maternal mortality was 35 per 100 000 live births in the same year, down from 61 in 1995 [7,8]. Immunization coverage for DPT3 among one-year olds is 99% [7]. Ninety-nine percent of urban dwellers and 92% of the rural population use improved drinking water sources. However, there are still many health outcomes that need to be strengthened. Child malnutrition remains a major issue; about 29% of children under five nationally are underweight and 14% are wasted [9]. Dengue and leptospirosis continue to be health problems. Understanding of the environmental drivers of these and other climate-sensitive health outcomes is an area where greater understanding is needed. Noncommunicable diseases are increasing in prevalence. Finally, there are still striking regional disparities in health outcomes and greater attention is needed to bridge gaps in these regions.

1.2 Policy context – overarching government policies


Produced by the Department of National Planning through the Ministry of Finance and Planning, the _Mahinda Chintana_ is the overarching development policy framework for the Government of Sri Lanka. This framework prioritizes urban settlements and development, housing and natural resource management [10].

The UNDAF is the agreement between the United Nations and the Government of Sri Lanka that provides a framework for UN assistance in Sri Lanka, in line with Sri Lankan national priorities outlined in the Mahinda Chintana and other relevant documents. The UNDAF 2013–2017 has four pillars:

1. Equitable Economic Growth and Sustainable Livelihoods
2. Disparity Reduction, Equitable and Quality Social Services
3. Governance, Human Rights, Gender Equality, Social Inclusion and Protection
4. Environmental Sustainability, Climate Change and Disaster Risk Reduction

The focus of pillar four is on natural resource preservation. Priority outcomes include emergency preparedness and response, disaster reduction, information management, public education, environmental management and governance, waste management, climate change, and working to achieve commitments made at the Rio+20 Conference on Sustainable Development in 2012 [11].

1.3 Health sector overview – approach and structure

Sri Lanka provides free universal healthcare. The Ministry of Health (MoH) is the main stakeholder providing stewardship to health service provision in Sri Lanka. The MoH provides curative and preventive health services. There are 593 government hospitals in the country, and 0.492 doctors and 1.93 nurses/midwives per 1000 population. Facilities are structured around primary care institutions and secondary care institutions that provide specialized care [1]. Private sector health facilities have also increased in popularity as GNI has risen in Sri Lanka, and currently private expenditures on healthcare account for 55.4% of all healthcare expenditures [7].

Public health is currently organized and delivered through 24 preventive healthcare programmes, directorates and units. These national programmes provide specific policy guidance, capacity-building of health staff, supply of equipment and material and overall monitoring and supervision of programmes. These programmes are implemented at grassroot level by 324 medical officers of health offices distributed throughout Sri Lanka [12].
1.4  Climate change in Sri Lanka
The Second National Communication (2011) includes temperature and rainfall analyses for Sri Lanka. Temperature is expected to rise from 1.1–2.4 °C by 2100, depending on the emission scenario. Rainfall is projected to increase by 48% for the Southwest Monsoon by 2050, which affects the wetter southern part of the country, while the Northeast Monsoon, which occurs in the drier northern region, is predicted to decrease by 27–29%. Therefore, “the wet zone is expected to become wetter and the dry zone drier with climate change” [1].

The National Climate Change Adaptation Strategy (NCCAS) Sector Vulnerability Profile for Health outlines the main climate change-induced threats, which include sea level rise and coastal flooding, rising temperatures, flooding and droughts, and landslides [13].

1.5  Climate change and expected health risks in Sri Lanka
The Sector Vulnerability Profile, developed to support the National Climate Change Adaptation Strategy, identifies five main public health concerns resulting from climate change. First, vector-borne diseases, and specifically dengue fever, are expected to increase in prevalence and incidence. Dengue transmission is sensitive to humidity and temperature. However, more research is needed to model weather changes and disease outcomes for dengue. Second, leptospirosis and other rodent-borne diseases correspond with the two yearly monsoons in Sri Lanka. Third, food and water-borne diseases, such as dysentery, viral hepatitis and typhoid, are expected to be affected by the floods, landslides and droughts associated with climate change. Fourth, a number of other disorders, such as heat-related illnesses, respiratory and cardiovascular disorders, and mental health issues, may be exacerbated by the changing environment. Finally, climate change is expected to affect nutrition through changes in food production and food security [13].

Over 50% of years of life lost (YLLs) are attributed to noncommunicable conditions in Sri Lanka [14]. However, there is a persistent burden of climate-sensitive communicable diseases, including lower respiratory infections (4.06% of total YLLs in 2010), typhoid (2.18%), and diarrhoea (1.04%). Additionally, child undernutrition continues to pose a problem; over 5% of deaths under 5 are attributed to children being underweight. Interestingly, self-harm was the second leading cause of YLLs in 1990 and in 2010, behind ischemic heart disease [14].
1.6 History of climate change and health activity in Sri Lanka

Sri Lanka ratified the United Nations Framework Convention on Climate Change (UNFCCC) on 23 November 1993. To meet its obligations under the convention, Sri Lanka submitted its Initial National Communication (INC) in 2000 and its Second National Communication (SNC) in 2011. Because Sri Lanka is not considered a least-developed country by the United Nations, the government did not prepare a National Adaptation Program of Action (NAPA).

Through the Global Environmental Facility (GEF) financing mechanism, 11 projects to date with a climate change focal area have been implemented in Sri Lanka. Project foci include renewable energy/emissions reduction (5 projects), preparing national communications (2 projects), rural development and resilience (1 project), urban development and resilience (1 project), and sustainable industries (1 project) [13]. To date, US$ 33 997 069 was allocated through the GEF grants for climate change activities [15].

Initial National Communication (INC) 2000

The Initial National Communication was completed with GEF assistance in 2000 to fulfill Sri Lanka's obligation to the United Nations Framework Convention on Climate Change (UNFCCC).

National Climate Change Adaptation Strategy (NCCAS) for Sri Lanka (2011–2016)

This document serves as the framework for the Sri Lankan Government’s climate change response. The strategy is structured into five strategic thrusts, each with specific interventions and performance indicators:

1. Mainstream Climate Change Adaptation into National Planning and Development
2. Enable Climate Resilient and Healthy Human Settlements
3. Minimize Climate Change Impacts on Food Security
4. Improve Climate Resilience of Key Economic Drivers
5. Safeguard Natural Resources and Biodiversity from Climate Change Impacts

In addition, this strategy includes five companion documents—Sector Vulnerability Profiles—that outline threats and priorities for agriculture...
and fisheries, water, health, urban development, human settlements, and economic infrastructure, and biodiversity and ecosystems services [17].

**Second National Communication (SNC) 2011**
The SNC was submitted to the UNFCCC Secretariat in 2011 with GEF and UNDP support, and expands on the strategies and priorities initially outlined in the INC.

**The National Climate Change Policy of Sri Lanka (2011)**
This policy was developed to provide high-level guidance and direction on climate change response for all stakeholders, with a particular policy focus on environmentally-friendly economic development [18].

**Technology Needs Assessment and Technology Action Plans for Climate Change Adaptation**
The Climate Change Secretariat of Sri Lanka (see section 1.8) carried out a Technology Needs Assessment (TNA) for Climate Change in Sri Lanka in 2011. Many needs identified in this report target the impacts of health on climate change:

- **Technology Action Plans for the Food Sector** prioritizes 1) sustainable inland culture-based fisheries, 2) sustainable land management and 3) crop diversification and precision farming

- **Technology Action Plans for the Health Sector** prioritizes 1) early warning systems for extreme weather events, 2) transfer of knowledge and skills to health personnel and 3) technology for management of health-care waste. While this plan is separate from the NCCAS Sector Vulnerability Profile for Health, both share the Climate Change Secretariat as the implementing body.

- **Technology Action Plans for the Water Sector** prioritizes 1) restoration of minor tank networks, 2) rainwater harvesting and 3) boreholes and tube wells as a drought prevention measure for the domestic water supply [19].

**National Climate Change Adaptation Plan of Sri Lanka 2015–2024**
The National Climate Change Adaptation Plan of Sri Lanka 2015–2024 is in the process of being developed with all relevant stakeholders by the Climate Change Secretariat. It is currently in draft form but is expected to be finalized by the end of 2015.
1.7 Governance structures relevant to climate change and health

Climate Change Secretariat Sri Lanka

Housed in the Ministry of Environment and Renewable Energy, the Climate Change Secretariat submitted its initial National Implementing Entity (NIE) accreditation application to UNEP in 2010 and review responses in 2012. UNEP began technical support in 2013. The Climate Change Secretariat was responsible for issuing the NCCAS 2011–2016, including the Sector Vulnerability Profile for Health.

Ministry of Finance and Planning

The Ministry of Finance and Planning has responsibility for the generation of national financial and economic policies, as well as the formulation of national development plans. Most pertinent in the context of climate change and health, this ministry is responsible for the Mahinda Chintana, Sri Lanka’s national development framework.

Ministry of Environment and Renewable Energy

The Ministry of Environment and Renewable Energy houses the Climate Change Secretariat of Sri Lanka. This ministry is responsible for formulating and implementing environmental and natural resource policies in Sri Lanka.

Foundation for Environment, Climate and Technology

This foundation, officially chartered as a nonprofit organization in 2003, partners with the Sri Lankan Government and academic institutions to produce research on climate predictions and monitoring, disaster management and early warning systems. Current projects focus on modeling the effects of climate change on agricultural systems, specifically rice and sugarcane [20].

Centre for Climate Change Studies (CCCS)

The Centre for Climate Change Studies (CCCS) was established in 1999 and is housed in the Department of Meteorology. In relation to health, this centre is responsible for research, monitoring and creating awareness about climate change, information dissemination and establishing links with relevant international agencies [21].
The Urban Development Authority (UDA)
Housed in the Ministry of Urban Development, Water Supply and Drainage, this authority conducts training on urban development in the context of climate change [1].

Department of Agriculture
This department provides training within the department and through schools of agriculture and on climate change mitigation through adjusting and changing agricultural practices.

Ministry of Healthcare and Nutrition

Environmental and Occupational Health Directorate
Housed in the Ministry of Health, this directorate is the focal point for climate change in the health sector. It is responsible for coordination and provision of technical expertise on health pertaining to policy development, strategic planning and other climate change-related activities for relevant stakeholders, especially the Ministry of Mahaveli Development and Environment. It is also engaged in building the capacity of health staff, conducting community-based training on health outcomes associated with climate change, and developing educational material appropriate for the general public in the area of climate change and health [1].

Epidemiology Unit
Housed in the Ministry of Health, this unit is responsible for communicable diseases surveillance in Sri Lanka. It has also developed educational materials on climate change and health for use by MoH staff, field epidemiologists and students at the undergraduate and postgraduate levels [1].
Awareness levels of stakeholders were assessed for trends in weather and climate events; the links between health and weather patterns; the magnitude and pattern of climate change over the next 25 years; and any associated health risks. In addition, stakeholders were asked their level of knowledge of current climate change and health adaptation measures, as well as their perspectives on the adequacy of these measures in Sri Lanka.

2.1 Weather, climate change and associated health risks

As detailed in the next section, the Sri Lankan Ministry of Health has undertaken several initiatives on climate change and health over the past few years within the context of National Adaptation Planning and the Technology Needs Assessment for climate change adaptation and mitigation. All stakeholders interviewed strongly agreed that Sri Lanka is vulnerable to current and projected climate variability and change. All recognized a variety of risks to health, particularly health risks associated with flooding and infectious diseases such as dengue and possibly leptospirosis. The last outbreak of malaria was in 1993. Heat-related morbidity and mortality also is of concern, particularly for the nearly half of the population who work in agriculture. Several stakeholders noted that air pollution is likely an issue, but limited air quality data are being collected. Other climate-sensitive health concerns include asthma, respiratory diseases
and skin allergies. There are very few deaths from diarrhoeal diseases. Water pollution from agricultural chemicals is a problem.

However, the stakeholders also noted that awareness of the health risks of climate change was highly uneven across the Ministry of Health, and very low in the general public. Stakeholders emphasized the need for and importance of advocacy to building awareness. Training programmes on climate change and health are needed for the MoH and courses are needed at universities. Pamphlets and fact sheets on climate change were developed based on the national communication and the technology needs assessment, but additional information is needed. The recently developed SEARO training materials should prove helpful in this regard.

The Sri Lankan National Department of Meteorology noted a range of changes to weather patterns, including changes in the start and length of rainy seasons, the consistency of rain during the rainy season and an increase in rainfall extremes. Overall, rainfall is deceasing, with high variability, in some regions. Temperatures are increasing, particularly night-time minimum temperatures. The Department of Meteorology is very interested in working with the Ministry of Health to identify weather variables associated with health outcomes, and in building early warning systems for vector-borne diseases. The problem of increasing salinity in coastal zones was raised.

All stakeholders were concerned that the magnitude and pattern of climate change over the coming 25 years could present significant risks to health. Stakeholders emphasized the need for capacity-building to analyse weather-health associations and the need for projections of how health risks could change with climate change. Having this capacity would increase the ability of the Ministry of Health to effectively prepare for, cope with and respond to the risks of a changing climate.

### 2.2 Awareness of measures being taken to address health risks from climate change

The Ministry of Health intends to include climate change in the Health Master Plan, with each unit asked to look at how climate change could affect their policies and budgeting. The Technology Needs Assessment identified three key activities for climate change and health, as outlined in section 1. The National Adaptation Plan is under development and will be finalized by the end of 2015; the MoH is actively engaged in the process. The MoH would like to set up a dedicated climate change and health
unit, but additional financial support would be needed. Other actions the MoH would like to undertake include strengthening research and development, developing more training materials, developing videos for schools on climate change and health, and establishing a national forum on climate change and health where information can be shared across local to national levels.

2.3 Adequacy of measures

Health indicators have been improving in Sri Lanka, except for Non communicable Diseases (NCDs). But without further understanding of the health risks of climate variability and change, there is limited evidence of how the effectiveness of current policies and programmes could be affected by changing weather patterns. Additional human and financial resources are needed to increase the capacity of the MoH to build the resilience of health systems to climate change.

There was interest in having guidance and training on how to estimate greenhouse gas emissions from hospitals to better link greening of hospitals with national mitigation efforts.
Mainstreaming of climate change into public health programmes


This is the national development strategy and policy framework for the Government of Sri Lanka. Climate change is addressed in this document in the context of urban development at the individual and city levels, through planning for floods, droughts and landslides in settlement expansions, updated construction standards and climate resilience in city planning. There is, however, no mention of climate change explicitly in the health sector [10].

3.2 Health Master Plan 2007–2016

Climate change is not mentioned in the Health Master Plan. However, various priorities within this plan intersect with climate change adaptation strategies for health, including assistance to disaster-affected populations, safe drinking water and strengthening surveillance systems for emerging and re-emerging infectious disease [22].

3.3 National Nutrition Policy of Sri Lanka (2010)

Climate change is not explicitly mentioned in the National Nutrition Policy of Sri Lanka. However, various policy statements within this document
intersect with health sector adaptation strategies for climate change, including:

- **Adequate food for vulnerable populations**: “Ensure access to adequate nutrition for people affected by emergencies (conflict or natural disasters) and ensure emergency preparedness and response plans to adequately address the basic nutrition needs of all people.”

- **Food security**: “Ensure access to adequate, nutritious, safe and quality food at affordable price throughout the year” [23].


This plan, issued by the National Council for Sustainable Development through the Ministry of Environment and Natural Resources, is comprised of 10 missions. Mission Three is “Meeting the Challenge of Climate Change.” Within this mission, twelve strategies are identified with output indicators and short, medium, and long-term goals. Strategies most relevant to health include: [7] Identify infrastructure vulnerability to climate change; [10] Take adaptive measures expecting an increase of vectors; and [11] Establish food security in the face of climate change threats [24]. Action plan items for these three strategies are detailed below:
<table>
<thead>
<tr>
<th>Strategy Number</th>
<th>Strategies/Actions</th>
<th>Key Performance Indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td><strong>Identify infrastructure vulnerability to climate change</strong></td>
<td></td>
</tr>
<tr>
<td>7.1</td>
<td>Discourage construction of buildings forming barriers along the sea coast and encourage creation of wind corridors perpendicular to the sea.</td>
<td>Relevant planning guidelines in place</td>
</tr>
<tr>
<td>7.2</td>
<td>Make shade tree planting along urban streets and urban public parks systems with at least 50% tree cover mandatory in all low and mid-country areas of the country and use of Clean Development Mechanism (CDM) financing to improve long-term sustainability of projects.</td>
<td>Regulations in place</td>
</tr>
<tr>
<td>7.3</td>
<td>Undertake infrastructure vulnerability assessment study.</td>
<td>Report on infrastructure vulnerability</td>
</tr>
<tr>
<td>10</td>
<td><strong>Take adaptive measures expecting an increase of vectors</strong></td>
<td></td>
</tr>
<tr>
<td>10.1</td>
<td>Identify high-risk areas with respect to predicted climate change impacts and upgrade vector-control programmes.</td>
<td>Number of high-risk areas identified; number of programmes introduced</td>
</tr>
<tr>
<td>10.2</td>
<td>Increase health surveillance by health authorities in more vulnerable provinces to monitor increase of heat-related diseases.</td>
<td>Improved systems to detect changes in health condition</td>
</tr>
<tr>
<td>11</td>
<td><strong>Establish food security in the face of climate change threats</strong></td>
<td></td>
</tr>
<tr>
<td>11.1</td>
<td>Select high yielding, improved climate change resistant rice varieties and those that are positively responsive to elevated CO2.</td>
<td>Number of varieties identified</td>
</tr>
<tr>
<td>11.2</td>
<td>Use of ultra short-term varieties that tolerate biotic and abiotic stress.</td>
<td>Number of hectares cultivated with such varieties; coverage</td>
</tr>
<tr>
<td>Strategy Number</td>
<td>Strategies/Actions</td>
<td>Key Performance Indicators</td>
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<tr>
<td>11.3</td>
<td>Adopt suitable land and crop management technologies.</td>
<td>Identification and application of better technologies</td>
</tr>
<tr>
<td>11.4</td>
<td>Adjust rain-fed farming to rainfall variations-cultivation of short duration paddy</td>
<td>New cultivation patterns identified and introduced</td>
</tr>
<tr>
<td></td>
<td>in the Yala season and long duration paddy in the Maha season.</td>
<td></td>
</tr>
<tr>
<td>11.5</td>
<td>Adjust crop seasons to suit new climate, e.g. certain climatic conditions favour</td>
<td>Changes made by farmers in crop patterns and crops cultivated</td>
</tr>
<tr>
<td></td>
<td>outbreak of the Brown Plant Hopper (BPH) in the low country dry zone – adapt changes</td>
<td></td>
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<td></td>
<td>in agronomic practices in paddy cultivation such as advancing the time of</td>
<td></td>
</tr>
<tr>
<td></td>
<td>of cultivation from May to March, introducing pest resisting varieties and use of</td>
<td></td>
</tr>
<tr>
<td></td>
<td>recommended insecticides.</td>
<td></td>
</tr>
<tr>
<td>11.6</td>
<td>Establish a surveillance and forecasting system.</td>
<td>Forecasting system in place</td>
</tr>
<tr>
<td>11.7</td>
<td>Select rubber genotypes to suit different environments – Clones RRISL 215 and</td>
<td>Cultivation of climate-adjusted rubber varieties by planters</td>
</tr>
<tr>
<td></td>
<td>RRISL 217 are highly stable overall with a high mean performance and are not as</td>
<td></td>
</tr>
<tr>
<td></td>
<td>sensitive to changes in environmental conditions. RRIC 100 is the most suitable</td>
<td></td>
</tr>
<tr>
<td></td>
<td>clone for areas with low rainfall (Withanage, 2004).</td>
<td></td>
</tr>
<tr>
<td>11.8</td>
<td>Adjust cultivation timing in home gardens – the cropping calendar should be altered</td>
<td>Changes made to cropping calendar by farmers and home gardeners considering climate change</td>
</tr>
<tr>
<td></td>
<td>to match the simulated cropping calendar in order to minimize irrigation water</td>
<td></td>
</tr>
<tr>
<td></td>
<td>demand for crops.</td>
<td></td>
</tr>
</tbody>
</table>
4.1 National Climate Change Adaptation Strategy (NCCAS) for Sri Lanka 2011–2016

The NCCAS has five strategic thrusts, two of which explicitly address climate change and health [17]:

- **Enable Climate Resilient and Healthy Human Settlements:**
  Includes a wide range of issues related to settlements, including housing, urban development and planning, public health, drainage, drinking water, urban wetlands, waste management and pollution control.

- **Minimize Climate Change Impacts on Food Security:**
  Includes major sectors and activities associated with food security, including agriculture, fisheries, irrigation and nutrition.

Each thrust includes intervention descriptions, performance indicators, key partners, activity types, a target implementation schedule (by year from 2011 to 2016) and estimated financing requirements (in Sri Lankan rupee, by year from 2011 to 2016). The NCCAS includes Sector Vulnerability Profiles for sectors where “climate vulnerabilities are expected to be critical in the Sri Lankan context,” one of which is health [17].

The table outlines interventions most relevant to health actions in the NCCAS. Performance indicators, key partners, budgets and timelines for each intervention are found in the NCCAS Appendices.
<table>
<thead>
<tr>
<th>Thrust</th>
<th>Intervention</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td><strong>Ensure adequate quality and quantity of water for settlements</strong></td>
<td>Several water saving technologies/options have been developed and tested in the Sri Lankan context, but their use is limited. A stepped up campaign, combined with incentives and regulations, is needed to increase adoption of these technologies, particularly in the Dry Zone.</td>
</tr>
<tr>
<td>2</td>
<td>Promote water saving technologies including rainwater harvesting</td>
<td>Monitoring of data such as water quality/quantity, disease incidence, building approvals, etc. are done by various agencies in Sri Lanka. However, such monitoring programmes need to be substantially strengthened and streamlined for cross-sectoral comparability. A mechanism for regular sharing of data needs to be developed and initiated, and a capable coordinating entity identified and assigned.</td>
</tr>
<tr>
<td>2</td>
<td>Improve monitoring/surveillance and sharing of data across sectors</td>
<td>Integrated water resource management practices are needed to ensure Sri Lanka’s settlements can cope with climate change vulnerabilities in the water sector. Pilot-scale initiatives should be encouraged to demonstrate benefits. Engagement with stakeholders to ensure policy and regulatory measures are put in place also need to be pursued.</td>
</tr>
<tr>
<td>2</td>
<td>Promote integrated water resources and watershed management</td>
<td>The body of research on climate change impacts on water availability for Sri Lanka’s growing settlements is needed—with a clear view towards developing a range of scalable adaptation measures, projects that can be deployed at household and community levels, as well as at a larger scale.</td>
</tr>
<tr>
<td>2</td>
<td><strong>Combat climate change-related health concerns in settlements</strong></td>
<td>An effective, nationwide, and systematic programme to monitor and control disease vectors (particularly mosquito vectors), which are on the rise with better prediction and control of potential outbreaks. Further in-depth research on climate-impacts on vectors is also needed.</td>
</tr>
<tr>
<td>Thrust</td>
<td>Intervention</td>
<td>Description</td>
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<tr>
<td>2</td>
<td>Facilitate data sharing and compatibility between Ministry of Health and other sectors</td>
<td>An initiative to clearly map MOH boundaries geographically and to define means to enable cross-sectoral comparison of the extensive data between MOH divisions and DSDs is crucial. This would be an intervention that will yield very rapid results and have far-reaching benefits for climate change adaptation as well as for planning in the health sector.</td>
</tr>
<tr>
<td>2</td>
<td>Engage health sector experts in local level planning</td>
<td>More active upstream engagement of health professionals is needed in settlement planning and management to prevent and control the spread of both communicable and noncommunicable diseases associated with climate change and poor environmental management.</td>
</tr>
<tr>
<td>2</td>
<td>Research health impacts of climate change in Sri Lankan context</td>
<td>A wider body of research into the extent and nature of climate change impacts on Sri Lanka’s health sector needs to be pursued.</td>
</tr>
<tr>
<td></td>
<td>Increase awareness on vulnerabilities and adaptation of settlements</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Improve the gathering, processing and dissemination of information related to human settlements</td>
<td>Information on the rapidly urbanizing human settlements is scattered across different sectors and agencies, e.g. demographic, geo-spatial, utilities, public health, etc. The integrated approach to climate change adaptation requires pooling and linking such information, which then becomes the basis of timely, targeted adaptation measures and planning.</td>
</tr>
<tr>
<td>2</td>
<td>Enhance awareness and demand for climate resilient construction</td>
<td>An aggressive and nationwide programme to raise awareness of the construction methods, targeted at technical personnel who are the sources of construction advice, is needed. These personnel include vocational groups such as masons, carpenters, designers, etc. as well professionals and students of architecture, engineering and planning.</td>
</tr>
</tbody>
</table>
### Thrust Intervention Description

<table>
<thead>
<tr>
<th>Thrust</th>
<th>Intervention</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>2</td>
<td>Improve coordination/dissemination through existing institutional mechanisms</td>
<td>Improving the currently scattered information gathering and researching processes on human settlements needs to be accompanied by similar measures to enhance the access to resulting information in the public domain. War-time restrictions on geo-spatial data and other information need to be reviewed and removed to enable informed decision-making at all levels.</td>
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<td>2</td>
<td>Engage media more proactively with messaging tailored for stakeholders</td>
<td>Urban sprawl has seen a parallel explosion in niche media outlets, especially in radio and TV sectors, that target urban audiences. In this multiplicity of outlets, media outreach need no longer be pursued entirely at all-island level. The urban media can be tapped to deliver specific information to different stakeholders.</td>
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<td>3</td>
<td>Ensure ability to meet food production and nutrition demand</td>
<td>Nutritional disorders remain a predominant issue in Sri Lanka and are likely to increase further with climate change induced threats to food security. In order to adapt and make our communities more resilient and healthy, we need to promote alternative options to meet the nutritional demands, especially of women and children. Household level food security and nutrition needs to be given priority, in adapting to these threats. To do so, women should be empowered to drive it especially in the poor farming communities of the country.</td>
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<td>3</td>
<td>Promote alternative options to meet nutrition requirements</td>
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<td>3</td>
<td>Improve weather forecasting and information dissemination</td>
<td>Many crop failures currently occur due to lack of accurate and timely information on the changing rainfall patterns – either due to lack of good forecasting ability or due to lack of an information dissemination mechanism to farmers. Improvement for both forecasting and information dissemination on weather would minimize crop failures helping farmers to adapt to changing conditions.</td>
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<td>Thrust</td>
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<tr>
<td>3</td>
<td>Ensure easy access to seedstock alternatives/advice to counter rainfall variability</td>
<td>Easy access to seedstock is necessary to help farming communities to adapt to changing rainfall pattern, droughts and floods. To facilitate progress, community-level seed stock programmes are necessary with a mechanism for rapid distribution. It is also necessary that the seedstock has seed varieties suitable for varied conditions.</td>
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<tr>
<td>3</td>
<td>Research climate impacts/adaptive measures for agriculture, livestock and fisheries sectors</td>
<td>The impacts of climate change on agriculture are yet not fully understood, especially in fisheries and livestock sectors. This knowledge is vital for us to adapt to climate change. It will facilitate the identification of adaptive measures suitable to scale up. Negative aspects on species as well as potential opportunities that climate change may provide should be explored. Impacts on pests, diseases, and IAS need to be better understood and managed. Traditional practices and community-level adaptation interventions should also be explored.</td>
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<tr>
<td>3</td>
<td>Conserve genetic resources for future crop and livestock improvement</td>
<td>Effective in-situ and ex-situ germplasm is necessary for future crop and livestock improvement. This will also help them to adapt to the impacts of climate change.</td>
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<td>3</td>
<td>Ensure adequate water availability for agriculture</td>
<td><strong>Ensure adequate water availability for agriculture</strong></td>
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<td>3</td>
<td>Promote water-efficient farming methods and crops</td>
<td>With increasing incidence of drought due to climate change and the increasing demand on water, a top priority is to ensure food security with the available water resources. For this, water efficient farming practices such as zero tillage, micro irrigation and SRI should be promoted. It is also necessary to promote water efficient crop varieties for future sustainability.</td>
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<td>Thrust</td>
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<td>3</td>
<td>Improve maintenance of existing tanks and reservoirs including catchments and watersheds</td>
<td>To meet increasing water demands under changing climatic conditions, the maintenance of existing reservoir and irrigation systems is necessary to ensure maximum storage capacity. Regular monitoring and maintenance through dredging, as well as prevention of siltation with effective erosion control of tanks and the irrigation systems are potential adaptations. It is also important to control anthropogenic activities such as sand mining.</td>
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<tr>
<td>3</td>
<td>Adopt and promote the principles of IWRM</td>
<td>With the predicted impacts of climate change, it is essential that available water resources are managed wisely. For this, IWRM was beneficial in dealing with multiple users and in controlling where the water flows. This should be done with better cross-sectoral coordination and consultation. Water requirements for wetlands should also be considered as they are the basis for all available water resources.</td>
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<td>3</td>
<td>Construct new reservoirs and trans-basin diversions to meet demand</td>
<td>To meet increased water demand for food production, new reservoirs may need to be built. With both floods and droughts expected to increase in the country, possible adaptation interventions could be to divert water from flood prone areas to drought prone areas through trans-basin transfers.</td>
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<td>3</td>
<td>Mitigate food security-related socioeconomic impacts</td>
<td>With increasing incidences of disasters associated with climate change, the farming and fishing communities become highly vulnerable. To encourage them to continue with their livelihoods, which are essential for national food security, risk transfer options such as insurance should be created and promoted.</td>
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<td>3</td>
<td>Encourage development of risk transfer methods</td>
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<td>Thrust</td>
<td>Intervention</td>
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<td>3</td>
<td>Research climate impacts on long-term food security and agriculture value chains</td>
<td>Research on impacts of climate change on long-term food security should be studied along with how agricultural value chains are affected. Research should focus on the impacts on all activities and processes that lead to a product or service that reaches the final consumer. Dimensions on impacts on the products pathway to reach the final consumer structure, economic relationships among players in the chain, anticipated changes in the structure, and key threats to the entire value chain should be well understood to determine adaptation interventions necessary.</td>
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<td>3</td>
<td>Identify and help vulnerable fishing communities to adapt or relocate</td>
<td>Marine and lagoon fishing communities are especially vulnerable to climate change due to their homes becoming threatened. Alternate livelihood options should be considered, and relocation programmes promoted in highly-vulnerable areas.</td>
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<td>3</td>
<td>Increase awareness and mobilize communities for climate change</td>
<td>Better information provision to farmers has helped achieve higher agricultural yields in recent decades. A similar campaign is needed to inform farmers and fishermen on climate-related impacts on their livelihoods and what adaptive measures are available to cope with. Communicating this specific information in accessible, practical ways is critical to building resilience among food producers and others in the value chain.</td>
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<td>3</td>
<td>Pilot test and scale up community-level agriculture/livestock/fisheries adaption models</td>
<td>A key lesson from the Green Revolution was the value of demonstrating new methods and practices. This can now be replicated with climate adaptation measures by starting with pilot projects that are then promoted and eventually scaled up.</td>
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<td>Thrust</td>
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<tr>
<td>3</td>
<td>Improve utilization of field level coordination mechanisms and civil society organizations</td>
<td>Crop farming, livestock and fisheries sectors all have well-established extension and support systems in the state sector, sometimes complemented by civil society networks. Both need to be tapped strategically to improve information provision, coordination and monitoring of climate adaptation measures.</td>
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<td>3</td>
<td>Promote risk transfer initiatives</td>
<td>Crop and livestock farmers need enhanced insurance support to buffer themselves from climate change impacts. Farmers and insurance industry in Sri Lanka have had limited engagement, so active promotion of new, customized insurance schemes would be needed. This requires working with both insurance operators and farmer organizations or networks.</td>
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</table>
4.2 Second National Communication (2011)

Climate change effects on health are addressed more directly in the Second National Communication than in the Initial National Communication. Unlike the INC, there is a section that addresses climate change impacts, vulnerability and adaptation specifically in a health context. However, there is relatively little discussion of implications for the health sector in comparison with other sectors addressed in the SNC. This communication does, however, reference the NCCAS as one of the main adaptation plans for Sri Lanka. The SNC identifies the following health adaptation strategies:

**Individual strategies:** Greater awareness and changes in knowledge, attitudes and practices.

**Community strategies:** The SNC outlines 26 categories of action that could take place at the policy, community, health facility, or government level. However, none of these recommendations are costed or operationalized.

**Other:** Nutrition interventions such as supplementary and therapeutic foods and treatment of severe acute malnutrition [1].

4.3 Initial National Communication (2000)

Health is addressed briefly in the context of broader climate change impacts. Specifically, sea level rise will affect health through flooding and storm damage, fisheries and the effects of saltwater intrusion on agricultural irrigation and drinking water. Temperature rise will lead to heat-related illnesses. Drought and increased rainfall will have implications for housing damage and a number of water- and vector-borne diseases, including diarrhoea, typhoid, dysentery and dengue.

The INC outlines five proposed action categories for the health sector, although none are costed or have clear timelines. They include:

1. General (primarily strategies for disaster management)
2. Heat Stress, Heat-Related Illnesses and Disorders
3. Health Effects of UV-B Light (monitoring indicators such as cataracts and skin malignancies, and promoting sun protection)
4. Spread of Infectious Diseases
5. Food Shortage and Nutritional Disorders [25]
Identification of gaps

Shortage of research between exposures and outcomes for climate-sensitive diseases

As the Sector Vulnerability Profile for Health emphasizes, “in the case of the health sector, the causal relationship between exposure events of climate change (temperature change, sea level rise, changing rainfall patterns, etc.) and the health impacts considered are not clearly understood” [13]. More research is needed on the relationships between climate change and both infectious and noncommunicable disease.

Lack of consistent climate change mainstreaming in public health and overarching government policies

While the policies reviewed contain strategies for addressing some impacts of climate change on health, many do not address climate change specifically, nor do they include a cohesive or comprehensive set of intervention plans.

Shortage of research on climate adaptation in the agricultural sector

Agriculture, and with it food security and nutrition, will be affected by climate change. The SNC details further research needs in this sector, including:

♦ Identification of pests and crop diseases most likely to be affected by climate change
♦ Research on current land use and projected land use change
♦ Vulnerability mapping for key crops, such as rice, tea, coconut, rubber and sugarcane

**Increased climate awareness among those in rural areas, and in the general population**

There is a need for more climate change education and awareness training at all levels of society.

**Better operationalization (timeline, costing) and clearer monitoring and evaluation framework**

Many key plans lack a clear implementation plan. The NCCAS is the most comprehensive in this respect; it is unclear how interventions will be monitored and their impact evaluated.
Next steps – suggested strategies for validation

Strategies are suggested here in light of the challenges and opportunities reported in this review. Consideration must be given to the importance of validating these suggested strategies with all relevant stakeholders, and to ensure that perspectives are shared. To assist planning and resourcing, strategies are indicated as short-term [ST] – in the next 12 months to 2 years; mid-term [MT] – in the next 2–5 years; and longer-term [LT] – 5 years and beyond. Organizations responsible for managing and implementing the strategies are generally not identified here as it is preferable this process is guided by national-level stakeholders to encourage ownership and sustainability of the strategies.

Establish early warning systems for extreme weather events [MT]

Early warning system (EWS) technology is being used in Sri Lanka. However, it needs to be strengthened in scope and structure; different agencies need to coordinate more effectively; and new technologies need to be explored. Additionally, personnel in government need to be trained to use this technology effectively. Response plans need to be understood by those implementing the plan and by the public.

Educate health personnel on climate change health issues [ST]

Climate change adaptation training and the appropriate knowledge and skills should be integrated into general health personnel and disaster preparedness training. The MoH could consider forming a training
coordination unit and train trainers. This will also increase capacity for advocacy and public awareness measures.

**Strengthen coordination between the Ministry of Health and Climate Change Secretariat [ST]**
Currently climate change is not mainstreamed into MoH policies. More coordination between the MoH and Climate Change Secretariat of Sri Lanka is necessary to prioritize climate change and health. Because of its focus on capacity-building, training and education on the issues of climate change and health, the Environmental and Occupational Health Directorate within the MoH is best positioned to lead these efforts and act as the focal point with the Climate Change Secretariat.

**Develop resources to increase research funding competitiveness for climate change effects on health and agriculture [MT]**
A major gap is definitive research and data on the impact of climate change on climate sensitive diseases and agriculture. The effects of climate change on health needs a greater evidence base, and indicators must be developed for different vectors and other disease determinants to guide monitoring, forecasting and research efforts. More funding is needed to encourage academic and research institutions to undertake exploratory and confirmatory projects in these areas.

**Create monitoring and evaluation unit within appropriate government authority [ST]**
Although many adaptation strategies are identified within the policy documents reviewed, it is unclear what follow-up or accountability mechanisms exist. A body should be created to monitor progress on climate change projects government-wide.

**Strengthening analytical capacity to monitor pollutants [MT]**
Air quality is not being monitored consistently throughout the country. This was targeted as one of the 10 missions of the Haritha Lanka Programme, with the goal of placing monitoring stations in all major cities [24].

**Explore technology solutions and expand capacity of these technologies**
Per the Technology Needs Assessment conducted by the Climate Change Secretariat in 2011, many technologies can both reduce greenhouse gas emissions and enable better adaptation to the health effects of climate change. These should be prioritized, and specific timelines identified to introduce existing technologies and develop new technologies, methods and tools.
References


3. FAO Fisheries and Aquaculture Department. Sri Lanka http://www.fao.org/docrep/003/t0028e/t0028e02.htm


The WHO Regional Office of South-East Asia together with WHO Sri Lanka carried out a review (through desk and in country visit) of the work on climate change and health in 2015. The review explored awareness levels of the impact of climate change on health among key stakeholders and capacity of health sector to respond and adapt. The review as detailed in this report identified short, medium and long term strategic directions for strengthening health adaptation to climate change.