Source - Mumbai Live,







DHARA

A blue-green landscape framework towards hydrological, ecological and communal re-instation of the Mumbai estuarine urbanscape

AYESHA MAHIIRA HUSSAIN Presentation 05 | 21st June 2022

Mentors - Steffen Nijhuis and Daniele Cannatella External Examiner - Stefano Milani

Delft University of Technology

DHARA

'A steady, continuous flowing movement"

Directing flows in Mumbai through Landscape





STRUCTURE OF THE PRESENTATION







FASCINATION Very Little Action



HI Flemium	Trending	Games Quiz	Bollywood	Photos
Home / Cities / Mum	bai News / Mumbai's C	limate Adaptation Pla	n: Designing the city	for water
MUMBAI NEWS				
Mumbal's Cli water	mate Adaptati	on Plan: Desi	gning the cit	y for
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FASCINATION

Life goes on

Source - Indranil Mukheerjeee /AFP via Getty Images



MUMBAI CITY

City on the western coast of India bound by the Arabian Sea. Surrounded by water, practically an island. Total Area - 603 km² and population 20.6 million Population density 25000 people per km²





LANDSCAPE AND URBANSCAPE



Natural Landscape

Source: Left: Flickr - Mr.OppenHeimerR Right: Flickr - Climate Group



Cultural Landscape

PROBLEM FIELD

URBANIZATION Modifying the natural system.

LOSS OF BLUE GREEN ELEMENTS Flooding, Ecology, Quality of Life





Current Landscape - Dense, highly urbanized city

CLIMATE CHANGE Sea level rise, Increased flash floods

WHAT IS AFFECTED?



Water System, Ecology and Communities

Source Left - FLYING OVER MUMBAI (DHARAVI) 4K Aerial Film. (2019, July 27). YouTube. https://www.youtube.com/ watch?v=uFEq-CB0Ev8&ab_channel=DannyMcgee Right - Flickr - Climate Group

Identify and explore the potentials of

BLUE GREEN LANDSCAPE STRUCTURES

that will provide conditions for

HYDRO-MORPHOLOGICAL RECOVERY ECOLOGICAL RESTORATION and COMMUNAL REQUALIFICATION

for the

URBANIZED ESTUARINE LANDSCAPE OF THE GREATER MUMBAI REGION,

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REDUCE FLOOD RISK,

RESTORE A HEALTHY ECOSYSTEM

and

IMPROVE THE LIVING CONDITIONS OF MARGINALIZED COMMUNITIES,

contributing to the **RESILIENCY**, **LIVEABILITY AND IDENTITY** of the city.

RESEARCH QUESTIONS

UNDERSTANDING

How does the Mumbai landscape system function, how did it change over time and what are the challenges related to its transformation?

FRAMEWORK AND PRINCIPLES

How can blue-green structures become a framework to help to mitigate these challenges and what design principles can create conditions to restore natural systems and guide future urban development?

APPLICATION

What are the spatial possibilities of the framework at the local scale to create the needed conditions for flood resiliency, restored ecology and communal safety?

RELEVANCE

What are the lessons learned from applying the blue green landscape framework at the local scale that can be used for other parts of Mumbai as well as in similar coastal urban environments with similar challenges?

O2 APPROACH

LANDSCAPE APPROACH
NATURAL LANDSCAPE
BLUE
GREEN

URBAN LANDSCAPE



LANDSCAPE APPROACH

ONE SYSTEM



LANDSCAPE AS INFRASTRUCTURE AND INFRASTRUCTURE AS LANDSCAPE

BLUE GREEN LANDSCAPE FRAMEWORK

that is CULTURE and CONTEXT specific for MUMBAI

03

UNDERSTANDING THE MUMBAI LANDSCAPE

Source: Flickr - Climate Group



UNDERSTANDING

How does the Mumbai landscape system function, how did it change over time and what are the challenges related to its transformation?





THE AMALGAMATION OF ELEMENTS IN MUMBAI

A natural estuarine system layered with local communities, historic and contemporary urban elements and mobility infrastructure.



Fishing Communities

STRUCTURE OF THE CITY

Natural Landscape remnants in the urbanized city





TIDAL WATER

TERRESTRIAL WATER

Urban structures

Reservoirs Informal Settlements Urban Sprawl Scattered Urban Green Natural Landscape Drains Low Slopes

Protected forest

Mangroves and Mudflats



SUBURBAN AREA



NATURAL LANDSCAPE

Estuarine System - open water, highlands, wetlands, mangroves, mudflats, sea





Natural Landscape

Rivers

Highlands

Plains

Mangroves and Mudflats



RECLAMATION PROJECTS



Source: Soak. (2009). Mathur / Da Cunha. https://www.mathurdacunha.com/soak (edited by author)

TRANSFORMATION OF THE CITY



Mumbai 1700 Areas above 10m



Mumbai 2021 Urban distribution

THREAT

Assumed 2050 submergence due to rising sea levels, tidal dynamics, improper drainage and overall water management.





Mumbai 1700 Areas above 10m

Mumbai 2021 Urban distribution



Mumbai 2050 Projected submergence - 10m - without immediate action

MITHI WATERSHED Loss of the Estuarine Landscape



Source: Soak. (2009). Mathur / Da Cunha. https://www.mathurdacunha.com/soak (edited by author)

CHALLENGES OF THE TRANSFORMATION

Low lying region, waterlogged





BLUE Highest flood impact zone

> GREEN Mangroves receded

GREY bound by infrastructural elements and greatest concentration of informal settlements

WHY? Because it is low lying but is also an area to connect Historic Mumbai with the rest of the city





CHARACTERISTICS OF THE MAHIM-MITHI ESTUARINE ZONE

Blue Green and Grey interaction. Mithi River, Infrastructural Crossings, Urban Development and Mangroves



Hydromorphology compromised - Sea Walls resulting in rise of ground water level with salt water intrusion



From natural coastal defense to constructed defense



CHARACTERISTICS OF THE MAHIM-MITHI ESTUARINE ZONE

Blue Green and Grey interaction. Mithi River, Infrastructural Crossings, Urban Development and Mangroves



Ecology compromised - Unhealthy mangrove landscape with infrastructure acting as a barriers



From gradients to hard edges



CHARACTERISTICS OF THE MAHIM-MITHI ESTUARINE ZONE

Blue Green and Grey interaction. Mithi River, Mangroves, Infrastructural Crossings and Informal Settlements



CHALLENGES AND POTENTIALS



DESIGN ASSIGNMENT



Blue

Hydro morphological

Recovery



Ecological Restoration

Green



Challenges

Systems



Infrastructure Lines



Restoring Flows



Mangroves

Coastal Protection

Design



Grey



Communal Requalification



Informal Settlements



Community Safety


FRAMEWORK AND PRINCIPLES

How can blue-green structures become a framework to help to mitigate these challenges and what design principles can create conditions to restore natural systems and guide future urban development?





Built environment

Connecting voids Ecological Corridors Cultural Revival

DESIGN PRINCIPLES

COASTAL PROTECTION

INCREASED DISCHARGE

SPONGE CAPACITY



Mangroves

Protection and restoration of the mangrove system to enable flood safety, shrimp production and river mouth ecology.



Widening Edges Making room for the river to increase capacity. Adjusting edges where possible





New Connections

Allowing controlled inlet and outlet of water for increased discharge as well as to improve mangrove health by creating tidal dynamics.



Gradients

Where possible naturalizing the river banks to allow natural dynamics of the river and flood protection. This will also allow for new riparian ecology.





Filtration and retention

Connecting rivers to wetlands and restoring movement of water to ensure filtration through halophyte planting.



Extensions

Where possible recreating natural systems where water used to flow. Extending streams that have been reduced or erased.



ECOLOGICAL CONTINUITY

Permeable Surfaces

Water flows and retention systems. Rearranging settlement to allow for absorption zones.



Highway Avenues

Using the areas under highways as drainage routes. Linking urban green pockets

Water Storage

Urban areas where there is open space to be reorganized with green pockets and water ponds allowing groundwater recharge through rain gardens, detention ponds and water squares.



Connections

Creating a network of slow mobility that impacts both ecology and public space

Climate Adaptive Building

Building systems with a network of green roofs, rain water harvesting, green facades, shaded streets, drainage channels and impervious pavements.



Ecological Corridors

Using train line as nature only zones allowing ecology to develop. Can be used as water management areas and slow moving traffic zones.

EXTRACTION OF PRINCIPLES



Sanya Mangrove Park - Turenscape



Rain City Strategy - Clty of Vancouver





NEW CONNECTIONS Facilitating tidal dynamics

PERMEABILITY Rain gardens, soft surfaces

THE BLUE GREEN FRAMEWORK THROUGH SCALES

Regional Scale - City of Mumbai





THE BLUE GREEN FRAMEWORK THROUGH SCALES

Scale of the system boundary - Mithi Watershed





ELEMENTS OF THE FRAMEWORK - OPEN WATER



0

2

Widening Edges

Making room for the river to increase capacity. Adjusting edges where possible



Tidal Dynamics

Allowing controlled inlet and outlet of water for increased discharge as well as to improve mangrove health by creating tidal dynamics.



3

Extensions

Where possible recreating natural systems where water used to flow. Extending streams that have been reduced or erased.



ELEMENTS OF THE FRAMEWORK - COASTAL ECOLOGY



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Protection and restoration of the mangrove system to enable flood safety, shrimp production and river mouth ecology.



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Connecting rivers to wetlands and restoring movement of water to ensure filtration through halophyte planting.



GREEN SYSTEM - PUBLIC SPACE



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Permeable Surfaces

Water flows and retention systems. Rearranging settlement to allow for absorption zones.



Water Storage

2

Urban areas where there is open space to be reorganized with green pockets and water ponds allowing groundwater recharge through rain gardens, detention ponds and water squares.



3

Public Space

Creating a system of absorption by greening streets and park areas. Using permeable pavings.



GREY SYSTEM - INFRASTRUCTURE



1

Ecological Corridors

Using train line as nature only zones allowing ecology to develop. Can be used as water management areas and slow moving traffic zones.



2

Avenues

Using the areas under highways as drainage routes. Linking urban green pockets



3

Climate Adaptive Building

Building systems with a network of green roofs, rain water harvesting, green facades, shaded streets, drainage channels and impervious pavements.



THE BLUE GREEN FRAMEWORK

Scale of the estuarine zone - Mahim-Mithi Estuary





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APPLICATION

What are the spatial possibilities of the framework at the local scale to create the needed conditions for flood resiliency, restored ecology and communal safety?



Landscape as Infrastructure Informal Settlements Mangroves

Infrastructure as Landscape Informal Settlements Infrastructure

EXISTING SITUATION



The Blue, Green and Grey elements

EXISTING SITUATION



VISION



The Blue, Green and Grey Flows Braided River System

- Revitalization of Existing Mithi Connection
 Public Space project for Fishing Community
 New River Connection at Mahim Beach
 Fort City Project Revitalization of historic forts
 Terraced Wetlands Project
 Urban Water Management in Dharavi
 Ecological Corridor of Mumbai Local Railway
 BKC Wetland Park
 Mangrove Restoration Project

- 9. Mangrove Restoration Project10. BKC Soft city Project

FOCUS AREA 1 LANDSCAPE AS INFRASTRUCTURE







LANDSCAPE AS INFRASTRUCTURE Informal Settlements Mangroves

SYSTEM





Barrier



Informal Settlements

Flow

LANDSCAPE AS INFRASTRUCTURE Informal Settlements Mangroves

Create transition zone of

WETLANDS between MANGROVES and INFORMAL SETTLEMENT

EXISTING SITUATION



SYSTEM OF GRADIENTS



SYSTEM OF GRADIENTS



SEASONAL CHANGES

SUMMER





Sediment Trapping

SEASONAL CHANGES

MONSOON





Hydro-morphological Recovery Ecological Restoration Communal Requalification



PROPOSED

URBAN AGRICULTURE	RAIN GARDENS STORAGE PONDS	WETLANDS
Groundwater recharge	Storage	Purification, Sedimentation
Preserving Green Space	Runoff Pollution	Halophytes - water cleansing plants
Food Production, Community Interaction space	Water Storage for washing and use in recycling and leather industry	Berm building, sediment collection



LANDSCAPE 1: COMMUNITY PUBLIC SPACE



Sponge Capacity + Permeability



Increased drainage and purification



Retention, purification + Sediment Balance



Sediment trapping, reducing coastal erosion

FOCUS AREA 2 INFRASTRUCTURE AS LANDSCAPE



INFRASTRUCTURE AS LANDSCAPE Informal Settlements Infrastructure Lines







Barrier



Flow

INFRASTRUCTURE AS LANDSCAPE Informal Settlements Infrastructure Lines

Create continuous PUBLIC SPACE STRUCTURE using various **INFRASTRUCTURE BARRIERS** within INFORMAL SETTLEMENT



SYSTEM

EXISTING SITUATION



SYSTEM OF CONTINUITY



SYSTEM OF CONTINUITY





SEASONAL CHANGES

SUMMER





SEASONAL CHANGES

MONSOON







CONNECTION Sea Wall	CONNECTION Public Space	CONNECTION Motorway
Access for Fishermen	Market space, urban agriculture	Slow Mobility access
Terraced gardens	Preserving Green Space	Boulevard with rain garden edges
Room for the sea to swell	Sponge capacity	Channelling water towards sea



Public Educative space, connection to mangroves

COMMUNITY

Fruit trees etc. Home for birds

ECOLOGY

Fresh water supply

WATER

CONNECTION 1: SEA WALL



Vertical Connection for fisherfolk - increase accessibility
EXPERIENCE



Boulevard with public space for slow mobility and street vendor activity



EXPERIENCE



Place for children, can be made into an extension of schools

REALIZING THE BLUE GREEN FRAMEWORK AT THE COAST





THE POWER OF THE BLUE GREEN LANDSCAPE FRAMEWORK

REGION

CONSEQUENCE OF THE APPROACH



UNDERSTANDING

WATER AS THE BASIS

LOCAL SCALE DESIGN



PUBLIC SPACE AND OWNERSHIP FOR COMMUNITY

A NEW OPPORTUNITY DEMOCRATIC APPROACH

BY THE PEOPLE, FOR THE PEOPLE





DHARA In the section of the section

Directing flows in Mumbai through Landscape