Climate Change Vulnerability in Sri Lanka

Sector Vulnerability Profile:
Urban Development, Human Settlements and Economic Infrastructure

Supplementary Document to:
The National Climate Change Adaptation Strategy for Sri Lanka 2011 to 2016

Sector Vulnerability Profile: Urban Development, Human Settlements and Economic Infrastructure

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We acknowledge and appreciate all support provided by the Climate Change Secretariat, Ministry of Environment, SNC Project Team, UDA, NPPD, NBRO, Min. of Transport, CCD, RDA, SLTDA, CEB, Water Resources Board and the many other stakeholders who have contributed to this document. Refer Appendix E for the full list of stakeholders consulted during SVP preparation.

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List of Abbreviations and Acronyms

CB	Central Bank
CC	Climate change
CCCS	Center for Climate Change Studies
CCD	Coast Conservation Department
CCS	Climate Change Secretariat
CDM	Clean Development Mechanism
CEB	Ceylon Electricity Board
CECB	Central Engineering Consultancy Bureau
CMR	Colombo Municipal Region
CZMP	Coastal Zone Management Plan
DMC	Disaster Management Center
DSD	Divisional Secretariat Division
DWLC	Department of Wildlife Conservation
EIA	Environmental Impact Assessment
EMRP	Emergency Management and Response Plan
IEE	Initial Environmental Examination
ETF	Employment Trust Fund
IPCC	International Panel on Climate Change
MENR	Ministry of Environment and Natural Resources
MICE	Meetings Incentives Conferences and Exhibitions
MOE	Ministry of Environment
MUDSAD	Ministry of Urban Development and Sacred Area Development
NARESA	Natural Resources Energy & Science Authority
NBRO	National Building Research Organization
NCSA	National Capacity Needs Self Assessment Project
NCSD	National Council for Sustainable Development
NDMP	National Disaster Management Plan
NHDA	National Housing Development Authority
NPD	National Planning Department
NPPD	National Physical Planning Policy and Plan
PUCSL	Public Utilities Commission of Sri Lanka
RDA	Road Development Authority
SCP	Sustainable Cities Program
SEA	Strategic Environmental Assessment
SLRRDC	Sri Lanka Land Reclamation and Development Corporation
SLTDA	Sri Lanka Tourism Development Authority
SLUMDMP	Sri Lanka Urban Multi-hazard Disaster Mitigation Project
SNC	Second National Communication
SVP	Sector Vulnerability Profiles
TRIP	Tourism Resources Improvement project
UDA	Urban Development Authority
UNDP	United Nations Development Program
UNEP	United Nations Environment Program
UNFCC	United Nations Framework Convention on Climate Change
USIP	Urban Settlement Improvement Program
USPAP	Urban Sector Policy Action Plan
USPF	Urban Sector Policy Framework

Urban Development, Human Settlements and Economic Infrastructure

Part I - Development of Urban Areas and Human Settlements

Urban Development, Human Settlements and Economic Infrastructure

Investments in urban development, human settlements and economic infrastructure become key to national development in Sri Lanka. Following the *Mahinda Chintana 10 Year Horizon Development Framework,* many infrastructure projects have been carried out under the *Gama Neguma* and *Maga Neguma* Programmes, and the Government has prioritised development of metro-areas as well as rural areas, roads, electricity, water supply and sanitation, ports and aviation and transport for Economic Infrastructure Development at national and regional levels under the *Randora* Infrastructure Development Programme. Optimising benefits from these projects require sustainable urban development and human settlements, and expansion of economic infrastructure and other development processes that take into account environmental management. This includes addressing the ramifications of already felt and future climate change, and measures for adaptation during National Physical Planning.

Part I- Development of Urban Areas and Human Settlements

1.0 Introduction

This section deals specifically with possible impacts of climate change on development of urban areas and human settlements - in both urban and rural areas. The future national development plans provide for high urban growth through establishment of metro-regions and metro-cities in the development agenda. With the anticipated rapid urbanization, growth of satellite towns and connecting rural areas, it can be expected that associated housing development will also rise in the near future. National development and economic advancement would depend on whether these initiatives are viable and sustainable in the long-term. As climate change is expected to affect many aspects of human wellbeing due to rising temperatures, water stress, sea level rise that would affect coastal areas, and the impacts of more intense rainfall events leading to more frequent floods and landslides, application of adaptation measures would be necessary to counteract the challenges brought about by climate change.

Urban populations in Sri Lanka have been broadly defined by the Urban Development Authority (UDA) as those living in areas serviced by the country's 18 Municipal Councils, 42 Urban Councils and 15 other areas termed urban development areas-identified on the basis of population density and national importance.[a] Overall, the share of the urban population has grown rather slowly during the latter part of the past century.[1]

BOX 1: PROJECTED URBAN DEVELOPMENT BY 2030

Expected outcomes

- The estimated annual urban growth rate of 3% between 2005-2015 will result in an urban population of over 50% of the total by 2016.[3]
- The NPPP&P targets the development of 5 Metro Regions, 9 Metro Cities, and a further 16 District Capitals by 2030, as key areas for human settlement and economic activity in the country.[4] (see also FIGURE 1)
- The above regions are to be developed with a range of infrastructure facilities to ensure access to urban centres for more than 70% of the population by 2030.[4]

Expected key economic impacts[3,4]

- Substantial direct and indirect employment opportunities through expansion of economic activities in new urban centres.
- Development of commercial and economic centres.
- Poverty reduction.
- Expansion of attractive places for foreign and domestic investors.
- Regional development.

Source: Mahinda Chintana, vision for a new Sri Lanka. A Ten Year Horizon Development Framework 2006-2016;[3] The National Physical Planning Policy and Plan, 2006 [4] and *Randora: National Infrastructure Development Programme* [5]
(See more details on over-arching policy framework for urban development and housing in APPENDIX A).

[a] Definition provided by UDA at the workshop to discuss the sector SVP.

However the definition of what comprises "urban" varies in different contexts, and a more realistic assessment of settlements, and in terms of population and housing density, reaches beyond administrative boundaries considered as "urban" and indicates a far more rapid pace of urbanization in the country than recorded. Future urban planning, therefore, needs to promote equitable, efficient and sustainable urban areas and human settlements to address emerging challenges of the 21st century, including rapid urbanisation, climate change and related disasters, urban sprawl and unplanned peri-urbanisation.[2]

In general, Sri Lanka's urban areas comprise cities and towns that are characterized by higher population densities, physical development, and other human induced changes that make them different from the more rural settlements such as villages and hamlets. In the past, urban growth in Sri Lanka was mainly due to migration from rural areas, mostly to the Western Province.[1] In more recent years, however, the emphasis given by successive governments for rural housing and other forms of rural development to uplift rural communities and to eliminate large urban-rural disparities in human settlements, has led to urbanization that is due to the growth of small and medium size towns around the major cities of the country.

Substantial investments for development of urban areas and housing are currently ongoing or planned in Sri Lanka including the setting up of several metro-regions (FIGURE 1). These metro-regions would not only include urban areas but also satellite towns and intervening rural areas that are socio-economically connected to the urban core city. Such investments are likely to be accelerated in the country with the dawn of peace and stability.

With the anticipated rapid urbanization and the associated housing development in the near future, the vibrant urban environment to be created is expected to considerably enhance the national economy.[3] With accelerated urbanization, Sri Lanka would face the challenge of ensuring that such development is systematic, equitable and sustainable. As such, ensuring that the projected metro-regions, existing urban areas and other rural human settlements, are developed sustainably with adequate housing; and increasing their resilience/adaptation capacity to impacts of potential climate change would be in the national interest.

Rural settlements

Rural areas are addressed by the State through programmes such as the Gama Naguma*, which is the main rural development programme of the National Development agenda. Through such programmes, it is envisaged that all villages in the country will emerge as micro-centres of growth, with implementation of specific programmes focused on livelihood development and poverty reduction. About 300,000 houses are also slated for development by 2016, under the* Gama Neguma *scheme.*[3]

BOX 2:TARGETS FOR GEOGRAPHICALLY BALANCED DEVELOPMENT THROUGH NATIONAL GROWTH CENTRES

Greater Dambulla

- Develop as commercial hub and transit centre for agri-cargo and other products
- Develop as a tourism and leisure hub

Greater Hambantota

- To become a catalyst for major economic development in the southern region
- To develop a seaport and airport to make it a transportation, industrial, and commercial centre

Colombo-Sri Jayewardenapura Kotte

- Sri Jayewardenapura to become the public/administrative centre, and Colombo to be a vibrant commercial and service centre
- To develop a light train and bus rapid transit systems
- To develop flagship projects to revitalize Colombo

Greater Trincomalee

- To become the developmental and social hub of the east
- To develop industrial and tourism zones
- To establish a coal power plant
- To enhance port-related development

Regional Growth Centres to be established

- Galle, Kandy, Horana, Kurunegala, Puttalam, Kegalle, Vavuniya, Badulla, Mahiyangana**,** Awissawella and Monaragala

Secondary Town Centres to be established

- Hikkaduwa, Tangalle, Nawalapitiya, Kataragama, Pottuvil, Maharagama, Panadura, Gampola, Beliatta, Eheliyagoda

Source: Mahinda Chintana, vision for a new Sri Lanka. A ten year Horizon Development Framework 2006-2016 p 116-117.[3]

1.1 Urban development

Economic perspective

Around 70% of Sri Lanka's population is yet rural[1,3,b] but like much of the world, Sri Lanka is urbanizing rapidly. It is also expected that the structural changes that are taking place as a result of development and its unevenness has caused a rapid growth in the urban sector in the country.[6] While accurate estimates of economic contribution from urban areas are difficult to obtain, in 2009, the manufacturing, construction, and services sectors, which are primarily urban-based, accounted for 83.3% of GDP.[7] Further, economic activity in Sri Lanka is not distributed geographically. The bulk of the industrial and service industry is concentrated in the Western Province, where there is the highest concentration of urban population in the country.[1,3]

The development trajectory that Sri Lanka is currently following[3,4,5] envisage an increase of the current urban population of 30% to 50% by 2016[3] and to 70% by 2030.[8] Urbanisation is expected to minimise unemployment and poverty.[4]

BOXES 1 and 2 indicate the trend for development of urban areas in the country. **Table 1** gives an indication of Sri Lanka's urban population in recent times. **Table 2** indicates the investments planned and ongoing for urban development in the country. **Table 3** presents target populations for the major urban regions in the future.

Due to historic reasons during colonial times, there is a heavy concentration of human settlements in some coastal areas,[9] with 285 km^2 of coastal land gazetted as municipal and urban land, which amounts to nearly half the urban areas in the island.[9] This has resulted in a large share of urban growth and development activities being concentrated along parts of the island's coast line.

TABLE 1 Indication of urban population growth in recent reports

Report and Publication Date	% Share of Urban Population	
	2006	2015
Presidential Task Force on Urbanization and Housing – 1998 (27-28% in 1998, 30% in 2000, 45% in 2015 and 65% in 2030)	36	45
Sri Lanka: Framework for Poverty Reduction – 2000 (22% in 1999 and 45% in 2015)	32	45
Urban Sector Policy Framework (USPF) – 2003 (30% in 2003 and 40-50% in 2015)	32	38
Mahinda Chintana: vision for new Sri Lanka, A ten year Horizon Development Framework (30% in 2006 and +50% in 2016)	30	50

Source: MENR and UNEP (2009)[6]

[b] Estimates of percentage varies based on varying definitions of "urban". *Mahinda Chintana* 10 Year Horizon Development Framework estimates a 30% urban population in Sri Lanka in 2006.

TABLE 2 Public and private investments in urban development (2007-2016)

Project/Programme	Funding Source	SLRs million			
		2007-2009	2010-2012	2013-2016	2007-2016
Urban Infrastructure					
Greater Hambantota Development	Treasury/Foreign Assistance	7,086	3,050	2,509	12,645
Greater Galle Development	Treasury/Capital Market	5,635	3,180		8,815
Greater Trincomalee Development	Treasury/Capital Market	3,000	865		3,865
Greater Dambulla Development	Treasury/Capital Market	16,020	14,100	8,450	38,570
Sri Jayewardenapura, Kotte Development	Treasury/Capital Market	2,800	1,238		4,038
Panchikawatte Triangle Development	Treasury/Capital Market	3,500	10,500	10,000	24,000
Development of Colombo Core Area	Treasury/Capital Market	19,620	10,900	8,050	38,570
Regional Growth Centres and Secondary Town Centres	Treasury/Capital Market	2,000	2,000	1,000	5,000
Urban Environment and Resource Management	Treasury/Donors	10,951	3,186		14,137
Urban Governance	Treasury/Donors	100	50	50	200
Total		70,712	49,069	30,059	149,840

Source: Mahinda Chintana, vision for a new Sri Lanka. A Ten Year Horizon Development Framework 2006-2016[3]

TABLE 3 Target populations for major urban regions envisaged under the national physical planning policy and plan

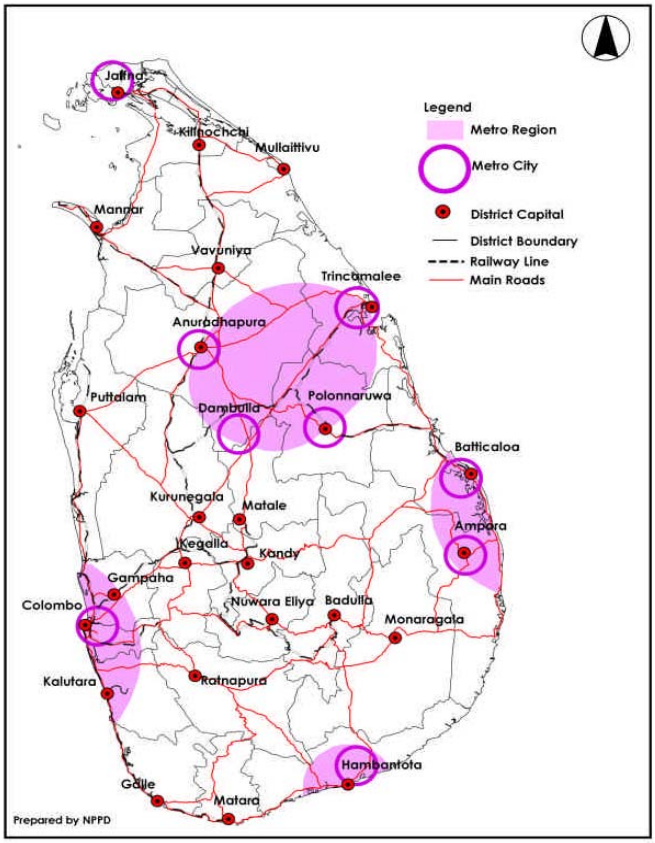
City Type	City Name	Target Population	Metro Region Total
	Western Metro Region		
MetroCity	Colombo	2,000,000	
District Capital	Gampaha	750,000	
District Capital	Kalutara	750,000	
			3,500,000
	North Central Metro Region		
MetroCity	Anuradhapura	1,000,000	
MetroCity	Dambulla	1,000,000	
MetroCity	Polonnaruwa	1,000,000	
MetroCity	Trincomalee	1,000,000	
			4,000,000
	Eastern Metro Region		
MetroCity	Ampara	500,000	
MetroCity	Batticaloa	500,000	
			1,000,000
	Hambanthota Metro Region		
MetroCity	Hambanthota	1,000,000	
			1,000,000
MetroCity	Jaffna	1,000,000	
District Capital	Badulla	75,000	
District Capital	Galle	300,000	
District Capital	Kandy	100,000	
District Capital	Kegalle	50,000	
District Capital	Killinochchi	50,000	
District Capital	Kurunegala	200,000	
District Capital	Mannar	200,000	
District Capital	Matale	100,000	
District Capital	Matara	100,000	
District Capital	Monaragala	100,000	
District Capital	Mulativu	50,000	
District Capital	Nuwara Eliya	50,000	
District Capital	Puttalam	100,000	
District Capital	Ratnapura	75,000	
District Capital	Vavuniya	100,000	
Total		12,250,000	9,500,000

Source: NPPD & MOUD&SAD, 2006[4]

Environmental considerations

Most urban areas in Sri Lanka have their share of environmental problems linked to local environmental contexts and prevailing socio-economic conditions. Some of these are partly linked to development activities and high population densities. These problems include increasing need for basic resources essential for human wellbeing such as land, housing, water and energy; resulting in rising land prices; depletion of canopy cover and loss of urban wetlands due to urban sprawl, decreasing land-man ratio, and congestion. Furthermore, the tendency for flooding, due to the loss of flood retention areas because of the filling of wetlands, is compounded by poor storm water drainage in most urban areas. While urbanization is inexorably linked with enhancing the national economy, the rather rapid urbanization of the proposed target areas would require very systematically planned urban growth and human settlements as a vital prerequisite for national development.

The urban areas located along the coastline are also highly exposed to impacts of climate change-related sea level rise. These, as well as other inland urban areas, are exposed to many other natural hazards, such as floods, droughts and cyclones; and urban areas in the highlands of the Wet Zone are subjected to landslides. To reduce the risk of natural disasters to human settlements, the National Physical Planning Policy and Plan (NPPP&P)[4,8] seeks to shift development away from the "central environmentally fragile area", the "coastal fragile area" and the Protected Areas by targeted development of several metro-regions, metro-cities, and District Capitals by 2030 as key areas for human settlement and economic activity in the country (see BOX 1 & BOX 2). FIGURE 1 indicates the geographic distribution of these planned Metro-Cities and regions. The *Mahinda Chintana* ten year Horizon Development Framework has set the foundation for this thinking.



Source: NPPD & MOUDSAD, 2006[4]

FIGURE 1 Planned Metro-Regions and cities by 2030

1.2 Human settlements and housing

Economic perspective

Housing for all! is an important component of Sri Lanka's development agenda.[10] The demand for houses and urban infrastructure is growing with population growth and economic advancement. Despite concerted efforts to improve housing through several public sector housing programmes (e.g. *Sevana Piyasa* Programme and the post-tsunami housing programme, the Public Servants' Housing Project, Pallimunai Housing Project, Estate Housing Programme and *Janasevana* Housing Grant[7] programme), the housing requirement in the country today is about 4.5 million housing units compared to 4.15 million that are presently available.[3] Of the latter, around 1.3 million are below the required standard,[3] a problem particularly acute for urban low-income families living in slums and shanties. For example, about 50% of the population in Colombo live in poor under-served settlements.[3]

Consequent to these problems, the shortfall of houses in the country has major economic, social and environmental ramifications that the state is striving to address through its national development plans.[3,4] With an increase in income levels and changing lifestyles, the private sector has emerged as the major provider of housing for the middle and high income groups, while the government is involved in facilitating housing for the low income families and other specific groups.[7] Accordingly, the government has planned to construct over 600,000 new houses in order to make "house ownership for all" a reality during the next six years.[10] Some of the government responses to address the need for housing are given in Table 4.

TABLE 4 Human settlements sub-programs and targets for 2007-2016

Policy	Programmes	Target (Housing Units)	Investment (SLRs Mn)
Planned residential development	Village housing support programme "*Gama Neguma*"	300,000	23,900
	Housing schemes for slums and shanty dwellers	5,000	60,000
	Housing scheme for public sector employees	3,000	7,920
	PPP for condominium property development	37,000	9,145
	Introduction of national guidelines on settlement planning		19
Special housing schemes for vulnerable community groups	Fisheries housing	20,000	5,635
Facilitation of individuals and private developers in residential development	Migrant worker housing programme	20,000	20,000
	Releasing land parcels at concessionary rates	100,000	
	Providing connectivity and other infrastructure to building sites	45,000	415,000
Rental housing/accommodation bacilities	Strengthen housing finance market	5,000	6,000
	Introduction of suitable legal instruments		

Policy	Programmes	Target (Housing Units)	Investment (SLRs Mn)
Strengthening Housing Finance Market	Development of primary and secondary mortgage financing		
	Concessionary housing loan scheme for Sri Lankans employed abroad	20,000	20,000
	Housing loan scheme for private sector employees through ETF	20,000	30,000
Ensure Property Rights	Issue of title deeds to all tenants of government housing schemes		
Totals		645,000	597,619

Source: Mahinda Chintana, vision for a new Sri Lanka. A ten year Horizon Development Framework 2006-2016[3]

Environmental considerations

Locating human settlements to address the quest for urban development and expansion, housing for all, and rural development, in a manner that is environmentally conducive is vital. The State has taken this into account to be addressed in the future.[3] Due to the uneven spatial distribution of population in the country, much of the human settlements are presently concentrated in the Wet Zone for historic reasons. This region is already affected by periodic flooding and landslides associated with high and persistent rainfall.[11]

The density of human settlements and associated demands on the environment are increasing in many areas to unsustainable levels. The blocking out, fragmentation and selling of home garden lands for more single family detached dwellings is increasing causing significant sprawl of settlements, which are often ill-serviced with infrastructure and totally devoid of tree canopy cover that could be expected to enhance environmental quality.[c] Large expanses of human settlements without tree cover could also respond more adversely to a future rise in ambient temperature. Furthermore, there is clearing and reclamation of lands and loss of natural drainage systems/wetlands which have significant impacts on ecological systems *(note: this is discussed in detail under the Biodiversity and Ecosystem Services SVP).* In an attempt to limit the impacts of urban sprawl, the government has highlighted the need to encourage vertical development (mid- and high-rise) especially in the major urban centres and for greening the cities. The former, however, poses a different set of challenges as the infrastructure demands of high-rise settlements are often technically more complex and expensive.

BOX 3: KEY ISSUES IN URBAN SETTLEMENTS

- Inadequacy of guidelines on settlement planning at national and regional levels
- Shortage of suitable land for residential purposes in urban areas
- Rapid escalation of land values in major cities and suburbs
- Blocking out and selling of lands by private developers without proper utilities and infrastructure
- Difficulties of access to affordable housing for the urban floating population and worker communities
- Poor maintenance of urban housing schemes by inhabitants, which burdens the government for their maintenance
- Regular price increases of, and lack of standards in, building materials
- Inadequate planning and space left for conserving or increasing the tree canopy along roads and village gardens

Source: Mahinda Chintana, vision for a new Sri Lanka. A ten year Horizon Development Framework 2006-2016[3] *and discussions at the workshop to discuss this SVP.*

[c] UDA standards decree that when subdividing lands > 1 ha in areas designated as urban areas, a 10% should be kept as open spaces. This may not, however, be implemented at all times.

The Dry Zone districts have remained sparsely populated, although successive governments since gaining independence have established human settlements associated with irrigation and agricultural schemes in these areas. They are even now vulnerable to drought, necessitating considerable payment of annual compensation. In the future too, the Dry Zone areas are being targeted for large scale urban development and human settlements (FIGURE 1). As such it is important that these houses and homesteads are adequately "climate proofed" to withstand the impacts of climate change.

2.0 Climate Change Related Issues and Vulnerability

According to the IPCC, *vulnerability* is the degree to which a system is susceptible to, or unable to cope with adverse effects of climate change. Vulnerability is a function of the character, magnitude and rate of climate variation and its effects to which a system is exposed, its sensitivity, and its adaptive capacity. *Exposure* means the nature and degree to which a system is exposed to significant climatic variations. *Sensitivity* is the degree to which a system is affected either adversely or beneficially by climate related stimuli. *Adaptive capacity* is the ability of the system to adjust to climate change to moderate potential damages, to take advantage of new opportunities or to cope with the consequences.

As Sri Lanka has begun moving into a trajectory of aggressive development with ambitious targets, evaluating climate change vulnerability becomes important to identify potential threats to the slated development goals. By doing so, any risks could be addressed early, to ensure that development targets can be achieved in a timely and sustainable manner, as any increase in the frequency and intensity of natural disasters will have immense socio-economic impacts on urban areas and human settlements. This makes climate change vulnerability a rather serious concern to be addressed in the development process. As 70% of Sri Lanka's population is targeted to reside in urban settlements by 2030,[8] it is crucial to ensure that such developments are adequately climate-proofed to ensure long term sustainability.

A summary of climate change issues, related impacts and possible areas for adaptation to be positioned under urban development and human settlements are explained below.

2.1 Climate change induced threats

Analysis of climate data for Sri Lanka clearly indicates changes in rainfall and temperature throughout the country (see BOX 4). When planning for adaptation, climate change related issues and vulnerability need to be considered at two levels:

a) The potential impacts on existing urban areas and infrastructure that need to be understood and addressed.
b) The potential climate change vulnerability of planned future urban development and human settlements that needs to be considered and addressed.

BOX 4: IMPACTS OF CLIMATE CHANGE ON THE WEATHER IN SRI LANKA

Increasing temperature

- Air temperature in Sri Lanka has increased by 0.64^0C over the past 40 years and 0.97^0C over the last 72 years, which revealed a trend of 0.14^0C per decade. However, the assessment of a more recent time band of 22 years has shown a 0.45^0C increase over the last 22 years, suggesting a rate of 0.2^0C per decade.
- Consecutive dry days are increasing in the Dry and Intermediate Zones.
- Ambient temperature (both minimum and maximum) has increased.
- The number of warm days and warm nights has increased, while the number of cold days and cold nights has decreased.

Rainfall variability

- The precipitation patterns have changed, but conclusive trends are difficult to establish.
- A trend for rainfall decrease has been observed historically over the past 30-40 years, but this is not statistically significant.
- There is a trend for the increase of one day heavy rainfall events.
- An increase in the frequency of extreme rainfall events are anticipated, which would lead to more floods.

Drought

- The increased frequency of dry periods and droughts are expected.
- The general warming trend is expected to increase the frequency of extreme hot days.

Source: Department of Meteorology, Sri Lanka, provided for preparation of this report (2010).

- *Vulnerability to natural hazards*

Several natural hazards affect Sri Lanka (see BOX 5).

Possible impacts of sea level rise, coastal flooding and storm surges:

At the global level, the estimated rise in mean sea level over the next 100 years range from 0.18 to 0.54 m *(source IPCC 4th Assessment Report [12])*

- There is a high possibility of the island's coastal region (defined as Divisional Secretariat Divisions (DSDs)) with a coastal boundary[8] being affected by sea level rise, with associated inundation of land, saltwater intrusion, and increased frequency of storm surges.
- Land, settlements, and coastal infrastructure including housing, roads, tourism infrastructure, and other livelihoods may be affected with substantial loss/damage of assets, disruption of economic opportunities and threats to the physical and social wellbeing of coastal communities. *See more in impacts on the coastal zone in* Box 6.[13]
- The coastal zone accounts for about 43% of the nation's GDP[14] so impacts on coastal settlements translate into substantial impacts on the nation's economy.
- Inundation and storm surges risks may result in the need for some communities to relocate entirely. Such migrations will put pressure on land availability in coastal areas and carry high economic and social costs; this may lead to localized land-related conflicts if such migrations are not managed effectively.
- Saltwater intrusion will reduce the availability of fresh water for both drinking and irrigation, again undermining the viability of settlements in certain coastal areas.
- Downstream effects of saltwater intrusion due to sea level rise will be felt by human settlements and urban areas further inland, well beyond the coastal zone.
- There is lack of clear data on sea level rise to highlight its seriousness and need for adaptation.

Possible impacts of a rise in temperature:

- The need for adequate ventilation and cooling in residential and commercial buildings will increase with the rise of ambient temperature. This can increase the energy demand at the national level and increase energy costs at the household level for cooling.

- Health concerns in settlements are also expected to worsen. *(Further details on health issues are discussed in the Health SVP).*

Projected average temperature increase for Sri Lanka:

- *2025 is 0.4°C*
- *2050 is 0.9°C*
- *2075 is 1.6°C*
- *2100 is 2.4°C*

Source: Department of Meteorology data, provided for preparation of this report in 2010

Possible impacts of changes in rainfall regimes:

Droughts:

- Droughts could become longer and more frequent, adversely affecting the drought prone districts even further. Future urban development and planned expansion of human settlements could be highly vulnerable to such impacts, particularly if local economies are sustained by industries highly sensitive to drought, such as agriculture.

- The quantity and quality of water available for domestic use will be affected.

Landslides:

- The incidence of landslides caused by heavy and continuous rain is on the rise, and the resultant loss/damage to housing and related infrastructure, livelihoods and lives need to be anticipated. The central hill region of the country would be particularly affected by this hazard.

- Communities highly vulnerable to landslide risks may seek to relocate. The economic costs and social issues related to such potential migration could be significant.

BOX 5: IMPACTS OF NATURAL HAZARDS THAT AFFECT SRI LANKA

"Natural hazards occur due to natural phenomena that have a human element, and result in a large number of fatalities and/or large scale damage to property."(MENR, 2002)[11]

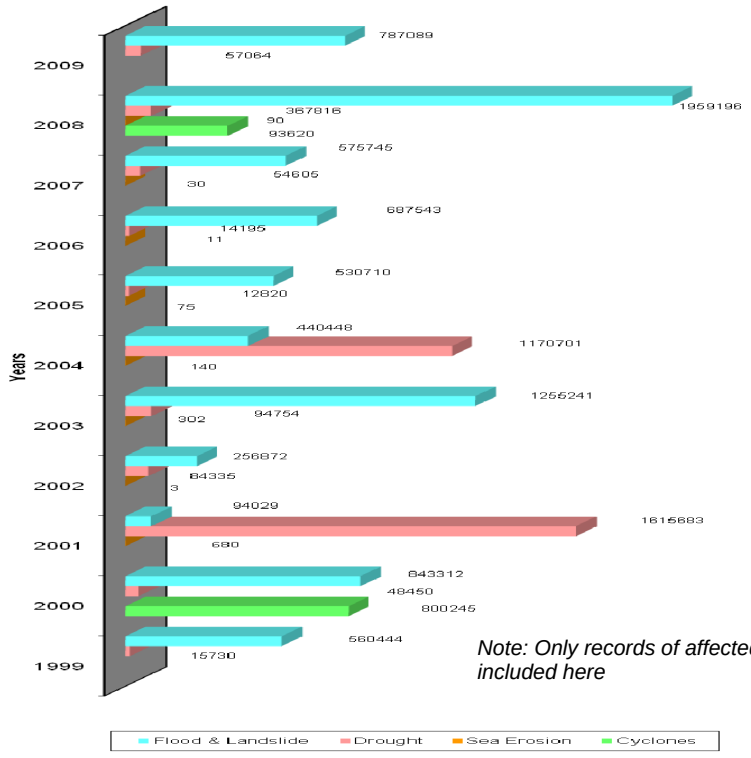
Coastal erosion affects Sri Lanka's beaches and adjacent coastal lands that are constantly subject to erosion, by winds, waves and currents that pound the coast. Available records indicate an average rate of coastal erosion of about 0.5 m/year and an accretion rate of about 0.2 m/year (CCD 2006[9]).

Landslides have been a frequent problem in Sri Lanka for many decades, and they generally follow heavy rains exceeding a threshold of 125 within 24 hours (NBRO data provided for preparation of this report, 2010).

Floods are associated with extreme rainfall conditions, and occur in almost all river basins in Sri Lanka. Serious flooding frequently occurs in the Kelani, Kalu and Mahaweli river basins. Floods occur mainly in the Wet Zone, in areas having high rainfall, though flooding may sometimes occur in the Dry Zone as well (Manchanayake and Madduma Bandara, 1999[15]; NARESA, 1991).[16]

Drought is the major natural hazard experienced in Sri Lanka, which, despite the lack of a heavy toll on life, has very serious negative impacts on the economic and social life of the country due to considerable expenditure by the government for compensation of crop failure due to drought (Manchanayake and Madduma Bandara, 1999).[15]

Cyclones are less felt in the island than the Indian subcontinent as Sri Lanka is situated outside the cyclone belt. However, several serious cyclones have been felt periodically, with most damage occurring in the Northern and Eastern parts of the island, and to a lesser degree in some areas of the North Central Province. (*Note: This situation can vary in the future with climate change, although no conclusive data or projections are available in the Sri Lankan context).*



Note: Only records of affected people provided by the DMC have been included here

Source of data for graph: DMC, 2010

Number of people affected by natural disasters

BOX 6: IMPACTS OF CLIMATE CHANGE ON THE COASTAL REGION

Sri Lanka's coastline of approximately 1,620 km includes the shoreline of bays and inlets but excludes lagoons.[9] The coastal region, defined as DS Divisions (DSDs) with a coastal boundary, currently number 74, lie within 14 of the island's 25 administrative districts that cover about 23% of the island's land area.[9] This area accommodate about 25% of the population, a heavy concentration of urban areas, tourism infrastructure and industries that are vulnerable to impacts of sea level rise and increased frequency of storms and the intensification of coastal erosion due to climate change. This increases the potential vulnerability of the coastal zone to inundation of coastal lands and infrastructure.

All major climatic divisions of the country are represented in the coastal region, so that impacts of climate change on this region will be varied. The Western and South-Western coasts fall within the Wet Zone characterized by an annual rainfall of over 2,500mm, and an average temperature of around 28^0C.[17] These areas are vulnerable to higher intensities of rainfall, and the resultant flooding and storm damage.

Much of the coastal zone lie within the Dry Zone, with an average annual rainfall between 1,250-1,750 mm and a temperature of around $28\text{-}32^0$C.[17] Due to the varied nature of potential hazard impacts, the coastal region can be expected to become very vulnerable to rising temperature and prolonged drought as a result of climate change. More frequent disaster events will also have significant social and economic dimensions. For example, climate change related hazard events may dislodge coastal communities that are already economically vulnerable, and disrupt their social safety nets and livelihoods. While men in these communities will be greatly affected by the loss of fishery associated livelihoods, women who play a considerable role in managing day-to-day domestic issues will also bear a major share of the associated socio-economic problems that are bound to arise. Livelihoods dependent on other industries such as tourism and agriculture may be similarly affected. Consequently, sea level rise and other climate change induced natural hazards that will impact on the coastal zone could have serious socio-economic ramifications on Sri Lanka's national development agenda.

Floods and high intensity rainfall:

- Erosion of road and rail embankments and physical damage to infrastructure and public utilities such as water supply lines, electricity and telecommunication cables, and storm water drains may impose significant burdens on both individual households and the national economy.

Flooding, unlike coastal erosion, is a comparatively rapid occurrence and will need prior disaster preparedness to minimise the severity of damage to lives and property.

Source: MENR, 2002[11]

- More frequent and severe flooding from flood prone rivers will exacerbate problems already faced by many communities in low-lying areas, causing loss of property, lives and livelihoods.
- More flash floods in urban low-lying areas may occur, especially where natural drainage paths and flood retention areas have been blocked or reclaimed—with resultant social and economic costs.
- Increase in the intensity of rainfall may overwhelm the urban storm-water drainage systems, resulting in more frequent flooding.
- Higher intensity rainfall may result in more frequent water damage to household and community level assets and infrastructure. Higher costs will be incurred for maintenance and repair.
- Health concerns in settlements are also expected to worsen.[18] *(Further details on health issues are discussed in the Health SVP).*
- Pressure on national food production (*Discussed in detail in the SVP on Agriculture*).

2.2 Vulnerability enhancing factors

- *Anthropogenic factors*

Several factors may contribute to exacerbate the impacts associated with climate change in the urban sector. They include:

- The location of settlements in environmentally sensitive and disaster prone areas.
- Decreasing canopy cover due to rapid sprawl of unplanned expansion of human settlements can add to increased ambient temperature, which in turn will impact on quality of life and the need for additional cooling and ventilation, increasing the energy demand.
- Large scale and long-term reduction of canopy cover in home gardens may increase ambient temperature at localised levels.
- Fragmentation and loss/degradation of natural forest patches and urban green spaces in human settlements can lead to the same effects as above, in addition to potential escalation of human wildlife conflicts.
- Replacement of natural vegetation with exotics in forest fragments near human settlements tend to worsen water shortages for those using ground water.
- Growing populations combined with inadequate land use planning results in unsustainable housing settlements that could be more at risk from climate change than well planned housing settlements.
- Filling up of wetlands which increases propensity for urban flooding.

- *Socio-economic factors*

Vulnerability of the Sri Lankan community to climate changes will be influenced by several socio-economic factors, including status of poverty and food security, education, amount of resource endowed, livelihoods, level of congestion in the environment (urban or rural), institutional supporting framework, and government policies. Several factors add to climate change vulnerability of urban development and human settlements in Sri Lanka. They are:

- High population density and high total population in a given area (such as a DSD) could mean that the scale of impact from natural hazards, made more frequent and or more intense by climate change, would increase as more people would be affected. As such, increased population density could be expected to increase potential vulnerability to climate change.
- Makeshift housing is less weather resistant and more likely to be damaged in extreme weather events, making communities with a high percentage of temporary housing units more vulnerable.
- The poor disproportionately bear the burden of climate change worldwide. In Sri Lanka, many of the highly vulnerable settlements along the coast as well as in other disaster prone areas are occupied by the poor who often cannot afford land in safer locations or afford high quality construction. They may also lack the financial strength to effectively recover from any damage to their homes.
- Communities with high levels of poverty are highly vulnerable to even temporary impacts on their livelihoods caused by climate change.
- Higher education levels often lead to higher ability to adapt to the risks associated with climate change, and communities with low education levels may be more vulnerable.

- There could be considerable social disruption and social conflict due to loss of livelihood and the need to relocate if and when affected by sea level rise. This will also cause pressure on land to make way for relocation of affected communities, national food production which will also impact on the people.

- *Other causes that adversely affect development of urban areas and human settlements*

- Planning for human settlements and related sectors (such as drainage, roads, etc.) often do not take climate change impacts into account.
- Inadequate data and freely available maps to enable easy identification of high-risk areas, and effective planning.
- Inability to enforce development plans due to various factors.
- Outdated technical guidelines such as rainfall intensity curves (last published in 1984) used for planning and engineering design.

2.3 Mapping climate change vulnerability

A vulnerability mapping exercise, using GIS, was undertaken in order to better understand climate change vulnerability in key sectors in Sri Lanka, building on the IPCC definitions of exposure, sensitivity, and adaptive capacity as defined under section 2.0 above.[d] The analysis is intended for use as a macro level planning tool, to illustrate where sector-specific vulnerability is high, in relative terms, across the nation, and to guide decisions on prioritization and targeting of potential climate change adaptation responses.

General methods

The basic methodology involved in the GIS mapping was to develop indices for exposure, sensitivity, and adaptive capacity relevant to each given sector. These three indices were then combined to create a composite sector-specific vulnerability index. The analysis, which is largely based on publicly available data sources including the 2001 National Census. Areas where complete and comparable data sets of relevant indicators could not be obtained (such as the North and East where census data is not available) were not analyzed, and will need to be evaluated at a future stage, perhaps after the 2011 census is complete.

Separate *exposure indices* for flood, drought, and landslide exposure were developed based on historic data on the frequency and scale (assessed in terms of number of people affected) from the Disaster Management Centre (DMC). The exposure index for sea level rise was based on a ratio of the area of land within 2M above sea level as a percentage of total land area within 5km from the coastline in each DS Division. Topography data was obtained from the ASTER 30M Digital Elevation Model. The above exposure indices are common across all sectors, however only exposure types relevant to a given sector were analyzed and illustrated.

The sensitivity and adaptive capacity indices are unique to each sector and the indicators used in their formulation are given in the following pages along with the vulnerability maps.

It must be noted that the mapping exercise itself is preliminary and limited in scope and should be refined on an ongoing basis, based on detailed data which may become available from various government agencies. It is also noted that relevant agencies are carrying out detailed hazard mapping at the national and regional levels[e].

[d] IWMI's CC Vulnerability Index as in Eriyagama *et. al.*, 2010 was used as a starting point and substantially refined for finer grain and sector specific analysis.[19]

[e] For example, the Disaster Management Centre (DMC) is currently coordinating a detailed risk profiling exercise for the major disaster types, at a much higher level of detail, in collaboration with the Coast Conservation Department, Irrigation Department, the National Building Research Organization, and several others. The maps generated through the DMC exercise would provide much finer grain information for exposure indices.

What the vulnerability maps foretell

- *Planned settlements*

The following maps (FIGURES 2 - 5) have been prepared by overlay of the Exposure Indices at DSD level, with the map giving proposed metro-regions, "Metro-Cities" and "District Capitals" in the NPPP&P and focus cities cited in the *Mahinda Chintana*: vision for a New Sri Lanka, a ten year Horizon Development Framework 2006-2016. (Larger maps are given in APPENDIX B).

Comparison of the NPPP&P structure plan with the exposure indices for floods, droughts, landslides, and sea level rise suggest that while the planned "Mega-Cities" and "Urban Areas" as a whole have low exposure levels, some pockets of high-exposure do exist within the planned zones.

It is impossible to completely avoid climate-change related impacts in planning settlements. Therefore, such vulnerability will need to be considered in designing and planning investments and infrastructure in these areas, so that resilience to climate change impacts can be ensured.

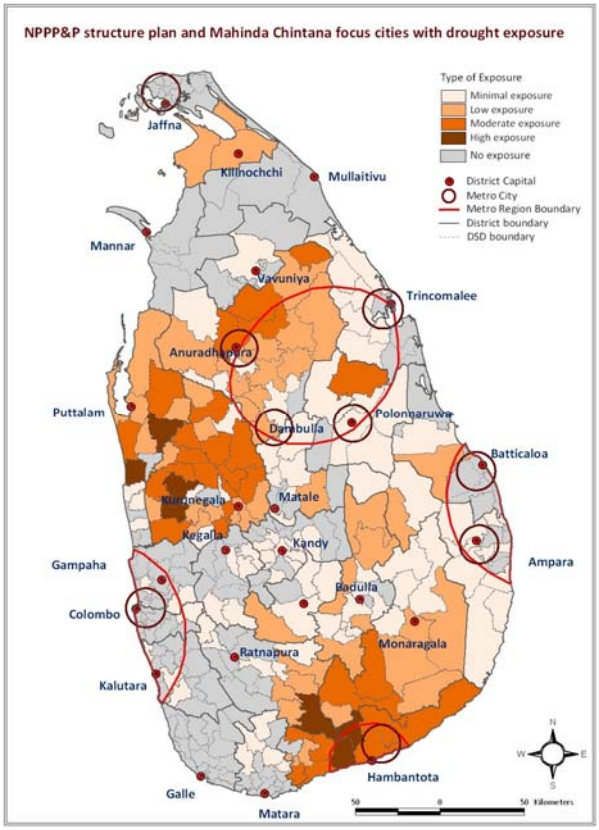


FIGURE 2 NPPP&P structure plan and Mahinda Chintana focus cities with drought exposure

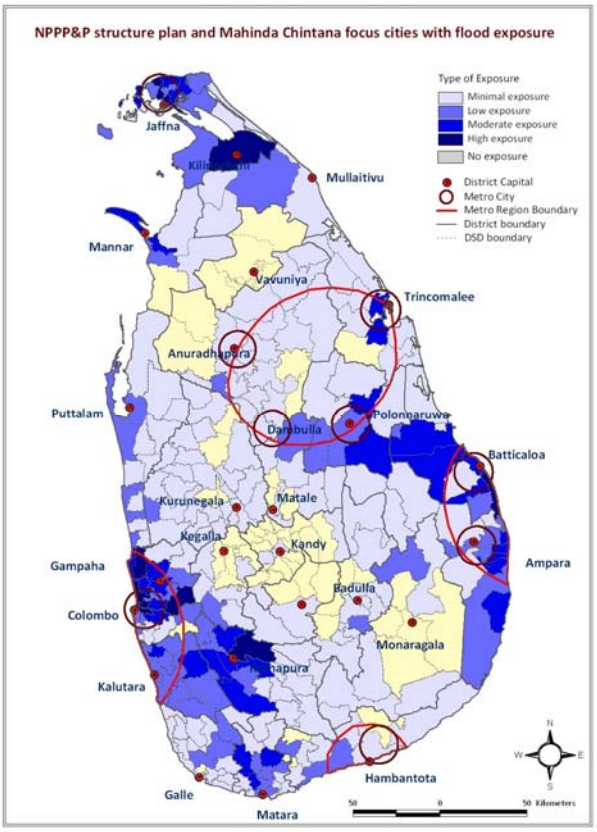


FIGURE 3 NPPP&P structure plan and Mahinda Chintana focus cities with flood exposure

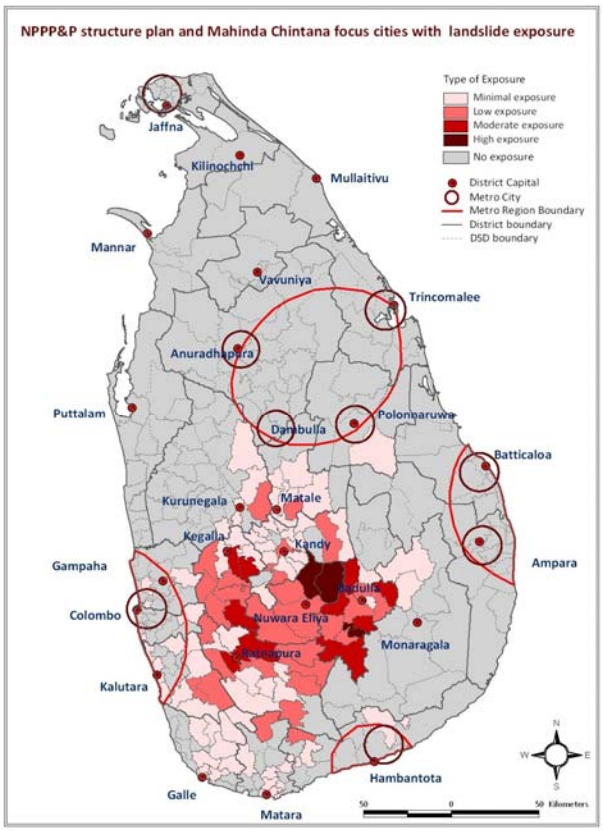


FIGURE 4 NPPP&P structure plan and Mahinda Chintana focus cities with landslide exposure

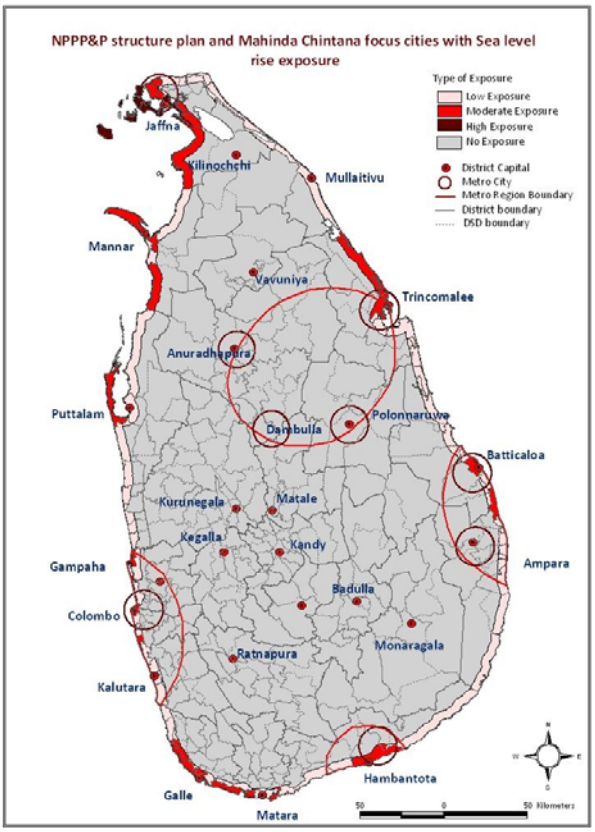


FIGURE 5 NPPP&P structure plan and Mahinda Chintana focus cities with sea level rise exposure

- *Existing human settlements*

FIGURES 6 TO 9 illustrate the geographic distribution of vulnerability to drought, flood, landslide, and sea level rise exposure in the housing and urban development sector .The indicators considered in developing the sensitivity and adaptive capacity indices used are below. The DSD vulnerability ranking tables and larger scale maps are in APPENDIX B.

The sensitivity index for housing and human settlements includes	**The adaptive capacity index for housing and human settlements includes**
A composite of data (at DSD level) on: • Population density • Number of housing units • % of housing units classified as temporary structures	A composite of data (at DSD level) on: • percentage of people above the poverty line • percentage of people who have completed secondary education
Raw data source: 2001 National Census	

Vulnerability of human settlements to *drought* exposure:

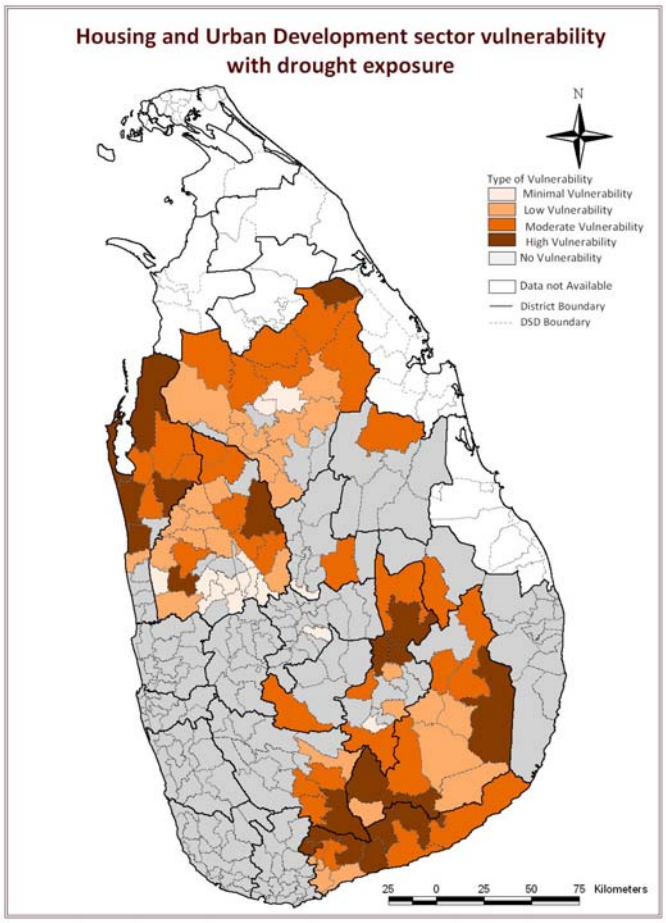


FIGURE 6 Vulnerability of human settlements to drought exposure

- Vulnerability of housing and human settlements to drought is widespread in the island, but more concentrated in the North-central and Southern regions of the country.

- 19 DS Divisions (DSDs) emerge as having settlements highly sensitive to drought. These DSDs combined, have:
  - A total population of 871,830 people, of whom 33.8% are below the poverty line.
  - A total housing stock of 219,231 housing units, of which 107,440 (49%) are of temporary construction.
  - 66.9% of their population (or 153,034 households) using wells and another 8.1% (18,416 households) using tube wells as their primary source of water.

- The three most vulnerable DSDs are Embilipitiya (Ratnapura District), Siyambalanduwa (Moneragala District), and Kalpitiya (Puttalam District).
  - Siyambalanduwa and Kalpitiya are highly sensitive as 68% of the housing stock in those DSD's comprise of temporary structures, while in Embilipitiya this figure is 38%.
  - Siyambalanduwa and Kalpitiya also have very high incidence of poverty (51% and 41%) among areas historically exposed to droughts.
  - Populations in Kalpitiya and Siyambalanduwa are heavily dependent on groundwater, with over 89% of the respective populations using wells or tube wells as their primary source of water.
  - Embilipitiya emerges as highly vulnerable because it has a relatively high population of 119,563, and a substantial volume of housing --29,027-- of which 11,000 are temporary structures. Embilipitiya is also among the DSDs that have historically recorded the

highest exposure to droughts; 55% of the population at Embilipitiya depend on groundwater.

- A further 32 DSDs are in the moderately vulnerable category. They have:
  - A total population of about 1,494,810 people, of whom 391,706 are below the poverty line.
  - A total of 371,327 housing units of which 159,967 are of temporary construction.

Vulnerability of human settlements to *landslide* exposure:

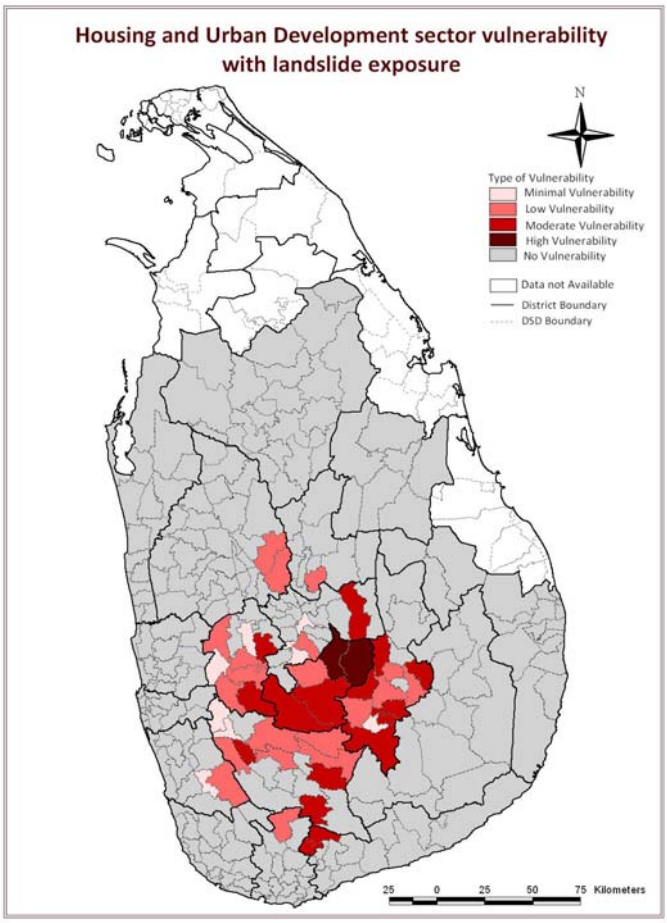


FIGURE 7 Vulnerability of human settlements to landslide exposure

- Vulnerability of housing and human settlements to the expected increase in landslides due to climate change is concentrated in the central hills of Sri Lanka.

- Walapane and Hanguranketha DSDs (both in the Nuwara Eliya District) emerge as having highly sensitive settlements to landslide exposure on their human settlements. These 2 DSDs have:
  - A total population of 194,194 people, of whom 29.4% are below the poverty line.
  - A total housing stock of 47,693 housing units, of which 19,715 (41.3%) are of temporary construction
  - The highest exposure to landslides, historically in terms of frequency and people affected

- A further 15 DSDs are expected to be moderately vulnerable to landslides as a result of climate change. These DSDs combined have:
  - A population of 969,660, of whom 275,276 (28.4%) are below the poverty line.
  - 235,667 housing units of which 36.5% are temporary structures.

Vulnerability of human settlements to *flood* exposure:

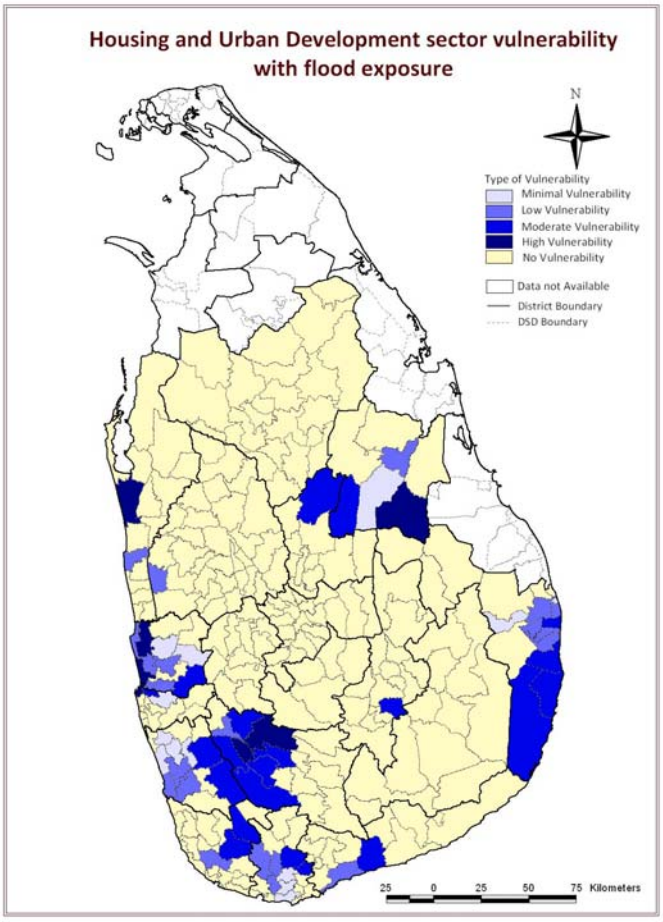


FIGURE 8 Vulnerability of human settlements to flood exposure

- Vulnerability of housing and human settlements to the expected increase in floods appears to be concentrated in the Western region of the country, although smaller pockets of high vulnerability are also seen elsewhere.

- 7 DSDs emerge as having settlements highly vulnerable to flood exposure. These DSDs combined have:
  - A population of 1,034,944, with poverty incidence of 13.3%, which is lower than the national average.
  - 214,475 housing units of which almost a quarter (53,330) are temporary structures.
  - 37% of their population (81,775 households) using wells as their primary source of water.

- Colombo (Colombo District) and Katana (Gampaha District) emerge as the two most vulnerable DSDs. These DSDs are home to 603,629 people living in 113,848 housing units. Colombo, the most vulnerable DSD, has the highest population density in the country.

- 21 additional DSDs emerge as having settlements that are moderately vulnerable to flood exposure. These DSDs combined have a population of 1,168,658 living in 276,442 housing units, over a third of which are temporary structures. 57.7% of these households use wells as their primary source of water.

Vulnerability of human settlements to *sea level rise* exposure:

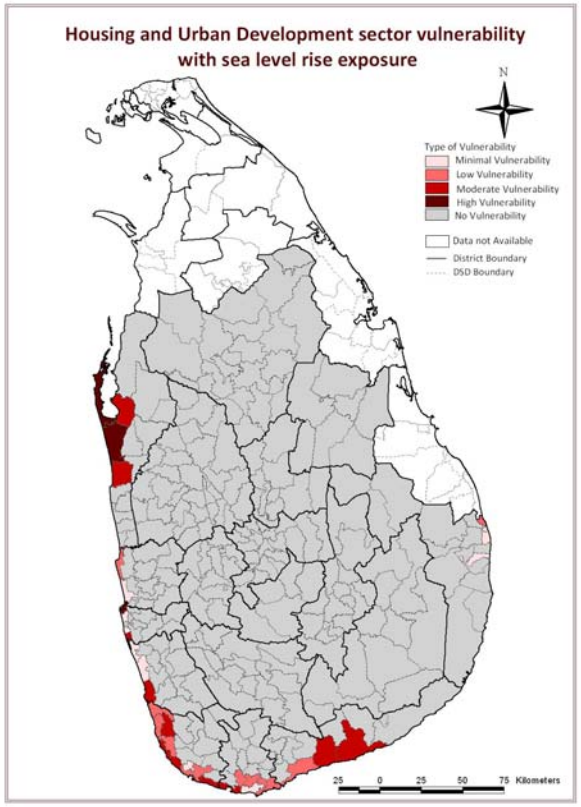


FIGURE 9 Vulnerability of human settlements to sea level rise exposure

- Vulnerability of housing and human settlements to sea level rise exposure appears to be highest in the Western and Southern regions of the island. Although "exposure" was high in the North and East, detailed vulnerability assessment of this region could not be done because of the lack of census data.

- Among the DSDs where data was available and could be mapped, Colombo (Colombo District), and Kalpitiya and Mundalama (both Puttalam District) show high levels of vulnerability. These 3 DSDs have:
  - A population of 519,020 people, of which almost a 100,000 are below the poverty line.
  - 96,196 housing units of which 29,422 are temporary structures

- The housing stock in Kalpitiya and Mundalama comprise primarily of temporary structures (68% and 51% respectively). This is the worst situation among all coastal DSDs where data were available. These two DSDs are also heavily dependent on groundwater, as over 86% of their populations use wells or tube wells as their primary source of water.

- A further 10 DSDs emerge as being moderately vulnerable to sea level rise exposure. These DSDs have a total population of 822,814 living in 183,867 housing units. 28% of these homes are temporary structures.

3.0 Institutional and policy framework

3.1 Institutional set up

Planning for and implementing actions related to urban development, establishment or enhancement of human settlements, and improving the housing stock involve many ministries and line agencies. The key ministries and agencies that have a major stake in development of urban areas, human settlements and housing are given in **Table 5**. Also included are other agencies that have substantial impact on these development areas.

TABLE 5 Institutions involved with development of urban areas and human settlements and better disaster preparedness

Key Ministries	Key Agencies	Other Agencies/Groups with impact
• Ministry of Defence	• Urban Development Authority	
• Ministry of Construction, Engineering Services, Housing & Common Amenities	• Department of National Physical Planning • Condominium Management Authority (Common Amenities Board) • National Housing Development Authority (NHDA) • Centre for Housing Planning and Building • Urban Settlement Development Authority • Department of Buildings	• Institute of Construction, Training and Development • State Development and Construction Corporation • State Engineering Corporation • National Equipment and Machinery Organization
• Ministry of Resettlement	• Resettlement Authority	
• Ministry of Lands & Land Development	• Department of Land Settlement	• Department of Land Commissioner General • Institute of Survey and Mapping
• Ministry of Disaster Management	• Disaster Management Centre • National Building Research Organization • National Disaster Relief Services Centre • Department of Meteorology	• National Disaster Management Council
• Ministry of Social Services	• Department of Social Services • National Institute of Social Development	
• Ministry of Irrigation & Water Resources Management		• Department of Irrigation • Mahaweli Authority of Sri Lanka • Central Engineering Consultancy Bureau (CECB) • Mahaweli Irrigation Development Programme • Water Resources Board
• Ministry of Ports & Aviation	• Department of Coast Conservation	
• Ministry of Environment	• Central Environmental Authority	
• Ministry of Local Government and Provincial Councils	• Municipal Councils • Urban Councils • Pradeshiya Sabhas	

3.2 Key policies and legislation that govern the sector

Key sector policies

Sri Lanka's development strategy espouses reduction of the urban-rural gap in terms of housing in the physical environment along with other amenities.[3] Sri Lanka's overall strategy for urban development, human settlement and economic infrastructure are dealt with in three inter-related policy documents – The National Physical Planning Policy and Plan (NPPP&P),[4] The *Mahinda Chintana* 10 year Development Plan[3] and The *Randora* National Infrastructure Development Plan.[5]

Within this framework, the State is striving to expand urban growth and to ensure planned human settlement through the adoption of new parameters based on population density, land suitability and environmental sustainability; including adoption of the vertical development approach in high and medium population density areas. As such, policies pertaining to urban development recognize the need for environmental considerations, while residential planning is expected to take into account environmental factors, lifestyles of people, demand for amenities, type of livelihoods, ethnic and social behaviours and the need for green spaces.

Policies and plans supported by several laws safeguard environmental considerations during urban development, setting up of human settlements and housing expansion. The main laws that are applicable in this context are in **Table 6**.

TABLE 6 Legislation/policies/plans/strategies influencing development of urban areas and other human settlements

Main legislation governing urban development and housing	Other legislation having impact on urban development and housing	Policies/plans/strategies governing urban development, human settlements and housing
• Urban Development Authority Law No. 41 of 1978 and the Urban Development Authority (Special Provisions) Act No. 44 of 1984 • Town and Country Planning Ordinance No 13 of 1946 as amended by Act No. 49 of 2000 • Coast Conservation Act No. 57 of 1981, and the amendment Act No. 64 of 1988 which governs all urban development and housing in the Coastal Zone. • Urban Councils Ordinance No. 61 of 1939 and its subsequent amendments. • Village Communities Ordinance of 1924, 1956, No. 35 of 1957, 1959. • Municipal Councils Ordinance No. 29 of 1947 and subsequent amendments of 1956, 1957 and 1958. • Land Development Ordinance No. 19 of 1935; and its subsequent amendments. • The Condominium Law – governs the promotion of condominium development in urban areas. • Colombo District (Low Lying Areas) Reclamation and Development Board Act of 1968, and the Amendment - Sri Lanka Land Reclamation and Development Corporation Act No. 52 of 1982 • Housing and Town Improvement Ordinance, No. 19 of 1950. • Greater Colombo Economic Commission Law No. 4 of 1978 as amended by Act No. 49 of 1992 • Condominium Act	• Soil Conservation Act, No. 25 of 1951; amended in 1996. • The Forest Ordinance No. 16 of 1907, and its subsequent amendments • The Fauna and Flora Protection Ordinance of 1937 and the subsequent amendments • The National Environmental Act No. 47 of 1980 and the 1988 revision for better control of environmental pollution and for assessment of impacts of development activities • The National Heritage Wilderness Area Act No. 3 of 1988 • Felling of Trees Control Act No. 9 of 1951	*Policies/plans/strategies* • Urban Sector Policy Action Plan (USPAP) 1996 - 2015 • Urban Sector Policy Framework (USPF) of 2003 • National Physical Planning Policy of 2006 • A National Policy on Air Quality Management of 2002 • The National Energy Policy of 1997 • National Transport Policy of 1991 • National Environment Policy of 2003 • Land Use Policy of 2009 • Resettlement Policy • Local Government Policy • The National Wetlands Policy and Strategy of 2006 • The National Watershed Management Policy of 2004 • The National Forest Policy of 1995 • The National Wildlife Policy of 2000 *Some key projects and activities:* • Urban Development and Low Income Housing Project (1999 – 2005) • Urban Settlement Improvement Programme (USIP) • Sustainable Cities Programme (SCP) • Urban Development Sector Project, 1993-1999 in 17 towns

4.0 Policies/Plans/Strategies and Actions that Support Adaptation

Adaptation **is the adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities. To minimize the impacts of climate change, it is necessary to adopt adaptation measures during development of urban areas, housing and human settlements in a timely manner.**

4.1 Development of human settlements

Urban planning

Adaptation to climate change would require better preparedness to natural hazards that are expected to become more pronounced, while enabling sustainable development. Climate proofing of urban areas, metro-regions—including associated rural settlements—would require an approach that enables human settlements and their housing stock to be well planned, designed and constructed so that they can withstand the impacts of climate change. They should be able to provide adequate water resources to inhabitants in the face of increased water requirements, have green spaces with tree cover to ameliorate the environment and have sufficient flood retention areas and flood control measures to withstand extreme rainfall events. There should also be provision to safeguard inhabitants in the face of increased intensity and frequency of natural hazards by way of early warning systems, and institutional support to cater to those affected by such disaster events.

The government has already identified these needs and addressed some of these requirements, which are prerequisites for adopting adaptation measures with regard to development of urban areas and housing. Some of the key policies, plans, strategies and actions that would support the formulation of adaptation measures during development of urban areas and housing stock are given below.[f]

BOX 7: LANDMARK ACTIONS TAKEN BY SRI LANKA IN RESPONSE TO CLIMATE CHANGE

- Ratification of the United Nations Framework Convention on Climate Change (1992) on 23.11.1993 followed by the Montreal Protocol (on substances that deplete the ozone layer) and the Kyoto Protocol (which commits countries (i.e. mainly Annex I parties) to reduce their collective emissions of greenhouse gases).
- Establishment of a Climate Change Secretariat (CCS) within the MENR to facilitate, formulate and implement projects and programmes at national level with regard to climate change.
- Preparation of an inventory of green house gases (2000) followed by an update which is ongoing.
- Establishment of a separate Climate Change Division within the Ministry of Environment and Natural Resources.
- Establishment of a Centre for Climate Change Studies (CCCS) in 2000, under the Department of Meteorology, to conduct research, monitor climate change, and provide the general public with current information on climate change and allied issues.
- Preparation of the Initial National Communication on Climate Change under the UNFCCC in 2000 by the MOE, which indicated the sectors most vulnerable to climate change and subsequent impacts, the sectors that most contribute to climate change, and the required mitigation options and adaptation responses.
- Initiation of the second National Communication on Climate Change under the UNFCCC which is ongoing.
- Addressing national capacity needs to implement the UNFCCC through the National Capacity Needs Self Assessment Project (NCSA) and preparation of the NCSA Action Plan based on a thematic assessment of existing capacity to address climate change, by the MENR.

- ***The National Physical Planning Policy & Plan***[4,8]

The National Physical Planning Policy and Plan was developed in 2006 to promote and regulate integrated planning of economic, social, physical and environmental aspects of land and territorial waters. This policy and plan clearly articulates the intention to ensure development that is mindful

[f] Table 5 gives the ministries and agencies involved with urban development, housing and disaster preparedness, and Table 6 provides the legislative framework and plans and policies that guide these area of national development.

of environmental factors. It identifies both the hill country and the entire coast as environmentally sensitive and under stress due to excessive human activity. The policy promotes maintaining an equilibrium between the environment and human settlements in regions exposed to natural hazards, while encouraging voluntary migration through economic stimuli to planned settlements in planned metro-regions and cities targeted for future growth and state investment.

- *Other plans and policies that support better planning of urban areas and human settlements*

Overarching plans and policies that govern national development – such as the *Mahinda Chintana* - also provide support for adaptation measures to climate change by promoting suitable development when planning and establishing urban areas and other human settlements. They are outlined in BOX 8.

BOX 8: SUPPORT FOR URBAN DEVELOPMENT AND HOUSING WITHIN THE NATIONAL DEVELOPMENT POLICY FRAMEWORK

- *The Mahinda Chintana –Vision for the future* **(2010 Presidential Election)** [10]

This document states that an action plan will be developed to address environmental change including droughts, floods and cyclones. It articulates planned urban development and conversion of suburbs of the capitol into green towns in collaboration with the Central Environmental Authority and the Urban Development Authority. They have already initiated the concept of green cities. It also states that green villages will be launched under the *Gama Naguma* Programme to make the villages environmentally friendly.

- *The Haritha Lanka Programme of Action*

This programme directly addresses climate change through Mission 3 and indirectly promotes adaptation through Missions 4 (wise use of the coastal belt and seas around), 5 (responsible use of the land resource),7 (water for all and always) and 8 (Green cities for health and prosperity). This programme has short-term, medium-term and long-term targets spanning 2009-2016 that could help adaptation to climate change.

(More details on these policies and plans in general are given in APPENDIX A).

Several significant planned urban development initiatives have taken place, including the Sri Jayewardenapura Kotte Parliamentary Complex. A new structure plan for the Colombo Metropolitan Region is being developed taking into consideration all aspects of the region, such as infrastructure, transport, health, education, industry, housing and agriculture. The proposed strategies for physical formations are aimed at making the City of Colombo more orderly and environmentally friendly and yet highly dynamic and economically diverse, by the application of appropriate environmental and physical planning strategies.

- *Improving the housing stock*

In most urban and rural areas the segment of society most vulnerable to natural hazards are the poor who live in temporary houses or poorly constructed buildings that are very vulnerable to damage from floods and the impacts of increased rainfall and temperature. The poor also tend to occupy vulnerable lands due to the lack of facilities and funds to relocate. Improving the housing stock of urban poor as well as rural communities have been addressed by successive governments, while the current national development framework addresses this aspect and facilitates voluntary relocation.

Some examples of State efforts to improve development of urban areas and housing stock

Urban Settlement Improvement Programme (USIP)
This project sought to improve basic social and environmental infrastructure with the active participation of beneficiary communities and other stakeholders in 210 underserved settlements between 2007and 2011.

Sustainable Cities Programme (SCP)
This project was started in 1999 in three municipal councils of the Greater Colombo Area to help develop institutional mechanisms and approaches to elicit community participation in environmental planning and management. Phase I of this project was successful and the project which covers 19 towns is now in Phase III.

Urban Development and Low Income Housing Project (1999 – 2005)

A 100 million dollar project was initiated in 1999 to bridge regional disparities in urban infrastructure in 27 secondary towns outside the Colombo Municipal Region (CMR). Under this over 80 infrastructure improvement sub-projects had been completed by 2005 for a cost of about SLRs 6,700 million. Considerable funds (approximately SLRs 2,400 million) have been disbursed for more than 28,000 housing loans for urban low-income families.

Source: Environmental Outlook, MENR and UNDP, 2009

4.2 Addressing disaster events

The National Physical Planning Department (NPPD) has adopted the stand that population growth within disaster prone lands defined as the "Central Environmentally Fragile Area and Coastal Fragile Area" should be discouraged, and some of that population be encouraged to relocate in risk free areas that are designated as Metro Cities. A policy of priority investment in infrastructure for these Metro Cities is also considered part of disaster management.

Sri Lanka has also already set in motion measures to reduce the impact of natural hazards felt in the island and to increase disaster preparedness. They include setting up Ministry of Disaster Management, and under it, a Disaster Management Centre, and a National Disaster Management Council.

- *The Natural Disaster Management Plan (NDMP) of 1999*

This plan covered the major phases of Disaster Management by addressing preparedness, mitigation and preventive action; recovery, relief, rehabilitation and reconstruction; control of floods, landslide hazards and cyclones; and improvement of meteorological observations, forecast and warning systems. *(After the formation of the ministry dealing with disaster management in 2005, a new NDMP was drafted by the DMC, and it is currently pending cabinet approval).*

- *The Sri Lanka Urban Multi-Hazard Disaster Mitigation Project (SLUMDMP)*

This project was established under the then Ministry of Urban Development, Housing and Construction to reduce natural disaster vulnerability among urban populations and to provide infrastructure, lifeline facilities and shelter while developing sustainable public and private sector mechanisms for disaster mitigation in the country.[11]

The SLUMDMP also prepared an Emergency Management and Response Plan (EMRP) for the Ratnapura Municipal Council which outlined the emergency management and response mechanism (i.e. organisational structure, inter-departmental linkages and the role of NGOs, voluntary organisations and local communities, etc.); the strategy for action at central, provincial, district and local levels; the operational procedures, guidelines and standards for various departments that provide food, water, shelter, health services, etc.[11]

- *The Landslide Hazard Mapping Project of 1990*

The Landslide Hazard Mapping Project which commenced in 1990 was carried out by the NBRO. This project provided vital information on the location of landslide prone areas in the districts of Badulla and Nuwara Eliya, Ratnapura and Kegalle to regulate the development of housing and infrastructure on a sustainable basis. The landslide prone areas were mapped and identified through the project, and important information was obtained for prevention and mitigation of earthslips and landslides and to enable the relocation of people away from such vulnerable areas.

- *The risk profile of Sri Lanka*

The Disaster Management Centre in collaboration with the UNDP is playing the lead role in this process and will provide inter-agency coordination and monitoring. The disaster risk profile of Sri Lanka would provide decision makers and planners to identify location, frequency and impact of main hazards affecting the country, as well as the elements at risk. With this knowledge, policies and strategies can be formulated for mitigation, preparedness and preparation of contingency plans. This would enable risk reduction strategies to be incorporated into development projects.

Urban Development, Human Settlements and Economic Infrastructure

Part II - Economic Infrastructure

Part II - Economic Infrastructure

This section deals specifically with possible impacts of climate change on infrastructure of the transport sector, geographical areas important for tourism[g] and the location of installations in the power sub-sector and water resources used for hydro-power. The selection of sectors was based on the high economic importance of the transport and tourism sectors and power generation for national development and the heavy emphasis given to these areas in the National Planning Agenda. The focus on the relevant sectors in this SVP are those that could be expected to be affected most by potential climate change impacts, and where adaptation measures are perceived as meaningful in view of the large scale investments planned for development of economic infrastructure connected with transportation, power-generation and expansion of tourism.

There are many initiatives taken by the government for economic infrastructure development in the country due to its vital importance for the economic development pathway that the country is now following. Significant improvements and expansions are planned in the areas of passenger and cargo transportation by land, sea and air. The power sub-sector too is critically important for the functioning of industry and for maintaining a high quality of life in both urban and rural areas. With the ending of the 30 year long civil strife, tourism has emerged as a potential top income earner and employment provider for Sri Lanka, making development of the tourist industry a major priority for national economic development.

The overarching policies, plans and strategies that guide national development are given in APPENDIX A. As an island nation Sri Lanka is vulnerable to the risk of sea level rise and increased frequency of storms and their impacts. Furthermore, the projected rise in temperature and changes in rainfall regimes, together with other impacts of climatic change, could increase the prevalence of natural disasters such as floods, droughts, landslides, storms and cyclonic conditions with consequent negative impacts on transportation infrastructure, power generation and tourism. This underlines the need for integrating climate change adaptation measures into the respective sectoral development processes with regard to transportation infrastructure, power generation and tourism expansion.

Part I of this document provides information on the already felt impacts of climate change on the weather in Sri Lanka (BOX 4), natural hazards that affect Sri Lanka and the number of people affected (in BOX 5), the impacts of climate change on the coastal region (BOX 6).

In planning for adaptation, it is perceived that climate change related issues and vulnerability should be considered at two levels: (1) the potential impacts of climate change on existing infrastructure at current development levels, and (2) the potential climate change vulnerability of planned development.

1.0 Transport Infrastructure

1.1 Introduction

Economic perspective

Sri Lanka's transportation network comprises road and rail, sea and air modes. Road and rail development is considered crucial for national development and to reduce disparity in regional development. The efficiency of the transport sector also influences the performance of all other economic sectors, and plays an important part in the national development process, particularly to enhance foreign investment and industrial growth. The total economic activity and employment in the transport sector has been substantial, with a contribution of 8.2% to the GDP in 2006.[5]

[g] Sectoral categorization follows MENR (2003). *Caring for the Environment: Path to Sustainable Development 2003-2008.*

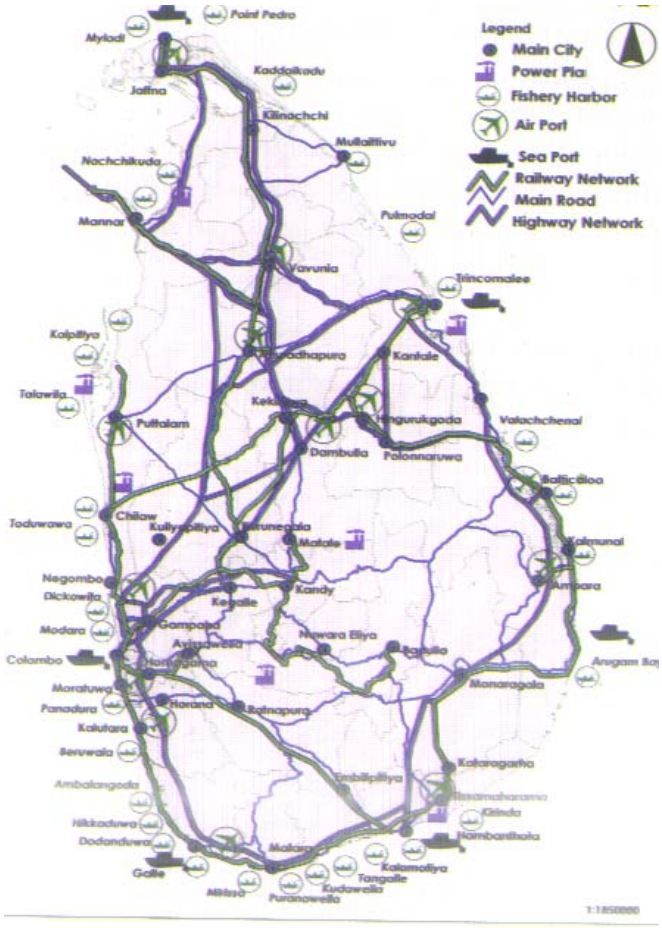


FIGURE 10 Proposed infrastructure network in the National Physical Planning Policy and Plan

- *Roads*

Sri Lanka's land transport system predominantly operates via road transport. The country has a very intensive road network and a road density of 1.5 km roads per square kilometre, which is very high when compared with most other Asian countries. Much of the main road network is centred on access to Colombo, due to historic reasons. The overall national road network consists of 11,921 km of A and B class roads, which are maintained and operated by the Road Development Authority (RDA). Over 1583.2 km of Class A & B roads are in the Western Province; 16,532 km of the overall road network comprise provincial roads; 64,659 km comprise rural roads and 24,000 km consist of estate roads. Around 4,200 bridges are also currently maintained by the Road Development Authority (RDA).[h] The total investment in the road sector has risen from Rs 52 billion in 2008 to Rs 82 billion in 2009.

__A__ class highways are mostly trunk routes linking the provincial, district and other growth centres; __B__ class roads link the A class networks to towns and other development centres of national importance. class __C__ and __D__ roads are labelled as Provincial Roads, and class __E__ roads are (i.e. bridle paths) that are generally un-motorable.
Source: MoENR, 2002[11]

There are a large number of road development projects currently undertaken and planned. They include rehabilitation of about 4,900 km of national roads (A & B class road); construction of express ways and new highways, flyovers and bridges. There are also several programmes to rehabilitate and reconstruct bridges under different funding agencies.[i]

A study done by JICA to reduce traffic congestion in the Colombo Metropolitan Area, Area Traffic Control has been recommended for the efficient management of road traffic in major cities which is expected to give economic benefits to the road users.[i]

[h] Data provided by the RDA during preparation of this report.

- *Rail*

Sri Lanka's rail network of 1,438 km in 1948 had increased only to 1,479 km by 2001, but due to recognition of its importance for transportation, development of the railway is now being accelerated. At present the national railway carries only 5% of passenger and 1% of freight transport.[7] However, the government is expecting to increase the volume and quantity of freight transport,[7] and the quality and quantity of passenger transport, thereby enabling a shift of passenger transportation from road to rail. This will involve extension and rehabilitation of existing railway lines, development of new lines and maintenance of both new and existing railway lines. Improving rail transport will involve rehabilitation of rail tracks and stations, electrification of the suburban railway services, introducing a Light Rapid Transit System in the Colombo metropolitan area and rationalisation of passenger and freight tariffs.[7] Key projects planned for railway development are in **Table 7**.

The new railroads planned or ongoing in 2009 include the new railroad from Matara to Kataragama and the northern railway line which is to be reconstructed in 5 phases, including the railway stretch between Omanthai and Pallai, Pallai to Kankasanturai, Madawachchiya to Madu, and Madu to Talaimannar.

Source: CB, 2010 and data from the Ministry of Transport

TABLE 7 Key projects planned for transport development

Project	Investment (SLRs. Mn)
Extension of the coastal line up to Kataragama	30,000
Upgrading and double tracking Colombo Matara railway line	18,750
Development and extension of Kelani Valley railway line up to Hambantota via Ratnapura and Embilipitiya	37,500
New railway line from Kurunagela to Habarana via Dambulla	24,000
Electrification of suburban railway line	7,000
Bus Rapid Transit System	690
Purchase of new buses for fleet replacement*	26,000
Colombo-Katunayake express railroad project	15,650

* Reported as already completed by the Ministry of Transport

Source: Mahinda Chintana, vision for a new Sri Lanka. A ten year Horizon Development Framework 2006-2016

- *Air and sea ports*

Presently Sri Lanka has one International Airport and 12 domestic airports.3.[4,8] The *Mahinda Chintana* Ten year Horizon Development Framework 2006-2016 aims to make Sri Lanka a prime aviation and shipping hub in the region.[3,10] As such, the Government has prioritised the development of aviation infrastructure through capacity building, modernising existing infrastructure at the Bandaranaike International Airport and building the new Mattala International Airport.[10] Through these

The Hambantota port, located on the southern coastline of the Dry Zone is of considerable economic importance due to its location within 10 nautical miles from the world's busiest shipping lane, and at the intersection of major international sea trading routes. The Port is expected to attract a large number of ships. It is to be initially developed as a service and industrial port and subsequently as a transshipment port. Due to its location, foreign exchange earning from the supply of fuel and water to vessels that navigate in the shipping lane is envisaged. The presence of the port is also expected to create new job opportunities and to enhance living conditions of the people in this region through the establishment of new oil refineries, power plants, cement mills, ship constructing and repairing yards and new highways adjacent to it.

Source: Randora National Infrastructure Development Programme[5]

investments, Sri Lanka aims to cater to the rapidly growing Asia-Pacific market in aviation, and capture the benefits of future growth in the travel and tourism industry.

Currently Sri Lanka has four major ports in Colombo, Galle, Trincomalee and Kankasanturai. To make Sri Lanka a leading navigation and trading hub in South Asia, the national development plans have targeted expansion of the Colombo Port which is considered as one of the leading seaports in the region. Development of several other ports including Oluvil and Hambantota are underway. As these projects are expected to propel Sri Lanka's economic advancement to greater heights, and considering the importance of these ports, addressing climate change adaptation needs at the planning stages is therefore of high national importance.

1.2 Climate change related issues and vulnerability of transport infrastructure

According to the IPCC, *vulnerability* is the degree to which a system is susceptible to, or unable to cope with adverse effects of climate change. Vulnerability is a function of the character, magnitude and rate of climate variation and its effects to which a system is exposed, its sensitivity, and its adaptive capacity. *Exposure* means the nature and degree to which a system is exposed to significant climatic variations. *Sensitivity* is the degree to which a system is affected either adversely or beneficially by climate related stimuli. *Adaptive capacity* is the ability of the system to adjust to climate change to moderate potential damages, to take advantage of new opportunities or to cope with the consequences.

The main transport infrastructure in Sri Lanka consisting of roads, railway, airports and sea ports are vulnerable to some impact of climate change, especially as most have not been designed to accommodate the consequences.

- *Vulnerability to natural hazards*

Possible impacts of sea level rise and storm surges:

- Due to climate change, there is a high possibility of the island's coastal zone[i] being affected by sea level rise, with associated inundation of land, saltwater intrusion, and increased frequency of storm surges.

- As the coastal region (i.e. DS Divisions with a coastal boundary[9]) contains nearly 20% of the island's Class A and B roads, and 33.3% of railroads,[j] transport infrastructure lying in coastal areas are particularly vulnerable to sea level rise. Already the railway lines from Colombo to the south on the coastline have been affected by coastal erosion at some places.
- Sea level rise and more frequent and intense storm surges may have serious impacts on the infrastructure of Sri Lanka's harbours and ports, and consequently on the service facilities they offer. This can incur costs from the national budget for constant repairs.

Possible impacts of increased temperature and rainfall intensity:

- The main roads in the country are generally surfaced with pre-mix bitumen or asphalt. Increased ambient temperatures could cause surface flow of asphalt, distortion of road markings, bleeding of bitumen in bitumen surfaced roads, making old road surfaced brittle.[20] This may necessitate heavy investment on repair and maintenance of the transport infrastructure.

- Increased rainfall intensity as a result of climate change could exacerbate flooding of roadways, particularly as many canals and drainage outfalls are already in disrepair or have been planned for lower rates of flow.

[i] Defined as the Divisional Secretariat Divisions with a coastal boundary in the CZMP of 2004.[9]
[j] GIS mapping carried out by this project during preparation of the Climate Change Adaptation Strategy.

Possible impacts of increased frequency/intensity of natural disasters:

- Risks to Sri Lanka's transport infrastructure will increase with the expected increase in both the frequency and intensity of disaster events, particularly landslides and floods.

- Potentially increased levels of damage to land-transportation infrastructure will cause direct costs for repair and rehabilitation, and also result in substantial losses across many other sectors that are dependent on the road and rail network.

- *Vulnerability enhancing factors*

The problems associated with climate change are not distributed evenly across the country. Vulnerability varies substantially by the characteristics of the region and the nature of the sector under consideration. The following are some of the factors that translate into higher levels of climate change vulnerability of infrastructure in Sri Lanka's transport sector:

- The length of roads and railways in a given geographic area is proportionate to the scale of impact that can be expected due to climate change impacts or natural hazards. As the potential cost of damage is high, areas with extensive investments in transportation infrastructure may tend to be more vulnerable.

- A higher road density (km of roads/square km) would indicate that in the event of a major problem, the presence of alternative routes are more likely to provide better access. Areas with low road density per square km will thus be more vulnerable.

- Urban areas in Sri Lanka are generally better organized, and their populations are better equipped to either mobilize themselves or the government to provide help to address transport-infrastructure related problems. Conversely, concerns of communities with relatively small populations will be more often neglected, rendering them more vulnerable to climate change impacts on their transportation infrastructure.

1.3 Mapping climate change vulnerability

A vulnerability mapping exercise, using GIS, was undertaken in order to better understand climate change vulnerability in key sectors in Sri Lanka, building on the IPCC definitions of exposure, sensitivity, and adaptive capacity as defined under section 2.0 above[k]. The analysis is intended for use as a macro level planning tool, to illustrate where sector-specific vulnerability is high, in relative terms, across the nation, and to guide decisions on prioritization and targeting of potential climate change adaptation responses.

General methods

The basic methodology involved in the GIS mapping was to develop indices for exposure, sensitivity, and adaptive capacity relevant to each given sector. These three indices were then combined to create a composite sector-specific vulnerability index. The analysis, which is largely based on publicly available data sources include the 2001 National Census. Areas where complete and comparable data sets of relevant indicators could not be obtained (such as the North and East where census data is not available) were not analyzed, and will need to be evaluated at a future stage, perhaps after the 2011 census is complete.

Separate *exposure indices* for flood, drought, and landslide exposure were developed based on historic data on the frequency and scale (assessed in terms of number of people affected) from the Disaster Management Centre (DMC). The exposure index for sea level rise was based on a ratio of the area of land within 2 m above sea level as a percentage of total land area within 5 km from the coastline in each DS Division. Topography data was obtained from the ASTER 30M Digital Elevation Model. The above exposure indices are common across all sectors, but only exposure types relevant to a given sector were analyzed and illustrated.

[k] IWMI's CC Vulnerability Index as in Eriyagama et. al., 2010[19] was used as a starting point and substantially refined for finer grain and sector specific analysis.

The sensitivity and adaptive capacity indices are unique to each sector and the indicators used in their formulation are given in the following pages along with the vulnerability maps.

It must be noted that the mapping exercise itself is preliminary and limited in scope and should be refined on an ongoing basis, based on detailed data which may become available from various government agencies. It is also noted that relevant agencies are carrying out detailed hazard mapping at the national and regional levels.[I]

What the vulnerability maps foretell

- *Transport sector*

FIGURES 11-12 illustrate the geographic distribution of vulnerability to flood, landslide, and sea level rise exposure in the transport sector. The indicators considered in developing the sensitivity and adaptive capacity indices for flood and landslide areas are given below, while the indicators used in assessing vulnerability to sea level rise exposure are provided in relevant maps. The DSD vulnerability ranking tables and larger scale maps are in APPENDIX B.

The sensitivity index for transport with flood and landslide exposure includes	**The adaptive capacity index for transport with flood and landslide exposure includes**
A composite of data (at DSD level) on: • Length of main roads • Length of secondary roads • Length of rail	• Road density (length of main roads, secondary roads, and rail roads per square kilometre in each DSD.)
Sources of data: 1:50,000 map sheets from Survey Department of Sri Lanka	

[I] For example, the Disaster Management Centre is currently coordinating a detailed risk profiling exercise for the major disaster types, at a much higher level of detail, in collaboration with the Coast Conservation Department, Irrigation Department, the National Building Research Organization, and several others. The maps generated through the DMC exercise would provide much finer grain information for exposure indices.

Vulnerability of the transport sector to *flood* exposure:

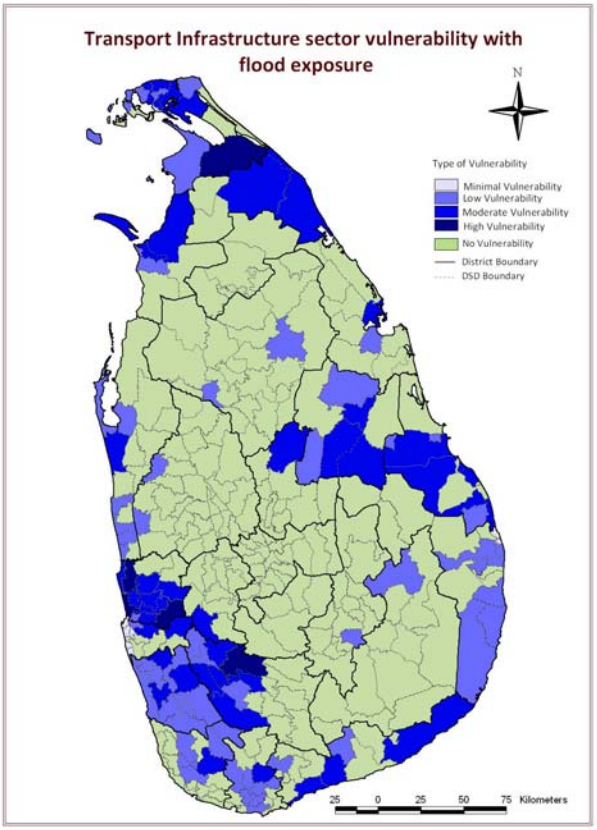


FIGURE 11 Transport infrastructure vulnerability to flood exposure

- Vulnerability of transport infrastructure to the expected increase in frequency and intensity of floods due to climate change is widespread and prevalent in many parts of the country.
- 5 DSDs emerge as being highly vulnerable in this regard to flood exposure. These DSDs combined have 235 km of main roads, 531 km of secondary roads and 33 km of railroads.
- A further 43 DSDs emerge as moderately vulnerable. These DSDs have 1,381 km of main roads, 2,906 km of secondary roads, and 278 km of railroads.
- Of the 13 DSDs in Gampaha District, 3 emerge as highly vulnerable, and another 7 emerge as moderately vulnerable, making this the most vulnerable district in this regard. Gampaha District has a population of 2,063,684 and a total of 487,184 housing units.

Vulnerability of the transport sector to *landslide* exposure:

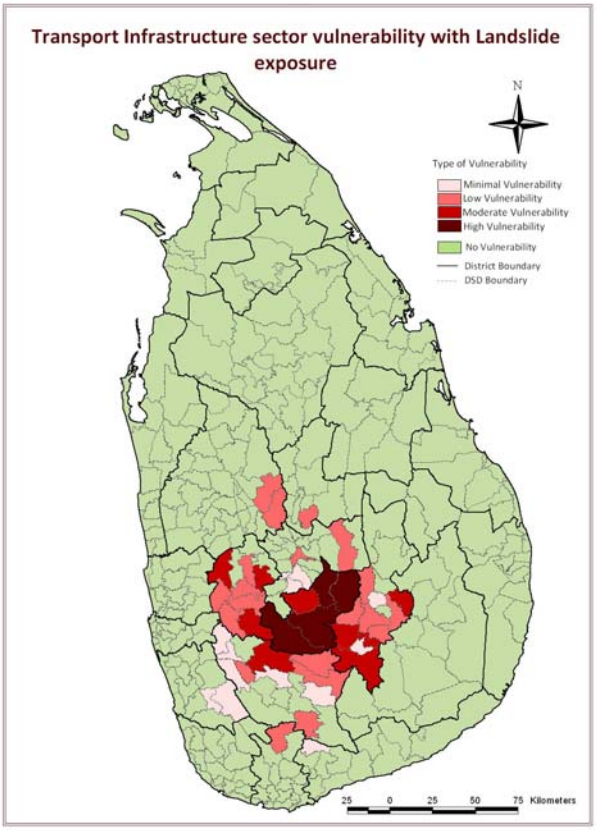


FIGURE 12 Transport infrastructure vulnerability to landslide exposure

- Vulnerability of transport infrastructure to landslides is expected increase in frequency and intensity and is focused mainly in the central hills.
- The four highly vulnerable DSDs that emerge from the analysis in this regard are all in the Nuwara Eliya District. These DSDs have 439 km of main roads, 366 km of secondary roads, and 66 km of railroads.
- Within the Nuwara Eliya District, the Nuwara Eliya DSD alone has 46.7 km of railroads.
- 9 DSDs fall into the moderately vulnerable category, and collectively have 419 km of main roads, 615 km of secondary roads, and 28 km of railroads.

Vulnerability of the transport sector to *sea level rise:*

The sensitivity index for transport sector in the coastal areas includes	The adaptive capacity index transport includes
A composite of data (at DSD level) on: • Length of main roads within 500 m from shoreline • Length of secondary roads within 500 m of shoreline • Length of railroads within 500 m of shoreline	• Road density (length of main roads, secondary roads, and rail roads per square kilometre in each DSD.)
Sources of data: 1:50,000 map sheets from Survey Department of Sri Lanka	

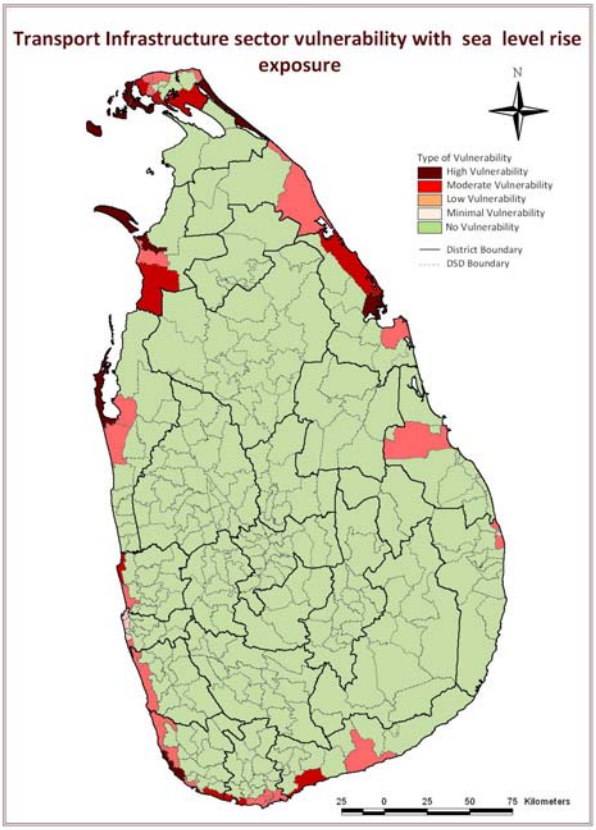


FIGURE 13 Transport infrastructure vulnerability to sea level rise exposure

- Vulnerability of the transport sector to sea level rise impacts due to climate change is highest in the Northern and South-western coastal region of the island. The impact of sea level rise could be critical to national development as a substantial segment of our national transportation network runs parallel to the coastline.
- 8 DSDs emerge as being highly vulnerable based on the analysis. These DSDs combined have 117 km of main roads, 183 km of secondary roads, and 38 km of railroads all within 500 m of the shoreline.
- The 10 DSDs that fall in the moderately vulnerable category together have another 75 km of main roads, 143 km of secondary roads, and 24 km of railroads, again within 500 m from the coastline.
- Of the 14 DSDs in Jaffna District, 4 are highly vulnerable, while another 4 are moderately vulnerable making it one of the most vulnerable districts overall. Jaffna is an area where substantial investments are expected to be expended over the next few years.

1.4 Institutional and policy framework governing the transport sector

- *Institutional set up*

Table 8 gives the list of key institutions and supporting institutions for development of the transport infrastructure.

TABLE 8 Institutions involved with transportation development

Key Ministries	Key Agencies	Other agencies /groups with impact
• Ministry of Highways	• Road Development Authority	• Sri Lanka Land Reclamation and Development Corporation (SLLRDC) • Irrigation Department • Urban Development Authority (UDA) • Coast Conservation Department (CCD) • Central Environmental Authority • National Planning • Department of Meteorology • Institute for Construction Training and Development
• Ministry of Ports & Aviation	• Civil Aviation Authority • Sri Lanka Ports Authority • Airport and Aviation Services (Sri Lanka) Ltd.	
• Ministry of Transport	• Department of Sri Lanka Railways • Department of Motor Traffic • National Transport Commission • Sri Lanka Central Transport Board • *Maga Neguma* • National Transport Medical Institute	
• Ministry of Local Government and Provincial Councils	• Provincial Road Development Authorities • Road Passenger Transport Authorities	

- *Key policies and legislation that govern the sector*

The development of transport infrastructure is envisioned in the *Mahinda Chintana ten year Horizon Development* Framework and the NPPP&P. The major investments for development of transport infrastructure are outlined in the *Randora* Infrastructure Development Programme (see APPENDIX A for more details).The transport sector is also governed by the National Transport Policy of 1991, which is due to be updated.

TABLE 9 Main legislation and policies that have an impact on transport infrastructure development

Main legislation	Other relevant legislation	Plans and policies that guide the transport sector
• Railways Ordinance No. 9 of 1902 as amended by various amendments, the Railways Act No. 18 of 1950 and the amendment) Act No. 49 of 1983 • Motor Traffic Act No. 14 of 1951 and the Amendment Act No. 21 of 1981 • Sri Lanka Transport Board Act No. 27 of 2005 • National Transport Commission (Amendment) Act No. 30 of 1996 • National Thoroughfares Act No. 40 of 2008 • RDA Act No.73 of 1981	• The National Environmental Act N o. 47 of 1980 and the 1988 revision that deals with EIAs for major road development • Urban Development Authority Law No. 37 of 1978, as amended by subsequent Acts, including Act No. 44 of 1984 and Act No. 4 of 1992 • Coast Conservation Act No. 57 of 1981, and the amendment Act No. 64 of 1988	• Motor Traffic Policy of 1991 • The National Transport Policy of 1991 and subsequent updates. • National Roads Policy

2.0 Tourism

2.1 Introduction

Tourism has been recognized as a high priority area capable of effectively driving the country's economic development in the *Mahinda Chintana* ten year Horizon Development Framework, with the vision of making Sri Lanka the most sought after tourist destination in South Asia. This targets 2.5 million tourists per year to be achieved by 2016**,** with tourism becoming the third largest foreign exchange earner for the country.[3,10] The *Randora* Infrastructure Development Programme identifies an investment of Rs 24,917 million between 2006-2016 for development of the Tourist Sector to make Sri Lanka a regional tourist hub.[5] The government targets for the tourist sector by 2016 are set out in **Table 10**.

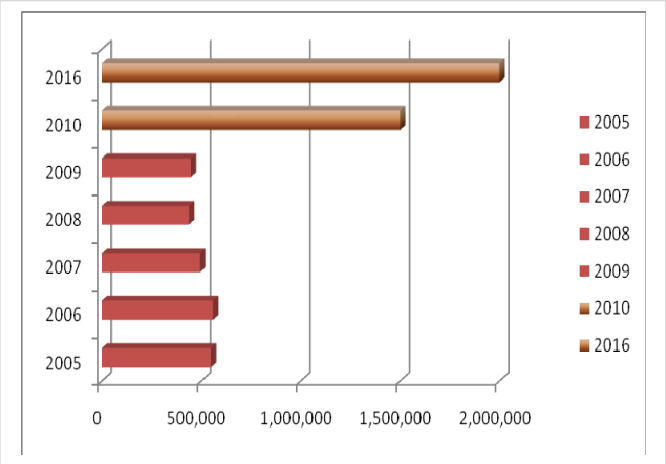
Investments for tourism development - The Tourism Resources Improvement (TRIP) project

The Tourism Resources Improvement Project (TRIP) implemented by the Ministry of Tourism aimed to alleviate poverty and contribute to peace in Sri Lanka through promoting the tourism sector by increasing the number of Asian tourists, especially Japanese tourists, to the country. The objective of the project was to contribute to social and economic development of the country through job creation and increased foreign exchange earning through increased Japanese tourists arrivals. The project aimed to improve tourism-related infrastructure and facilities, develop human resources in the tourism sector, and conduct marketing and promotion activities in Japan to attract Japanese tourists.

Source: http://www.slmts.slt.lk/trip.htm downloaded on 9.5.10 [21]

Economic perspective

On average, tourist arrivals to the country exceed 400,000 persons per year since 2005 (FIGURE 15), despite a drop in 2008 due to the unfavourable conditions that prevailed in the country. Tourism which was formerly the 4th highest foreign exchange earner, dropped to 6th place in 2008.[22] It is, however, re-emerging as a key economic sector with peace in the country. Direct and indirect employment in the tourist sector recorded a drop of 14.3% in 2008 to reach 124,456.[22] Overall, tourist arrivals grew by 2.1% in 2009 compared to a contraction of 11.2% in 2008.[7] A total of 60,516 and 51,857 persons were, however, directly employed in the tourism sector in 2007 and 2008 respectively.[22]



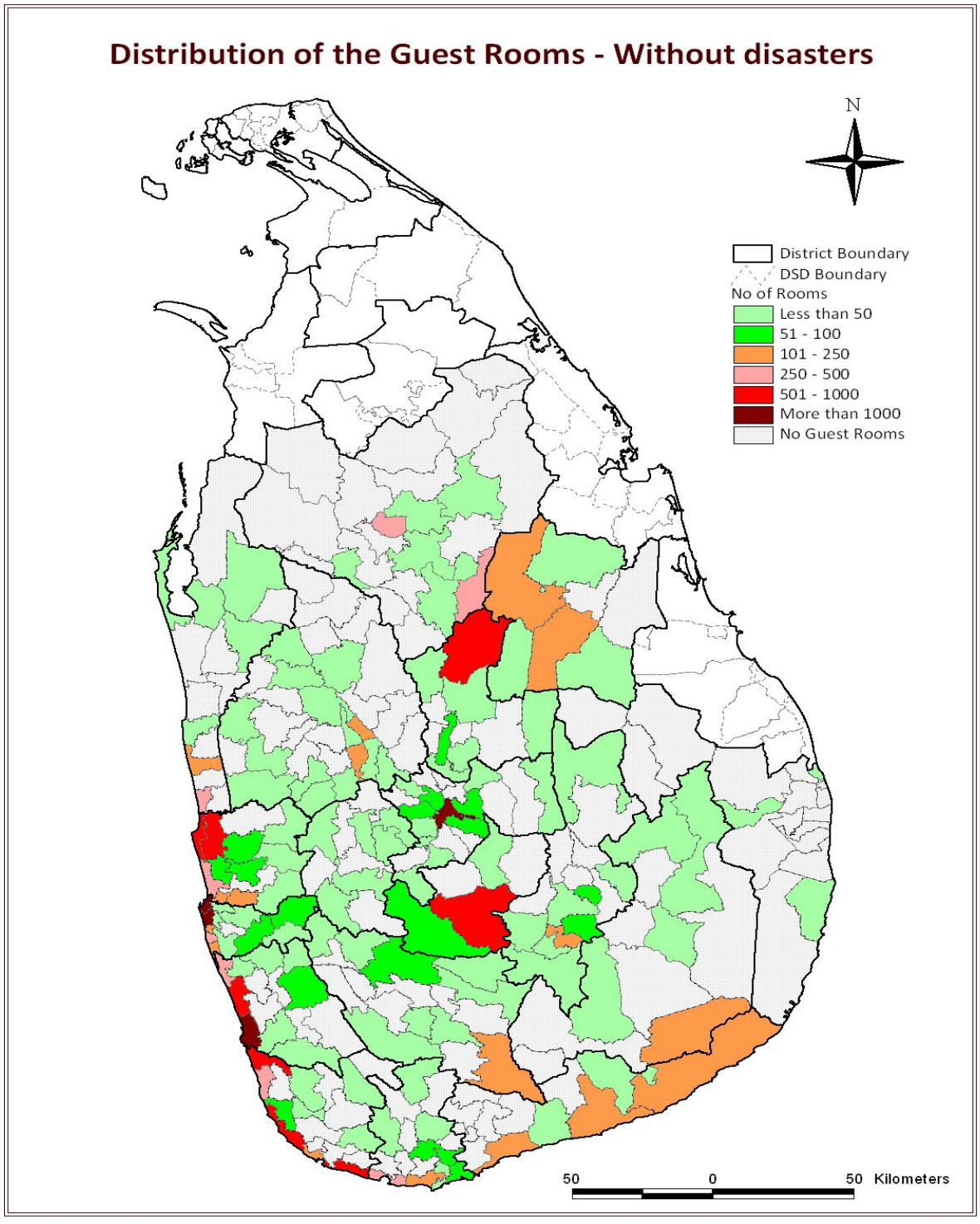
Source: Arrivals data from CB, 2010, projected arrivals from the Mahinda Chintana ten year Horizon Development Framework.

FIGURE 14 Number of tourist arrivals 2005-2009 and projected arrivals for 2010 and 2016 (arrivals in red, projected arrivals in brown)

TABLE 10 Government targets for the tourist sector by 2016

Tourist sector	2005	2010	2016
Tourist arrivals (000')	549	1,500	2,000
Hotel rooms	13,162	25,000	35,000
Average duration of stay (days)	8.7	10	12
Average spending (US$ per day)	74.6	200	250
Direct and indirect Employment	125	350	500
Earnings (Rs.bn)	362.3	800	1,200

Source: Mahinda Chintana, Vision for a New Sri Lanka. A Ten Year HorizonDevelopment Framework 2006-2016[3]



Source of data: Tourism Development Authority, provided for preparation of this report

FIGURE 15 Distribution of guest rooms by DSD based on tourist hotels

Environmental considerations

Tourism development in Sri Lanka has occurred in pockets throughout the country over the last several decades, but over 62% of the tourist hotels and about 41% of guesthouses/hotel rooms in the country are in the coastal zone (see FIGURE 15),[m] due to the promotion of Sri Lanka in terms of the island's wide sandy beaches during the initial stages of tourism development. The main tourist areas on the coast were located in the Colombo City and Greater Colombo, the South-west coast, and the East coast. This coastal concentration led to significant destruction of tourism infrastructure during the 2004 tsunami. However, the country's positioning as a tourist destination over the last decade has been shifting to a more diversified product base, with increasing emphasis on nature and cultural tourism inland. Nevertheless, the coastline will remain the focus of most major planned tourism developments in the foreseeable future, particularly considering the unexploited potential of the North and East which were effectively not marketed for the last 30 years.

The need for a planned approach to tourism development that takes into account environmental considerations is a core principle of the sector in Sri Lanka. In line with this, tourism developments are mandated to obtain various clearances from the Central Environmental Authority (CEA) and the Coast Conservation Department (CCD), depending on their scale. Compliance with guidelines are also monitored through the issuance of annual licenses for registered establishments.

Effective regulation and control of the informal sector in tourism, however, poses a challenge. The SLTDA estimates that only about 55-60% of all tourism facilities are registered with at the central level, and therefore effectively regulated. The remaining 40% are either registered with local authorities or are not registered at all, and are therefore largely unregulated.

2.2 Climate change related issues and vulnerability of the tourism sector

The existing areas that are important for the tourism industry with a concentration of tourism related infrastructure, as well as other areas projected for tourism development, are vulnerable to some impact of climate change, especially those that have not been designed to accommodate the resultant consequences.

- *Vulnerability to natural hazards*

Possible impacts of sea level rise and storm surges:

- The coastal region (DSDs with a coastal boundary) is home to 62% of all registered tourist hotels.[n] As such, the industry would be heavily exposed to potential risks from sea level rise, storm surges and related coastal flooding.

- Within the coastal region, tourist hotels are concentrated along the beach, where setbacks may not be adequate to address sea level rise, or are not adequately enforced to ensure safety from storms and hurricanes. Coastal hotels may therefore be directly affected by storm surges or inundation, resulting in loss of assets, tourism revenue, and employment opportunities in the industry.

- The impacts of more frequent storms that can accelerate coastal erosion and cause flooding could also negatively impact on beaches, and disrupt coastal tourism.

- Loss of prime land in the shorefront will affect the tourism industry, particularly the beach resorts.

[m] FIGURE 16 uses data provided by the Sri Lanka Tourism Development Authority.

[n] Analysis based on data provided by the Sri Lanka Tourism Development Authority

- A rise in sea levels and increased intensity of storm surges would increase the cost of coastal protection works where major investments have been made with regard to coastal tourist infrastructure. The establishment and enforcement of realistic setback standards are seen as more cost-effective than high spending on coastal protection measures.[14]

Possible impacts of temperature rise and changes in rainfall patterns:

- Rising ocean temperatures and changing weather patterns could have substantial impacts on Sri Lanka's coastal habitats that underpin Sri Lanka's tourism product.

- Rising ocean temperatures and changing rainfall patterns may cause substantial damage and alteration to Sri Lanka's coastal wetlands and other coastal ecosystems – such as coral bleaching and degradation of coral reefs and alteration and degradation of other ecosystems that attract tourists.

- Changing temperatures may negatively impact terrestrial forest cover, and the flora and fauna they contain, diminishing Sri Lanka's appeal to eco-tourists as a biodiversity hotspot.

- Energy consumption in the tourist industry may increase, as cooling requirements will increase with rising ambient temperatures.

Possible impacts of increased frequency/intensity of natural disasters:

- Disruption of the transportation networks due to natural disasters such as floods and landslides can significantly impact the tourism sector when mobility is reduced periodically.

- Areas affected by natural hazards frequently will be avoided by tourists who prefer less vulnerable areas.

- *Vulnerability enhancing factors*

Vulnerability to climate change varies accordingly to the characteristics of the region and the nature of the sector. The following are some of the factors that could translate into climate change vulnerability in the tourist sector in Sri Lanka:

- Areas with large scale tourism operations and infrastructure, or more guest rooms, would feel greater negative impact from major hazards than others. Therefore, areas with more hotels/guest rooms would be more vulnerable to climate change related impacts on the tourist sector.

- The level of dependency on the tourism industry as an economic and employment driver also correlates with its level of vulnerability to climate change related impacts. Areas with a higher percentage of the workforce employed in the tourism sector would be where the local economy is not very diversified. Such areas would therefore be more vulnerable to climate change impacts on the tourism sector.

- Smaller tourist operators will have weaker capacity to adapt to, and recover from any negative impacts of climate change, than the larger and better capitalized operators who will be better equipped to pass through such situations. Therefore regions with a higher prevalence of small-scale hotels or guest houses will be more vulnerable to climate change impacts on the tourism sector.

2.3 Mapping climate change vulnerability

A vulnerability mapping exercise, using GIS, was undertaken in order to better understand climate change vulnerability in key sectors in Sri Lanka, building on the IPCC definitions of exposure, sensitivity, and adaptive capacity as defined under section 2.0 above.[o] The analysis is intended for use as a macro level planning tool, to illustrate where sector-specific vulnerability is high, in relative terms, across the nation, and to guide decisions on prioritization and targeting of potential climate change adaptation responses.

General methods

The basic methodology involved in the GIS mapping was to develop indices for exposure, sensitivity, and adaptive capacity relevant to each given sector. These three indices were then combined to create a composite sector-specific vulnerability index. The analysis, which is largely based on publicly available data sources include the 2001 National Census. Areas where complete and comparable data sets of relevant indicators could not be obtained (such as the North and East where census data is not available) were not analyzed, and will need to be evaluated at a future stage, perhaps after the 2011 census is complete.

The *exposure indices* for flood exposure were developed based on historic data on the frequency and scale (assessed in terms of number of people affected) from the Disaster Management Centre (DMC). The exposure index for sea level rise was based on a ratio of the area of land within 2 m above sea level as a percentage of total land area within 5 km from the coastline in each DS Division. Topography data was obtained from the ASTER 30 m Digital Elevation Model. The above exposure indices are common across all sectors, however only exposure types relevant to a given sector were analyzed and illustrated.

The sensitivity and adaptive capacity indices are unique to each sector and the indicators used in their formulation are given in the following pages along with the vulnerability maps.

It must be noted that the mapping exercise itself is preliminary and limited in scope and should be refined on an ongoing basis, based on detailed data which may become available from various government agencies. It is also noted that relevant agencies are carrying out detailed hazard mapping at the national and regional levels.[p]

What the vulnerability maps foretell

- *Tourism sector*

FIGURES 16-17 illustrate the geographic distribution of vulnerability to flood and sea level rise exposure in the tourism sector. The indicators considered in developing the sensitivity and adaptive capacity indices are given below. The DSD vulnerability ranking tables and larger scale maps are in APPENDIX B.

The sensitivity index for housing and human settlements includes:	**The adaptive capacity index for housing and human settlements includes:**
A composite of data (at DSD level) on: • Percentage of livelihoods dependent on tourism • Total number of guestrooms in hotels/guesthouses	A composite of data (at DSD level) on: • percentage of people employed in sectors other than tourism • percentage of people who have completed secondary education • Number of hotels/guesthouses with over 15 room capacity
Data sources: 2001 National Census and SLTDA	

[o] IWMI's CC Vulnerability Index as in Eriyagama *et. al.*, 2010[19] was used as a starting point and substantially refined for finer grain and sector specific analysis.

[p] For example, the Disaster Management Centre is currently coordinating a detailed risk profiling exercise for the major disaster types, at a much higher level of detail, in collaboration with the Coast Conservation Department, Irrigation Department, the National Building Research Organization, and several others. The maps generated through the DMC exercise would provide much finer grain information for exposure indices.

Vulnerability of tourism sector to *flood* exposure:

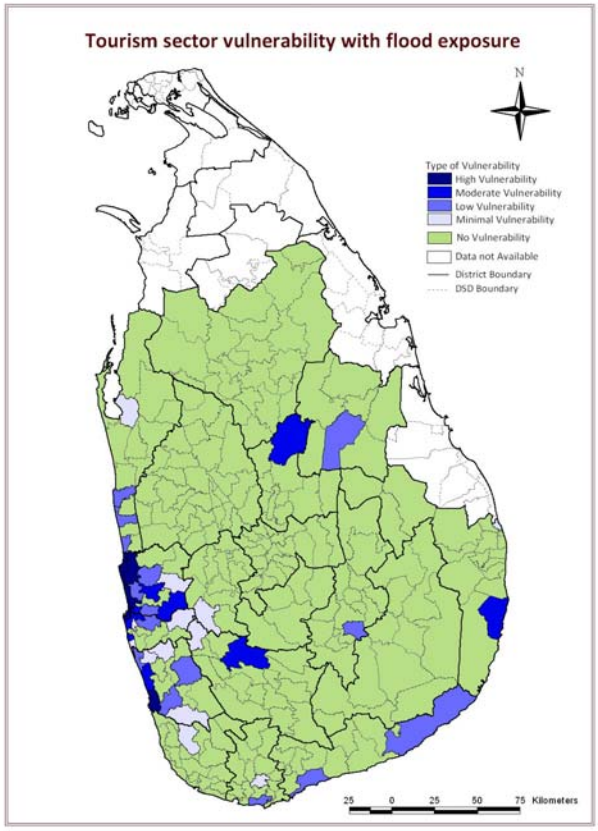


FIGURE 16 Tourism sector vulnerability to flood exposure

- Vulnerability of the tourism sector to the expected increase of floods due to climate change is generally focused in the Western region of the country, although pockets of moderate vulnerability can be found in several other areas.

- 5 DSDs are highly vulnerable. These 5 DSDs have:
  - 4,466 hotel rooms and 713 guest house rooms (amounting to 30.6% and 12.6% of capacity in each category respectively)
  - 386,449 jobs of which 14,876 are directly dependent on tourism

- Colombo DSD (Colombo District) is the most vulnerable in this regard, followed by Beruwela DSD (Kalutara District).

- 10 DSDs emerge as moderately vulnerable to flood exposure in this regard. These DSDs have:
  - 2,652 hotel rooms and 853 guestrooms (amounting to 18.2% and 15.1% of total capacity in each category)
  - 13,699 jobs directly dependent on tourism

Vulnerability of tourism sector to *sea level rise* exposure:

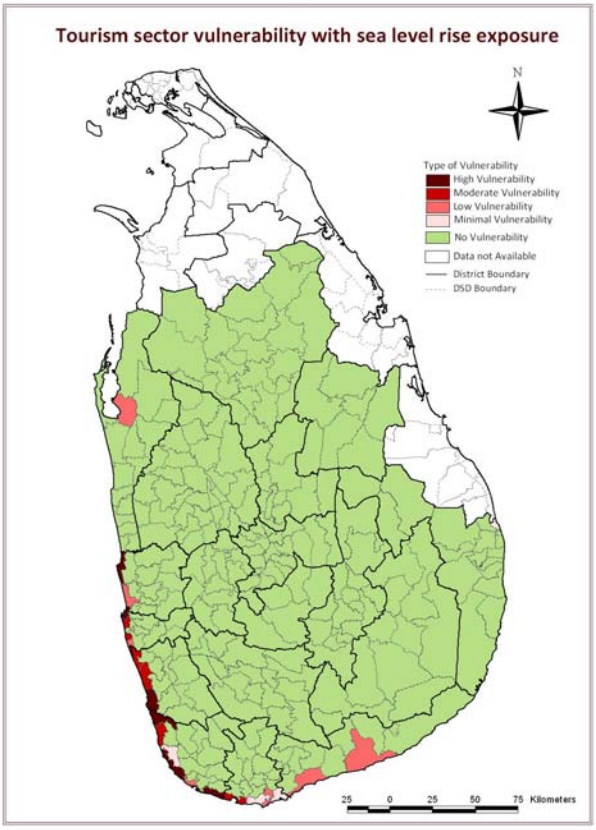


FIGURE 17 Tourism sector vulnerability to sea level rise exposure

- The most vulnerable areas are concentrated along the Western and South-western coastline of the country, reflecting the concentration of tourism activities in these areas.

- 5 DSDs emerge as being highly vulnerable to potential sea level rise exposure. These 5 DSDs had:
  - 4,960 hotel rooms and 895 guest rooms (amounting to 34% and 20.1% of national capacity in each category).
  - have 13,810 jobs directly dependent on tourism

- A further 6 DSDs emerge as moderately vulnerable in this regard. These DSDs have:
  - 2,928 hotel rooms and 808 guest rooms (amounting to 20.1% and 14.3% of the total capacity in each category respectively)
  - 9,715 livelihoods directly dependent on tourism

- Complete and comparable data was not available for the North and East

- The distribution of hotel rooms is likely to change substantially with planned new tourism developments in the Kalpitiya (Puttalam District) and along the Eastern coastline. A planning scenario simulating 1,500 hotel rooms in Kalpitiya raised it to be one of the most vulnerable DSDs with regard to tourism in terms of sea level rise exposure.

2.4 Institutional and policy framework for the tourism sector

- *Institutional set up*

The key ministry and line agencies that govern tourism development in Sri Lanka are given in **Table 11**. The Tourism Division of the Ministry of Economic Development is the Tourism Policy formulating body in Sri Lanka. Its role is to ensure compliance for a sustainable tourism industry in the country with the key objectives of supervising and managing the Sri Lanka Tourism Promotion Bureau, Sri Lanka Tourism Development Authority, Sri Lanka Institute of Tourism & Hotel Management and the Sri Lanka Convention Bureau. The Ministry also has to address various aspects of tourism to create a conducive environment for the private sector led industry to perform optimally.

TABLE 11 Institutions connected with tourism development and tourist infrastructure development

Key Ministries	Key Agencies	Other agencies/groups with impact
• Ministry of Economic Development	• Sri Lanka Tourism Promotion Bureau • Sri Lanka Tourism Development Authority	• Department of Wildlife Conservation • Coast Conservation Department (CCD) • Central Environmental Authority • Department of National Zoological Gardens • Department of National Botanical Gardens • Sri Lanka Convention Bureau
		• Urban Development Authority (UDA) (which functions under the Ministry of Defence)

- *Key legislation and policies that govern the sector and provide support for adaptation mechanisms*

Sri Lanka's overall strategy for development of the tourism sector are dealt with in three inter-related policy documents – The National Physical Planning Policy and Plan (NPPP&P), The *Mahinda Chintana* 10 Year Horizon Development Framework and The *Randora* National Infrastructure Development Plan. These are dealt with in Part I of this document.

The policy followed in the tourist sector takes into account the need for moving away from coastal tourism, which is a positive feature when considering the possible impacts of sea level rise. However, Sri Lanka's rich biodiversity in forests and wildlife habitats inland that offer ample potential to support the government's current tourism related policy to maximise potential for nature-based and cultural tourism may also be at risk from the varied impacts of climate change. While both ecotourism and culture tourism have the capacity to provide conducive employment opportunities to rural youth, and thereby motivate communities to protect the natural environment that provides their livelihood, the impacts of climate change and variability of weather patterns on Sri Lanka's biodiversity is yet to be fully understood.

Currently, a strategic medium-term (10 years) infrastructure and product planning and development plan has been formulated and implemented for the tourism industry. This plan is based on market demand for high and mid-end markets. The plan aims at gaining profitability through better yields, sustain the integrity and value of Sri Lanka's natural, cultural and human resources, and ensure optimum visitor experiences. The Sri Lanka Tourism Development Authority hopes that the strategic plan will accrue benefits to all communities connected with the tourism industry.

Policies and plans supported by several laws safeguard environmental considerations during development of tourism infrastructure. When tourist development takes place within the coastal

zone demarcated by the Coast Conservation Act, approval needs to be sought from the Coast Conservation Department (CCD). Likewise tourism development and construction of hotels should follow the EIA procedures decreed by the National Environmental Act No. 56 of 1988. Under the National Environmental Amendment Act of 1988, EIAs carried out by the CEA are mandatory for tourist hotels with over 99 rooms or covering an area of over 40 ha. Hotels built within urban areas need to comply with the requirements of the UDA. Hotels built within one mile of a national reserve managed by the Department of Wildlife Conservation (DWLC) would be required to submit an IEE or an EIA by the DWLC.

TABLE 12 Key legislation, policies, plans and projects connected with tourism development in Sri Lanka

Main legislation	Other legislation	Policies, Plans and Projects
• Tourism Act No. 38 of 2005 *(This replaced the Sri Lanka Tourist Board Act No. 10 of 1966 which was effective for the past 41 years).*	• The National Environmental Act NEA No. 47 of 1980 and 1988 • The Fauna and Flora Protection Ordinance No. 2 of 1937 and the subsequent amendments • Urban Development Authority Law No. 41 of 1978 and the Urban Development Authority (Special Provisions) Act No. 44 of 1984 • Coast Conservation Act No. 57 of 1981, and the amendment Act No.64 of 1988 • The Forest Ordinance No. 10 of 1907 and the subsequent amendments • The Botanic Gardens Ordinance No. 31 of 1928 • The National Zoological Gardens Act No. 14 of 1982	**Tourism related** • Tourism Master Plan of 1992 • Tourism Resources Improvement Project (TRIP) • The National Strategy for Sri Lanka Tourism **Location of infrastructure in the Coastal Zone** • Coastal Zone Management Plan (CZMP) of 2004 **Overarching policies and plans** • *Mahinda Chintana* tenyear Horizon Development Framework • *Randora* National Infrastructure Development Plan

The National Strategy for Sri Lanka Tourism [23]
This document offers a strategic medium-term (10 year) infrastructure and product planning and development plan for Development of Sri Lanka Tourism. Its main objectives are to address the immediate and long term needs of the industry and to promote the operational aspects of the four divisions that formulate Sri Lanka Tourism. Apart from these there are short term plans that will address the immediate issues of the tourism sector such as marketing and communications, services and hospitality, training and development, MICE and Domestic Tourism. This strategic plan provides a blueprint for incorporating the traditional and the not so conventional aspects of tourism such as nature, culture, and adventure tourism to develop the tourist industry.

3.0 Power Generation

3.1 Introduction

Economic perspective

Expanding the power sector to provide electricity for all is a major objective of the National Physical Planning Policy & Plan as well as the *Mahinda Chintana*. The power sub-sector (within the energy sector) is also critically important for national development. While electricity has been provided for 85.4% of households in the country[24] aggressive development is planned to achieve 100% coverage by 2012. Installed generation capacity in 2009 was 2684 MW, while gross generation in the year was 9882 GWh of which 40% was supplied by hydropower.[24]

Among the plans for the future to assist with power generation are the 150 MW generating Upper Kotmale Hydropower Station to be completed in 2012, the 120 MW generating Uma Oya Hydropower Station, the 35 MW Broadlands Hydropower Station, 27 MW Moragolla Hydropower Station and the 49 MW Gin Ganga Hydropower Station.[q] Besides the above, substantial expansion in generation capacity through coal-fired power plants is being planned.

TABLE 13 Power generation statistics, 2009

Type of Power Station	No. of Power Stations	Installed Capacity (MW)	Gross Generation (GWH)	Percentage of Total Generation
CEB Total	**23**	**1758**	**5450**	**55%**
Hydro	16	1207	3356	34%
Thermal	6	548	2091	21%
Wind	1	3	3	0%
P.P.P. Total	**98**	**926**	**4433**	**45%**
Hydro-small	87	184	549	6%
Thermal	11	742	3884	39%
Total	121	2684	9883	

Source: CEB 2009 Statistical Digest [24]

Environmental considerations

The share of installed capacity provided by hydropower is currently 51.8% and expected to decline over the future due to planned aggressive investment in thermal power plants. Regardless, hydropower is critical for Sri Lanka's energy supply, and will remain so in the foreseeable future. The difference in hydro-power generation and installed capacity could become more pronounced with changes in rainfall patterns due to climate change in the future. Thermal power plants that are a major source of air pollution and greenhouse gases have been used largely to bridge the power deficit in the past, but the current policy is to move away from thermal power plants to coal fired power plants. As such, two major coal fired power plants are being installed to bridge the national power deficit, one in Norochcholai (Puttalam District), and the other is planned to be installed in Trincomalee. A gas-fired power plant is planned for installation at Kerawalapitiya. Cleaner sources of power generation are also being promoted by the government through establishment of non-conventional renewable energy such as use of wind power, and dendro-thermal power. Mini-hydropower is promoted and connections to the national grid are provided.[r]

[q] Data provided by the CEB for preparation of this report and discussions with the CEB.

3.2 Climate change related issues and vulnerability

- *Vulnerability to natural hazards*

Possible impacts of temperature rise and changing rainfall patterns:

- Rising temperatures will result in higher rates of water evaporation from hydro-reservoirs reducing power generation capacity.[20]
- The limited availability of water in the multi-purpose reservoirs will be faced with complex water management issues with regard to power-generation and irrigation.[20]
- Rising temperatures will increase the demands on the power sector for cooling (air-conditioning and ventilation),[20] and require higher power generation capacity.
- Increased soil erosion and siltation of reservoirs at hydropower facilities due to high intensity rains would translate into higher maintenance costs of these facilities and a reduction of capacity which will likely need to be filled by more costly thermal generation.
- Increased ambient temperatures could reduce the efficiency of thermal generation plants and necessitate higher consumption of fuel.

Possible impacts of increased floods, droughts, and landslides:

- Increases in the frequency and intensity of droughts will reduce the power generation capacity of hydro-power plants.
- Communities that are not grid-connected and dependent on micro-hydro systems will be very vulnerable to the impact of droughts that will affect surface waters.
- More frequent and intense floods, cyclones and landslides may cause substantial damage to distribution networks, and possibly transmission networks as well.

One of the anticipated impacts of global warming is that plant respiration would become more rapid than photosynthesis, resulting in the production of more short-lived foliage than woody biomass. This may result in a net reduction of woody biomass, but the exact implications of climate change in this regard is not well understood as yet.
Source Goreu (1995): [25]

- *Vulnerability enhancing factors*

Vulnerability varies substantially by the characteristics of the region and the nature of the sector. The following are some of the factors that translate into higher levels of climate change vulnerability in the power-sub sector in the case of Sri Lanka:

- Communities that are solely dependent on local micro-hydro power generation systems will be more vulnerable to negative climate change impacts than communities that are connected to the national power grid.

3.3 Institutional and policy framework for the power sub-sector

- *Institutional set up*

The power sector is mainly handled by the Ministry of Power and Energy under which functions the Ceylon Electricity Board (CEB). The Ministry dealing with Science and Technology, and the institutions under it, also have a stake in the energy sector due to their involvement with the research and development aspects.

TABLE 14 Institutions involved with power development

Key Ministries	Key Agencies	Other agencies groups with possible impact
• Ministry of Power & Energy	• Sri Lanka Sustainable Energy Authority • Ceylon Electricity Board • Atomic Energy Authority • Lanka Electricity Company	• Urban Development Authority (UDA) • Coast Conservation Department (CCD) • Central Environmental Authority • National Planning • Department of Meteorology • Irrigation Department • Mahaweli Authority • National Building Research Organization (NBRO) • Pradeshiya Sabhas and Divisional Secretariats • Public Utilities Commission of Sri Lanka (PUCSL)
• Ministry of Petroleum Industries	• Ceylon Petroleum Corporation	

- *Key policies and legislation that govern the sector and provide support for adaptation mechanisms*

An important development in the power sector has been the considerable move towards power-generation from sources other than hydro-power, and the promotion of viable and environment-friendly alternate options, although renewable energy is more costly in financial terms. In parallel, however, there is also a move for substantial coal based power generation in the future.

The current policy adopted by the power sector has encouraged measures to reduce the reliance on coal and oil powered thermal electricity, by promoting wind power generation which was connected to the national grid in early 1999. Interest has been expressed by the private sector to establish grid connected wind turbine plants.The sector has also encouraged the development of mini-hydropower plants that can be connected to the national grid.

The development of sites suitable for micro-hydropower plants is addressed in the Electricity Master Plan.

Fuel wood based dendro-thermal electricity generation— with net low carbon dioxide emission due to the establishment of fuel wood plantations (energy forests) — has also been suggested.[26] While it could be an important alternative to hydro carbon fuelled thermal power, it needs detailed studies, and close collaboration and co-ordination between the forestry and energy sectors to ascertain the viability of such an option, in view of the power sector requirements and the possible supply of fuel wood for power generation.[26] Further, energy plantations will have to be set up after identification of appropriate species and locations in keeping with the existing forest policy and the Forestry Sector Master Plan of 1995 as care should be taken to prevent depletion of natural forests for establishment of mono-culture dendri-plantations.

TABLE 15 Key legislation, policies, plans and projects connected with power generation in Sri Lanka

Main Legislation	Other Legislation	Policies, Plans and Project
Ceylon Electricity Board Act **Sustainable Energy Act**	**Impact on siting power generation plans and reservoirs**. • The National Environmental Act NEA Act N o. 47 of 1980 and the 1988 • Power Sector Policy Directions 21 • Urban Development Authority Law No 37 of 1978, as amended by subsequent Acts, the recent ones being Act No. 44 of 1984 and Act No. 4 of 1992 • Coast Conservation Act No. 57 of 1981, and the amendment Act No. 64 of 1988. • Coastal Zone Management Plan (CZMP) of 2004	• Electricity Master Plan of 1987 and subsequent updates. • National Energy Policy **Overall impact** • *Mahinda Chintana* ten year Horizon Development Framework • *Randora* National Infrastructure Development Plan • National Action Plan for the *Haritha Lanka* Programme

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Appendices

Appendix A
Overarching Policies for Sustainable Development in Sri Lanka

Mahinda Chinthana: **A Vision for a New Sri Lanka**

The Mahinda Chintana: A Vision for a New Sri Lanka - 10 Year Horizon Development Framework 2006-2016 is the overarching development vision for the country, which is mirrored in the NPPP&P and the Randora Infrastructure Development Programme. This gives a very high priority for urban settlements, projecting that more than half the population of the country will be living in urban centers by 2016, calling for policies and strategies to be in place to ensure sustainable urban development in cities. It also outlines the pressing need to improve access by the urban poor to basic facilities.

The Mahinda Chintana also focuses sharply on the housing situation in the country, and suggests the adoption of a "vertical development approach" in high and medium density areas and residential planning during the rapid development of urban infrastructure in urban centres.

In addition to initiatives aimed at stimulating the housing finance market, the plan also targets the development of over 600,000 housing units by 2016, using a mix of financing sources including government, private, foreign assistance, and community participation. Of this total, the Gama Neguma programme, which is targeted at rural settlements, is slated to construct 300,000 housing units.

In terms of specific strategies for urban development and human settlements, the Mahinda Chintana 10 Year Development Plan places emphasis on city/town development as the engine of regional development, and the need to ensure sustainable development through planned urban centres, green cities and villages that concurrently ensure effective management of natural resources and the environment.

The Action Plan for *Haritha Lanka* Programme

This programme was developed through an interactive process involving all key ministries. Its mission is to focus on addressing critical environmental issues that, if left unattended, would frustrate the nation's economic development programme. Actions to address key issues that would enable sustainable development are embodied in the strategies and proposed actions set out under the ten missions of the Haritha Lanka Programme. The implementation of the programme will be overseen by the Ministry of Plan Implementation, while the secretariat for the NCSD is located within the Ministry of Environment and Natural Resources.

The 10 missions of the Action Plan for *Haritha Lanka* Programme:

1. Clean air – everywhere
2. Saving the fauna, flora and ecosystems
3. Meeting the challenges of climate change
4. Wise use of the coastal belt and the sea around
5. Responsible use of the land resources
6. Doing away with dumps
7. Water for all and always
8. Green cities for health and prosperity
9. Greening the industries
10. Knowledge for right choices

Appendix B
Vulnerability Maps and Ranking Tables

Part 1. Urban Areas and Human Settlements

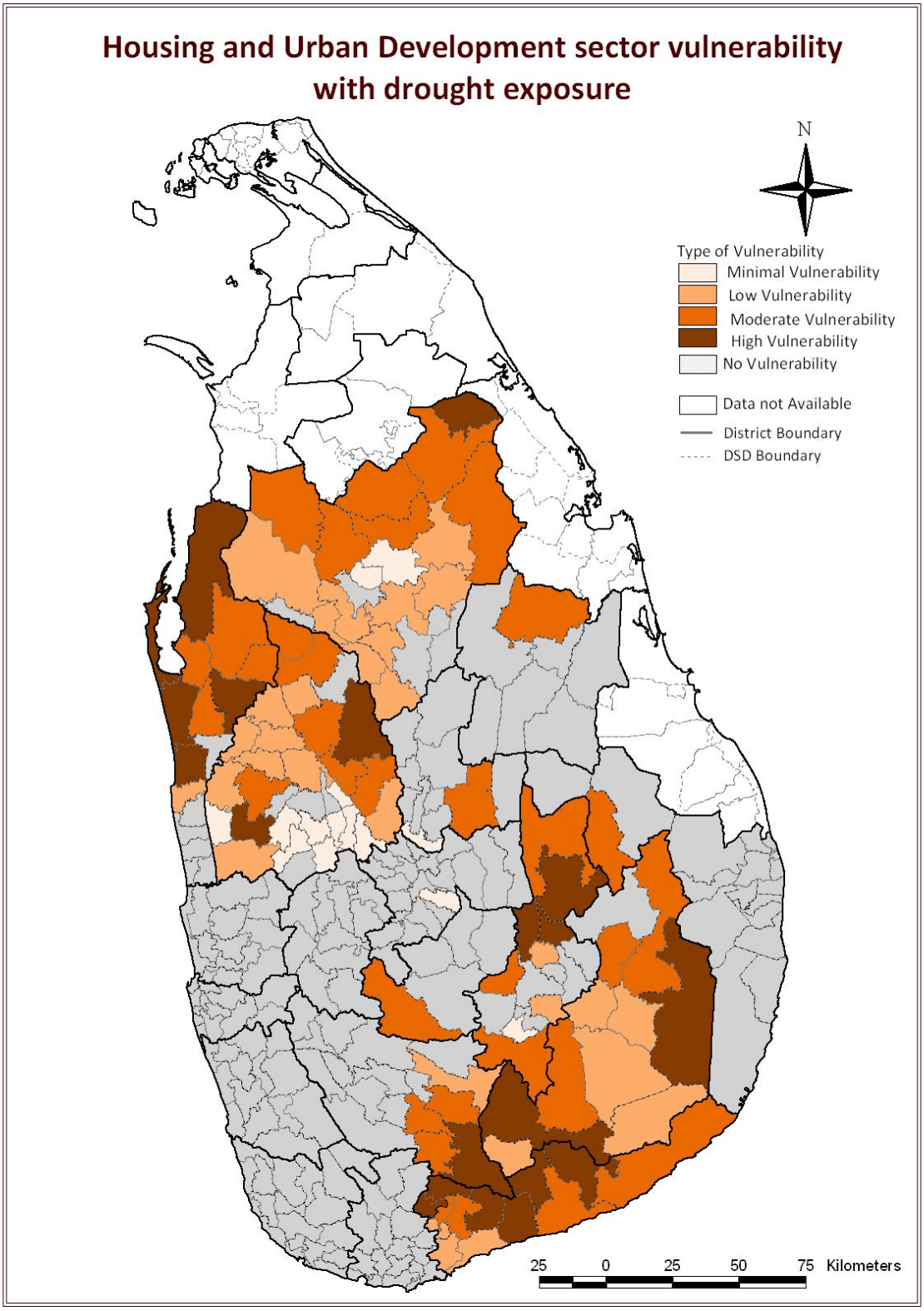
- ### Human Settlements

Highly vulnerable to impacts of droughts - human settlements

Rank	District	DS Division	
1	Rathnapura	Embilipitiya	Highly Vulnerable
2	Moneragala	Siyambalanduwa	
3	Puttalam	Kalpitiya	
4	Hambantota	Suriyawewa	
5	Badulla	Rideemaliyadda	
6	Kurunegala	Polpithigama	
7	Puttalam	Anamaduwa	
8	Hambantota	Ambalantota	
9	Puttalam	Mundalama	
10	Puttalam	Arachchikattuwa	
11	Moneragala	Thanamalwila	
12	Badulla	Meegahakivula	
13	Puttalam	Vanathavilluwa	
14	Hambantota	Lunugamvehera	
15	Anuradhapura	Padaviya	
16	Hambantota	Katuwana	
17	Kurunegala	Kuliyapitiya West	
18	Hambantota	Angunukolapelessa	
19	Badulla	Kandaketiya	

Moderately vulnerable to impacts of droughts - human settlements

Rank	District	DS Division		Rank	District	DS Division
20	Rathnapura	Kolonna	Moderately Vulnerable	36	Ampara	Padiyathalawa
21	Puttalam	Karuwalagaswewa		37	Nuwara Eliya	Ambagamuwa
22	Rathnapura	Godakawela		38	Anuradhapura	Medawachchiya
23	Hambantota	Tissamaharama		39	Kurunegala	Panduwasnuwara
24	Moneragala	Madulla		40	Anuradhapura	Horowpothana
25	Rathnapura	Weligepola		41	Matale	Laggala-Pallegama
26	Puttalam	Mahakumbukkadawala		42	Anuradhapura	Nuwaragam Palatha Central
27	Polonnaruwa	Medirigiriya		43	Hambantota	Weeraketiya
28	Badulla	Mahiyanganaya		44	Moneragala	Medagama
29	Anuradhapura	Rambewa		45	Kurunegala	Giribawa
30	Kurunegala	Ganewatta		46	Anuradhapura	Kebithigollewa
31	Hambantota	Hambantota		47	Badulla	Haldummulla
32	Kurunegala	Ibbagamuwa		48	Puttalam	Nawagattegama
33	Moneragala	Wellawaya		49	Puttalam	Puttalam
34	Kurunegala	Galgamuwa		50	Kurunegala	Mahawa
35	Badulla	Uva Paranagama		51	Anuradhapura	Maha Vilachchiya

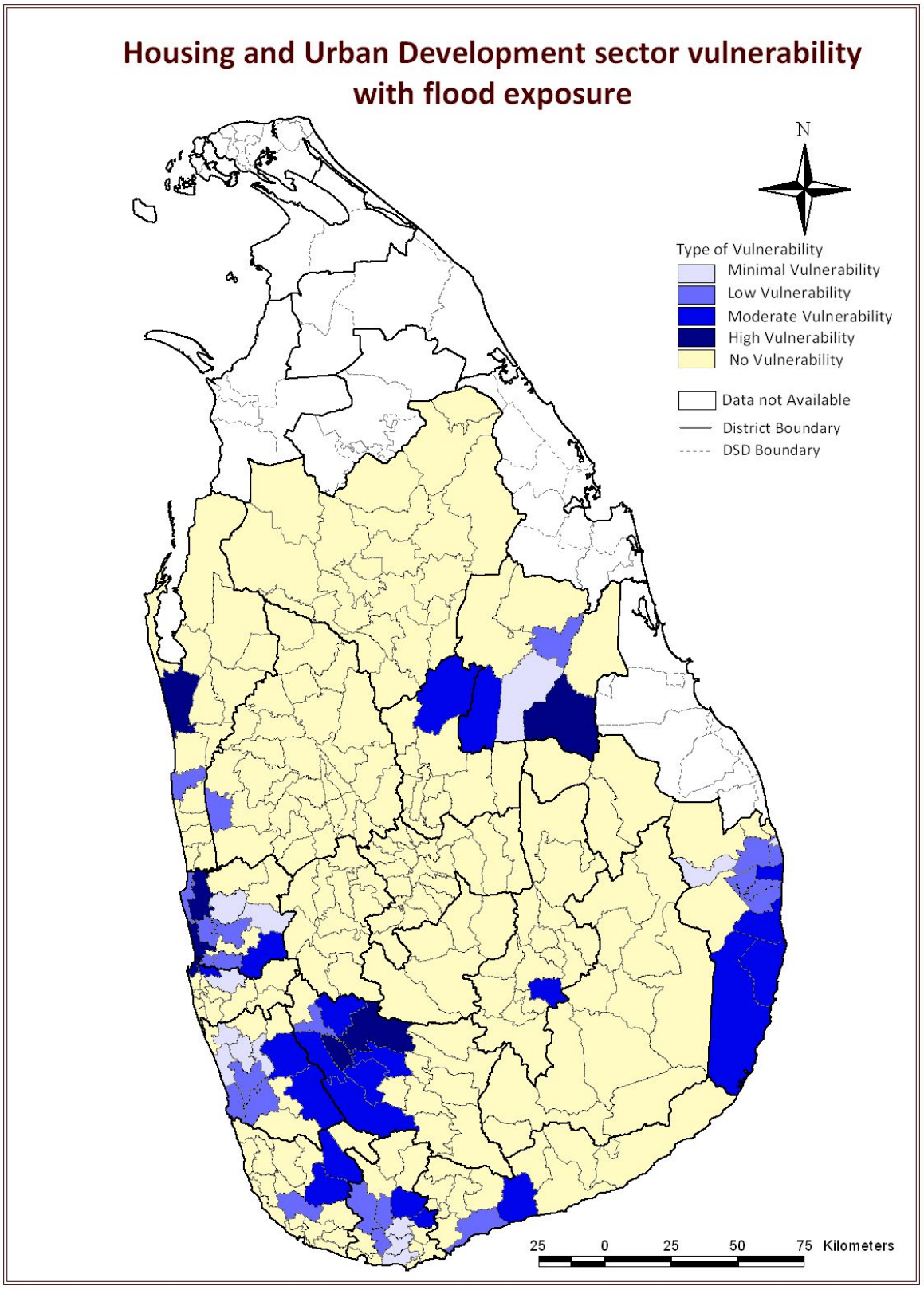

Housing and Urban Development sector vulnerability with drought exposure
N
Type of Vulnerability
Minimal Vulnerability
Low Vulnerability
Moderate Vulnerability
High Vulnerability
No Vulnerability
Data not Available
District Boundary
DSD Boundary
25 0 25 50 75 Kilometers

Highly vulnerable to impacts of floods - human settlements

Rank	District	DS Division	
1	Colombo	Colombo	Highly Vulnerable
2	Gampaha	Katana	
3	Polonnaruwa	Dimbulagala	
4	Rathnapura	Elapatha	
5	Puttalam	Mundalama	
6	Rathnapura	Rathnapura	
7	Gampaha	Wattala	

Moderately vulnerable to impacts of floods - human settlements

Rank	District	DS Division	
8	Rathnapura	Ayagama	Moderately Vulnerable
9	Rathnapura	Kalawana	
10	Matara	Mulatiyana	
11	Gampaha	Dompe	
12	Rathnapura	Nivithigala	
13	Ampara	Pothuvil	
14	Rathnapura	Pelmadulla	
15	Ampara	Lahugala	
16	Rathnapura	Kuruwita	
17	Kalutara	Bulathsinhala	
18	Hambantota	Ambalantota	
19	Colombo	Kolonnawa	
20	Polonnaruwa	Elahera	
21	Galle	Thawalama	
22	Kalutara	Palindanuwara	
23	Matale	Dambulla	
24	Matara	Hakmana	
25	Ampara	Thirukkovil	
26	Ampara	Addalachchenai	
27	Badulla	Ella	
28	Galle	Nagoda	

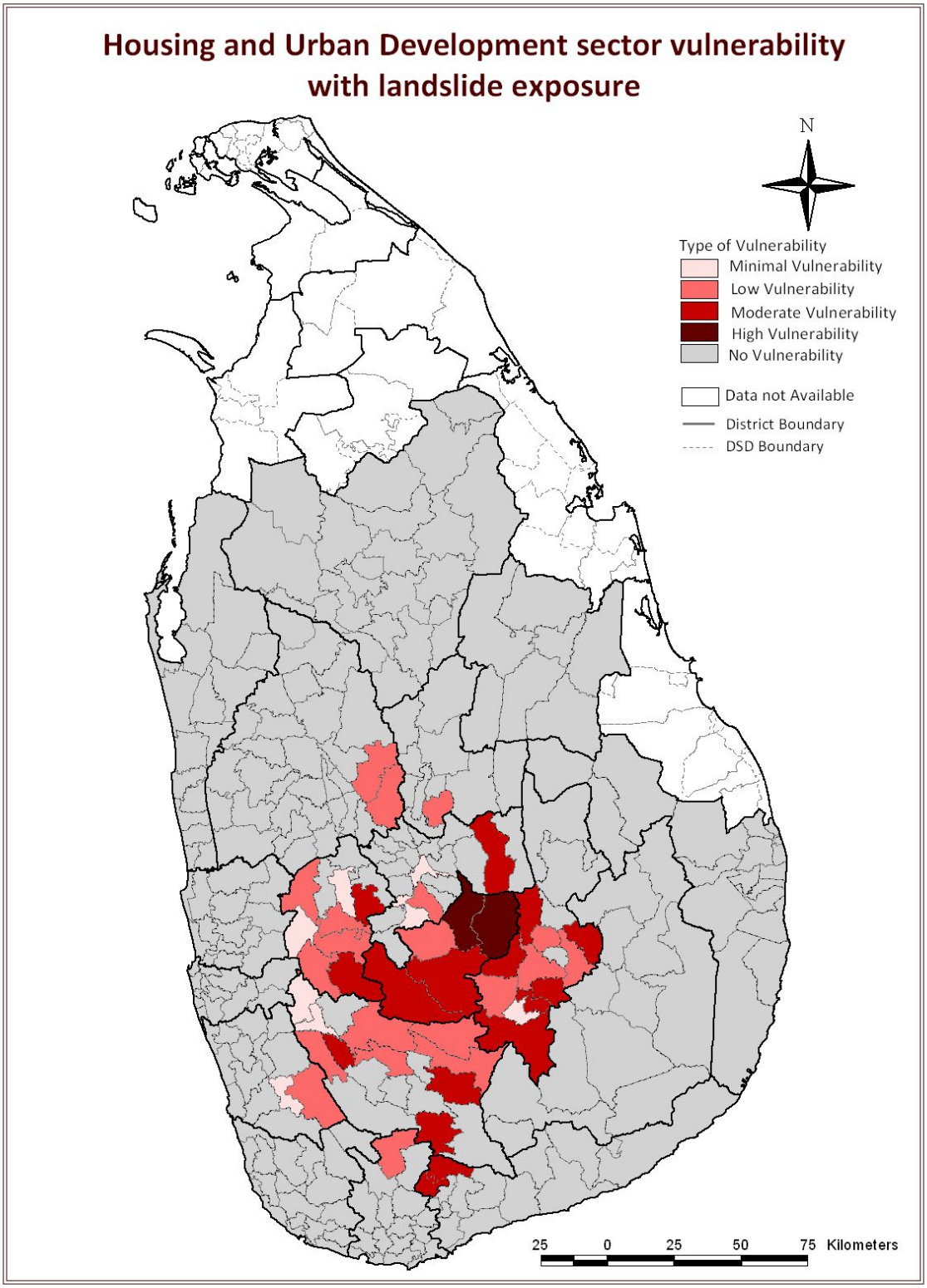

Housing and Urban Development sector vulnerability with flood exposure
N
Type of Vulnerability
Minimal Vulnerability
Low Vulnerability
Moderate Vulnerability
High Vulnerability
No Vulnerability
Data not Available
District Boundary
DSD Boundary
25 0 25 50 75 Kilometers

Highly vulnerable to impacts of landslides - human settlements

Rank	District	DS Division	
1	Nuwara Eliya	Walapane	**Highly Vulnerable**
2	Nuwara Eliya	Hanguranketha	

Moderately vulnerable to impacts of landslides - human settlements

Rank	District	DS Division	
3	Badulla	Kandaketiya	**Moderately Vulnerable**
4	Badulla	Lunugala	
5	Ratnapura	Elapatha	
6	Badulla	Haldummulla	
7	Kegalle	Aranayaka	
8	Kegalle	Deraniyagala	
9	Badulla	Uva Paranagama	
10	Ratnapura	Kolonna	
11	Nuwara Eliya	Ambagamuwa	
12	Nuwara Eliya	Nuwara Eliya	
13	Badulla	Bandarawela	
14	Ratnapura	Weligepola	
15	Hambantota	Katuwana	
16	Kandy	Ududumbara	
17	Badulla	Ella	

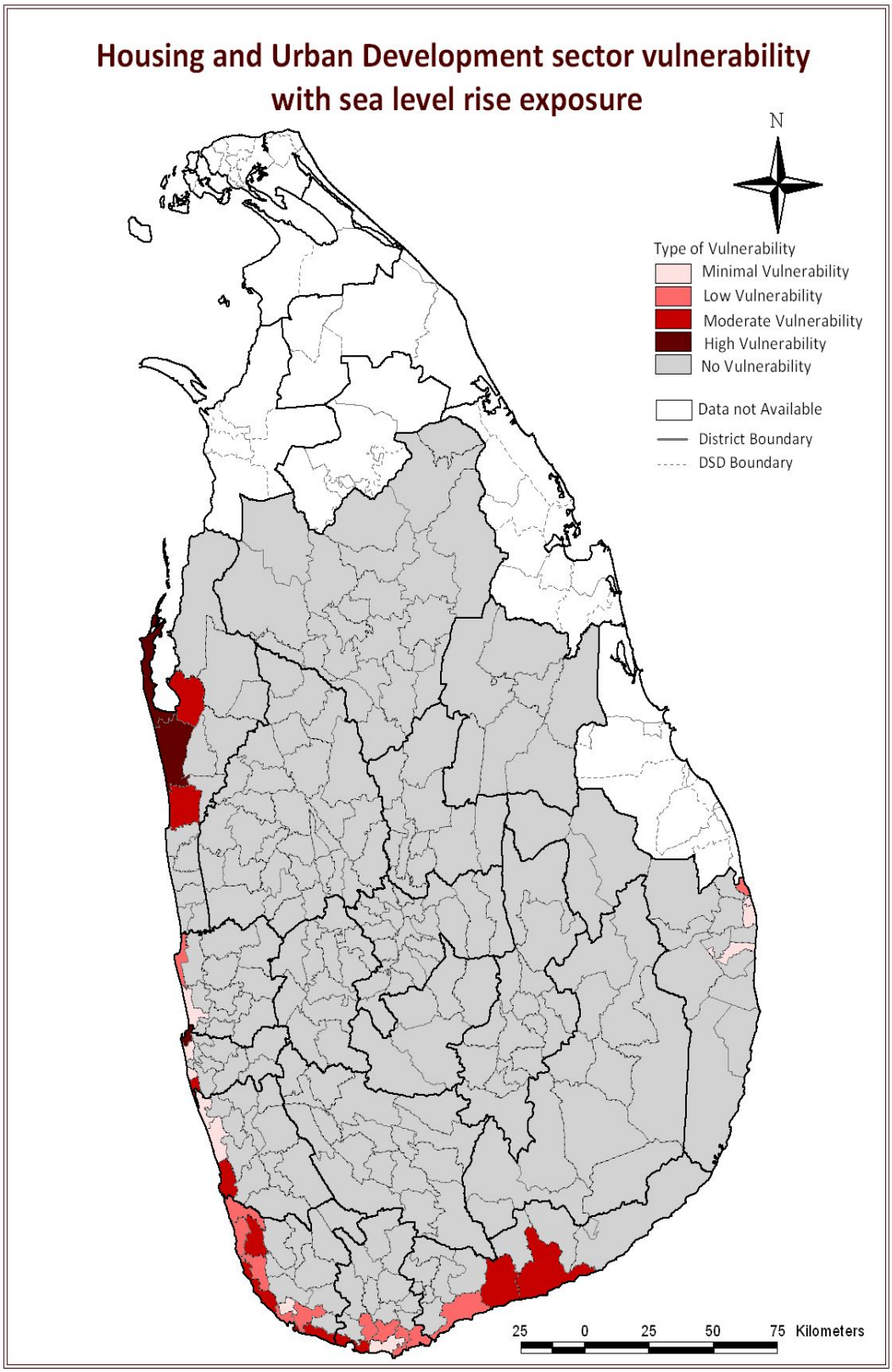

Housing and Urban Development sector vulnerability with landslide exposure
N
Type of Vulnerability
Minimal Vulnerability
Low Vulnerability
Moderate Vulnerability
High Vulnerability
No Vulnerability
Data not Available
District Boundary
DSD Boundary
25 0 25 50 75 Kilometers

Highly vulnerable to impacts of sea-level rise - human Settlements

Rank	District	DS Division	Highly Vulnerable
1	Puttalam	Kalpitiya	
2	Colombo	Colombo	
3	Puttalam	Mundalama	

Moderately vulnerable to impacts of sea-level rise - human settlements

Rank	District	DS Division	Moderately Vulnerable
4	Puttalam	Puttalam	
5	Hambantota	Hambantota	
6	Hambantota	Ambalantota	
7	Galle	Habaraduwa	
8	Puttalam	Arachchikattuwa	
9	Matara	Weligama	
10	Galle	Karandeniya	
11	Galle	Hikkaduwa	
12	Colombo	Moratuwa	
13	Kalutara	Beruwala	


Housing and Urban Development sector vulnerability with sea level rise exposure
N
Type of Vulnerability
Minimal Vulnerability
Low Vulnerability
Moderate Vulnerability
High Vulnerability
No Vulnerability
Data not Available
District Boundary
DSD Boundary
25 0 25 50 75 Kilometers

Part 2. Economic Infrastructure

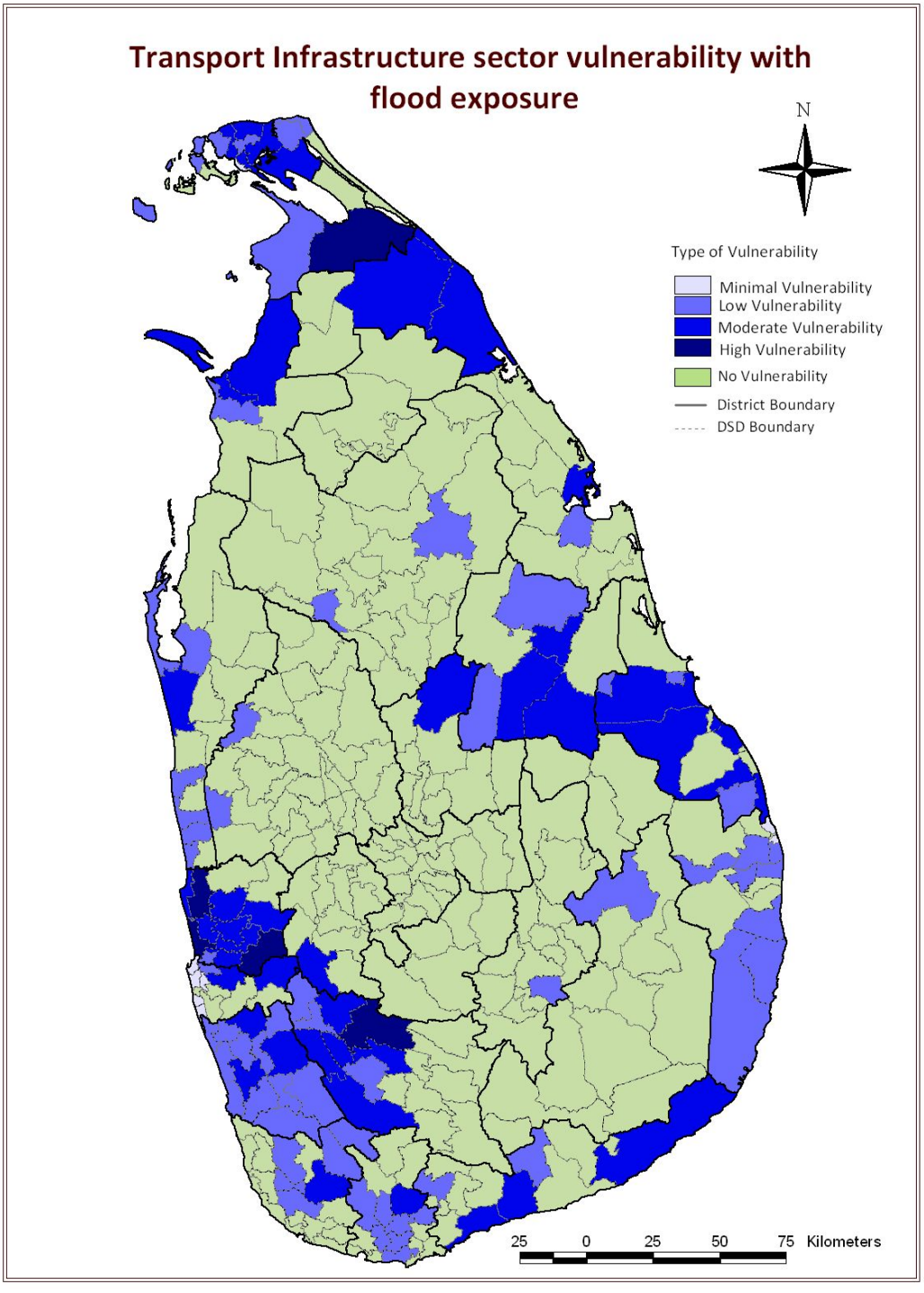
• Transport

Highly vulnerable to Impacts of Floods – Transport

Rank	District	DS Division	Highly Vulnerable
1	Gampaha	Katana	
2	Kilinochchi	Karachchi	
3	Gampaha	Dompe	
4	Gampaha	Wattala	
5	Ratnapura	Ratnapura	

Moderately vulnerable to impacts of floods - transport

Rank	District	DS Division	Moderately Vulnerable	Rank	District	DS Division
6	Hambantota	Ambalantota		28	Ratnapura	Kuruwita
7	Gampaha	Minuwangoda		29	Ratnapura	Kalawana
8	Gampaha	Gampaha		30	Batticaloa	Manmunai South - West
9	Jaffna	Chavakachcheri		31	Jaffna	Kopay
10	Colombo	Kaduwela		32	Matara	Mulatiyana
11	Mannar	MannarTown		33	Hambantota	Tissamaharama
12	Gampaha	Attanagalla		34	Jaffna	Nallur
13	Batticaloa	Eravur Pattu		35	Gampaha	Mahara
14	Jaffna	Sandilipay		36	Mannar	Manthai West
15	Batticaloa	Koralai Pattu (Valach.)		37	Puttalam	Mundalama
16	Gampaha	Ja-Ela		38	Batticaloa	Manmunai North
17	Gampaha	Biyagama		39	Polonnaruwa	Lankapura
18	Polonnaruwa	Dimbulagala		40	Kalutara	Horana
19	Batticaloa	Manmunai S. and Eruvilpattu		41	Ratnapura	Pelmadulla
20	Polonnaruwa	Thamankaduwa		42	Colombo	Hanwella
21	Kalutara	Bulathsinhala		43	Gampaha	Negombo
22	Hambantota	Tangalle		44	Ratnapura	Ayagama
23	Matale	Dambulla		45	Kegalle	Dehiowita
24	Ratnapura	Elapatha		46	Kalutara	Dodangoda
25	Trincomalee	Town & Gravets		47	Galle	Nagoda
26	Jaffna	Tellipallai		48	Mulaittivu	Maritimepattu
27	Mulattivu	Pudukudiyirippu				

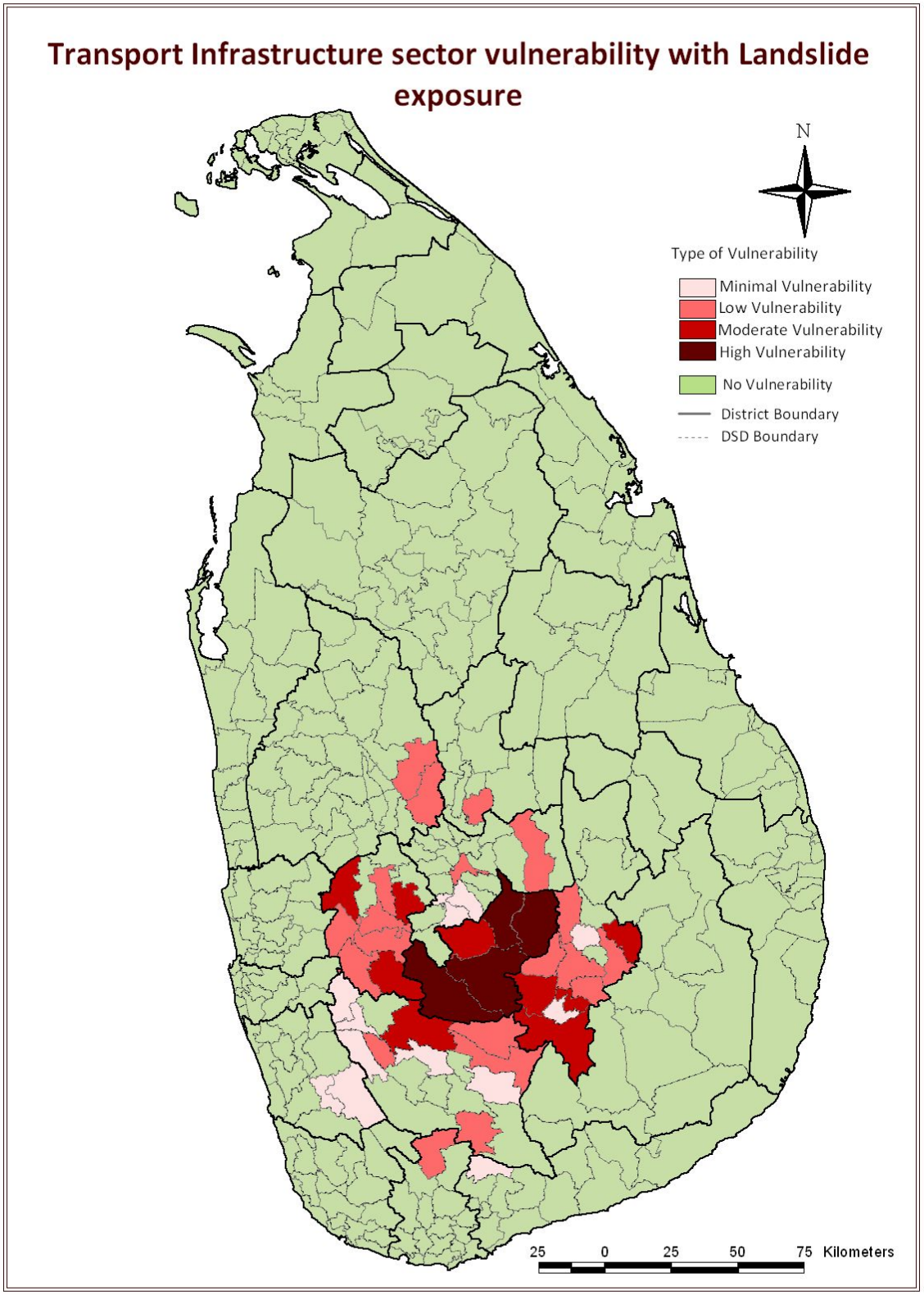

Transport Infrastructure sector vulnerability with flood exposure
N
Type of Vulnerability
Minimal Vulnerability
Low Vulnerability
Moderate Vulnerability
High Vulnerability
No Vulnerability
District Boundary
DSD Boundary
25 0 25 50 75 Kilometers

Highly vulnerable to impacts of landslides - transport

Rank	District	DS Division	
1	Nuwara Eliya	Walapane	Highly Vulnerable
2	Nuwara Eliya	Nuwara Eliya	
3	Nuwara Eliya	Ambagamuwa	
4	Nuwara Eliya	Hanguranketha	

Moderately vulnerable to impacts of landslides - transport

Rank	District	DS Division	
5	Badulla	Haldummulla	Moderately Vulnerable
6	Badulla	Bandarawela	
7	Badulla	Lunugala	
8	Kegalle	Deraniyagala	
9	Nuwara Eliya	Kothmale	
10	Ratnapura	Ratnapura	
11	Badulla	Welimada	
12	Kegalle	Aranayaka	
13	Kegalle	Warakapola	

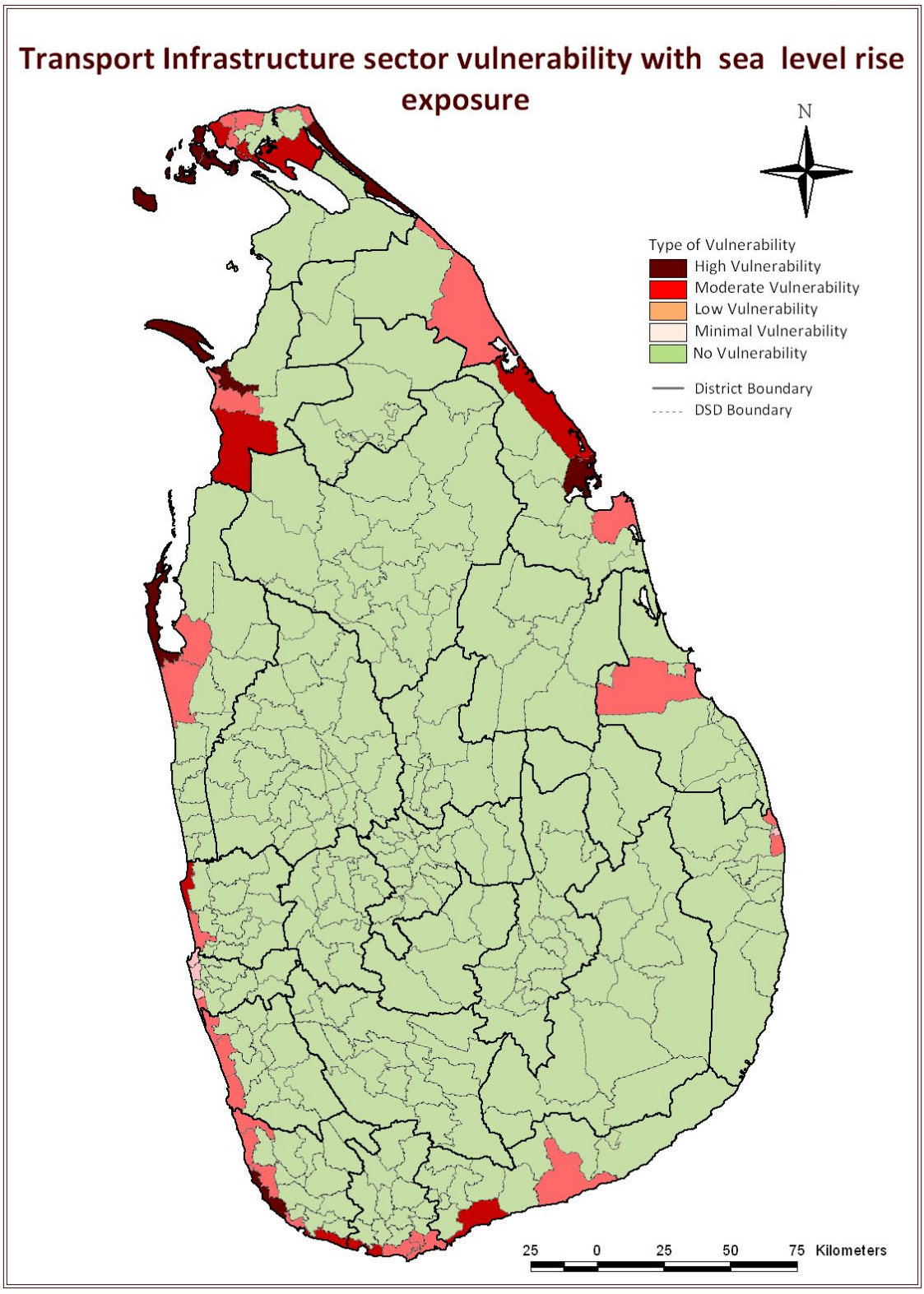

Transport Infrastructure sector vulnerability with Landslide exposure
N
Type of Vulnerability
Minimal Vulnerability
Low Vulnerability
Moderate Vulnerability
High Vulnerability
No Vulnerability
District Boundary
DSD Boundary
25 0 25 50 75 Kilometers

Highly vulnerable to impacts of sea-level rise - transport

Rank	District	DS Division	
1	Jaffna	Velanai	Highly Vulnerable
2	Trincomalee	Town & Gravets	
3	Jaffna	Delft	
4	Jaffna	Kayts	
5	Mannar	Mannar Town	
6	Jaffna	Maruthnkerny	
7	Galle	Hikkaduwa	
8	Puttalam	Kalpitiya	

Moderately vulnerable to impacts of sea-level rise - transport

Rank	District	DS Division	
9	Trincomalee	Kuchaveli	Moderately Vulnerable
10	Jaffna	Jaffna	
11	Galle	Habaraduwa	
12	Matara	Weligama	
13	Jaffna	Chankanai	
14	Jaffna	Chavakachcheri	
15	Gampaha	Negombo	
16	Jaffna	Nallur	
17	Hambantota	Tangalle	
18	Mannar	Musalai	


Transport Infrastructure sector vulnerability with sea level rise exposure
N
Type of Vulnerability
High Vulnerability
Moderate Vulnerability
Low Vulnerability
Minimal Vulnerability
No Vulnerability
District Boundary
DSD Boundary
25 0 25 50 75 Kilometers

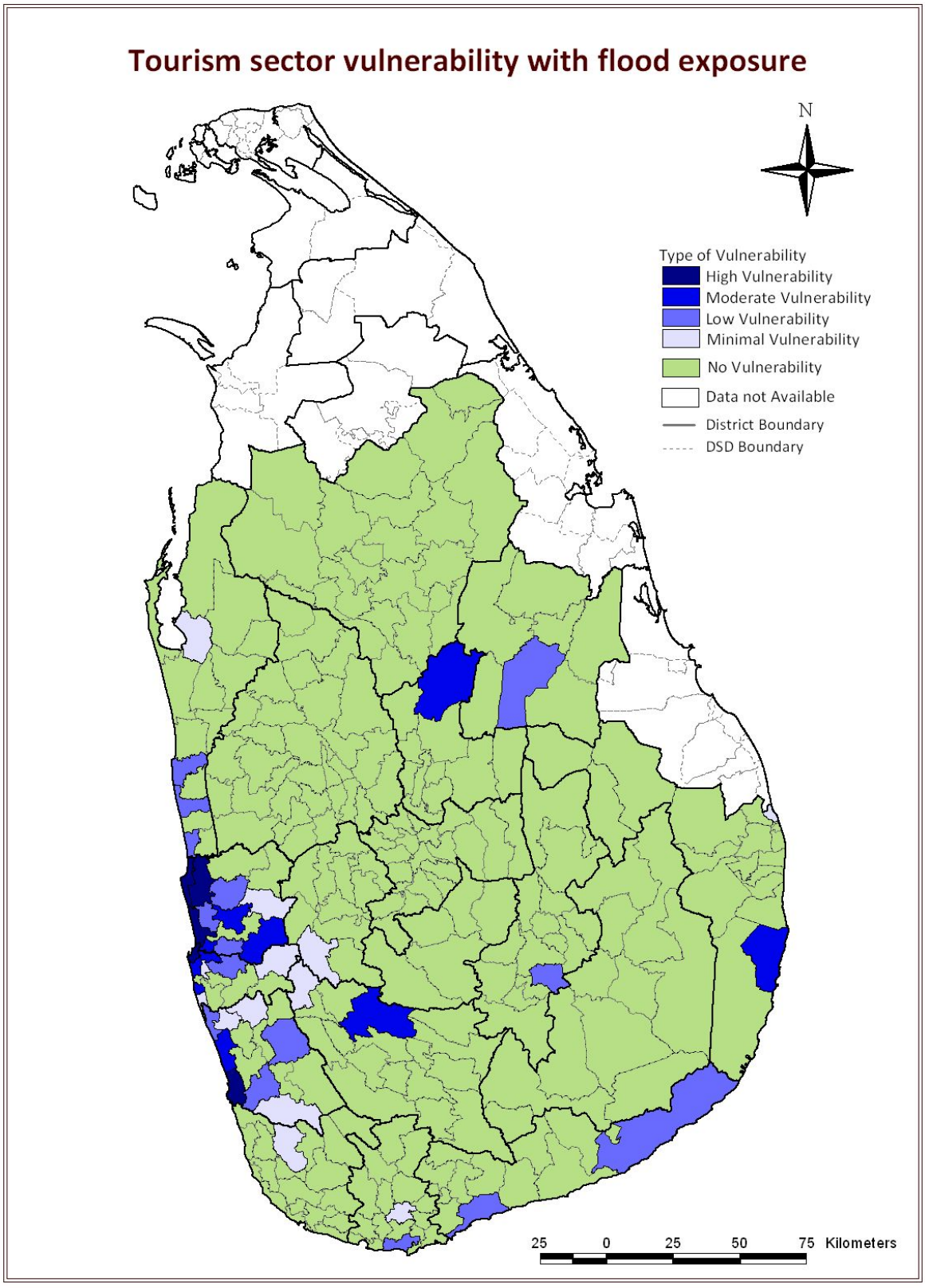
- ## Tourism

Highly vulnerable to impacts of floods - tourism

Rank	District	DS Division	Highly Vulnerable
1	Colombo	Colombo	
2	Kalutara	Beruwela	
3	Gampaha	Katana	
4	Gampaha	Negombo	
5	Gampaha	Wattala	

Moderately vulnerable to impacts of floods – tourism

Rank	District	DS Division	Moderately Vulnerable
6	Matale	Dambulla	
7	Colombo	Thimbirigasyaya	
8	Ratnapura	Ratnapura	
9	Gampaha	Kelaniya	
10	Kalutara	Kalutara	
11	Ampara	Pothuvil	
12	Colombo	Kolonnawa	
13	Colombo	Ratmalana	
14	Gampaha	Dompe	
15	Gampaha	Gampaha	

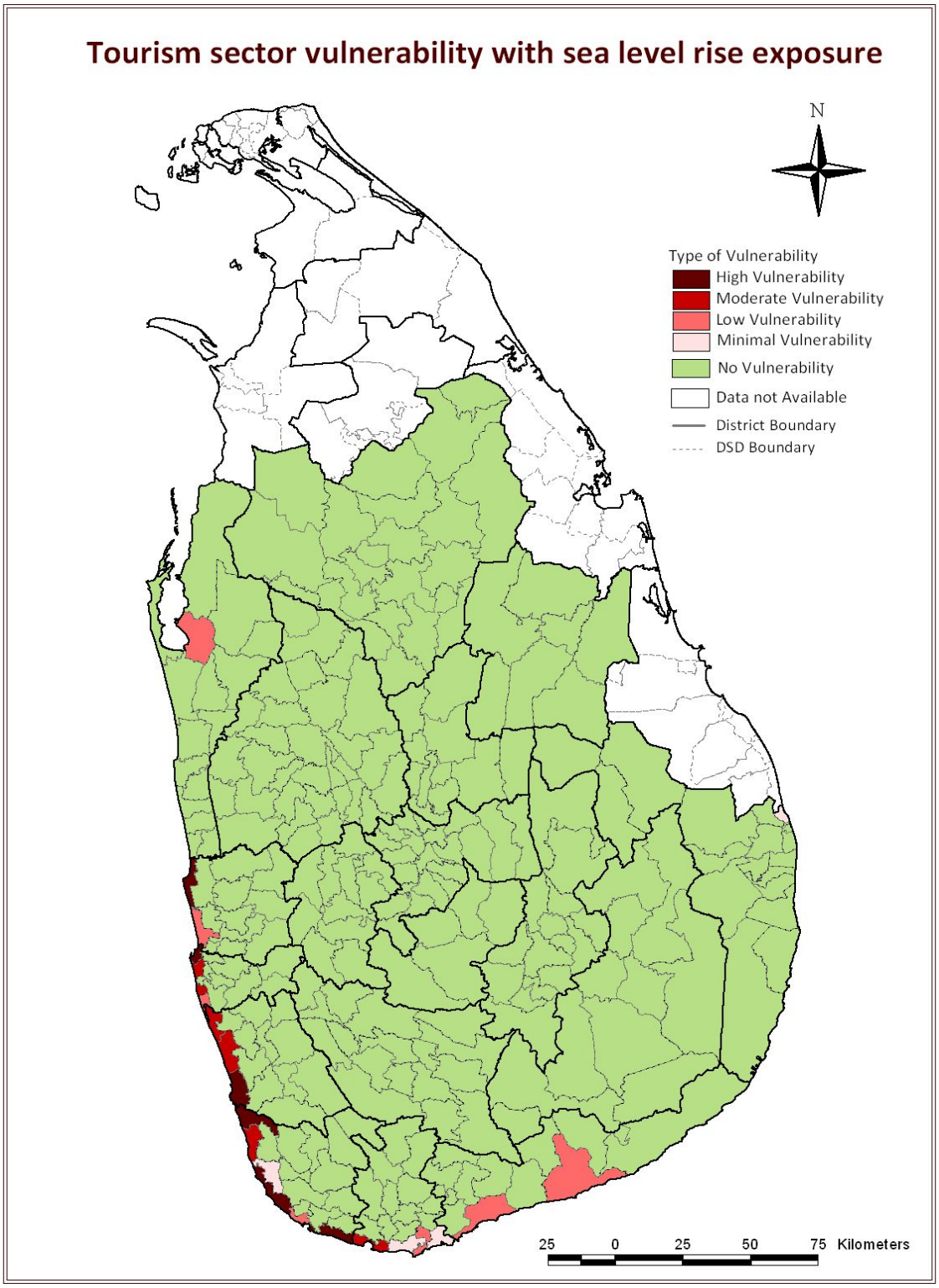

Tourism sector vulnerability with flood exposure
N
Type of Vulnerability
High Vulnerability
Moderate Vulnerability
Low Vulnerability
Minimal Vulnerability
No Vulnerability
Data not Available
District Boundary
DSD Boundary
25 0 25 50 75 Kilometers

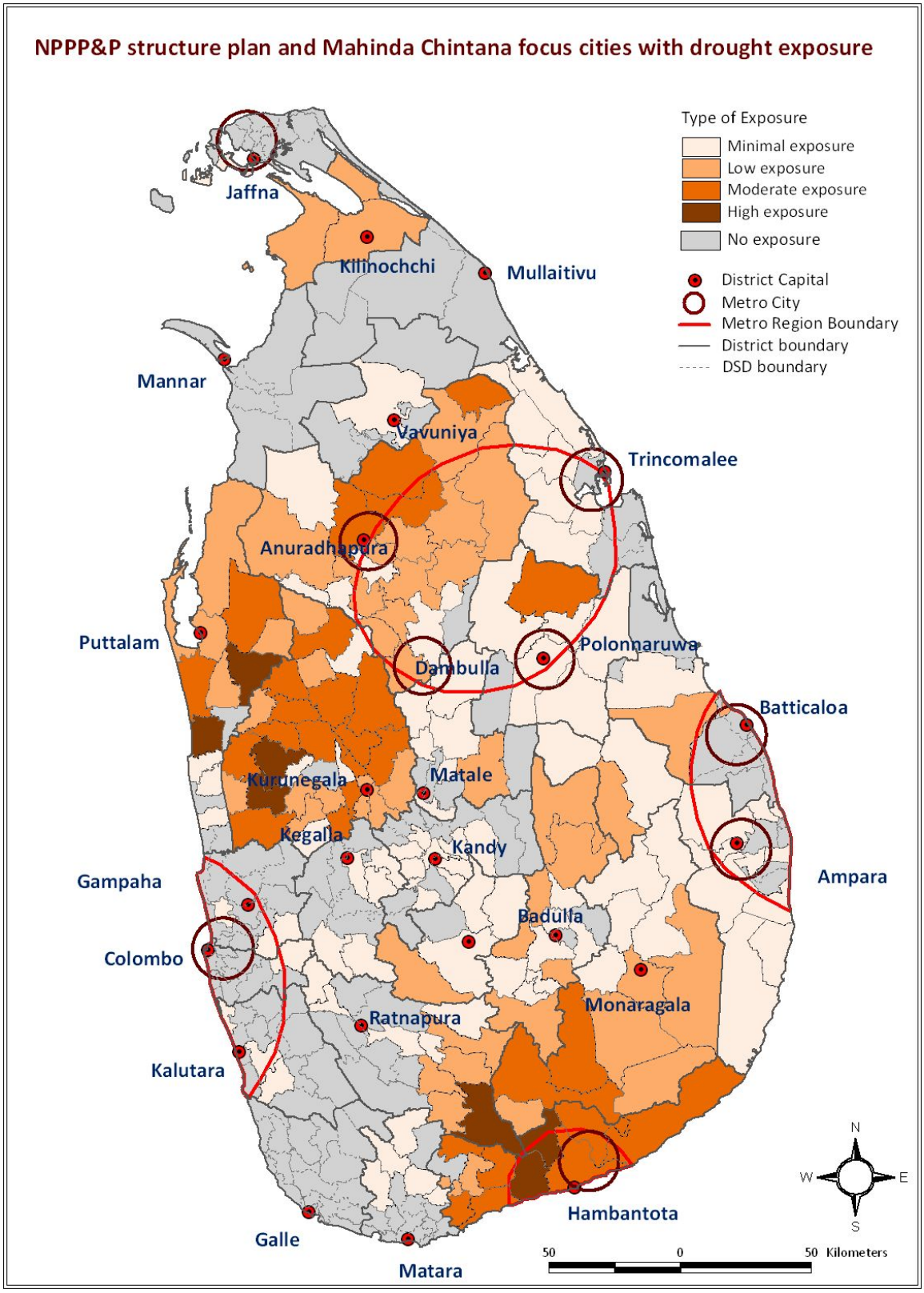
Highly vulnerable to impacts of sea-level rise - tourism

Rank	District	DS Division	
1	Galle	Bentota	Highly Vulnerable
2	Kalutara	Beruwela	
3	Galle	Habaraduwa	
4	Gampaha	Negombo	
5	Colombo	Colombo	

Moderately vulnerable to impacts of sea-level rise - tourism

Rank	District	DS Division	
6	Galle	Hikkaduwa	Moderately Vulnerable
7	Colombo	Thimbirigasyaya	
8	Matara	Weligama	
9	Colombo	Ratmalana	
10	Kalutara	Kalutara	
11	Galle	Balapitiya	


Tourism sector vulnerability with sea level rise exposure
N
Type of Vulnerability
High Vulnerability
Moderate Vulnerability
Low Vulnerability
Minimal Vulnerability
No Vulnerability
Data not Available
District Boundary
DSD Boundary
25 0 25 50 75 Kilometers


NPPP&P structure plan and Mahinda Chintana focus cities with drought exposure
Type of Exposure
Minimal exposure
Low exposure
Moderate exposure
High exposure
No exposure
District Capital
Metro City
Metro Region Boundary
District boundary
DSD boundary
Jaffna
Kilinochchi
Mullaitivu
Mannar
Vavuniya
Trincomalee
Anuradhapura
Puttalam
Dambulla
Polonnaruwa
Batticaloa
Kurunegala
Matale
Kegalla
Kandy
Ampara
Gampaha
Badulla
Colombo
Monaragala
Ratnapura
Kalutara
Hambantota
Galle
Matara
N
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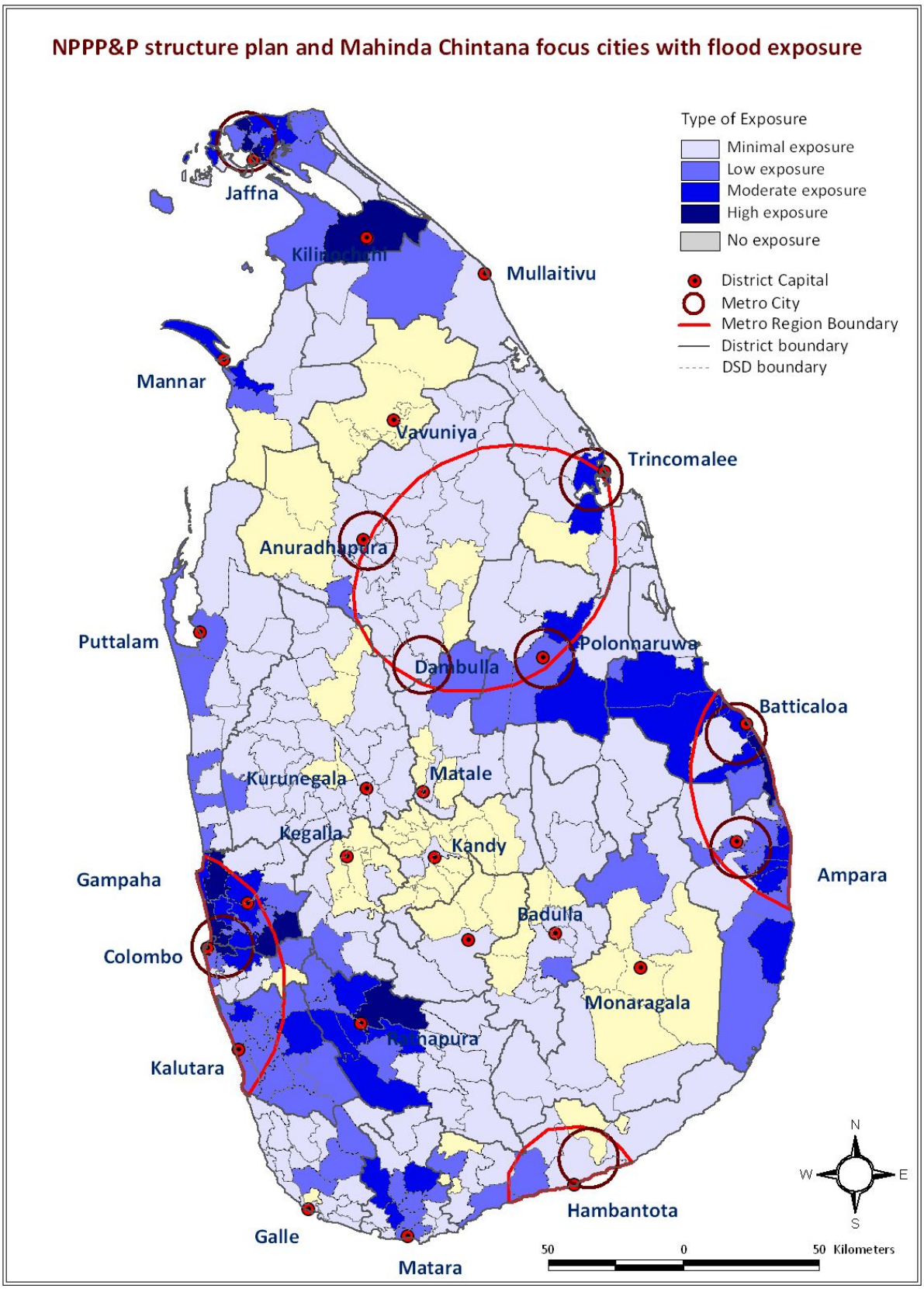
50 Kilometers


NPPP&P structure plan and Mahinda Chintana focus cities with flood exposure
Type of Exposure
Minimal exposure
Low exposure
Moderate exposure
High exposure
No exposure
District Capital
Metro City
Metro Region Boundary
District boundary
DSD boundary
Jaffna
Mullaitivu
Mannar
Vavuniya
Trincomalee
Anuradhapura
Puttalam
Polonnaruwa
Dambulla
Batticaloa
Kurunegala
Matale
Kegalla
Kandy
Ampara
Gampaha
Badulla
Colombo
Monaragala
Kalutara
Hambantota
Galle
Matara
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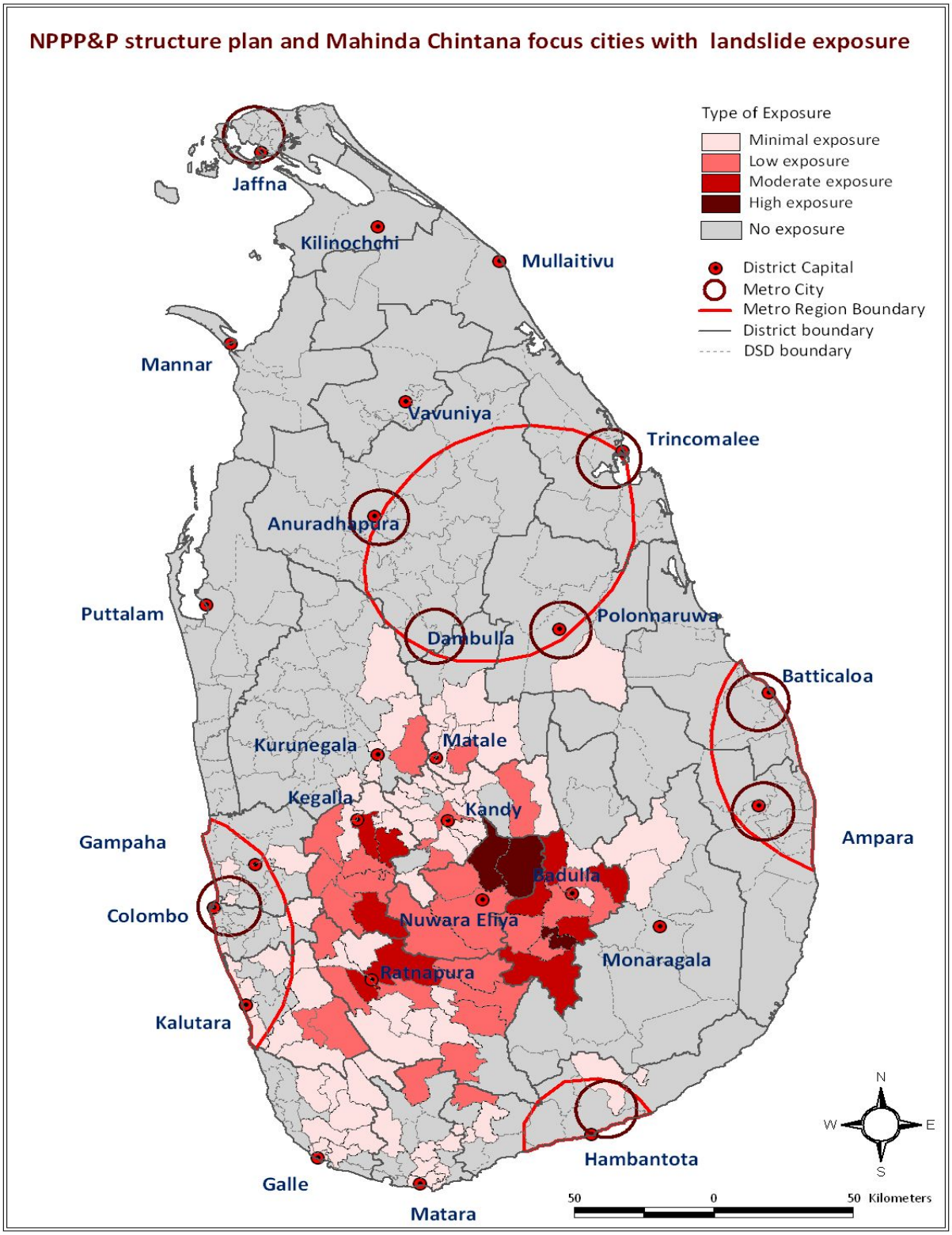
50 Kilometers


NPPP&P structure plan and Mahinda Chintana focus cities with landslide exposure
Type of Exposure
Minimal exposure
Low exposure
Moderate exposure
High exposure
No exposure
District Capital
Metro City
Metro Region Boundary
District boundary
DSD boundary
Jaffna
Kilinochchi
Mullaitivu
Mannar
Vavuniya
Trincomalee
Anuradhapura
Puttalam
Polonnaruwa
Dambulla
Batticaloa
Kurunegala
Matale
Kegalla
Kandy
Gampaha
Ampara
Badulla
Colombo
Nuwara Eliya
Monaragala
Ratnapura
Kalutara
Hambantota
Galle
Matara
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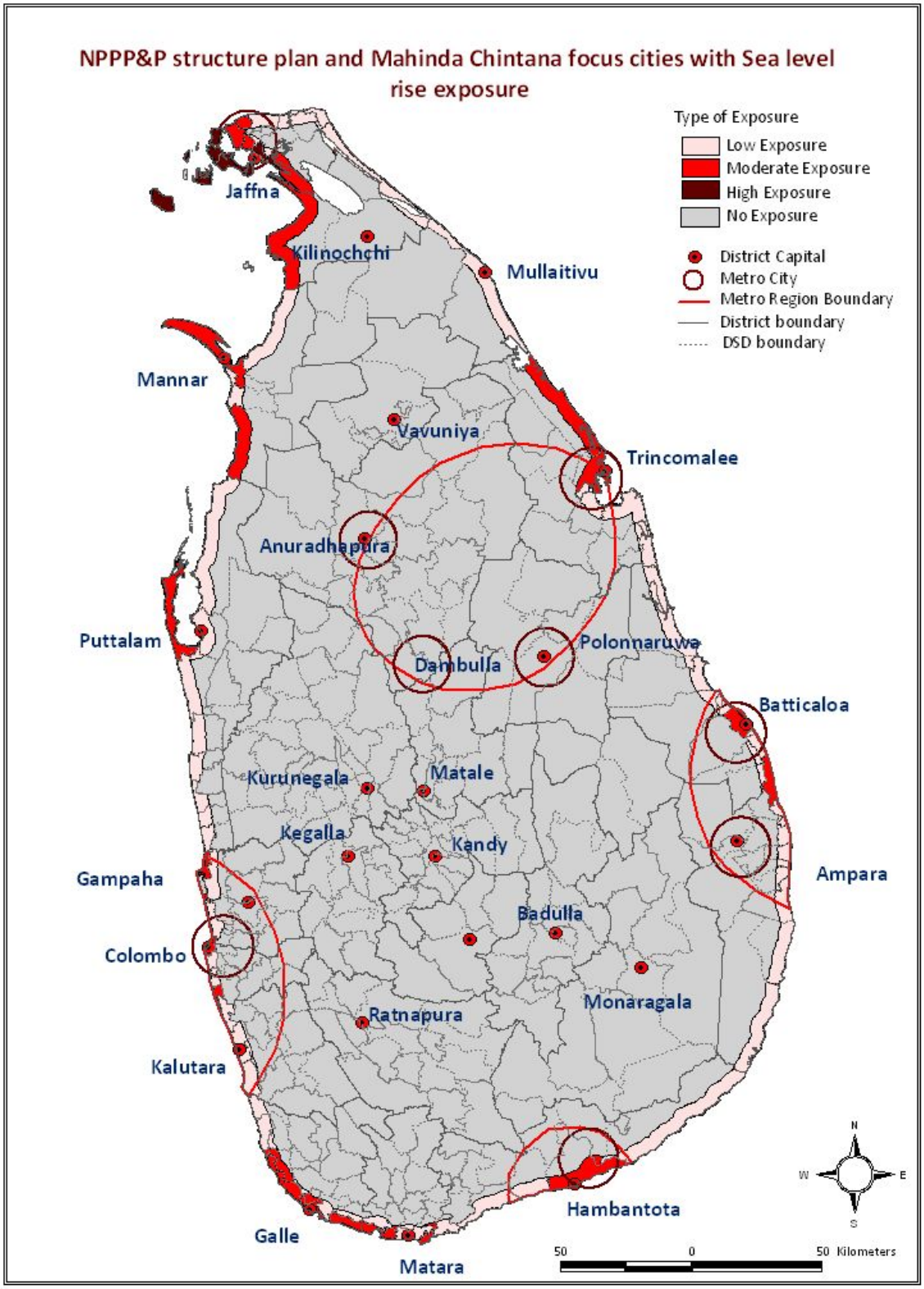
NPPP&P structure plan and Mahinda Chintana focus cities with Sea level rise exposure
Type of Exposure
Low Exposure
Moderate Exposure
High Exposure
No Exposure
District Capital
Metro City
Metro Region Boundary
District boundary
DSD boundary
Jaffna
Kilinochchi
Mullaitivu
Mannar
Vavuniya
Trincomalee
Anuradhapura
Puttalam
Dambulla
Polonnaruwa
Batticaloa
Kurunegala
Matale
Kegalla
Kandy
Ampara
Gampaha
Badulla
Colombo
Monaragala
Ratnapura
Kalutara
Hambantota
Galle
Matara
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50 Kilometers

Appendix C
Descriptions of Key Government Agencies

Part 1. Involved in Implementing Urban Development and Housing Activities

- **National Physical Planning Department**

At a national level, the Department of National Planning was established in 2000, under the Ministry of Finance to overseas the development and implementation of the over-arching *Mahinda Chintana* 10 Year Development Plan, to spearhead all state, donor, and other external investments, and to be responsible for ensuring that development is broadly compatible with Sri Lanka's National Development Agenda.

- **Urban Development Authority**

The Urban Development Authority (UDA) is mandated to promote the integrated planning and implementation of social, economic and physical development of areas declared as "Urban Development Areas" under the UDA Act with the overall vision of guidance, facilitation, and regulation of urban development through innovative and integrated physical planning. The UDA monitors urban areas, including 1 km inland from the coast in all areas of the coastal zone. The planning committee of the UDA looks into all environmental aspects of urban development within and outside the coastal areas. There are also monitoring and coordination committees for each major project undertaken by the UDA. However this does not always happen in practice.

- **Coast Conservation Department (CCD) (for development in the coastal zone)**

This department is located under the Ministry dealing with fisheries, and is the prime agency responsible for coastal issues in Sri Lanka. Its mandate provides it with a key role to play in conserving and managing coastal and marine biodiversity according to the periodically revised Coastal Zone Management Plan. The Director of the Coast Conservation Department is responsible for administration and implementation of the provisions of the Coast Conservation Act, including the survey and inventorization of coastal resources.

The CCD is also responsible for the conservation and management of natural coastal habitats and areas of cultural and recreational value in the coastal zone. Programmes carried out so far by the CCD cover mitigating coastal erosion, policy development and coastal resources management, including issuing of permits for coastal development and revision of the Coastal Zone Management Plans periodically to regulate and control development activities in the coastal zone.

- **National Council for Sustainable Development**

This was established under the *Haritha Lanka* Programme and functions under H E the President, and includes ministers in charge of major economic development programmes. This Council is charged with responsibility for policy integration and overseeing and guiding the implementation of the *Haritha Lanka* Programme to ensure the sustainability of socio-economic development programmes.

Part 2. Economic Infrastructure and development

• Transport

Road Development Authority (RDA)
The RDA is the premier highway authority in the country and is responsible for the maintenance and development of the National Highway Network, comprising the Trunk (A Class) and Main (B Class) roads and the planning, design and construction of new highways, bridges and expressways to augment the existing network.

• Tourism

Sri Lanka Tourism Development Authority (SLTDA)
The SLTDA was formed as a body corporate in terms of provisions in Section 2 of the Tourism Act No. 38 of 2005 with the objectives to develop Sri Lanka as a tourist and travel destination both in Sri Lanka and abroad, advise the Minister on matters relating to travel and the tourism industry, within the policy formulated by the Cabinet of Ministers in relation to the sector.

Sri Lanka Tourism Promotions Bureau (SLTPB)
Sri Lanka Tourism Promotions Bureau was founded in October 2007 and is governed by a Board of Directors with a Chairman appointed by the Ministry of Tourism with the goal of promoting the destination more effectively with the resources available. Apart from promotions Sri Lanka Tourism also engages in research and international affairs, tourism marketing and tourism product development.

Sri Lanka Convention Bureau (SLCB)
Sri Lanka Convention Bureau is the Government arm established for the development of the meetings industry in Sri Lanka. Sri Lanka Convention Bureau is the primary contact point for meeting planners, incentive houses, corporates and associations for information, advice and expertise when planning and organizing events in Sri Lanka. The SLCB works closely with the industry and the national airline not only to promote Sri Lanka as a venue for MICE events but also to ensure that these events are conducted in a professional manner to the entire satisfaction of the visitors and delegates.

Appendix D
Country Profile in Brief

Population status
Sri Lanka is a multi-ethnic, multi-religious secular state, with a total population of over 20.4 million and a population density of 326 persons per km^2. The Wet Zone, with a very high biological diversity, and more favourable climate and better socio-economic considerations than the water scarce Dry Zone, contains about two thirds of the country's population despite its coverage of less than a third of the island. The population in Sri Lanka is still predominantly rural as only about 20% of the population live in urban areas.

Healthcare and life expectancy
Sri Lanka has achieved remarkable progress in health and social welfare relative to other low income countries and its neighbouring South Asian counterparts as shown by a Human Development Index (HDI) of 0.759 in 2007. This is due to a large share of public expenditure being redistributed to households perceived to be in need in the form of free education and health services, as well as food subsidies and subsidized credit to improve living standards.

Sri Lanka has relatively high standards of health care, and the national health indicators are comparable with those of developed countries. The Government of Sri Lanka provides free health care services through a network of western and traditional health care institutions including hospitals, dispensaries and health units located in all parts of the country. There is also significant enhancement of health services for women and children through pre- and post-natal care nutritional programmes. Sri Lanka's consistent decline in maternal mortality for over 5 decades is attributed to a wide network of maternal services which is integrated with childcare. The life expectancy at birth for males and females is respectively 70.3 and 77.9 years. Infant mortality rates are low at 10 (per '000), while under five mortality at 14 (per 1,000) live births is the lowest for the WHO South East Asian region.

Education
The net enrolment ratio in primary education exceeds 98%, and the country has an island-wide network of schools which include public, private and religious education centers. Education was made compulsory for all children between the ages of 5-14 in 1997 and is free of charge to all students in state schools since 1945. Hence, Sri Lanka has a high adult literacy rate of 92.5%. Sri Lanka has 15 universities, six postgraduate institutions and about seven institutions affiliated to the universities which offer Bachelor's Degree courses in specialised fields. University education is a public sector monopoly as yet and free of charge, except for the Open University which is open to students of any age and with varying basic educational backgrounds.

Status of women
Men and women are granted equal status and rights under the Constitution of Sri Lanka and Sri Lankan women - including women in the rural areas - have a comparatively better status than their counterparts in many developing countries. Gender wise the literacy rate is 94.5% for males and 90.6% for females. Sri Lanka has achieved gender equality in primary and secondary education in the generations that had access to free education. Overall there has been a perceptible upward social mobility in the status of women since gaining independence in 1948, mainly due to increased access to free education, economic opportunities for employment in the industrial sector and migrant domestic employment overseas. Sri Lanka's Gender Development Index (GDI) in 2007 was 0.756 but the Gender Empowerment Measure (GEM) was only 0.389.

Housing and lifestyles
Lifestyles are changing in Sri Lanka with increased household income, and household consumption is shifting from food (as in the past) to communication, education, recreation, housing and utilities. The average household size is at present 4.1 persons. About 79% of households now own a radio or TV and 36% own a refrigerator. Household access to motorized transport and telephone facilities stand at 22% and 25% of households respectively. The demand for houses and urban infrastructure is increasing. About 75% of the population outside the north and east live in houses with more than three rooms, and over 72% of houses throughout the island comprise modern building and roofing

materials such as bricks and cement for walls and tiles or asbestos for roofing; about 77% of households have sanitary and toilet facilities, 86% have electricity and 84.8% of households have access to safe water – although only about 35.5% have access to pipe-borne water. Consequently much of the rural population still depend mainly on well water, water from forest streams, reservoirs, canals and streams which become contaminated with faecal matter and other pollutants.

Economic trends and poverty

Per capita income in Sri Lanka exceeded US$2000 in 2009, but very high regional disparities remain. According to government figures, 15 percent of Sri Lankans live below the official poverty line of Rs 3,087 a month. The country's commitment to alleviating poverty is reflected in Sri Lanka's macroeconomic policies which are pro-growth and pro-poor while continuing to uphold market based economic policies. The economic policies of the country also encourage foreign investments by providing foreign exchange and employment opportunities to catalyze the development process. Overall, the country's monetary and fiscal policies are geared towards improving macroeconomic stability by enhancing development, increasing investment and poverty reduction. The country's economic growth and poverty alleviation programmes focus on regionally balanced growth with rural and small and medium private sector development with the medium-term objective of macroeconomic stability and a regionally balanced economic growth rate of about 6-8 percent**.** Being an open economy, open market operations prevail with considerable individual freedom. This has to some degree had a positive impact on the environment.

Importance of bio-resources for economic development

Sri Lanka's diverse bio resources serve to maintain a range of economic activities within the island. Foremost among these are agriculture, the marine and brackish water fishery and tourism. Agriculture, forestry and fisheries had contributed only about 12% of the GDP. The fisheries sector provides direct employment to about 208,731 people, and sustenance to at least 2.5 million. Fish also constitutes the top source of animal protein for Sri Lankans. Sri Lanka's rich biodiversity offers ample potential to support the government's current tourism related policy aimed at maximizing potential for nature-based tourism and cultural tourism.

Industrial growth

Sri Lanka has been gradually changing from an agricultural based economy to an industrial based one over the last few decades and presently follows a liberalized industrial policy. At present industry comprises 28.6% of the GDP. Sri Lanka has been promoting the development of private sector-led, export-oriented industries with sufficient diversification in relation to both products and geographical location. However, relatively little attention has been paid in the past to ensure environmentally sustainable economic growth.

Adapted from the Country Profile in Brief from the 4th National Report to the Convention on Biological Diversity as updated with data from Central Bank (2010), Human Development Report 2009, UNDP; Household Income and Expenditure Survey, 2005, Department of Census and Statistics.

Appendix E
List of Persons/Institutions Consulted

The consulting team has attempted to consult a broad range of stakeholders throughout the SVP preparation process through working group discussions and individual consultations. All consulted across sectors are given below.

Government Organizations (GOs)

SNC Project Team	Mr. H.M. Bandarathillake	National Project Manager
	Dr. M.C.M. Iqbal	Team Leader – Vulnerability and Adaptation(SNC)
	Mr. Jayathilaka Banda	Team Leader- Education, Training & Awareness(SNC)
	Prof. Hemanthi Ranasinghe	Team Leader- Mitigation(SNC)
	Mr. Nimal Perera	Team Leader- GHG Inventory(SNC)
Asian Disaster Preparedness Centre (ADPC), DMC	Mr. Rohan Cooray	Program Co-ordinator (PIP-SL)
Ministry of Tourism	Mr Tissa Sooriyagoda Mr D.L.P.R. Abeyratne Mr Prabhath Uyanwatta Mr Rohana Abeyratne	Additional Project Director Senior Assistant Secretary
Coast Conservation Department	Mr H.N.R. Perera Mr K.M.D.P. Dissanayake Mr K.D.D. Wijewardene Mr. R.A.S. Ranawaka Mr. T.L.C. Vinodh	Acting Project Director Senior Engineer Chief Engineer (R & D) Senior Engineer (Development) Engineer(R & D)
Ministry of Environment	Hon. Patali Champaka Ranawake Mr. M.A.R.D. Jayathillaka Mr. Faiszer Musthapha Dr. R.H.S. Samarathunga Ms. L.P. Batuwitage Mr. W.M. Wijesoriya Mr. W.M.V. Narampanawa Dr. W.L. Sumathipala Mr. A.A. Kulathunga Mr. Anura Jayathillake Mr. Gamini Gamage Mr. U.P.L.D. Pathirana Mr. S.M. Werahera Mr. Ajith Silva Dr. Sunimal Jayathunga Mr. Chandana Ranaweeraarachchi Mr. G.M.J.K. Gunawardane Mr. Sugath Dharmakeerthi Ms. Anoja Herath Ms. N.D. Wickramaarachchi Ms. Shyamali Priyanthie Ms. L. Hapuarachchi Mr. Leel Randeni Ms. Thiris Inoka Ms. Kema Kasturiarachchi	Former Minister Former Secretary Deputy Minister Secretary Additional Secretary Additional Secretary Additional Secretary Senior Technical Advisor Director/NRM Director/ Air Resources Management & International Relations Director/Biodiversity Secretariat Director/Administration Assistant Director/Air Resources Management Director/Policy & Planning Director/Sustainable Development Director/Sustainable Environment Director/Promotion & Education Assistant Director/CCS Assistant Director/CCS Assistant Director/NRM EMO/P & P EMO/Biodiversity Secretariat EMO/Promotion & Education EMO/CCS EMO/CCS

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NCCAS Brochures

Compilation of Climate Change Adaptation Project Concept Notes

Sector Vulnerability Profiles:

- Urban Develoment, Human Settlements and Economic Infrastructure
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- Water
- Health
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Public Perceptions Survey on Climate Change in Sri Lanka

Prepared with assistance from
ADB TA 7326 (SRI)
Strengthening Capacity for Climate Change Adaptation

Implemented by:
Climate Change Secretariat
Ministry of Environment
Sri Lanka

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