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Urbanization and Climate Change: Transition for and Transformation of Urban Forestry in Sri Lanka

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Background

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Urban-Rural Population of Sri Lanka

Census Year	Population	Urban Population	Urban %
1971	12,689,897	2,848,116	22.4%
1981	14,846,750	3,192,489	21.5%
2001*	18,797,257**	2,467,301*	13.1%*
2012	20,359,439	3,704,470	18.2%

* - Incomplete census ** - Estimate

UN Habitat III Country Report- Sri Lanka

- Rapid urbanization trends in Sri Lanka shows:
  - Rapid transformation of rural areas to urban
  - With 3% of annual urban growth

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Population Changes in Selected Cities (2001-2012)

District	City	Population (2001)	Population (2012)	Change	% Change
Colombo	Colombo	647,100	561,314	-85,486	-13.2%
Matara	Matara	64,361	96,570	+32,109	+49.9%
Hambantota	Hambantota	21,571	31,709	+10,138	+47.0%
Kurunegala	Kurunegala	34,691	30,342 -	4,349 -	12.5%
Anuradhapura	Anuradhapura	53,151	50,595 -	2,556	-4.8%
Kegalle	Kegalle	17,139	15,993	-1,146	-6.7%

UN Habitat III Country Report- Sri Lanka

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Climate Change in Sri Lanka

- Sri Lanka is not responsible for causes of climate change
- Affected by its effects as a victim
- Challenge to adapt or mitigate effects

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The Resilience

- Urbanization with climatic change affect urban life, and pose challenges
- Government attempt to create cities as environment friendly
- Urban forestry is considered in urban planning:
  - As resilience of ecosystems degradation and climate change impacts
- Urban forestry promote capacity of ecosystems to provide environmental services

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Risk of Urbanization and Impact of Climate Change

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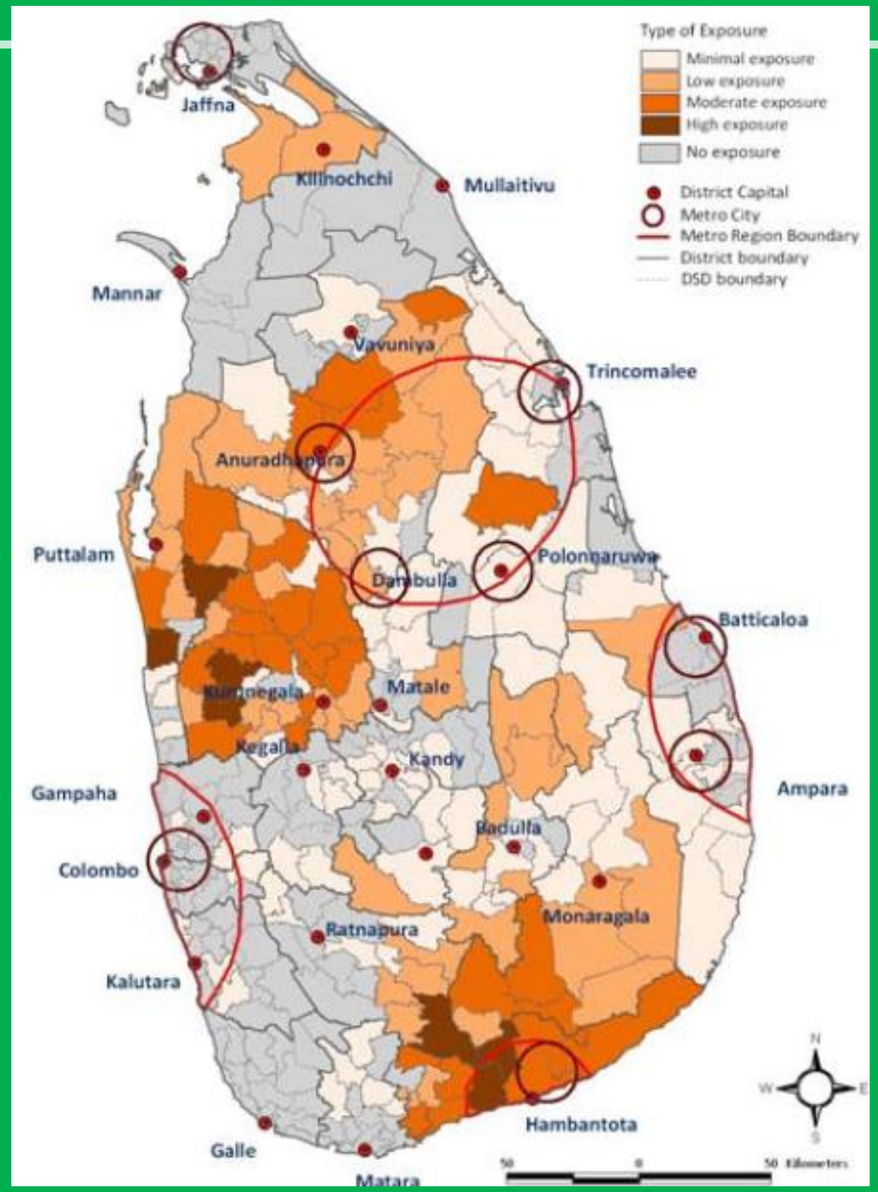
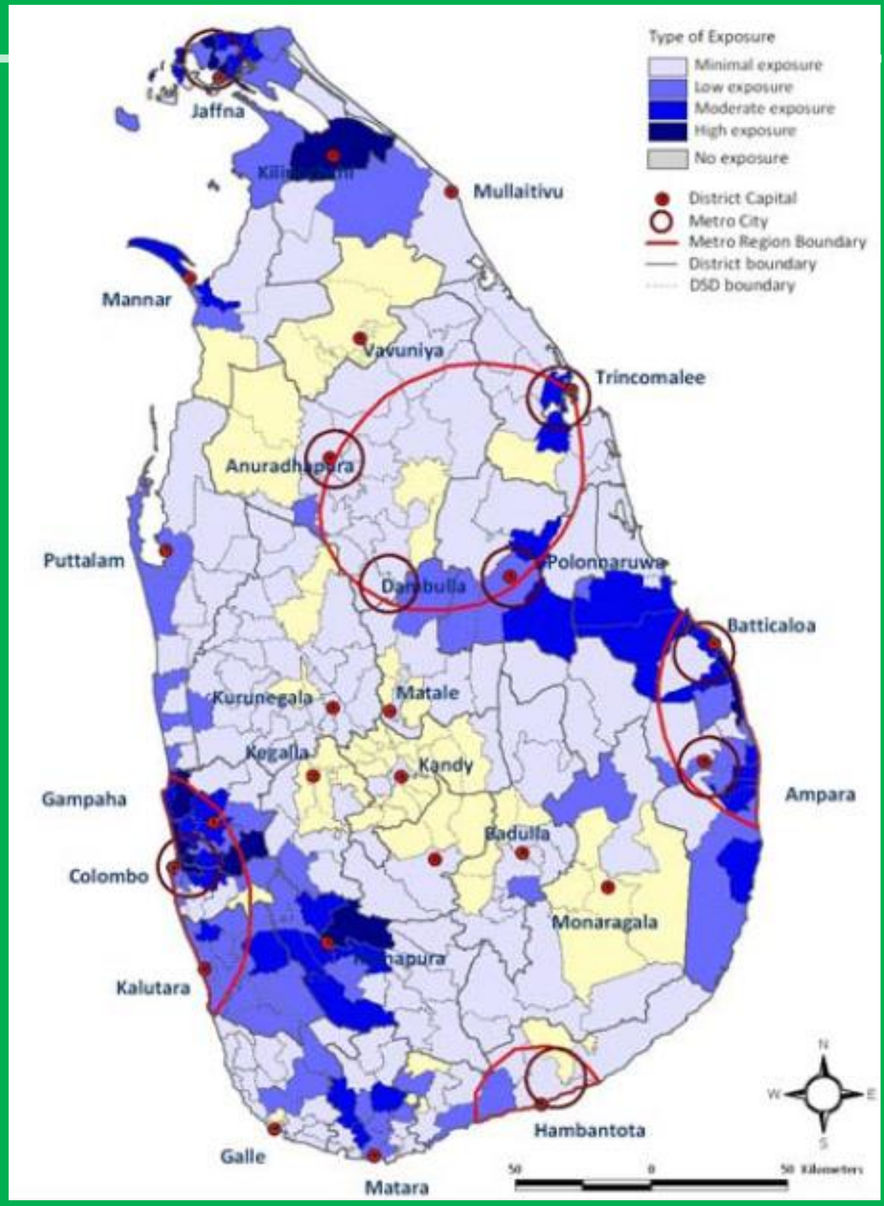
Climate Change Vulnerability



Cities With Drought Exposure

Cities With Flood Exposure

www.climatechange.lk



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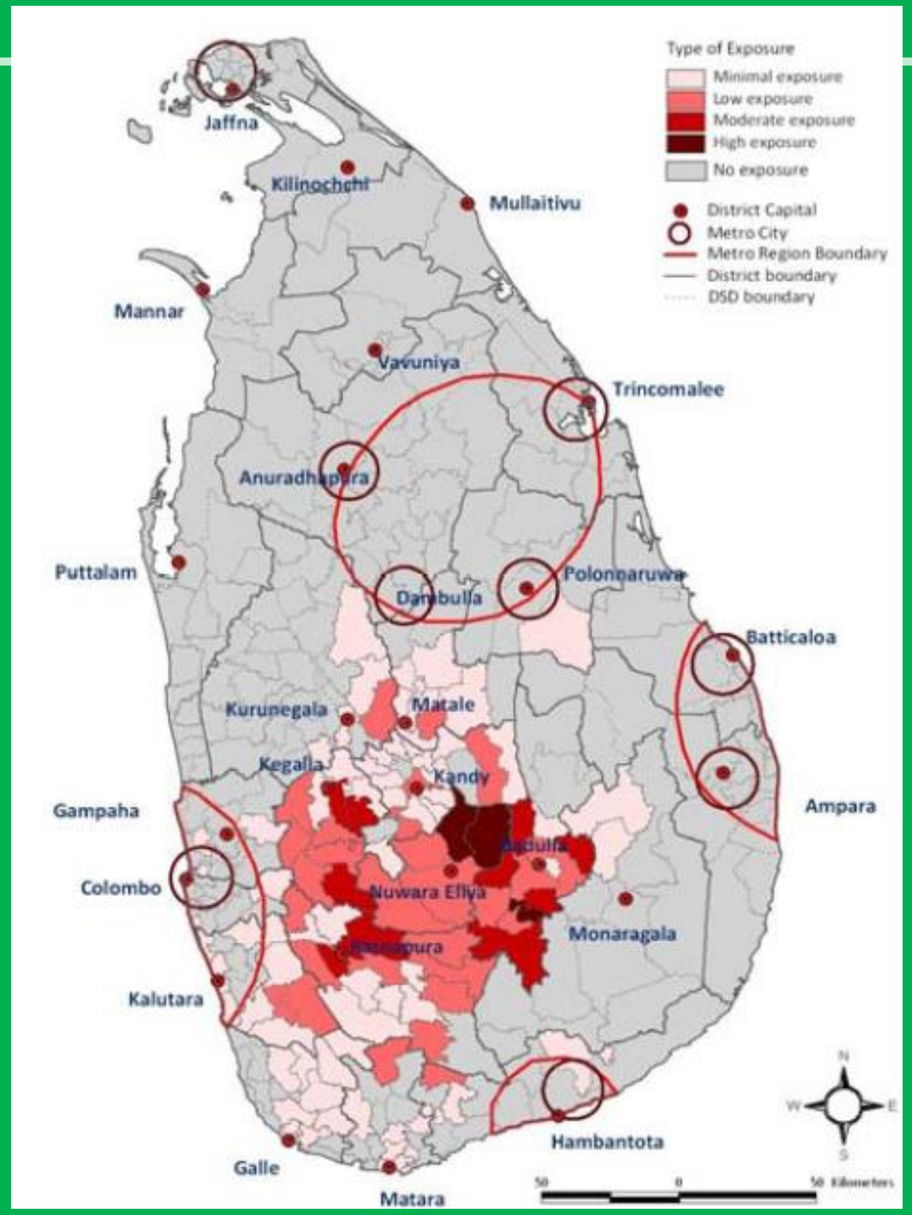
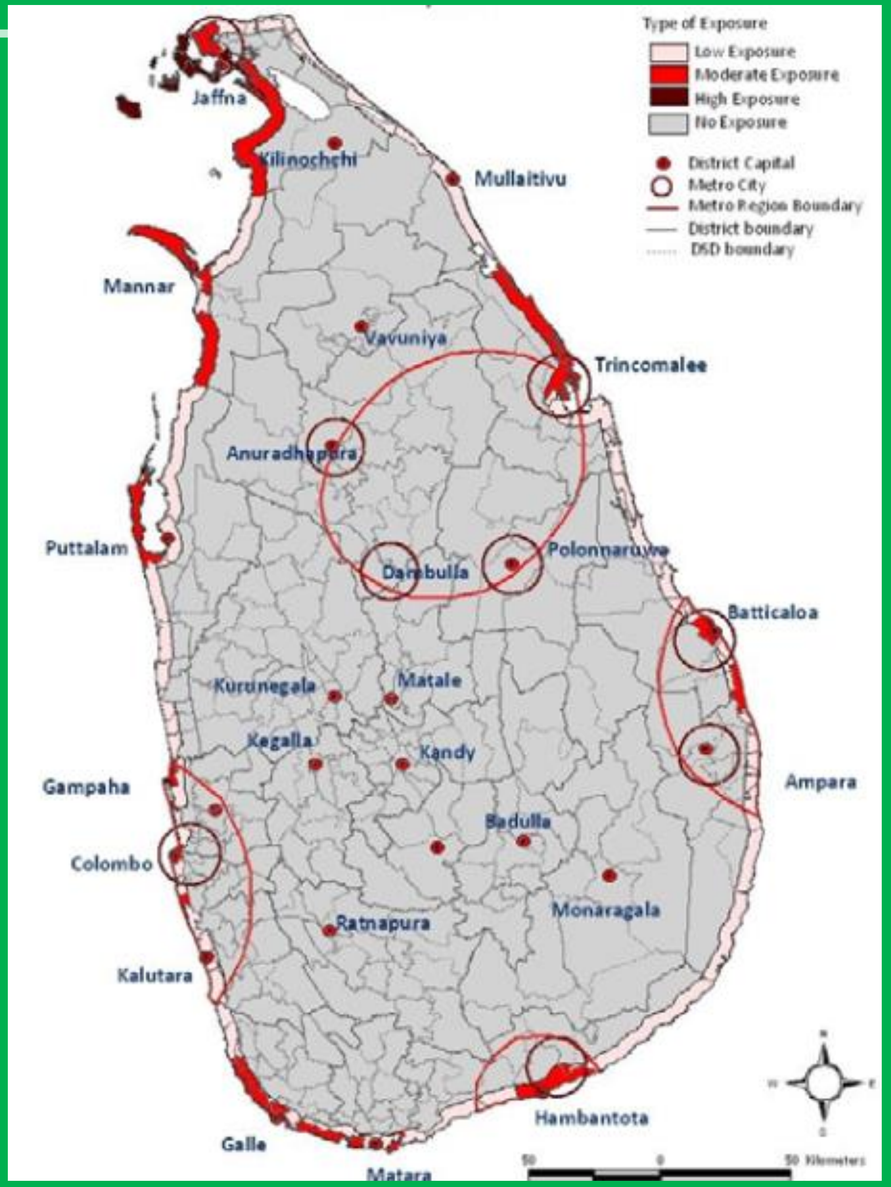


Cities With Landslide Exposure

Cities With Sea Level Rise Exposure

www.climatechange.lk



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Changing Land Use Practices

Land use change of Colombo City in 1990 and 2015

Land use	Area km^2		Percentage%		Land use changes km^2
	1990	2015	1990	2015	
Buildup	142.87	172.23	67	81	29.36
Boggy	8.99	3.88	4	2	-5.11
Water	5.41	3.67	3	2	-1.74
Paddy	29.89	21.43	14	10	-8.46
Other Cultivation	23.87	12.12	11	5	-11.75
Sand Land Use	1.51	0	1	0	-1.51

Source: https://www.researchgate.net/publication/327513239

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Initiative of Urban Development Authority

Historic City of Galle - Apartment Configurations

Wetlands Surrounding of Colombo High-rise Apartments

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Altering Livelihoods Strategies

- Urbanization and climate change altering traditional livelihoods strategies displacing agriculture

Change Percentage of Population under Poverty Line

Sector	1995/96	2002	2006	2009
Urban	14.0	7.9	6.7	5.3
Rural	30.9	24.7	15.7	9.4

Source: Shun, et.al . (2011)

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Increasing CO_2 Emission

- Sri Lanka is among the few countries:
  - Carbon emissions below maximum sustainable levels
- Effects of climate change felt in a big way as this is an island

Annual Carbon dioxide emission in Business District of Colombo city (Pettah GN division) (96.83 ha.)

Sources of emission	CO2 Emission (t CO2)
Kerosene	3.38
LPG	11.17
Fire wood	41.85
Commuting population	2557.96
Vehicle emission	47737.69
Total emission	50352.05

Source: After Sugathapala and Jayathilake (2012)

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Urban Heat Island Effect

- High building densities and high degree of surface sealing:
  - Cities exhibit higher temperatures
- Urbanization worsening climate change producing heat island effects
- Air pollution worse effects of high temperatures:
  - Stressing body's respiratory and circulatory systems

Kandy

Source: www.worldbank.org/lk

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Increasing Natural Disasters

- 70% of population and 80% economic infrastructure:
  - In cities located in coastal and hilly areas
- Coastal cities highly vulnerable to:
  - Sea level rise and storm surges, flooding, droughts and extreme climatic events
- Mountainous cities threatened by water scarcity and degradation of catchments
- Tsunami of 2004 claimed nearly 35,000 human lives

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Urbanization, Climate Change and Transition For Urban Forestry

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CO_2 Emission and Emission Reduction by Urban Forestry in Colombo City (Pettah GN Division) (96.83 ha.)

Total Annual CO2 emission

Sources of emission	CO2 Emission (t CO2)
Kerosene	3.38
LPG	11.17
Fire wood	41.85
Commuting population	2557.96
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Total emission	50352.05

Number of trees required to absorb emitted CO2

A	B	C	D	E	F
Name of the tree Species	Tree Age	Number of Trees	Area of trees	Annual Sequestration rate	Carbon Sequestered
			(ha)	(Kg/Yr)	(Kg) (C x F)
Mahogany	20	685995	343	20	13719905
Robarosia	20	685995	343	20	13719905
Kottamba	20	685995	343	20	13719905
Acacia	20	1371990	457	10	13719905
Teak	20	914660	392	15	13719905
Mara	20	914660	392	15	13719905
Total amount of Carbon Sequestered (t)					13719.09
Total amount of CO2 Sequestered (t) x 3.67					50352.05

Source: Sugathapala and Jayathilake (2012)

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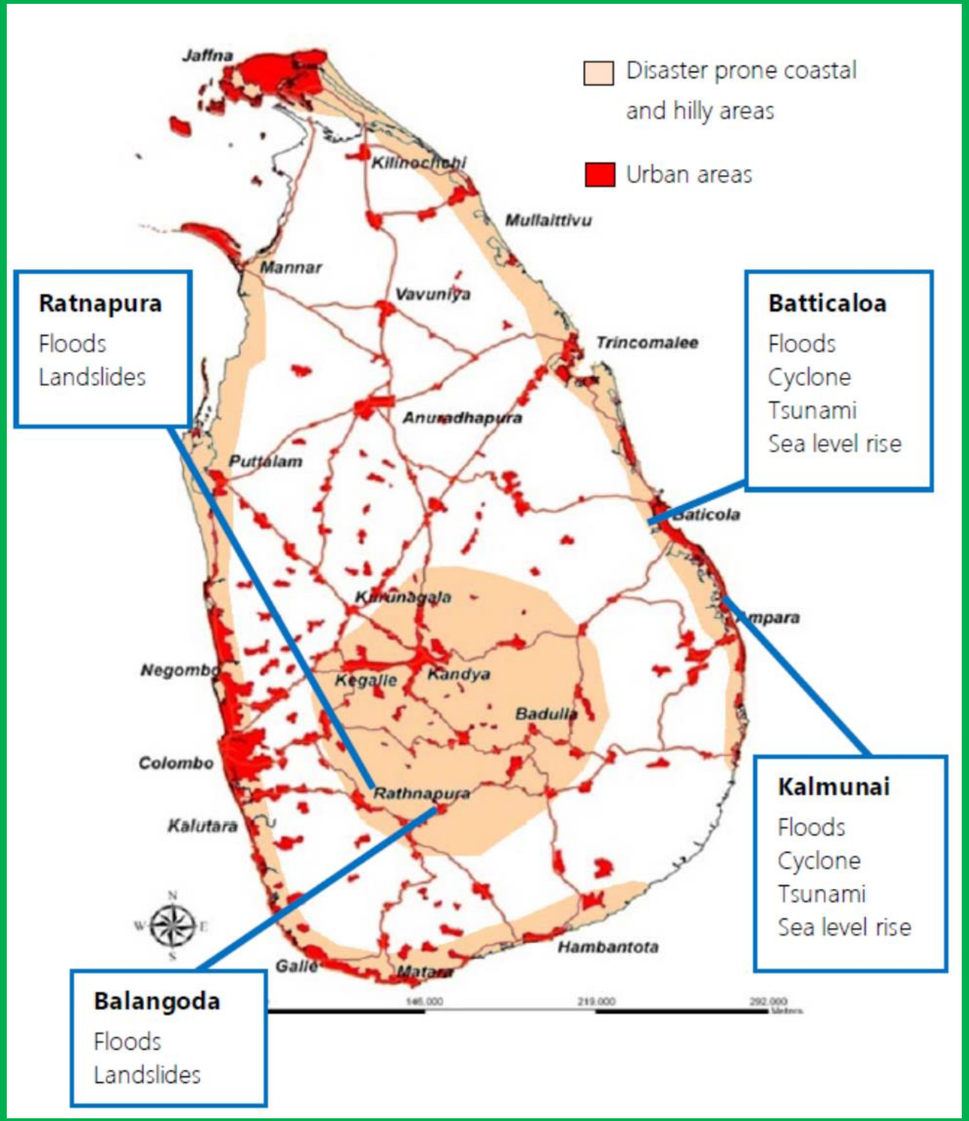
Disaster Resilient City Development Strategies for Sri Lankan Cities

- Implemented by: United Nations Human Settlements Program (UN-Habitat)
- Locations: Batticaloa, Ratnapura, Kalmunai and Balangoda Council Areas



Source: http://www.unhabitat.lk

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Climate Resilient Action Plans for Coastal Urban Areas

- Multi-purpose green belt (12 km in length):
  - Protect lagoon and coastal areas
  - Restore mangrove eco-systems & coastal bio-diversity
- Multi-purpose green belt is a defense mechanism:
  - To reduce exposure to climate exacerbated disasters:
    - Storm surges, strong winds, sea level rise and coastal floods

Multipurpose Green belt:
Batticaloa Municipal Council

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Implementation of Intended Nationally Determined Contributions (INDCs): 2017 - 2019

Urban forestry:

1. Identify sites for planting along roadside, car parks, housing schemes temple lands, schools and other govt. lands
2. Prioritize areas for tree planting
3. Develop greening plans with selected local authorities and other relevant stakeholders
4. Identify tree species suitable for roadside, temple lands, schools and other government lands
5. Prepare detailed project implementation plan to implement the INDCs

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Transformation of Urban Forestry to Adapt Urbanization and Climate Change

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Develop Urban Land Use Management

- Climate is a main controllers of plant distribution
- Urban forest responses to climate change and land use management
- Urban trees dominate natural feature in cities
- Urban forests have a diverse structure

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Promote Sustain Ecosystem Services

- Urban forests sustain ecosystem services
- Reduces impacts of higher rainfall:
  - Reduce storm water runoff, store excess water, infiltrate in green open spaces
- Improve ecosystem services on urban life quality:
  - Noise reduction, urban cooling, air purification, recreation, and
  - Contributions to mental and physical health

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Micro-Climate Moderation

- Urban forest improve air quality
- Reduces heat island effect providing shade and capturing CO_2 and dust
- Urban green lead to cooling effects
  - Reduce absorption of solar radiation
  - Increase evapotranspiration
  - Lower temperatures through evaporative cooling

Diyasuru Uyana urban wetland park in Sri Jayawardenapura

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Reduce GHG Emissions

- Reduce GHG emissions from landfills uptake wastes for recycling
- Reuses urban wastewater and reduce emissions from wastewater treatment
- Urban home-gardens improves nutrient cycling:
  - Maintaining soil biota
  - Recycling waste and wastewater

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Biodiversity, Conservation and Connectivity of Gardens

- Flora and fauna in gardens, spaces and buildings
- Connectivity of garden, corridors and watersheds in urban landscapes
- Increase connectivity of forest and wild margins

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Feed Urban People

- Enhance nutritious food and diversifying food sources
- Reduce food miles by producing fresh food close to urban markets

City Farmer

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Provide Aesthetic Green Spaces and Leisure

- Urban trees connected to human activities and infrastructure
- Coupling natural processes and human processes influence development

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Conclusions and Policy Implications

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- Risks with urbanization and impact of climate change in Sri Lanka are complex, dynamic and dependent on a wide and diverse set of factors
- Urbanization and climate change have alter livelihoods strategies and land use practices preserving ecosystems
- Urban forestry strategies incorporates urbanization, land use management and addresses mitigation and adaptation climate change
- Urbanization and urban ecosystems and impacts of climate change have to be integrated into planning of urban forests

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Thank You