

Sri Lanka
State of the Economy Report 2013

Chapter 11
Climate Resilient Urban Infrastructure

by
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11. Climate Resilient Urban Infrastructure

11.1 Introduction

As Sri Lanka invests large sums in infrastructure to support its long term growth and development objectives, the ability of the country's infrastructure stock to withstand emerging climate-related events needs to be mainstreamed into the planning process. With the frequency and scale of natural disasters on the rise, the impact of climate change effects on infrastructure need greater attention today than ever before. Whilst the vulnerability of infrastructure to natural disasters such as floods and earthquakes has always been at the forefront of infrastructure designers and builders, the increasing frequencies and intensities of climate change events such as rainfall, heat waves, etc., have made it essential that the risks are recognized when planning new infrastructure, as well as in the renovation and reconstruction of existing and damaged infrastructure. Infrastructure which is built by incorporating adaptation measures to climate change impacts will minimize the damages in extreme climate change events, minimizing both economic and social losses.¹

In the construction and development of infrastructure, existing climate conditions, as well as climate variations that could occur in the next few decades, need to be carefully considered. For example, a substantial proportion of infrastructure built in the next five years, will still be in use long after 2030.² Therefore, to increase the resilience of both new and existing infrastructure, forward planning to mitigate the impacts of climate change is essential. This is an important aspect of the transition to a green economy. The sustainability of infrastructure, and its ability to withstand adverse climate change impacts such as floods, is a guarantee of the safety of the people who inhabit areas around such infrastructure.

Climate resilient infrastructure is an essential intervention to fight against climate change impacts, and increasing urbanization

¹ Department of Sustainability and Environment (2006), "Climate Change and Infrastructure: Planning Ahead," State of Victoria, Victorian Climate Change Adaptation Programme.

² Wilbanks, T. and S. Fernandez (2011), "Climate Change and Infrastructure, Urban Systems and Vulnerabilities," Technical Report for the U.S Department of Energy In Support of the National Climate Assessment.

New infrastructure can be climate resilient by ensuring that it is located, designed, built, and operated, with the current and future climate change variations incorporated in to the design and planning process.³ Existing infrastructure can be climate resilient by ensuring that maintenance regimes incorporate resilience to the impacts of climate change over the lifetime of an asset, especially by making the necessary adjustments to the structure of the infrastructure. For example, drainage canals constructed a few decades back may no longer be able to withstand the rainfall frequencies and intensities of today and in the future. Therefore, these canals must be cleaned and widened, and should be connected to the larger storages to ensure that floods and inundations will not occur.

The impact of climate change effects on infrastructure can be cumulative, and hence have snowball effects on the whole infrastructure set. A flood caused by the incapacitated storm water canals will cause cities to be flooded, affecting telecommunication, power generation and distribution, roads, transportation facilities, and domestic water use. These ripple effects have the capabilities to bring down cities and economic centers of a country within hours. Therefore, the design of storm water drainages, roads, railways, and power lines, and the management of the supply/demand balance through water infrastructure are critical. If today's extreme weather events be-

come both more frequent and severe, so too will the level of disruption that they cause.⁴

The economic and social costs associated with infrastructure damage caused by climate change impacts are high. Repair costs to meet damaging effects of heavy rain falls, floods, coastal flooding and inundation with sea level rise can be very high.⁵ The affected and displaced people need immediate assistance by way of food, housing, and health care, which is again an additional cost. Hence, the opportunity costs associated with damages to infrastructure from climate change events are very high. The impacts of climate change events on infrastructure are higher among urban areas compared to rural areas, given that infrastructure is heavily concentrated in urban centers of economic activity.⁶ Urban centers also have high population densities. Here, studies have shown that the urban poor are much more vulnerable to impacts of climate change, than the rich. This situation is aggravated by the high rate of urbanization and income inequalities in urban areas of developing countries,⁷ and can hold back their economic development.⁸

11.2 Climate Resilient Infrastructure in Developing Countries

Urban settlements are expanding rapidly in the developing world, with rising rural-to-urban migration.⁹ Developing countries are more vulnerable to the climate change impacts on infrastructure, in view of the fact

³ Government of UK (2011), "Climate Resilient Infrastructure: Preparing for a Changing Climate," Department of Environment, Food and Rural Affairs, UK.

⁴ Stewart, M., et. al. (2011), "Climate Change Impact and Risk of Concrete Infrastructure Deterioration," *Engineering Structures*, Vol 33, No 4, pp 1326-1337.

⁵ Neumann, J., (2009), "Adaptation to Climate Change: Revisiting Infrastructure Norms," Issue Brief, Resources For the Future, Washington D.C.

⁶ Boshier, L., et. al. (2007), "Built in Resilience to Disasters: A Pre-Emptive Approach," Department of Civil and Building Engineering, Loughborough University, UK.

⁷ OECD, (2008), "Competitive Cities and Climate Change," 2nd Annual Meeting of the OECD Roundtable Strategy for Urban Development, Milan, Italy.

⁸ Hasan A. et. al. (2005), "How to Meet the Millennium Development Goals (MGDs) in Urban Areas," *Environment and Urbanization*, Vol 17, No 1, pp 3-19.

⁹ Tomas, T., et. al. (2009), "Urban Governance for Adaptation: Assessing Climate Change Resilience in Ten Asian Cities," Institute of Development Studies, University of Sussex, U.K.

that urban cities in developing countries are poorly planned, over populated, and have higher concentrations of urban poor. Therefore, without effective, locally driven adaptation, these countries will be called on to bear high costs from potential threats. However, climate resilient infrastructure as an adaptation measure would always have its limits. No matter how resilient the infrastructure is, devastating climate change events can take it down within a matter of hours. How resilient the infrastructure is to such disasters is determined by the capacities of governments to implement and finance sound infrastructure construction in collaboration with international donors and the private sector. In this respect, developing countries are at a disadvantage compared to developed countries. Indeed, reductions in poverty, including improvements in housing and living conditions, and in provision for infrastructure and services, are central to adaptation. Successful, well governed cities greatly reduce climate related risks for low-income populations; unsuccessful, badly governed cities do not, and may greatly increase such risks.

Research has proved that the lives and livelihoods of hundreds of millions of people in developing countries will be affected by what is done and not done in urban centers in regard to climate change over the next 5-10 years. Approximately 6.4 billion people – nearly 50 per cent of the world population – live in urban centers today compared to less than 15 per cent in 1900.¹⁰ Many aspects of urban change in recent decades are extraor-

dinary, including not only the world's level of urbanization and the size of its urban population, but also the number of countries becoming more urbanized, and the size and number of very large cities. This is more evident among the developing countries in the Asian, Latin American and African regions. The populations of dozens of major cities in these regions have grown more than ten-fold in the last 50 years, and many have grown more than twenty-fold.¹¹ Not only the population sizes, but also significant demographic changes – rural to urban migration in search of employment and education – are also apparent in all developing nations over the last 50 years, influencing high urbanization.¹²

While being vulnerable to impacts of climate change, urban areas are also the major contributor to the emission of GHGs. Commercial industries and heavy use of fossil fuel based vehicles have contributed to urban areas becoming more polluted with GHGs.¹³ Urban areas of developing countries have more than one-third of the world's total population, a majority of its urban population and most of the world's large cities. These urban areas contain the bulk of economic activities in these nations and most of the new jobs created over the last few decades. They are also likely to house most of the world's growth in population, in the next 10-20 years. At the same time, they share a high risk from extreme weather events and sea level rise.¹⁴ In most of the urban areas of developing countries, high proportions of urban dwellers still live in settlements surrounded by infrastructure that is not ame-

¹⁰ Graumann, John V. (1977), "Orders of Magnitude of the World's Urban and Rural Population in History," United Nations Population Bulletin 8, United Nations, New York.

¹¹ Satterthwaite D., et. al. (2007), "Adapting to Climate Change in Urban Area: The Possibilities and Constraints in Low- and Middle Income Nations," Human Settlement Discussion Paper Series, International Institute for Environment and Development.

¹² Montgomery, Mark R., et. al. (2003), *Cities Transformed; Demographic Change and its Implications in the Developing World*, The National Academy Press (North America)/ Earthscan (Europe), Washington. D.C.

¹³ Romero Lankao, Patricia (2007), "Are We Missing the Point? Particularities of Urbanization, Sustainability and Carbon Emissions in Latin American Cities," *Environment and Urbanization*, Vol. 19, No. 1, pages 157–175.

¹⁴ United Nations (2006), "World Urbanization Prospects: The 2005 Revision," United Nations Population Division, United Nations, New York.

nable to withstand the impacts of climate change. In most developing country cities, close to 30-50 per cent of the population live in illegal settlements – slums or shanty houses – which are heavily vulnerable to climate change impacts. These illegal settlements tend to be built close to inland water bodies in urban areas, close to the ocean in coastal urban areas, and often close to infrastructure such as storm water drainage canals. These settlements, therefore, are in great danger in extreme climate change events.¹⁵

Most of the developing countries are making successful efforts to secure the lives of the urban dwellers, especially the urban poor. They are increasingly relying on climate resilient infrastructure such as storm water drainage systems, roads, and railways, that can withstand heavy rains and heat; inland water bodies within urban areas to collect rainfall water; buildings that can withstand heavy rain storms and winds; infrastructure to prevent soil erosion and sea level rise; and reliable power and telecommunication distribution channels.¹⁶ However, it is often the case that the urban poor are not seen as critical parts of the city economy, but as holding back the city's success.¹⁷

However, such efforts by developing countries face financial constraints. Developing countries faced with the necessity to fight poverty and inequality among the urban poor, do not always have sufficient funds to construct climate resilient infrastructure. Furthermore, even with financing available, some

developing countries face institutional and technological constraints to adopt climate resilient infrastructure. Therefore, most developing countries are in a dilemma, where the impacts of climate change are fully understood, but actions against it are constrained by budgets, institutional capacities, and other development priorities.¹⁸

11.3 Sri Lankan Context

11.3.1 Why Sri Lanka Needs to Look at Climate Resilient Infrastructure

The urban setting in Sri Lanka is characterized by small urban settlements which are concentrated along the coast. However, there are urban areas emerging within the country side, especially in the hill country. More than one-fourth of the population lives within 1 km of the coastal line. The coastal line represent close to 5 per cent of the country's land area.¹⁹ All urban areas of Sri Lanka are small settlements, with 6 cities that consist of a population of more than 100,000. There are 34 intermediate and medium sized urban settlements, with a population ranging from 20,000-100,000. Further, there are 94 small settlement towns with a population less than 20,000.²⁰

According to the census data of 2001, Sri Lanka has only a 15 per cent rate of urbanization which is relatively low compared to other urban settlements of developing countries. However, it is important to note that the demarcation of urban areas in Sri Lanka is based on the administrative boundaries and

¹⁵ UN-Habitat (2003), "The Challenge of Slums: Global Report on Human Settlements 2003," Earthscan, London.

¹⁶ Satterthwaite D., et. al. (2007), "Adapting to Climate Change in Urban Area: The Possibilities and Constraints in Low and Middle Income Nations," Human Settlement Discussion Paper Series, International Institute for Environment and Development.

¹⁷ Hardoy, Jorge E., et. al. (2001), *Environmental Problems in an Urbanizing World: Finding Solutions for Cities in Africa, Asia and Latin America*, Earthscan, London, U.K.

¹⁸ Huq, S., et. al. (2007) 'Building Climate Change Resilience in Urban Areas and among Urban Populations in Low and Middle Income Nations', draft paper prepared for Rockefeller Foundation.

¹⁹ Samarappulli, Nihal, and L.D. Dickman (2010), "City Cluster Economic Development: Sri Lanka Case Study." Asian Development Bank, Manila.

²⁰ World Bank (2010), "Sri Lanka: Reshaping Economic Geography – Connecting People to Prosperity," World Bank, Washington, D.C.

not on population densities.²¹ Studies suggest that if the population densities are taken into consideration, Sri Lanka would have an urbanization rate that would range from 23-43 per cent. Therefore, Sri Lanka has a relatively high urbanization rate, and it is increasing.²² The Colombo Municipal Region (CMR) records the highest urbanization in the country, characterized by high economic density. The CMR accounts for 35 per cent of the national population increase, with its population rising rapidly to 5.8 million in 2012, from 3.9 million in 1981. The CRM hosts close to 28 per cent of the country's population, but covers only 6 per cent of the land area.²³

While all the urban areas of Sri Lanka are equipped with infrastructure to a varying degree, the CMR tended to benefit the most in view of its economic importance. More recently, however, efforts have been underway to extend infrastructure to all parts of the country, with the development of highways, harbours, and airports, in other parts of the country. Therefore, when looking at the importance of climate resilient infrastructure, the discussion can no longer be confined to the CMR alone, but also to other urban settlements, especially along the coastal belt. However, the CMR is still the most significant, since it is the economic center of Sri Lanka, with the highest concentration of urban poor, slums and shanty houses, and solid waste production.²⁴

With the focus on climate change issues being relatively new in Sri Lanka – a climate change policy being formulated only in 2012 – the infrastructure that was built several decades back did not consider climate change impacts. In recent years, urban cities have been affected by the results of climate change, especially heavy rain storms and floods. These have caused many economic losses, including shutting down transportation, power, and telecommunication facilities, and disrupting economic activities. There have also been the social impacts by way of displaced families and the spread of communicable diseases. Besides losses incurred from disruption to economic activities, other expenses incurred include spending on rehabilitation and repairs, support to the displaced communities, etc.²⁵

As climate change impacts such as heavy rains and floods are set to occur at higher frequencies, urban cities with high population densities need to adapt to climate resilient infrastructure. The latter will allow storm water to be drained into the sea and other water bodies, without causing floods and inundations; coastal areas to be protected from sea level rise; transportation facilities and power and telecommunications to be operated in extreme climate events.²⁶ It is encouraging to see that there are many climate resilient infrastructure initiatives by the GoSL, especially in the CMR. In addition, initiatives in the other coastal urban areas

²¹ Sri Lanka is urbanizing rapidly, with at least 50 per cent of its projected 22 million population expected to be living in urban local authorities by 2020. The estimated urban growth is 3 per cent annually, and the urbanization trends show a rapid transformation of rural areas to urban.

²² Department of National Planning (2010), "Sri Lanka: The Emerging Wonder of Asia: Mahinda Chintana Vision for the Future," Ministry of Finance and Planning, Colombo.

²³ Department of Census and Statistics (2012), "Census of Population and Housing 2011 – Preliminary Report," Department of Census and Statistics, Colombo.

²⁴ Ministry of Environment and Natural Resources (2011), "Sector Vulnerability Profile: Urban Development, Human Settlements and Economic Infrastructure," Ministry of Environment and Natural Resources, Colombo.

²⁵ World Bank (2010), "Sri Lanka: Reshaping Economic Geography – Connecting People to Prosperity," World Bank, Washington, D.C.

²⁶ Rodrigo, C., (2013), "The Need for Climate Resilience in Urban Infrastructure: A Closer Look at Sri Lanka," *Daily News*, 20th February 2013, visited online 5th May 2012.

are also being taken, with the assistance of international organizations such as UNHABITAT and UNDP.

11.4 Climate Resilient Infrastructure Initiatives in Sri Lanka

The GoSL has taken some significant steps to build climate resilient infrastructure. The newly built infrastructure has already taken climate change impacts into consideration, as prescribed by the policy framework on climate change. New road and highway systems, airports, harbours, and even multi-storey building, have taken climate change impacts into their design and planning process. New highways and roads are constructed with proper storm water drainage facilities, and roads are capable of withstanding heavy rainfalls and heat waves at the same time. Airports and harbours are equipped with information regarding climate change events, including weather changes and sea water level rise.

At the same time, there are special projects being carried out by the GoSL to rehabilitate existing infrastructure to withstand climate change events. These are concentrated on rehabilitating water collection and drainage capacities of urban areas, where the CMR is being targeted as the primary location. The Ministry of Defense and Urban Development, with assistance from the World Bank, is undertaking the Metro Colombo Urban Development Project (MCUDP). This project has two main objectives: (1) reduce flooding in the catchment of the Colombo Water Basin, and (2) support local authorities in the Colombo Metropolitan Area to rehabilitate, improve, and manage, local infrastructures

and services to minimize the impacts of adverse climate change impacts.²⁷

The concept of climate resilient infrastructure and cities has now extended beyond the CMR, and there are new initiatives focusing on other urban settlements as well. The "Disaster Resilient City Development Strategies for Sri Lanka Cities" is such an initiative implemented by UNHABITAT, in partnership with the Urban Development Authority (UDA), Ministry of Local Government and Provincial Councils, and the Disaster Management Centre. The main objective of the project is to establish cities that are resilient to climate change impacts and can withstand disaster situations. The project is being implemented in four municipal council/local authorities in Eastern and Sabaragamuwa Provinces.

Another initiative that looks at improving the urban settlement's capability to withstand the impacts of climate change is the "Climate Resilient Action Plans for Coastal Urban Areas of Sri Lanka." This projects aims to bring in a multi stakeholder approach to promote climate resilient infrastructure, involving many parties who are experts on designing and implementing climate resilient infrastructure, such as the Norwegian Institute of Water Research (NIVA). The project aims to design and implement water resource management practices that involves climate resilient infrastructure that can withstand heavy rainfalls. It will also implement a multipurpose green belt, mangrove and coastal bio-diversity restoration programme, a GIS-based Rapid Response System, and Knowledge Management Centre.²⁸

²⁷ There are two main components to the activities involved. Under the first, activities such as improvements to main canals and lakes, secondary canals, improvements and rehabilitation to storm water drainage, road improvements and other social and physical infrastructure will be done. Under the second component, activities such as institutional strengthening for sustainable metropolitan and local infrastructure and service provision, and implementation support will be done with the aim of mainstreaming climate change into the planning and design of infrastructure at the local authority level.

²⁸ Climate Resilient Action Plan for Coastal Urban Areas for Sri Lanka (CCSL), <http://www.climate resilience.lk/> visited on 5th Many 2013.

It is clear that while building climate resilient infrastructure, it is quite important to remove and relocate the urban poor from vulnerable environments. In this context, the Ministry of Construction, Engineering Services, Housing and Common Amenities of Sri Lanka initiated a programme to build 20,000 new houses for low income families in the CMR, that lived in areas vulnerable to climate change impacts. These areas and infrastructure are being rehabilitated under the MCUDP, and affected people are being offered better housing, such as those under the Colombo City Revival Project, where multi-storied housing complexes are being constructed.

11.5 Challenges for Climate Resilient Infrastructure in Sri Lanka

As mentioned before, developing countries face three major constrains in engaging in climate resilient infrastructure: budgets, development priorities, and institutional and technological know-how. Sri Lanka as a developing country shares these same constrains to a varying degree. There are some other challenges as well that need to be addressed.

Sri Lanka finalized its policy on climate change only in 2012. Therefore, sectoral policies are yet to include elements of climate change in them, including the policy approach in infrastructure development. However, without waiting for a comprehensive climate resilient infrastructure policy, strategies and plans of infrastructure have already taken up the recommendations suggested by the climate change policy, which is a positive aspect. Nonetheless, a climate resilient infrastructure policy will help to mainstream climate change aspects into infrastructure in a consistent fashion, helping to identify relevant entities responsible for necessary action.

Public perception is very crucial in implementing action against climate change. People's perceptions of climate change impacts and the importance of climate resilient infrastructure will encourage active participation in actions related to climate change. For example, climate resilient infrastructure building might involve relocating people to some other place temporarily or permanently. In such instances, governments have to acquire lands. This becomes difficult unless people are willing to participate in relocation and land acquisition activities, and that will be driven by the people's perception.²⁹ The public has to look at these in terms of social welfare, and not in terms of private gains and losses. Therefore, raising public interest and awareness on climate resilient infrastructure and ensuring active public participation is a challenge for Sri Lanka.

Efforts of climate resilient infrastructure involve many organizations and they need to act in a coordinated manner. Urban infrastructure involves many government organizations: Road Development Authority, Urban Development Authority, Water Supply and Drainage Board, Central Environment Authority, Ministry of Power and Energy, and Ministry of Construction, Engineering Services, Housing and Common Amenities, etc. Climate resilient infrastructure plans need to be developed in consultations with all these organizations. In that way, the infrastructure will be built in such a way that it attempts to satisfy the criteria of relevant stakeholders, and does not have to be stopped or demolished half way. However, ensuring such a coordinated approach is clearly a challenge for Sri Lanka.

Sri Lanka is in rapid development mode. Infrastructure is being built all over the country. However, climate resilient infrastructure

²⁹ Rodrigo, C., (2013), "Evaluating Public Interest on Climate Resilient Infrastructure," 4th International Conference on Evaluation, Sri Lanka Evaluations Association, Sri Lanka.

demands technology as well as expertise. Finding these technologies and expertise within the country is a challenge. At the same time, these efforts require larger chunks of budgets, higher than conventional infrastructure spending would require. This is mainly due to the technology and expertise that this infrastructure demands. Therefore, without further financial allocations, funding budgets for climate resilient infrastructure will be a challenge for Sri Lanka.

11.6 Way Forward for Sri Lanka

Effective, reliable infrastructure underpins sustainable economic activity. Recent impacts from flooding and severe weather events emphasize the risks that national infrastructure could face, and the significant economic damage such events bring. If today's extreme weather events become both more frequent and extreme, so too will the level of disruption that they cause, unless appropriate adaptation action is taken. To reduce the risks faced from climate change, planned but flexible adaptation responses are required. It is not about eliminating all risks from climate change or extreme weather; it is about making the necessary interventions to the development plans and practices to make sure that what is being built will withstand the adverse effects of any future event.

While Sri Lanka has not yet published a separate policy on climate resilient infrastructure, elements of it are appearing in national discussions and in development initiatives, with respect to urban areas. Most importantly, the government's vision document, the "Mahinda Chinthana - Vision for the Future", has also put a considerable emphasis on the importance of building cities that are sustainable, and are able to withstand the effects of climate change. Therefore, as a starting point, it is quite essential that climate change is

mainstreamed into infrastructure development policy.

Currently, the "National Climate Change Policy of Sri Lanka" has placed emphasis on climate resilient infrastructure and has mentioned that integrated adaptive measures should be taken in designing, developing and maintaining infrastructure in Sri Lanka, regardless of being urban or rural.³⁰ However, these policies have to be incorporated into strategies of government institutions that are responsible for building infrastructure in urban as well as rural areas. Furthermore, these institutions have to act in a coordinated manner, developing the infrastructure plans together. Increasing public awareness on the importance of climate resilient infrastructure, and ensuring their participation in development efforts, is also a must. Infrastructure development can pose temporary disturbances such as relocation, and in such instances the public must put social welfare ahead of private gains and losses.

As mentioned before, the Ministry of Defense and Urban Development has already taken steps to incorporate climate resilient infrastructure into their development strategies and plans. At the same time, the Ministry of Construction, Engineering services, Housing and Common Amenities also has taken several very important steps in mainstreaming climate change and disaster management into their plans and strategies. Government institutions taking the problems in hand and addressing them is a positive development. Organizations such as UNHABITAT and other NGO/INGOs participating actively in building climate resilient infrastructures in urban areas, would add more confidence to the efforts of the government.

³⁰ Ministry of Environment (2012), "The National Climate Change Policy of Sri Lanka," Ministry of Environment, Colombo.