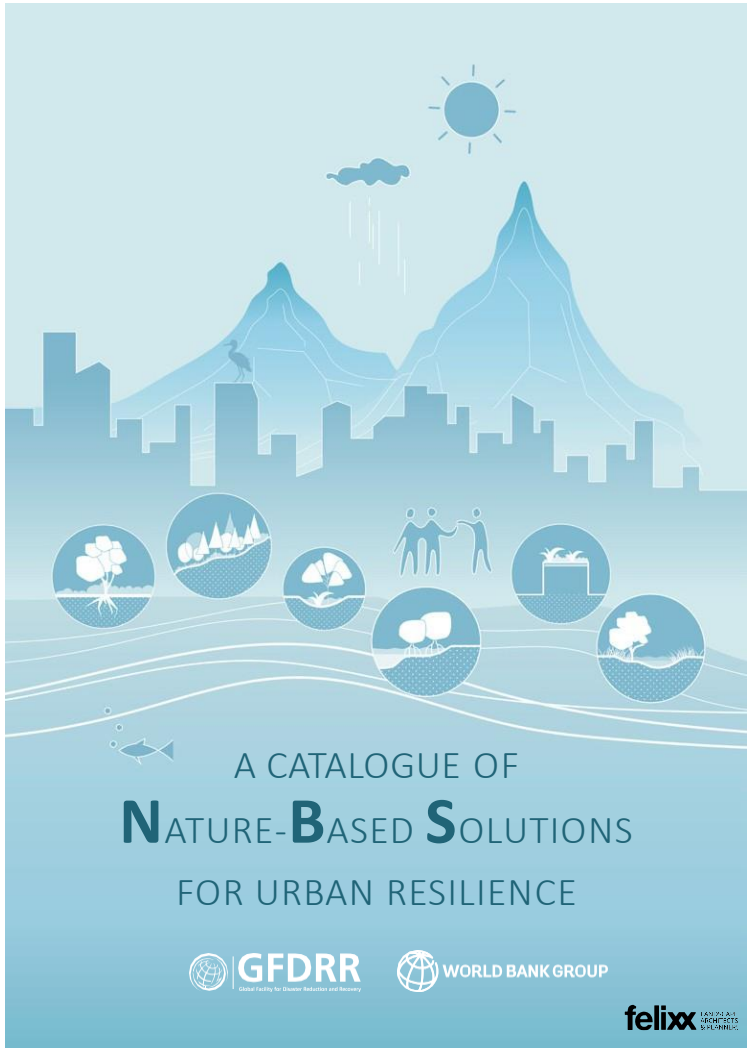


Cities4Biodiversity (C4B)

Greening Cities: Global initiatives

THE GLOBAL PROGRAM ON NATURE-BASED SOLUTIONS

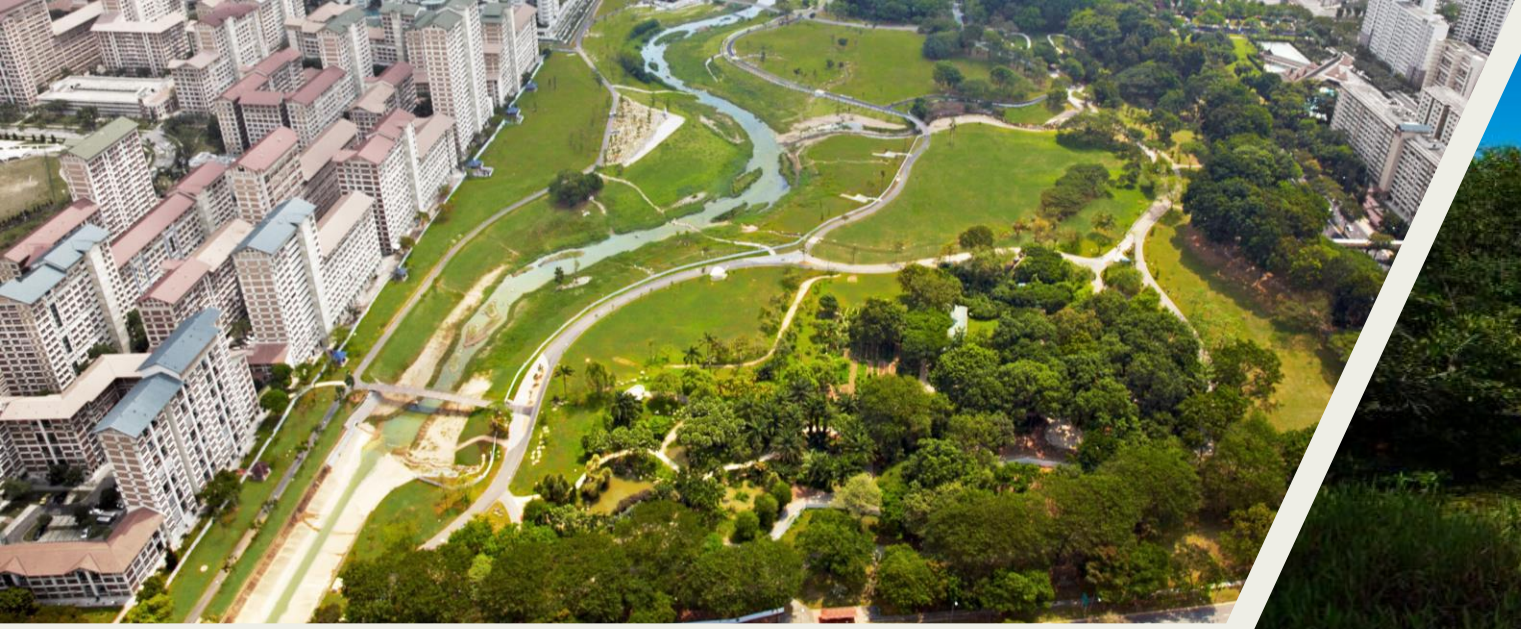
CATALOGUE OF NBS FOR URBAN RESILIENCE

GFDRR
Global Facility for Disaster Reduction and Recovery

April 13, 2022
Defne Osmanoglou

GLOBAL PROGRAM ON
NATURE-BASED SOLUTIONS
FOR CLIMATE RESILIENCE

01 INTRODUCTION
WORLD BANK GP NBS



Nature-based solutions are often cost-effective when combined with gray infrastructure

Urban green space with integrated drainage infrastructure to reduce stormwater flooding

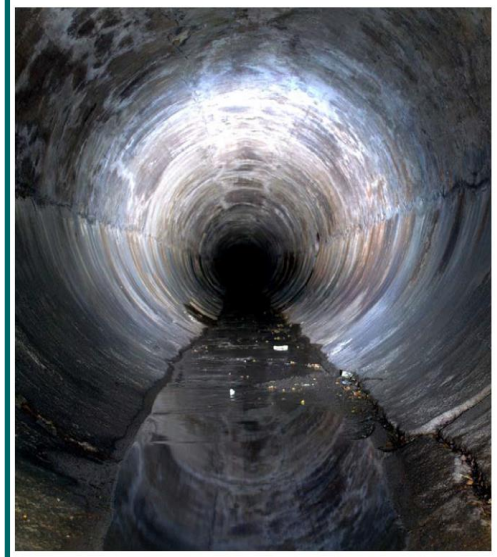
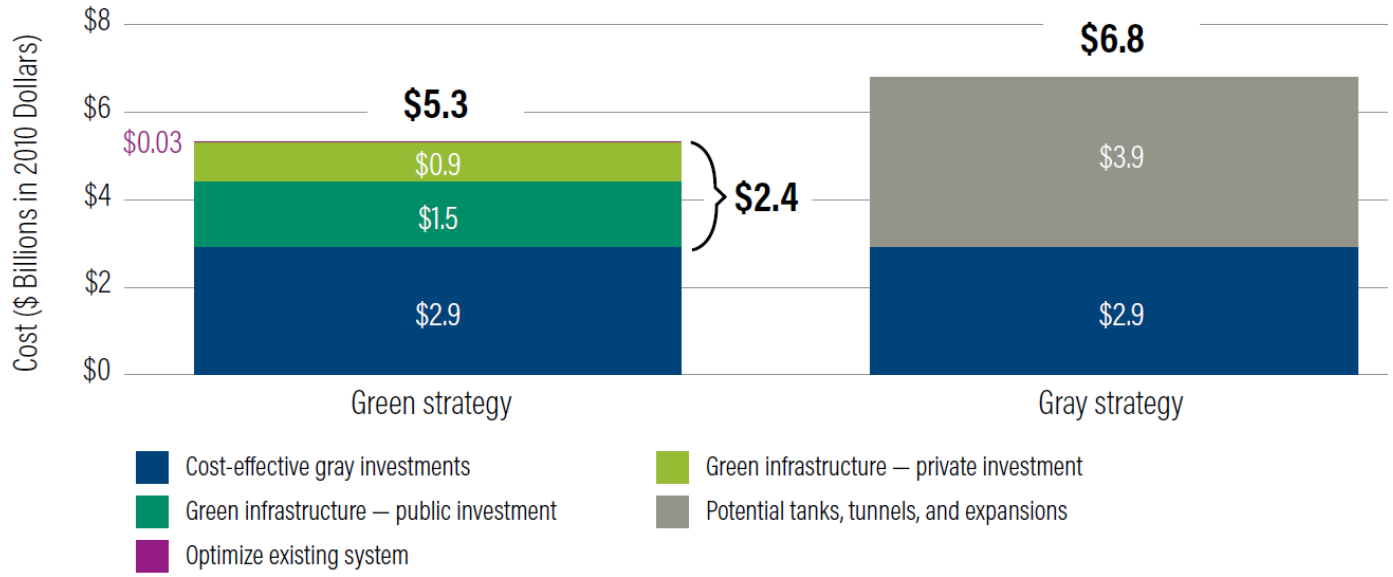


Figure 4.2 | Reducing Cost by Mixing Green and Gray Infrastructure*, New York City



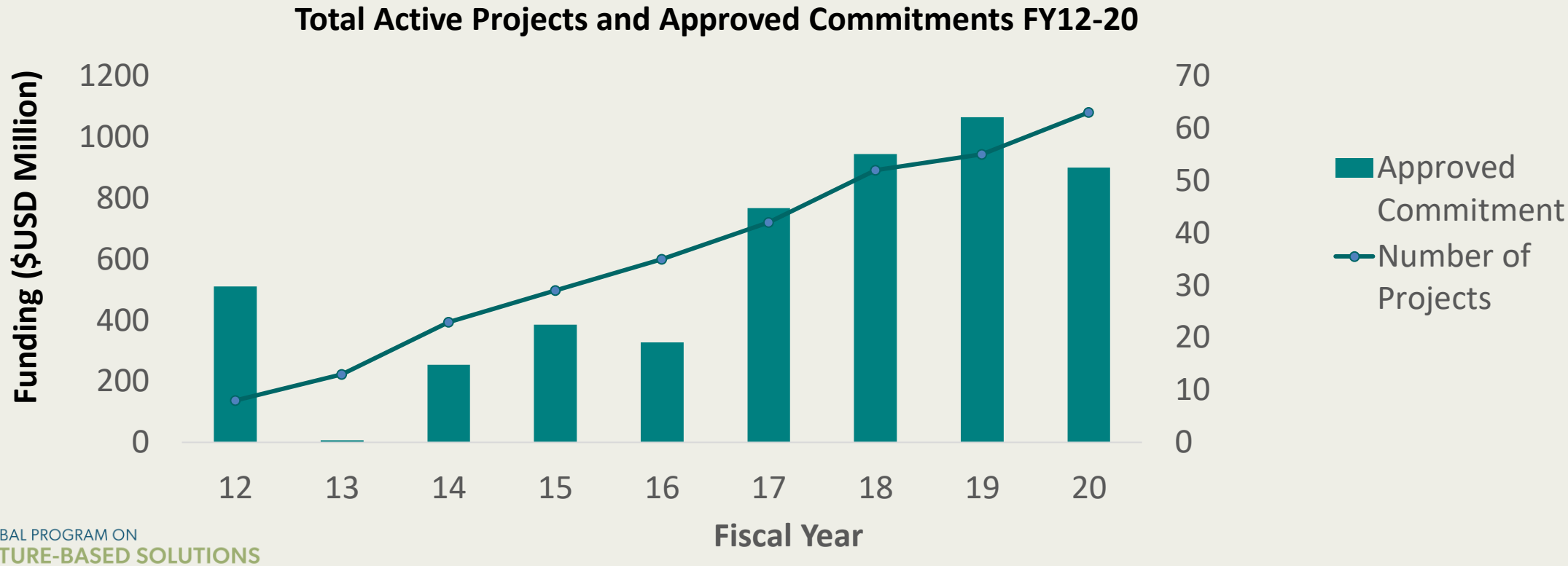
Note: *Combining green and gray infrastructure cost 22 percent less than gray alone.
Source: Bloomberg and Holloway 2018.

GLOBAL PROGRAM ON
NATURE-BASED SOLUTIONS
FOR CLIMATE RESILIENCE

The World Bank's **Nature-based solutions for Climate Resilience** portfolio is growing

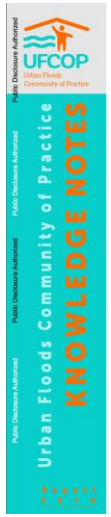
A portfolio review identified a total of **73 lending projects** with project components using NBS for Climate Resilience from FY12 to FY20.

These components are valued at an estimated **4.6 Billion USD**



GLOBAL PROGRAM ON NATURE-BASED SOLUTIONS FOR CLIMATE RESILIENCE

Selected knowledge products – also available at naturebasedsolutions.org




The Role of Green Infrastructure Solutions in Urban Flood Risk Management

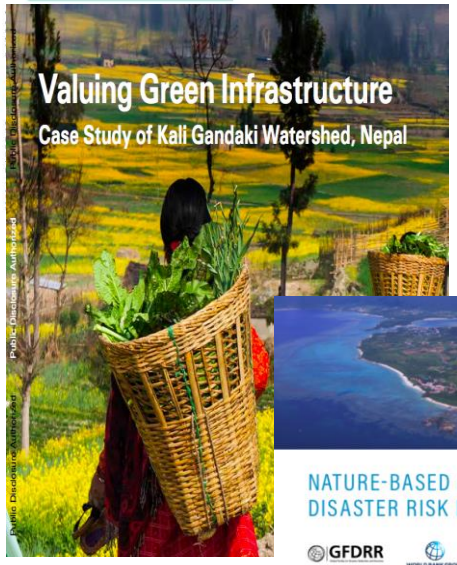
SUMMARY

Rapid urbanization, concentration of economic activity, and climate change are magnifying risks of major disasters in urban settings around the world. Unplanned development, competition for space in dense urban agglomerations, and environmental degradation often result in choking of floodplains and natural catchment areas of rivers and coastal zones. Natural disasters have a disproportionate impact on the urban poor, who often live in informal settlements in vulnerable parts of urban centers.

For a long time, governments implemented hard engineering or gray solutions such as dams and levees to mitigate flood risk. However, with adverse impacts of floods growing, interest in a more integrated approach to urban flood risk management is growing as well. Green infrastructure (GI) solutions have emerged as a key component of this integrated approach. GI solutions include wetlands, bioshields, buffer zones, green roofing, street side swales, porous pavements, wetlands, mangroves, etc.

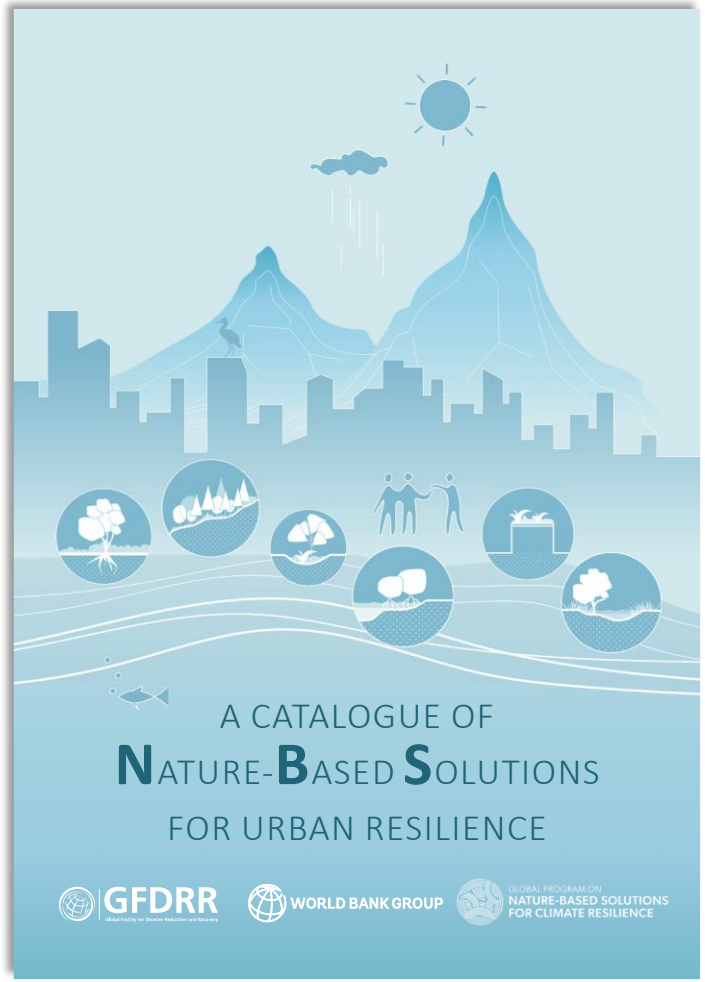
GI is an approach that focuses on using natural processes for managing wet weather impacts while delivering environmental, social, and economic benefits.

The Role of Green Infrastructure Solutions in FRM



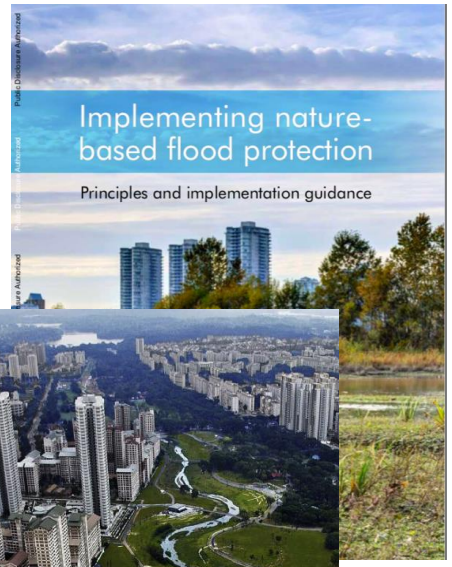
Valuing Green Infrastructure

NBS for DRM Booklet

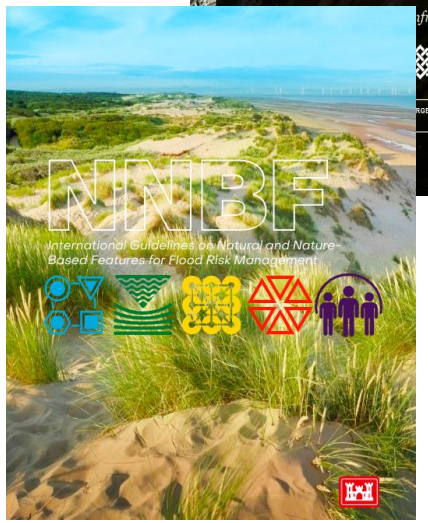


Catalogue of NBS for Urban Resilience (2021)

NBS Guidance Note



NBS Flagship Report



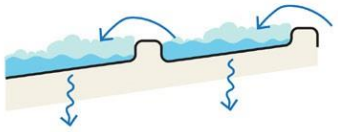
International guidelines for NBS Flood Risk Management

GLOBAL PROGRAM ON
NATURE-BASED SOLUTIONS
FOR CLIMATE RESILIENCE

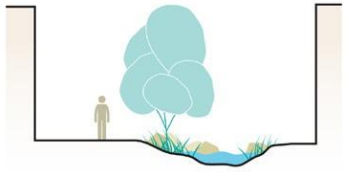
02 CATALOGUE OF NATURE-BASED SOLUTIONS FOR URBAN RESILIENCE

DIVERSITY OF NATURE-BASED SOLUTIONS FOR URBAN APPLICATION: “NBS FAMILIES”

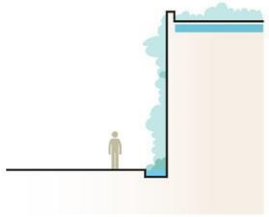
Urban Forests



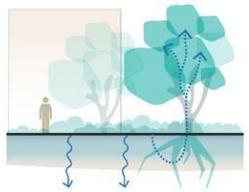
Terraces and Slopes



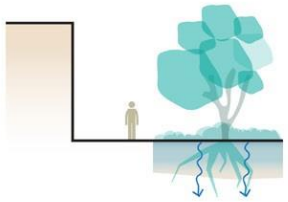
River and Stream Renaturation



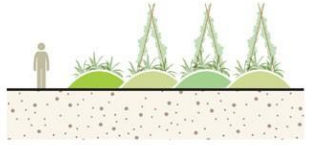
Building Solutions



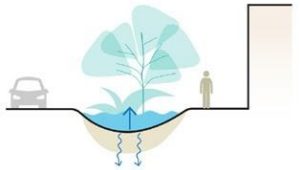
Open Green Spaces



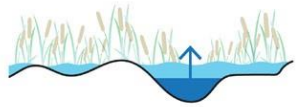
Green Corridors



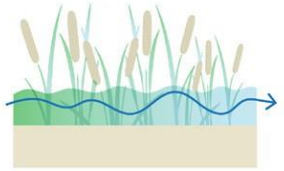
Urban Farming



Bioretention Areas

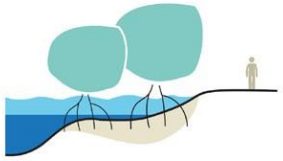


Natural Inland Wetlands

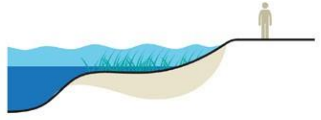


Constructed Inland Wetlands

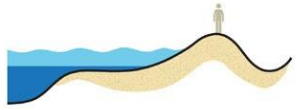
River Floodplains



Mangrove Forests



Salt Marshes



Sandy Shores

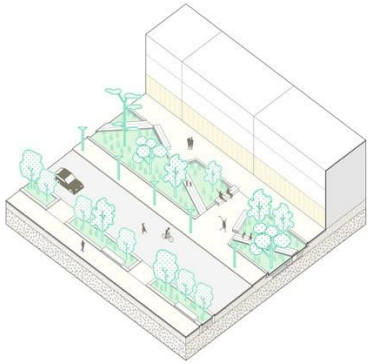
14 NBS FAMILIES

1 - PRINCIPLES FOR INTEGRATING NATURE-BASED SOLUTIONS FOR URBAN RESILIENCE

2- CATALOGUE CONTENT PER NBS FAMILY

FACTS AND FIGURES

PROCESSES



VISUALIZATIONS

FUNCTIONS

BENEFITS

SUITABILITY CONSIDERATIONS
Environmental, Technical, Urban, and Maintenance

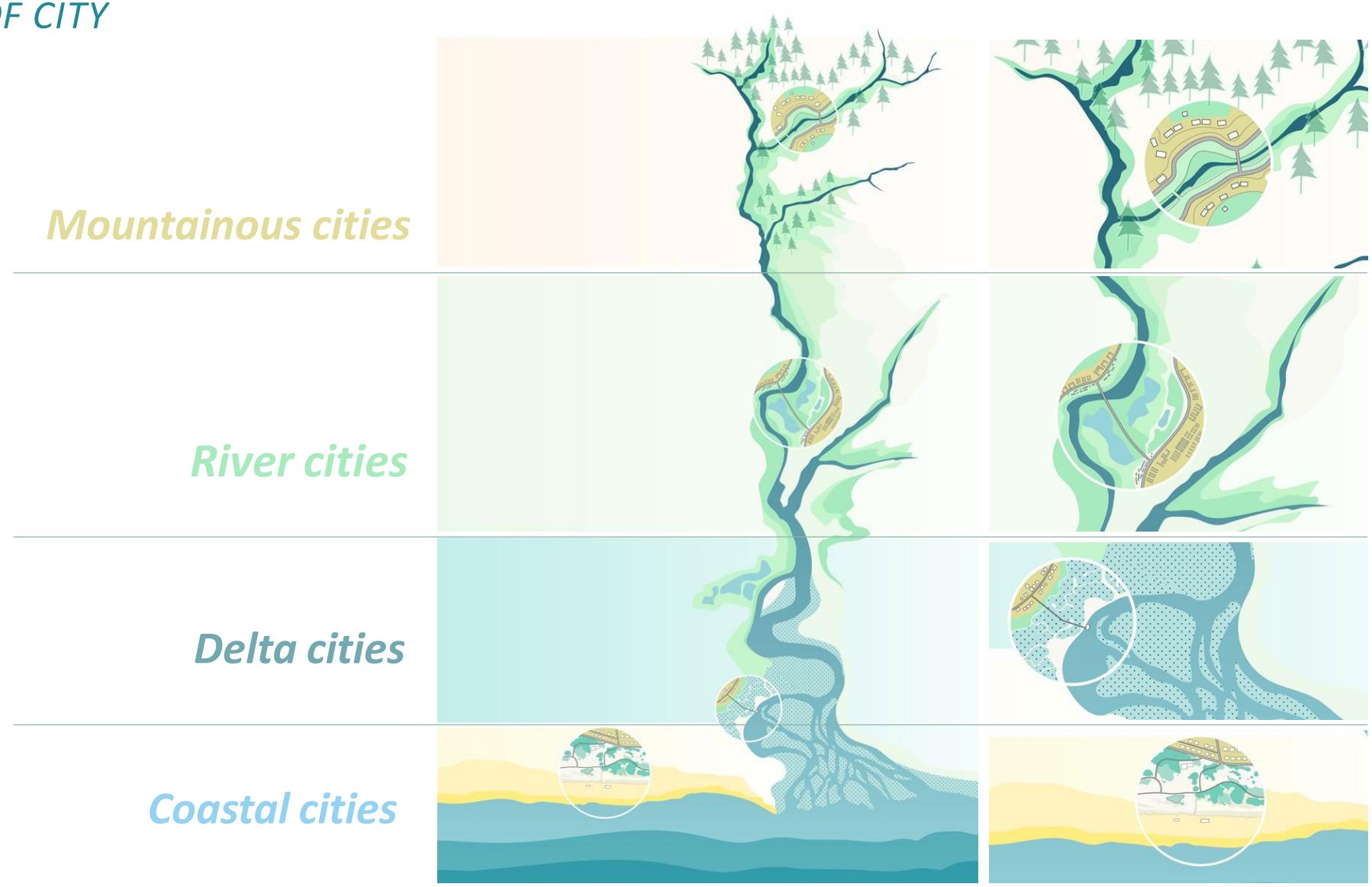
COSTS
Land, Construction and Implementation, and Maintenance

NBS IN PRACTICE

Integrating Nature-based Solutions for Urban Resilience

CONSIDER THE INTEGRATION OF NBS ACROSS A RANGE OF SPATIAL SCALES

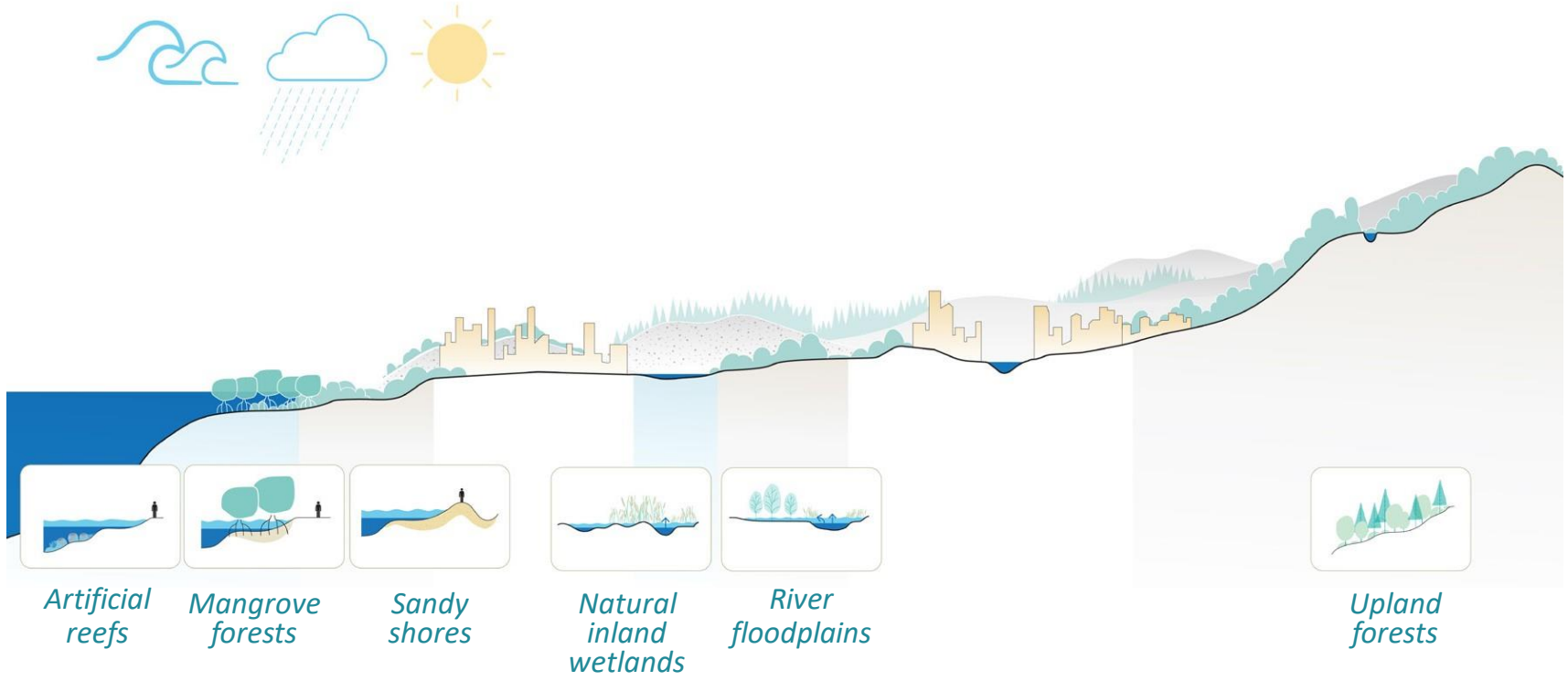
TYPE OF CITY



Integrating Nature-based Solutions for Urban Resilience

CONSIDER THE INTEGRATION OF NBS ACROSS A RANGE OF SPATIAL SCALES

NBS AT THE RIVER BASIN SCALE



Upland forests

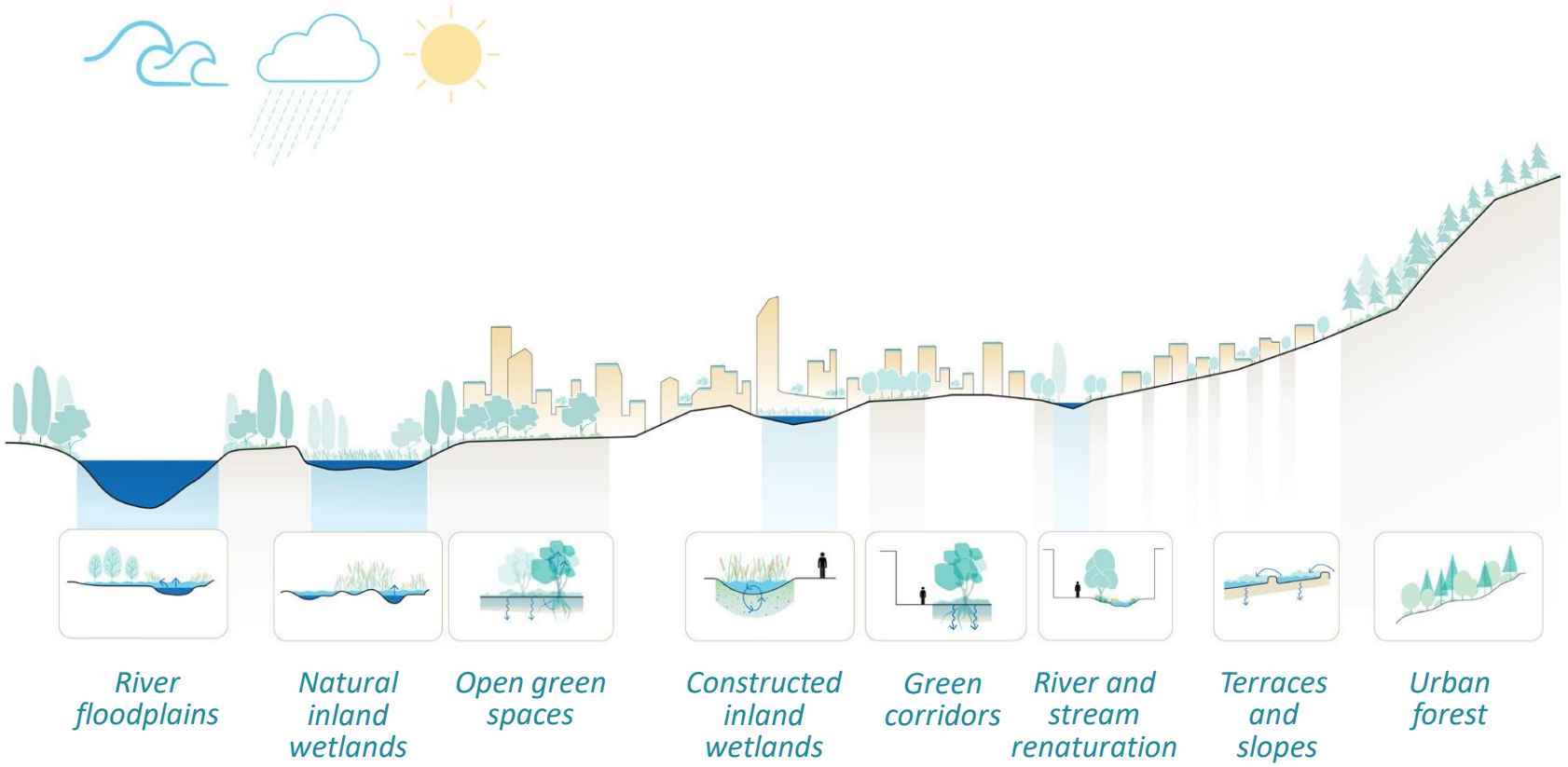
Mangrove forests

Sandy shores

Integrating Nature-based Solutions for Urban Resilience

CONSIDER THE INTEGRATION OF NBS ACROSS A RANGE OF SPATIAL SCALES

NBS AT THE CITY SCALE



Green corridors

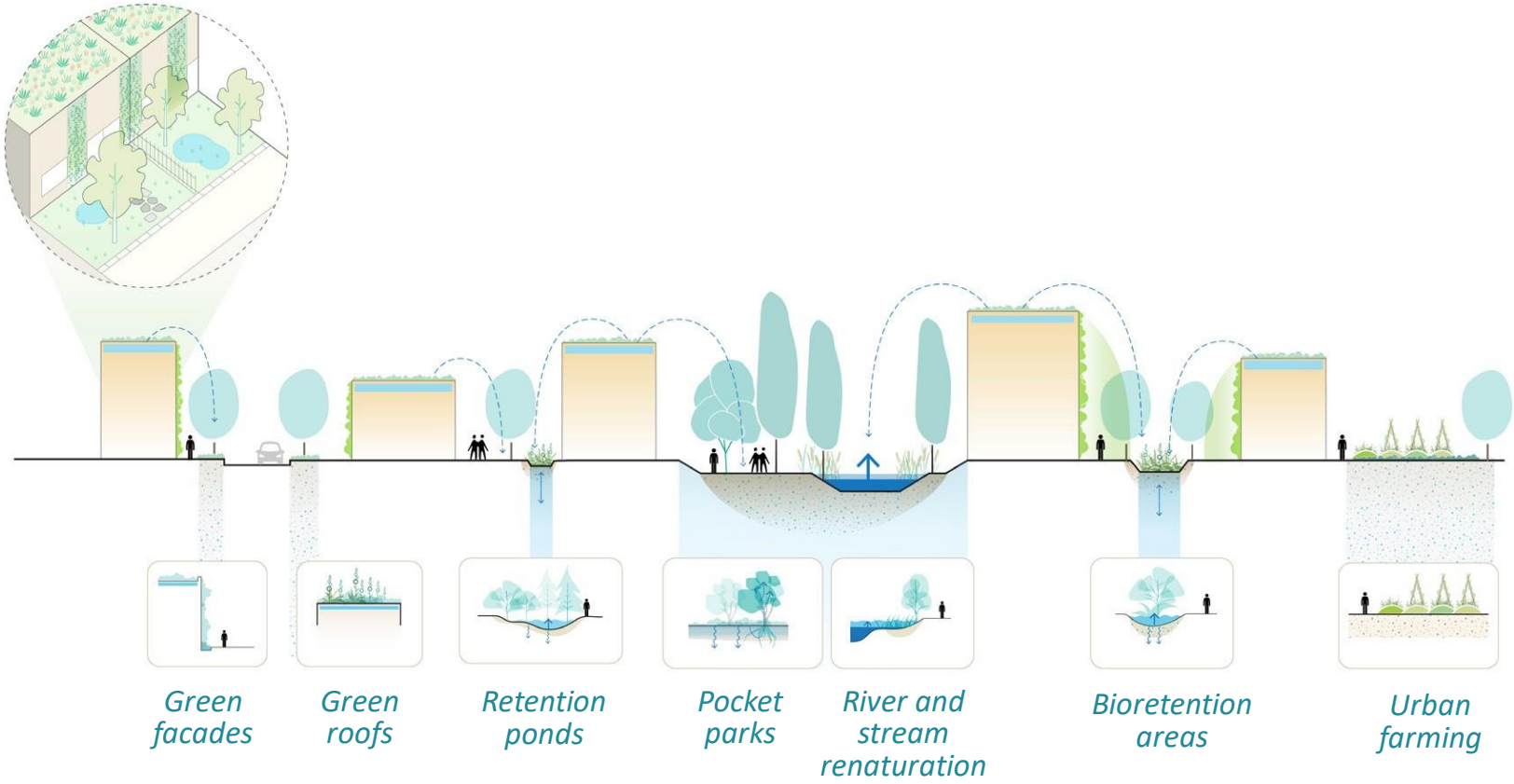
Open green spaces

River floodplains

Integrating Nature-based Solutions for Urban Resilience

CONSIDER THE INTEGRATION OF NBS ACROSS A RANGE OF SPATIAL SCALES

NBS AT THE NEIGHBORHOOD SCALE

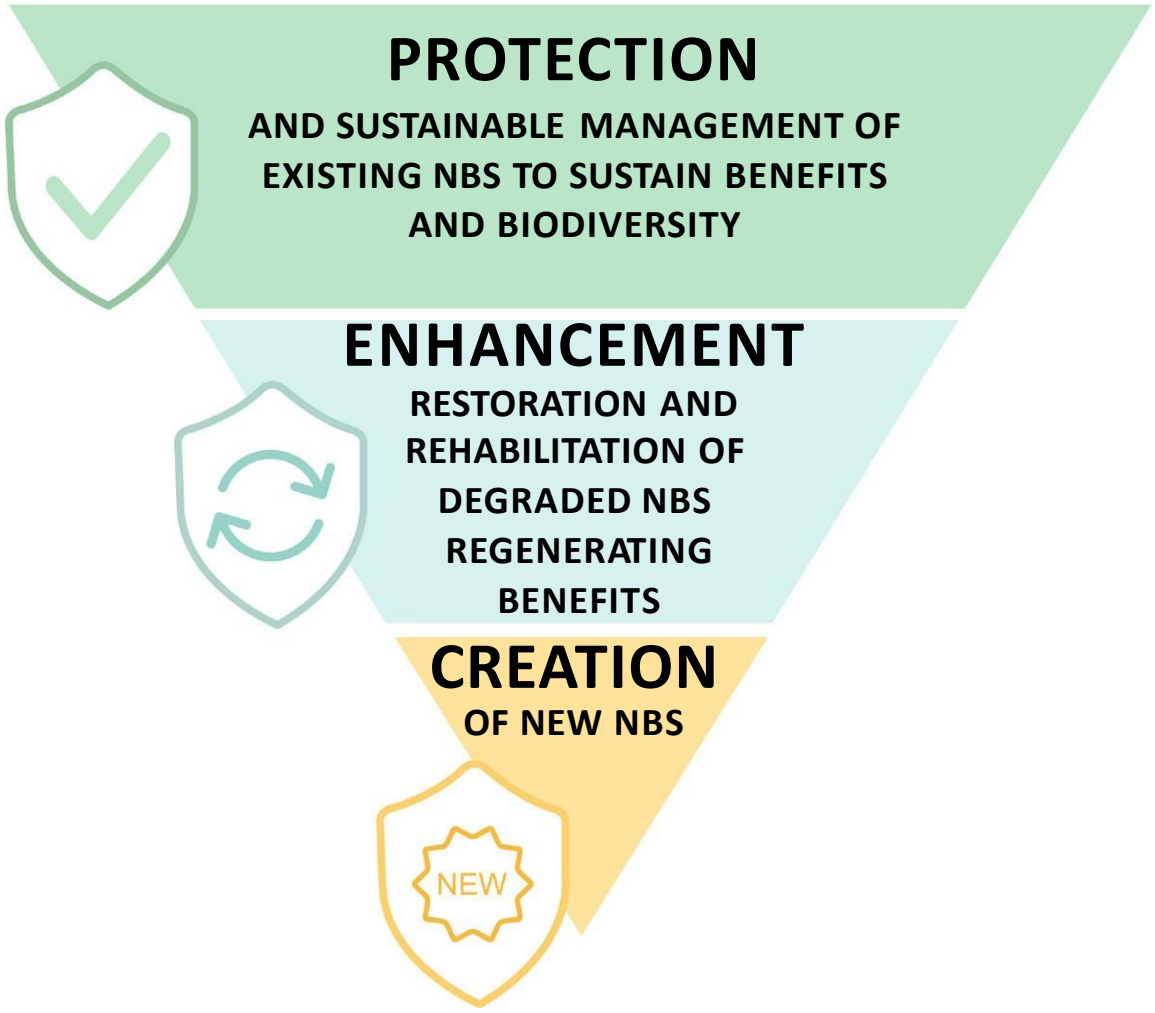


Pocket parks

Bioretention areas

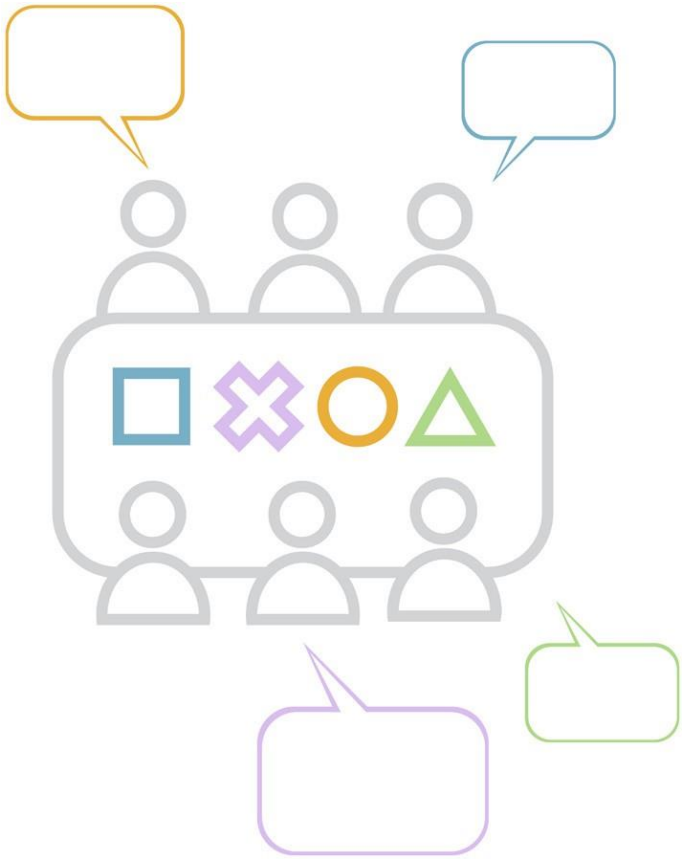
Urban farming

CONSIDER THE PRINCIPLES OF ECOSYSTEM CONSERVATION BY ADOPTING A HIERARCHY OF ECOSYSTEM-BASED APPROACHES



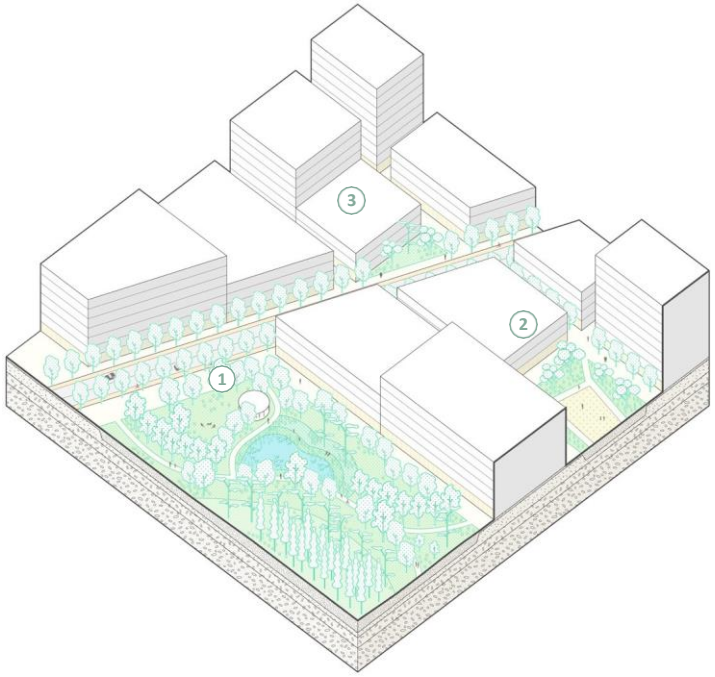
ADOPT A MULTISTAKEHOLDER AND INTERDISCIPLINARY APPROACH

" Interdisciplinary teams of urban planners, landscape architects, urbanists, civil engineers, ecologists, and stakeholders should actively collaborate in the planning and design process of urban resilience projects to provide more comprehensive solutions to urban challenges"

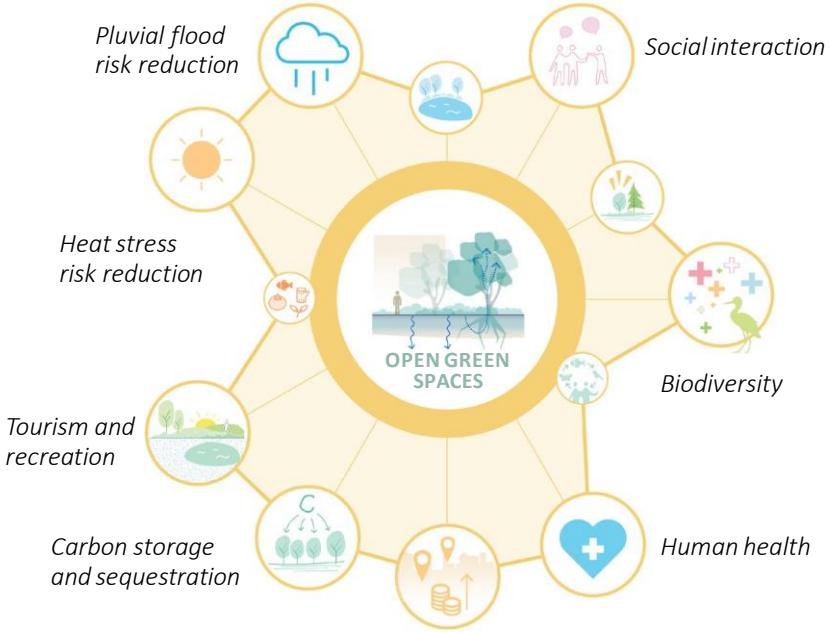


OPEN GREEN SPACES

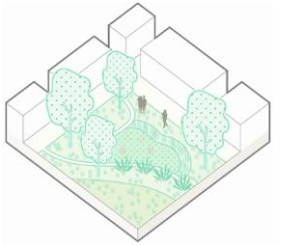
VISUALIZATION IN THE URBAN CONTEXT



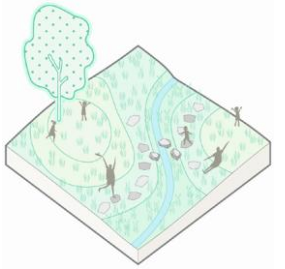
BENEFITS



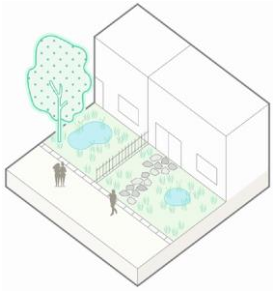
SPECIAL TECHNIQUES



Pocket parks



Natural playgrounds



Climate-proof residential gardens

TYPE OF CITY

Coastal *Delta*

River *Mountain*

SCALE

River basin

City

Neighborhood

APPROACH

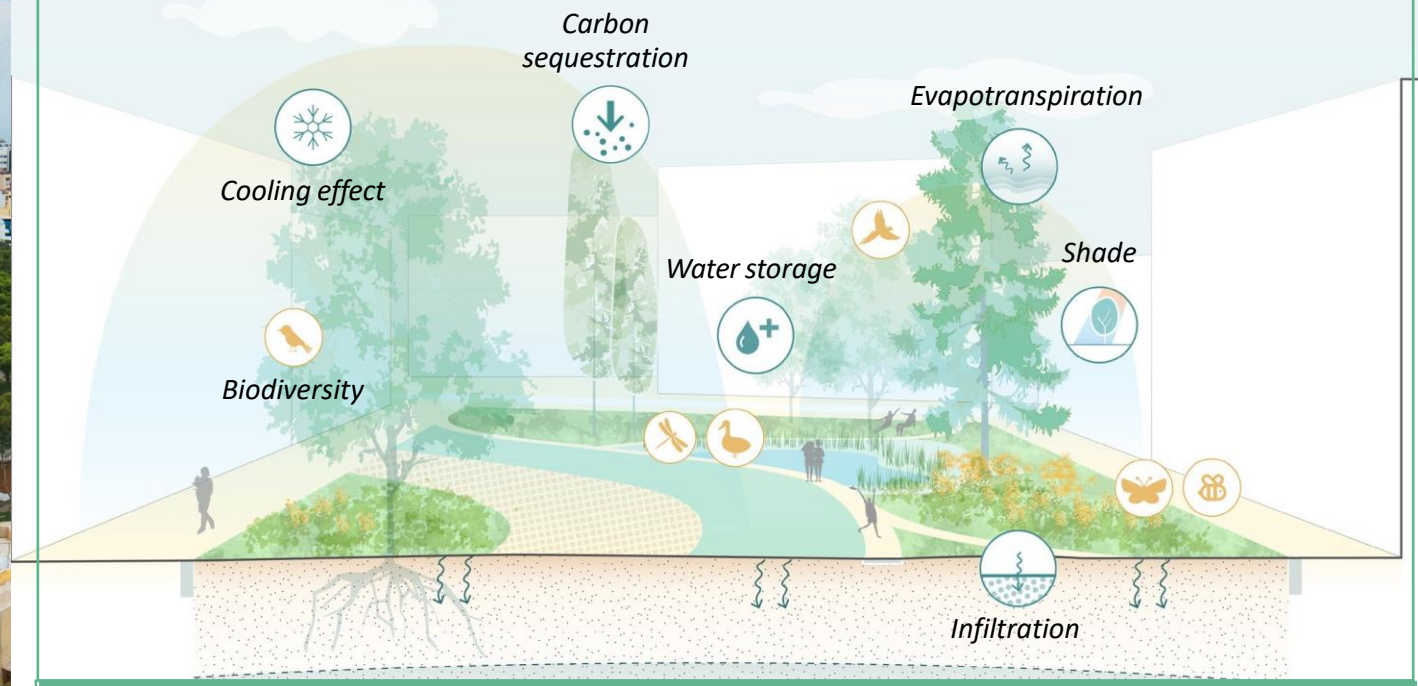
Protect: Protect existing open green spaces.

Rehabilitate, restore, and enhance:
Upgrade or renovation existing green spaces; allow temporal use of undefined areas as green spaces.

Create: Construct new open green spaces.

OPEN GREEN SPACES

PROCESSES



COSTS

Land

Example land-related costs:

- Acquisition costs
- Land use (e.g., payments to landowners) costs
- Land protection costs, including managing and controlling access
- Community resettlement costs

Construction and implementation

Urban open green space costs are a function of:

- Labor
- Site preparation
- Design
- Construction costs
- Costs associated with managing and controlling access

Maintenance

Maintenance costs for urban open green spaces vary depending on open space design, use, type of vegetation, and local climatic conditions.

- Estimates of maintenance costs in the United Kingdom vary between **US$0.4–US$2/m²/year** (**US$4,000–US$20,000/ha/year**) (Tempesta

NBS IN PRACTICE

Chulalongkorn Centenary: Bangkok, Thailand

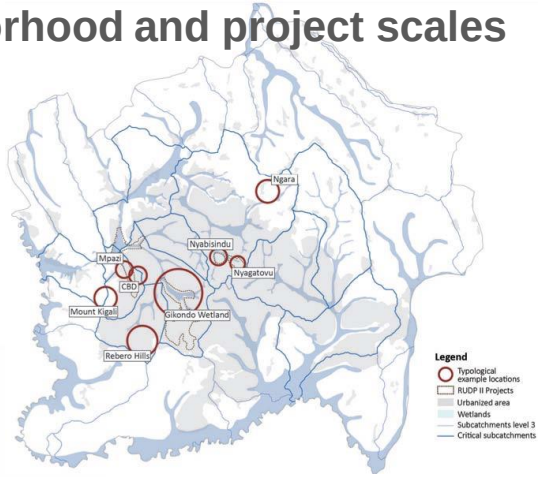
Water square: Rotterdam, the N etherlands

03 EXAMPLES

SECOND RWANDA URBAN DEVELOPMENT PROJECT (RUDP-II)

A Landscape Analysis and Pre-Feasibility Study of Urban NBS to Reduce Flood Risk and Strengthen Resilience in Kigali

I. Assessment catchment, city, neighborhood and project scales



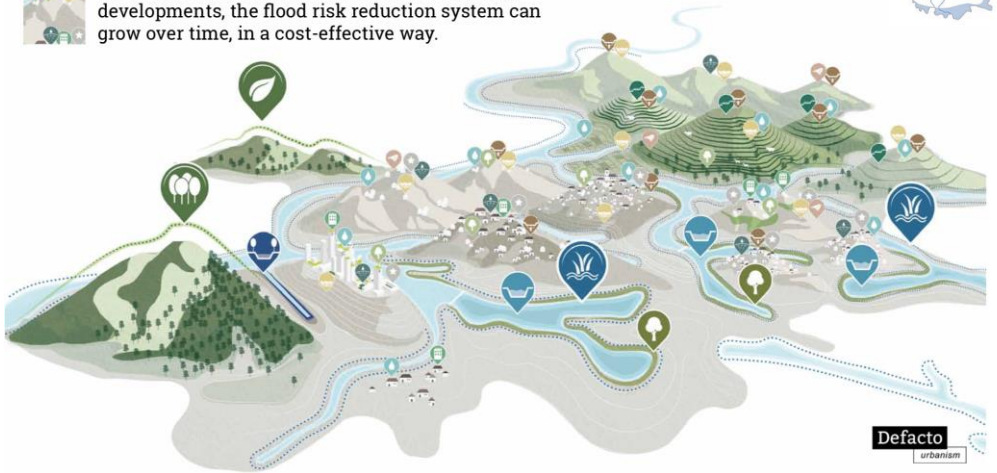
II. Twenty-seven NBS in Toolbox, design & implementation guidance

III. Neighborhood and project recommendations

IV. City-wide strategy for Kigali

Big difference: The wetland system is the city's most important NBS and should (together with the forest) be protected and cherished as such.

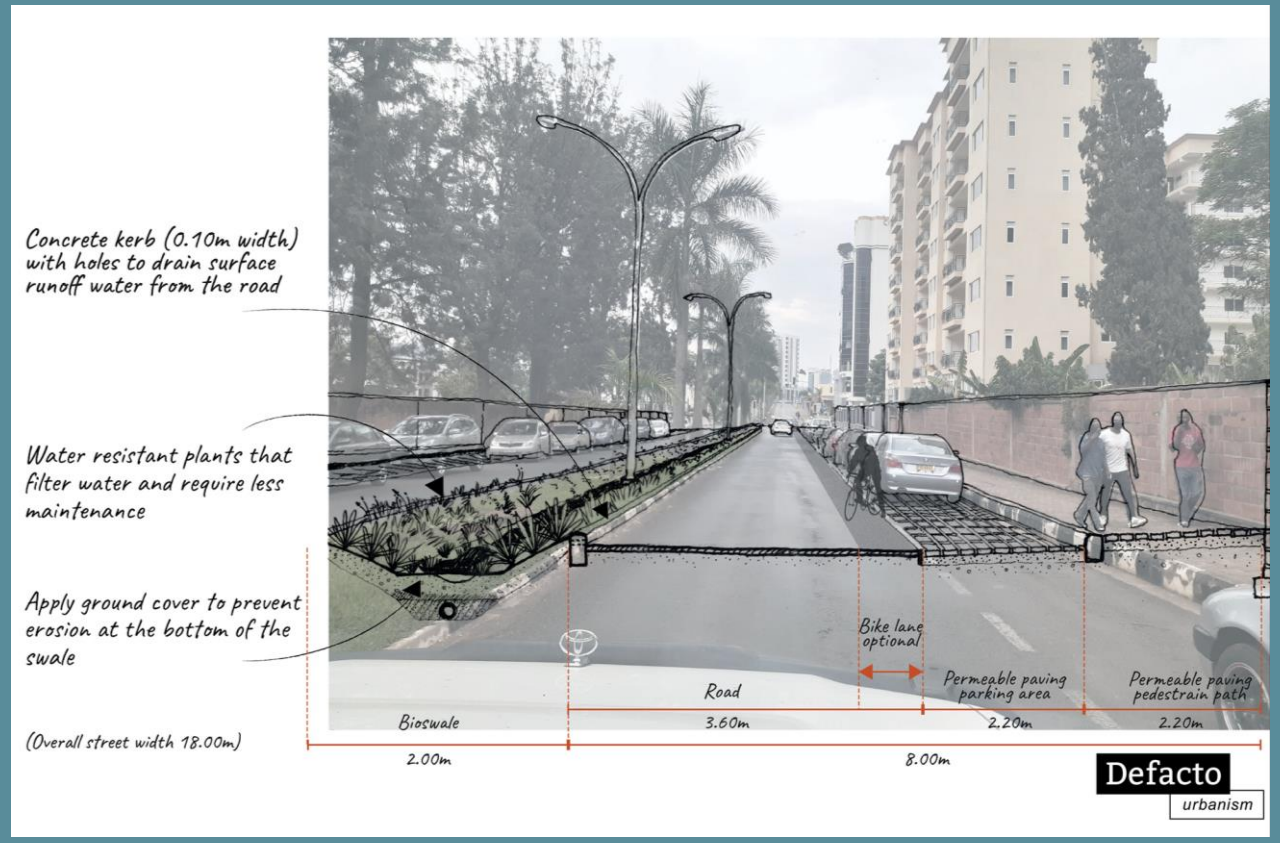
1000 x 1 measures: By including NBS in ongoing developments, the flood risk reduction system can grow over time, in a cost-effective way.



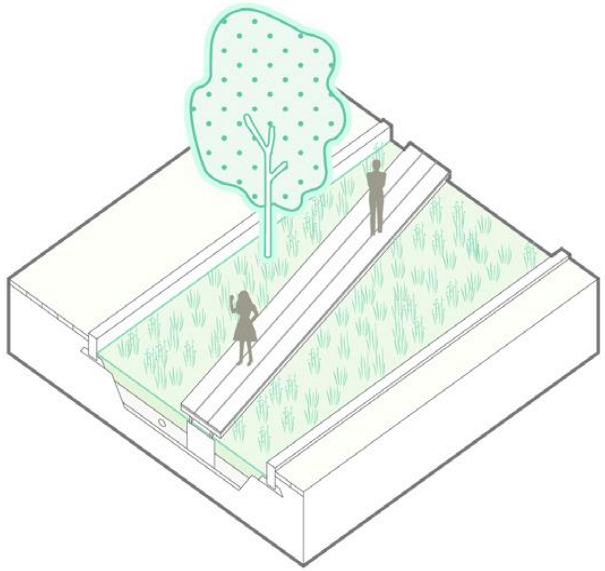
ACP-EU Natural Disaster Risk Reduction Program

An initiative of the African, Caribbean and Pacific Group, funded by the European Union and managed by GFDRR

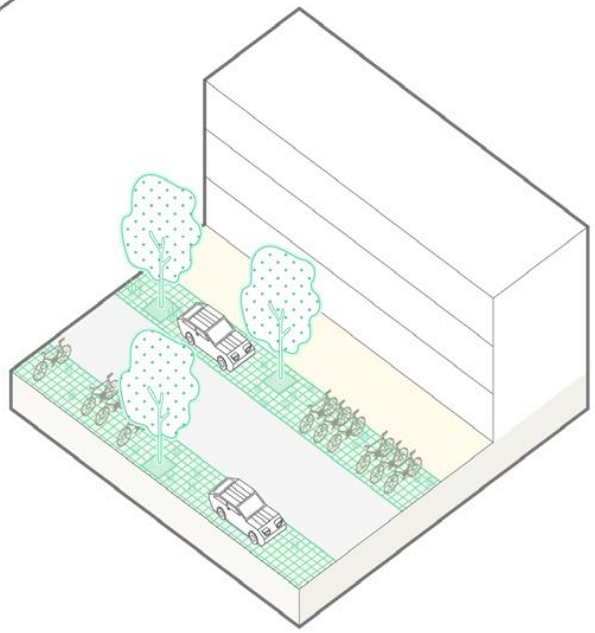
Kigali, Rwanda: NBS techniques to be integrated into detailed design



Kigali, Integrated road profile

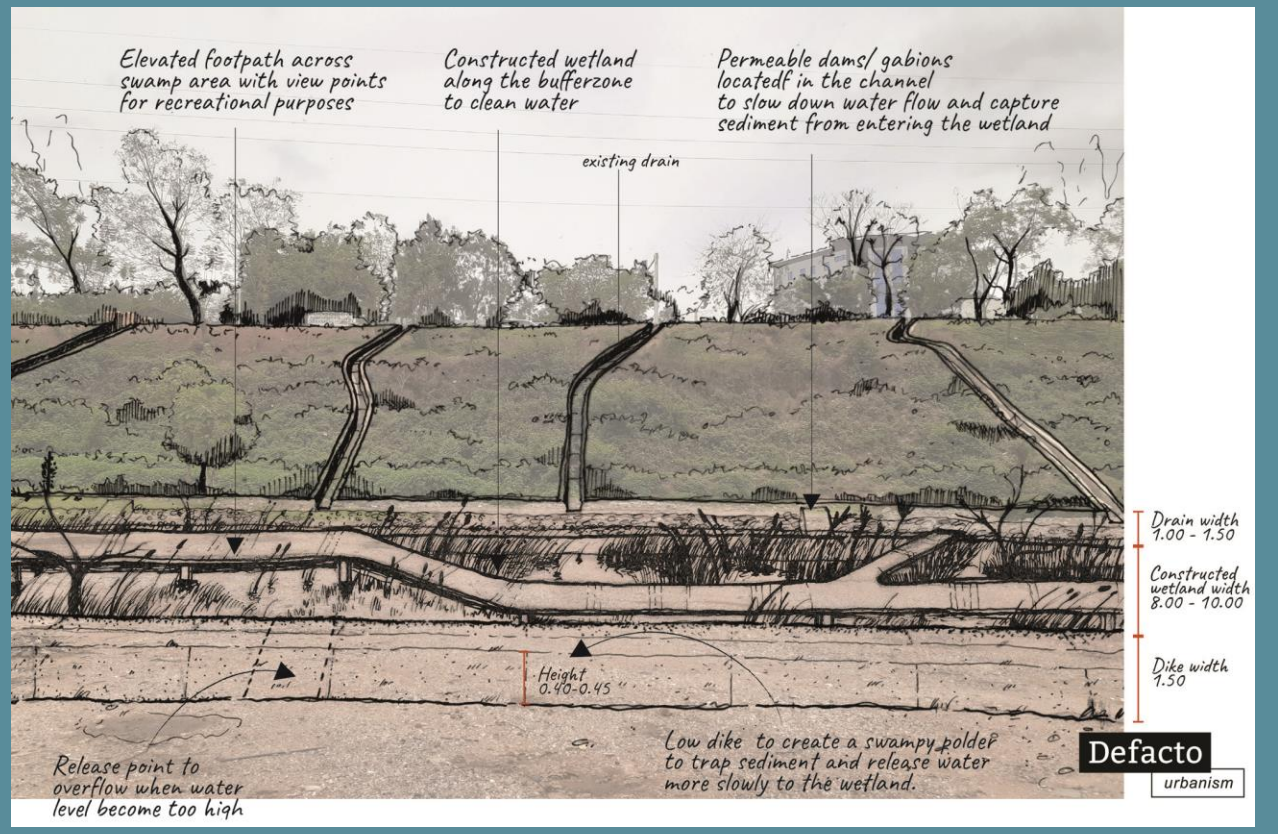


Bioswales and rain gardens



Permeable pavement

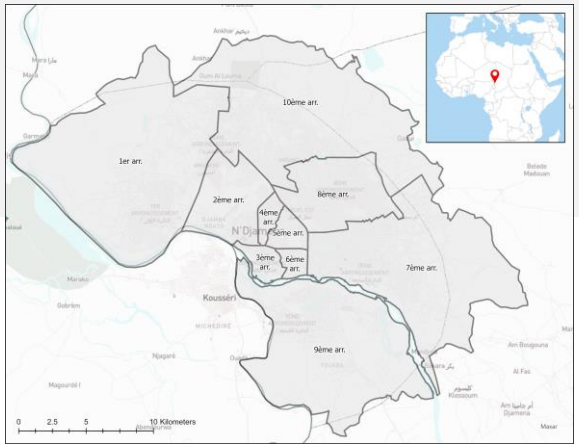
Kigali, Rwanda: Cost considerations that need to be addressed for NBS at the neighborhood scale



Kigali, Constructed wetland park

1. **Land use costs**:
   Payment to landowners
2. **Construction and Implementation costs:**
   Removal of impervious surfaces
3. **Construction and Implementation costs:**
   Labor and material costs
4. **Maintenance costs:**
   Clearing dead plants and watering
5. **Maintenance costs:**
   Removal of debris, weeding and pruning.

NBS OPPORTUNITY SCAN: NDJAMENA, CHAD



SCANNING METHODOLOGY

STEP 1

ASSESSING TRENDS IN VEGETATION AND SOIL CONDITIONS

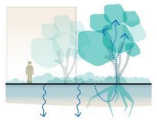
STEP 2

STEP 3

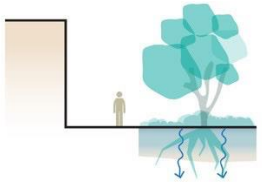
MODELING NBS BENEFITS

STEP 4

MAPPING NBS OPPORTUNITY AREAS



Open Green Spaces

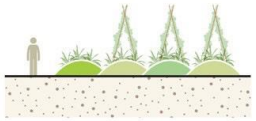


Green Corridors

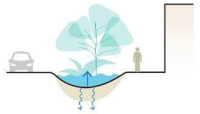
River Floodplains

River and Stream Renaturation

Urban Forests



Urban Farming



Bioretention Areas

GLOBAL PROGRAM ON
NATURE-BASED SOLUTIONS
FOR CLIMATE RESILIENCE

NBS OPPORTUNITY SCAN:
NDJAMENA, CHAD

Urban Forests

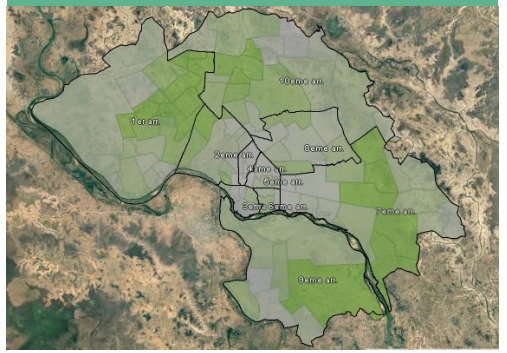
Step 2

NBS Suitability Mapping

SUITABLE AREAS FOR URBAN FORESTS & OPEN GREEN SPACE

SUITABILITY MAP

SUITABILITY DISTRICT LEVEL



CLOSE-UP CITY CENTRE

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FOR CLIMATE RESILIENCE

Kinshasa, DRC: Exploring NBS Family for flood risk reduction

Kinshasa, DRC

Kinshasa, DRC: Combination of NBS Benefits

Kinshasa, landslide and erosion

Landslide and erosion risk reduction

1 & Biodiversity

2 & Stimulate local economies and job creation

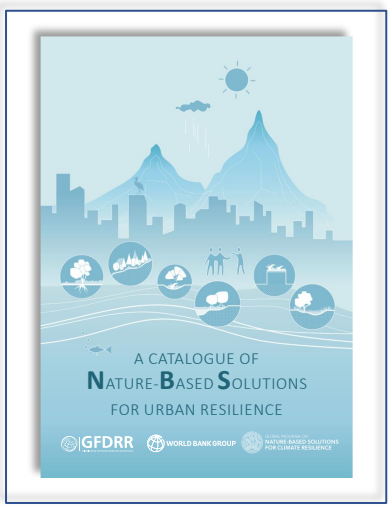
3 & Human health

4 & Education

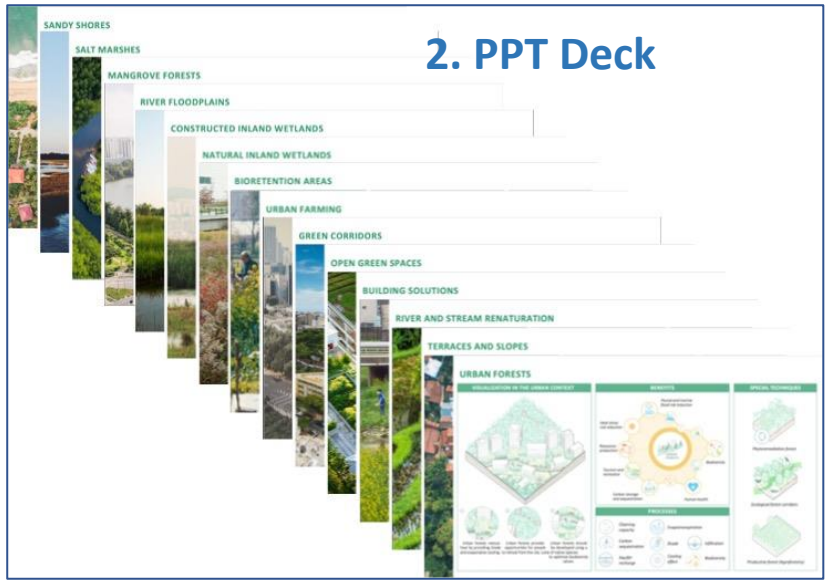
5 & Carbon storage and sequestration

1. Catalogue report

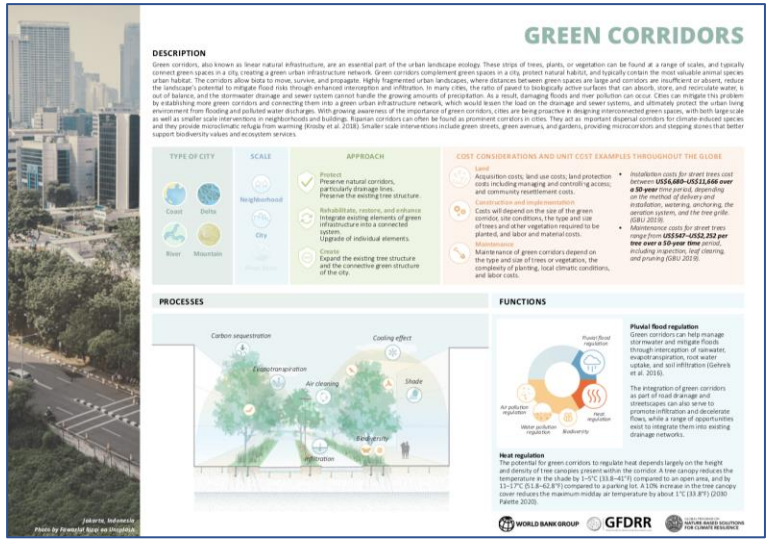
naturebasedsolutions.org

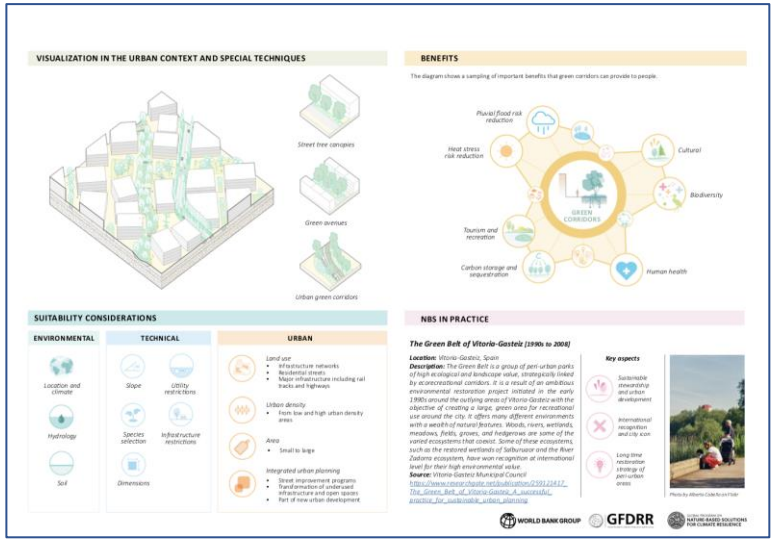


2. PPT Deck

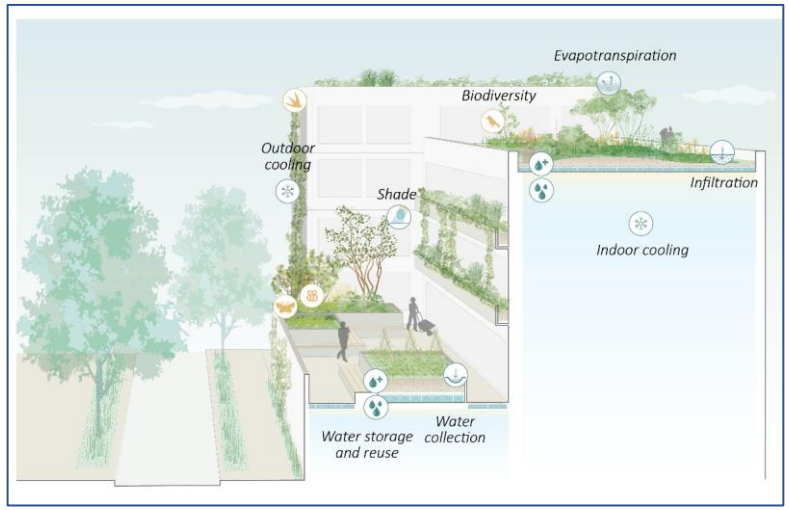


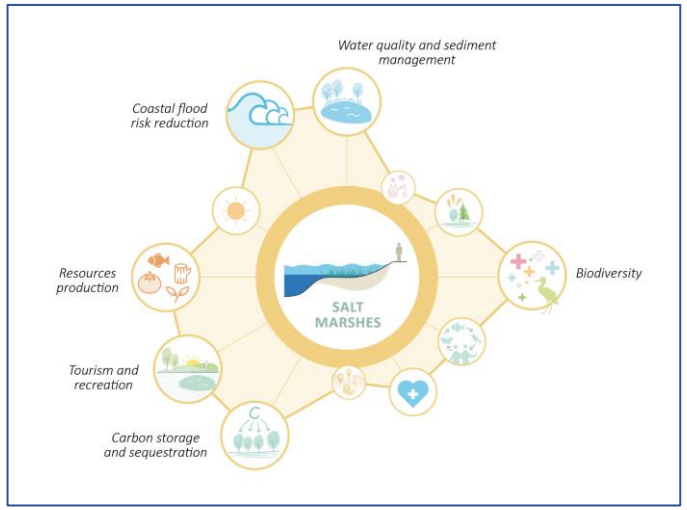
3. Factsheets





4. Infographics





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GFDRR Global Facility for Disaster Reduction and Recovery

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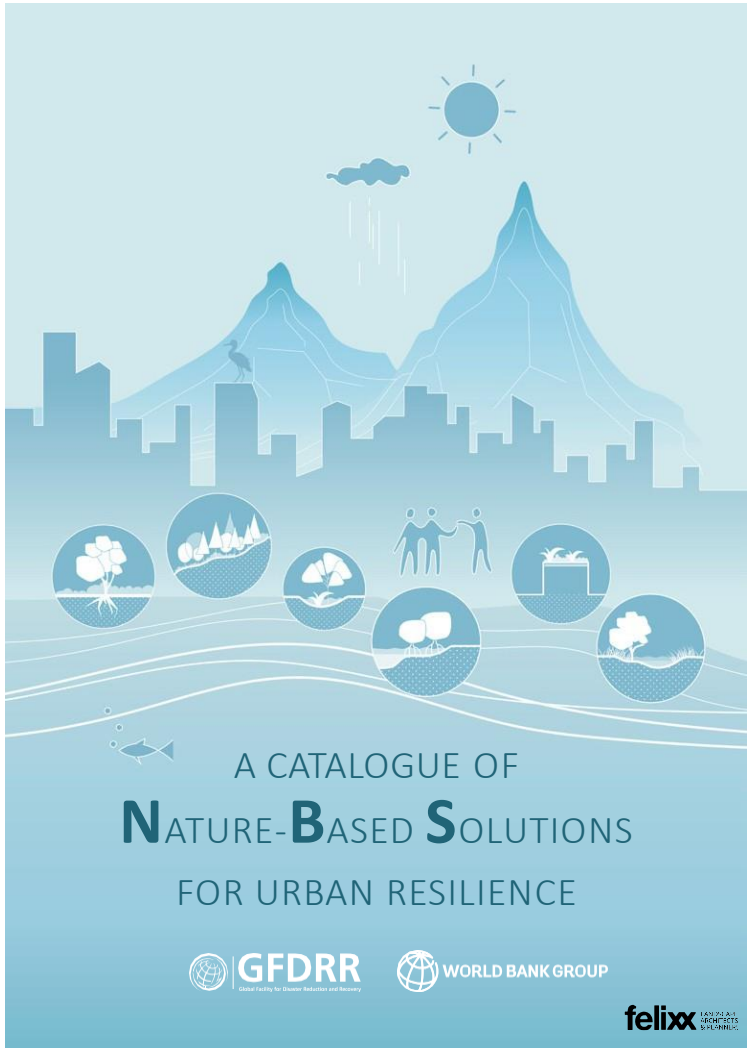

GFDRR
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