Enhancing Urban Resilience through Energy Efficient Measures in the Residential Buildings of Dhaka, Bangladesh

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Presentation outline

-Concept of Resilience
-Urban resilience & Disaster Resilience indicators
-Risk Reduction Approaches for Urban Areas
-Urban Issues & Challenges of Dhaka MegaCity
-Climate Risks in Dhaka
-Climate Risk Reduction Approach for Dhaka MegaCity
(Harnessing renewable energy resources, enhancing energy efficient measures in the residential buildings etc., greening/plantation etc.),
-Conclusions and recommendations

Preamble

Concept of Resilience

-The term ‘resilience’ was primarily used to refer to “the capacity of the ecosystems to get back to the original state after any disturbance takes place” (Surjan et al. 2011).

-“The ability of a system, community or society exposed to hazards to resist, absorb, accommodate to and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions” (UNISDR 2009).

Preamble contd…

Urban Resilience

-“The ability to prepare and plan for, absorb, recover from, or more successfully adapt to actual or potential adverse events” (USNRC, 2012).

-Urban resilience therefore is defined as the “capability to prepare for, respond to, and recover from significant multi-hazard threats with minimum damage to public safety and health, the economy, and security” of a given urban area.

Urban Resilience contd…

-Contemporary academic discussion of urban resilience focuses on three distinct threats; climate change, natural disasters and terrorism (Coaffee, 2008).

-The concept of resilience is increasingly used to describe how cities and regions are being embedded with security and risk management features into the built environment (Coaffee and Bosher, 2008).

Risk Reduction in Urban Areas

-With increasing urbanization, urban areas are becoming more complex. Any action towards urban risk reduction of vulnerabilities thus enhances resilience (Surjan et al. 2011).

-In addition to various hazard risks in urban areas (water logging, earthquake, subsidence etc.), climate change induced risks are gradually becoming acute.

Climate Risk Reduction in Urban Areas

-Urban areas are becoming a major contributor in carbon-di-oxide emission and are also vulnerable to climate risks.

-The possible redesign of residential and commercial buildings might cut 29% of projected greenhouse gas emission by 2020 (IPCC, 2007 cited in Coaffee, 2008)

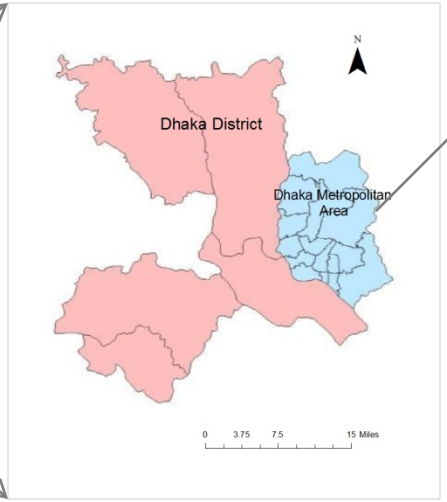
Urban Issues & Challenges of Dhaka MegaCity

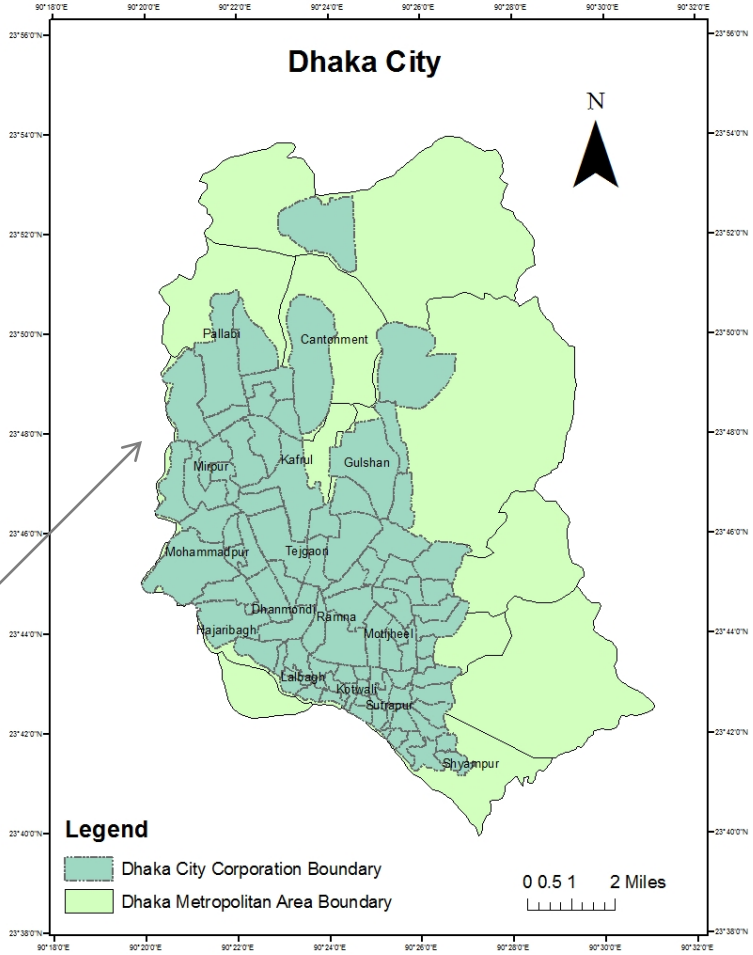
-Dhaka (1500 sq. km.), the capital city of Bangladesh since 1971 celebrated its 400 years in 2010.

-With a population of nearly 18 m (until 2014), it has become country’s only prime city.

-it has experienced exceptional growth in the last few decades mainly due to rural-urban influx (Islam, 2014).

Urban Issues & Challenges of Dhaka MegaCity



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Urban Issues & Challenges of Dhaka contd…

-Recently, rural-urban migration is thought to be accelerated due to climate change impacts.

-Around 1 m people being displaced specifically due to coastal erosion, riverbank erosion, lack of safe drinking water, salinity intrusion etc. move to big cities (particularly Dhaka).

Urban Issues & Challenges of Dhaka contd…

-The city currently faces tremendous problems due to different issues (e.g. energy/power supply, drainage, waste management, water and sanitation, traffic congestion, pollution etc.).

-High level of air & noise pollution through around 1.5 m vehicles (mostly aged) run by petroleum & CNG.

-City peripheral areas accommodate around 1000 brick-kilns making significant emission of country's annual carbon-di-oxide.

Climate Risks in Dhaka Megacity

-Rapid vertical and horizontal growth of Dhaka has recently led to the creation of UHIs.

-Due to UHI condition and urban microclimatic variations in Dhaka, cardiovascular diseases are increasing among the age groups from 50 to 80 years (Burkart et al. 2011).

-Significant seasonal and diurnal temperature variations exists in different parts of Dhaka (Rabbi et al. 2014).

-Climate change impacts are considered to have high implications (e.g. gradual rise of Dhaka's population, increasing slum dwellers etc.).

Climate Risk Reduction Approach for Dhaka

-Climate risk reduction strategies in Dhaka may include enhancement of green-cover, roof-top application of Solar PVs, replacement of traditional electrical appliances etc., enhancing HHs' awareness

-Dhaka's residential buildings are highly energy inefficient using traditional electrical appliances.

Climate Risk Reduction Approach for Dhaka contd..

Harnessing Renewable Energy Resources

-Dhaka offers high potential for photovoltaic applications

-Geographical location of Dhaka offers very satisfactory GHI & annual sunshine hours in Dhaka is around 2,800.

-Average GHI in Dhaka 4.20 kWh/m2/day (1,533 kWh/m2/year)

Climate Risk Reduction Approach for Dhaka contd..

Harnessing Renewable Energy Resources

-More than 50% of Dhaka MegaCity are built-up

(the rest is water bodies, vegetation cover, open land)

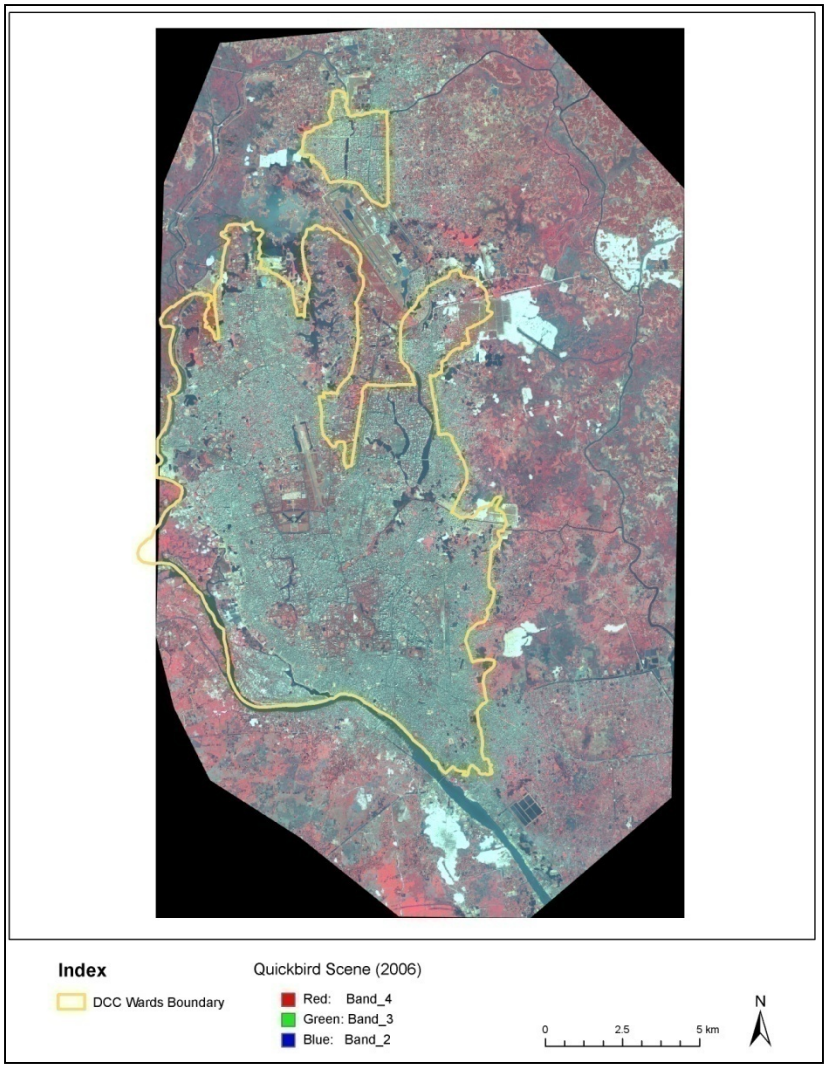
-PV plant (ground mounted) is not feasible in the urban areas

-Dhaka Megacity has >200,000 buildings with unused flat roof-tops

-SPV application is feasible on bright roof surfaces.

Buildings Roofs in the Study Areas

Harnessing Renewable Energy Resources



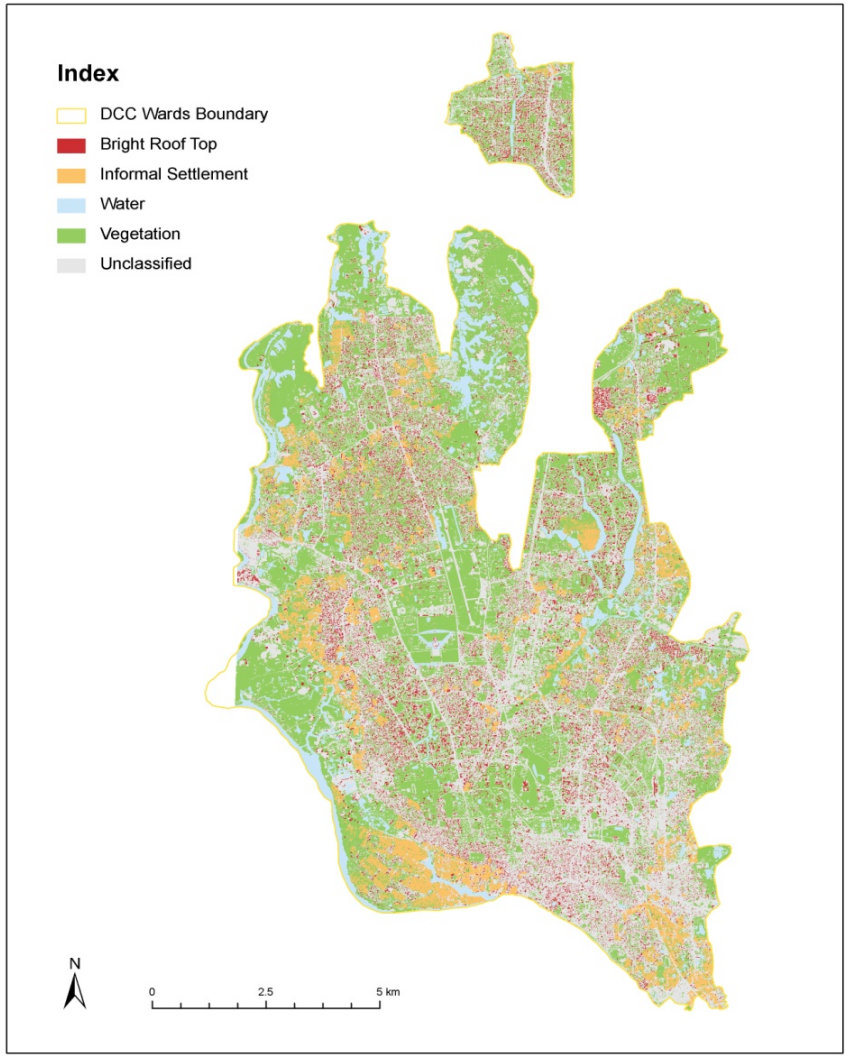
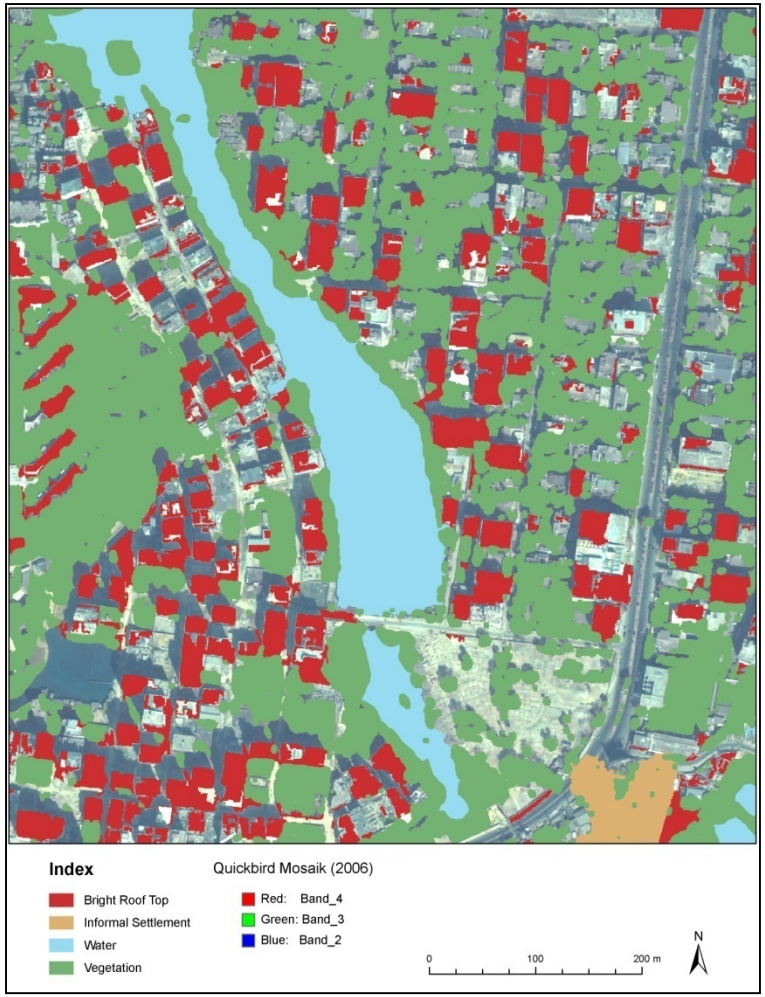


Figure: DCC Ward Area for Bright Roof-Tops Identification

Harnessing Renewable Energy Resources



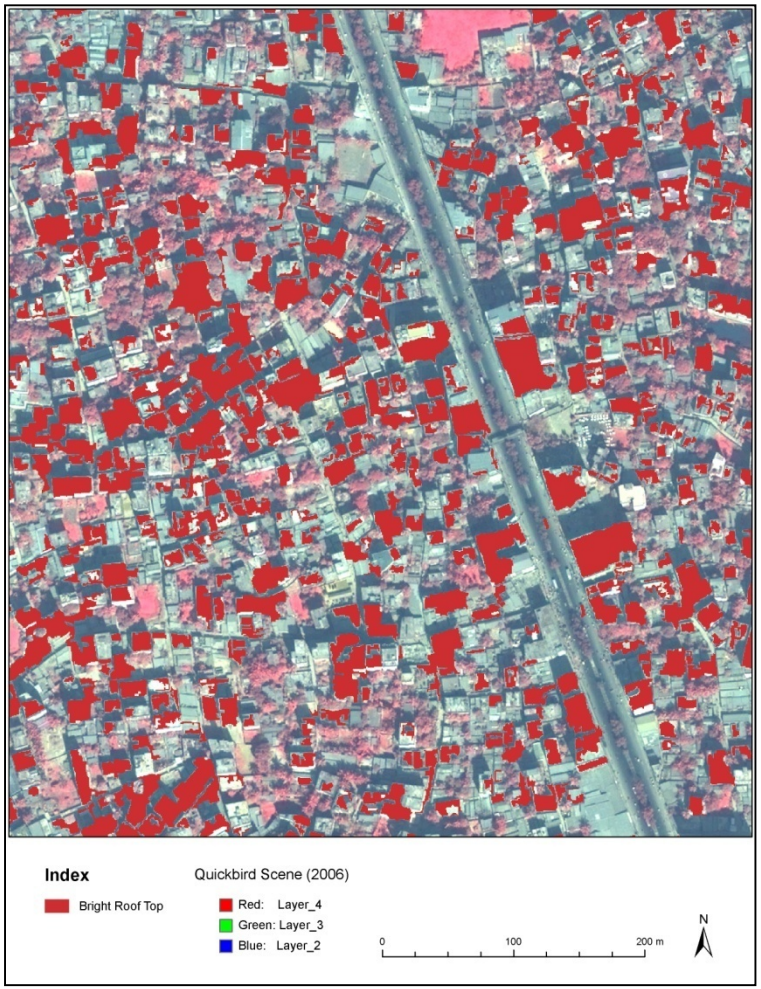


Figure: Subsets Showing well-illuminated Roof-Tops

Climate Risk Reduction Approach for Dhaka contd..

Harnessing Renewable Energy Resources

Table 1: Calculation of Bright Roof Area from the Quick-bird Scene of Dhaka 2006

Objects classified	**Area (sq. km.)**	**Percent (%)**
Bright roof tops	10.554	7.86
Informal settlements	9.646	7.18
Vegetation	53.364	39.74
Water bodies	9.583	7.14
Others (roads, open lands, shadow etc.)	51.135	28.98
Total	**134.282**	**100.00**

Kabir et al. 2010

Climate Risk Reduction Approach for Dhaka contd..

Harnessing Renewable Energy Resources

Electricity Generation from Solar PV Systems

-Available roof-area calculated is 10.554 sq. km. within DCCWA
-Application of 75 Wp PV module with 10% efficiency can generate nearly 1,000 MW electricity

-Electricity generation can be much higher (1,500 MW) with modules of high capacity (e.g., 210 Wp) and efficiency

Climate Risk Reduction Approach for Dhaka contd..

Harnessing Renewable Energy Resources

-Within DCC ward area nearly 10 sq. km. informal settlements (*bastees*)

-5 MW electricity can be generated with stand-alone PVs

-Kabir and Jahan (2011) reported that over 75% of the total HHs of Dhaka City showed their willingness to pay for Solar PV systems.

Climate Risk Reduction Approach for Dhaka contd..

Energy Efficient Measures in RBs

-Dhaka's residential buildings are highly energy inefficient using traditional electrical appliances.

-Promoting energy saving appliances, enhancing HHs' awareness could save substantial electrical power in Dhaka.

-Recent study by Jerin (2015) identified low level of energy efficiency measures in densely population residential areas in Dhaka

Climate Risk Reduction Approach for Dhaka contd..

Energy Efficient Measures in RBs

-Relatively high class residential areas need more electricity and during power outages, diesel fired generators are used for uninterrupted power supply

-Therefore the HCRBs are high power consuming units and emitters of maximum amount of GHGs

-Around 300 MW of electricity will be saved if IPSs are banned.

Energy Efficient Measures in RBs

-Jerin (2015) indentifies that all buildings of DCC can save 55% on an average of their power consumption.

-High class buildings can save 45% to 56%, medium class up to 60% and low class up to 58% of their power consumption by replacing their traditional lightings, fans and the most common other appliances.

GHG Emission Reduction Potential in Dhaka

-Electricity generation from renewable energy (SPV) in Dhaka's roof-tops can reduce around 500 tons of carbon-di-oxide emission every year.

-Another 500 tons of carbon-di-oxide emission can be reduced through replacement of traditional electrical appliances with energy-efficient measures.

-Replacement of IPSs from residential buildings can save around 200 tons of carbon-di-oxide emission.

Questions related to Urban Resilience in Dhaka

-How to measure climate risks in Dhaka (e.g. measuring increasing urban heat island effects, increasing water logging incidence etc.)

-What criteria would be considered to make energy and power supply sustainable and resilient for Dhaka Megacity?

-How can the resilience of buildings in Dhaka be measured? structure, types, facilities and utilities provided?)

THANK YOU