

MODULE 4

Climate Adaptation and Resilience Options

Acknowledgements

We would like to acknowledge the following partners and funders involved in designing and delivering the Climate Resilient Water Services Masterclass:

The Modules were developed with

GLOBAL CENTER ON ADAPTATION

IRC Supporting water sanitation and hygiene services for life

Today’s focus

go.mwater.co/irc/2025_kenya

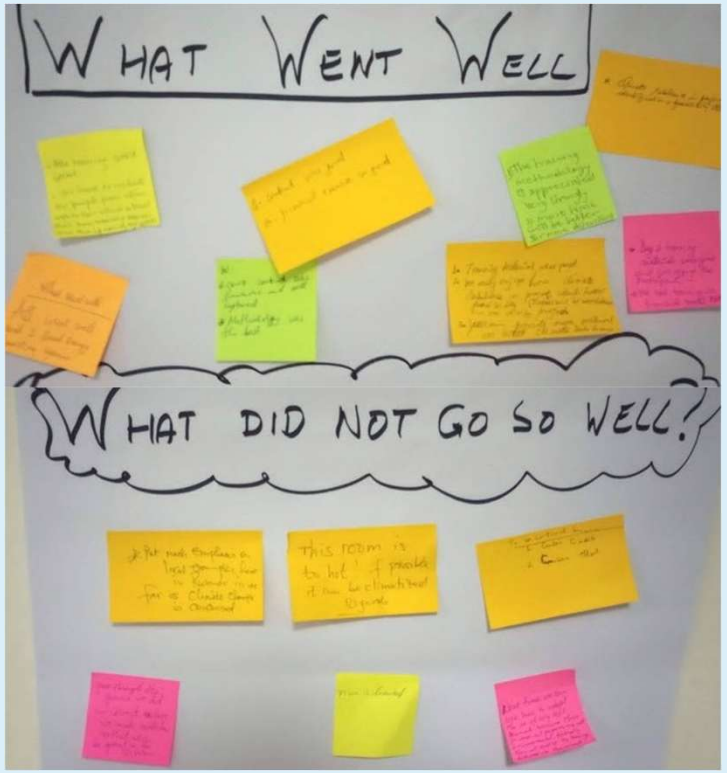
All information of this course

01	Overview Module 4 Including Learning objectives
02	Why it matters
03	Climate-resilient infrastructure & services
	LUNCH
04	The broader enabling environment
05	Ways to build resilient infrastructure
06	Exercise
07	A quiz & end of the day reflection

Feedback

- Short feedback on follow-up of yesterday's feedback session.

- Parking lot review

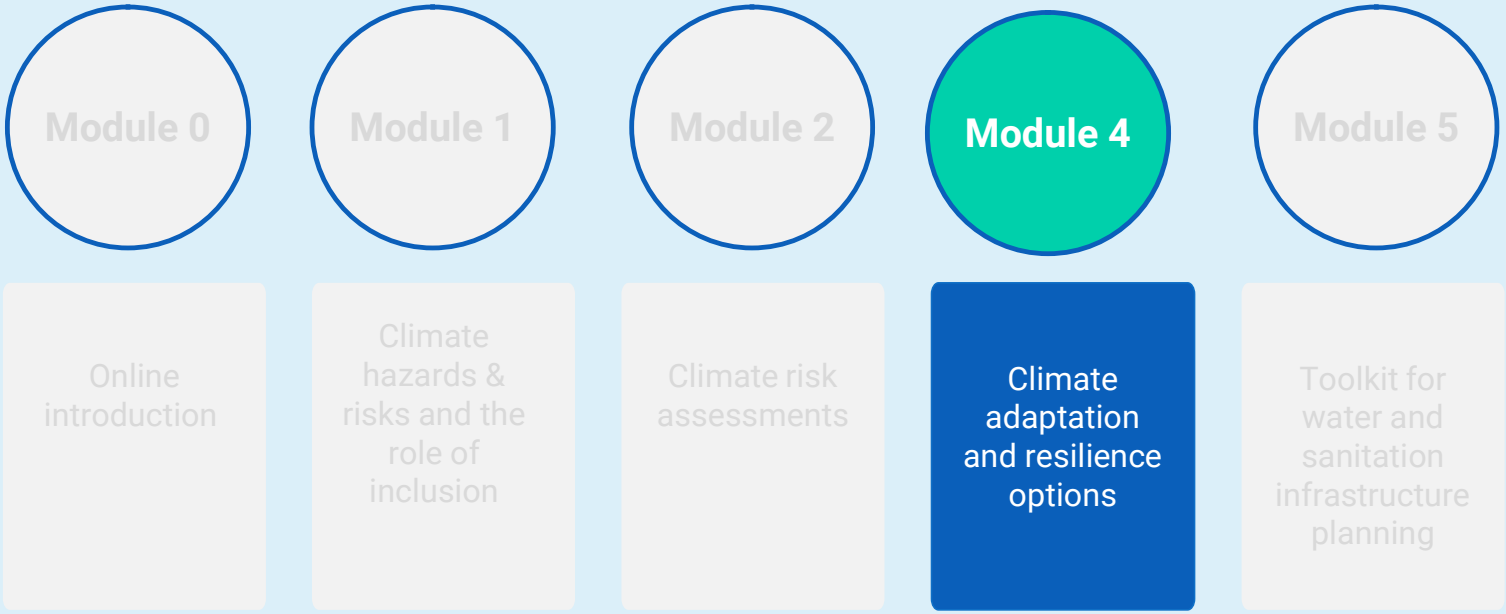


Our river

Our river is not alone – there are side rivers and tributaries joining forces

01| Overview Module 4

Masterclass overview



Explores approaches to enhancing climate resilience in water and sanitation infrastructure and services

MODULE 4 Climate adaptation and resilience options

Key components include:

- **Exploration** of engineering, design, and strategic solutions, including **Nature-based Solutions and non-structural solutions** for resilient water and sanitation systems.
- **Presentation** of evidence-based adaptation strategies from diverse contexts.
- **Introduction** to key guidance materials.

Duration: 1 day

Learning objectives

MODULE 4 Learning objectives

By the end of this module, participants will be able to:

- **Explain** technical, strategic, and policy-based approaches to enhancing climate resilience in water and sanitation infrastructure and services, including **Nature-based Solutions and non-structural solutions**
- **Describe** how resilience is affected by the broader enabling environment.
- **Explain** the strategies - Green and blue strategies, Grey strategies, and Hybrid strategies, and identify where each of these might be appropriate

02 | Why it matters

Why it is important to make infrastructure resilient

Climate resilient infrastructure positively impacts the social and economic wellbeing of populations. Building resilience of infrastructure can ensure:



Increased Reliability of Service Provision

Ensures consistent access to essential services, even during climate-related extreme weather events including floods and heatwaves



Increased Asset Life

Prolongs the lifespan of infrastructure assets, maintaining their functionality and service provision capabilities over time



Improved Efficiency of Service Provision

Optimizes resource allocation and streamlines service delivery, leading to more effective and equitable delivery of essential services

Why it is important to make infrastructure resilient

	Increased Reliability of Service Provision	Increased Asset Life	Improved Efficiency of Service Provision
 **Social**	• Enhanced public health and well-being, particularly in vulnerable communities during emergencies • Reduced vulnerabilities of human life and livelihoods by providing continued access to vital services	• Preservation of public health and safety through preventing infrastructure failures and service interruptions • Promotion of social stability and resilience by ensuring continued functionality of infrastructure assets	• More equitable access to essential services, reducing disparities in service delivery and promoting social inclusion • Greater public satisfaction and trust in urban infrastructure systems through streamlined service provision processes
 **Economic**	• Economic stability and resilience in urban areas, with businesses able to operate without interruption • Attraction of investment and support for economic growth by providing a conducive environment for businesses to thrive	• Economic savings and efficiencies through reduced frequency of asset replacements and repairs • Maximization of benefits derived from infrastructure development, supporting long-term economic sustainability	• Reduces financial burden on governments and taxpayers through cost-effective operation of infrastructure systems • Fosters innovation and competitiveness by attracting investment and supporting economic growth in urban areas

03 | Climate-resilient infrastructure & services

How climate change impacts infrastructure



Asset damage

Climate change can cause direct physical damage to infrastructure assets. Asset damage leads to additional costs and deterioration in the performance and value of the asset and the services it provides.



Service disruption

Climate change can cause disruptions in the provision of infrastructure services. This can cause additional costs to maintain the same level of service under different climatic conditions (e.g. larger reservoirs are needed to address more variable precipitation).



Changing demand for infrastructure services

Climate change impacts the demand for infrastructure services, putting pressure on service providers.

Examples

Heatwaves lead to overheating of power generation equipment, causing failure.

Flooded water treatment plant or wash-out water transmission pipelines cause disruption to provision of water supply services and impacting communities

Increased electricity demand for cooling due to increased temperatures, which can lead to power outages and grid overloads.

How climate change impacts water infrastructure

	Storms & Cyclones	Flooding	Droughts
 **Water**	• Damage to water infrastructure such as pipes and treatment plants during storms. Storm runoff contaminates water supply with pollutants and debris. • Landslides wash away pipes, intakes etc.	• Damage to water distribution systems, such as burst pipes leading to disrupted services. • Flooding overwhelms water treatment facilities, leading to contamination of water supply.	• Loss of coastal water infrastructure and natural water buffers like wetlands. • Saltwater intrusion compromises the quality of freshwater resources.

How climate change impacts sanitation

	Storms & Cyclones	Flooding	Droughts
 **Sanitation**	• Damage to super structure of latrines due to strong winds and intense rain • faecal waste to spread, contaminating water sources, and sharply increasing health risks—especially in low-lying and informal settlements.	• Flooding compromises sanitation systems, escalating the risk of waterborne diseases. • Damage to facilities, for example due to water ingress.	• Droughts disrupt sanitation by reducing water needed for toilet use and system functioning, increasing unsafe practices, and raising health risks when waste becomes concentrated and poorly managed.

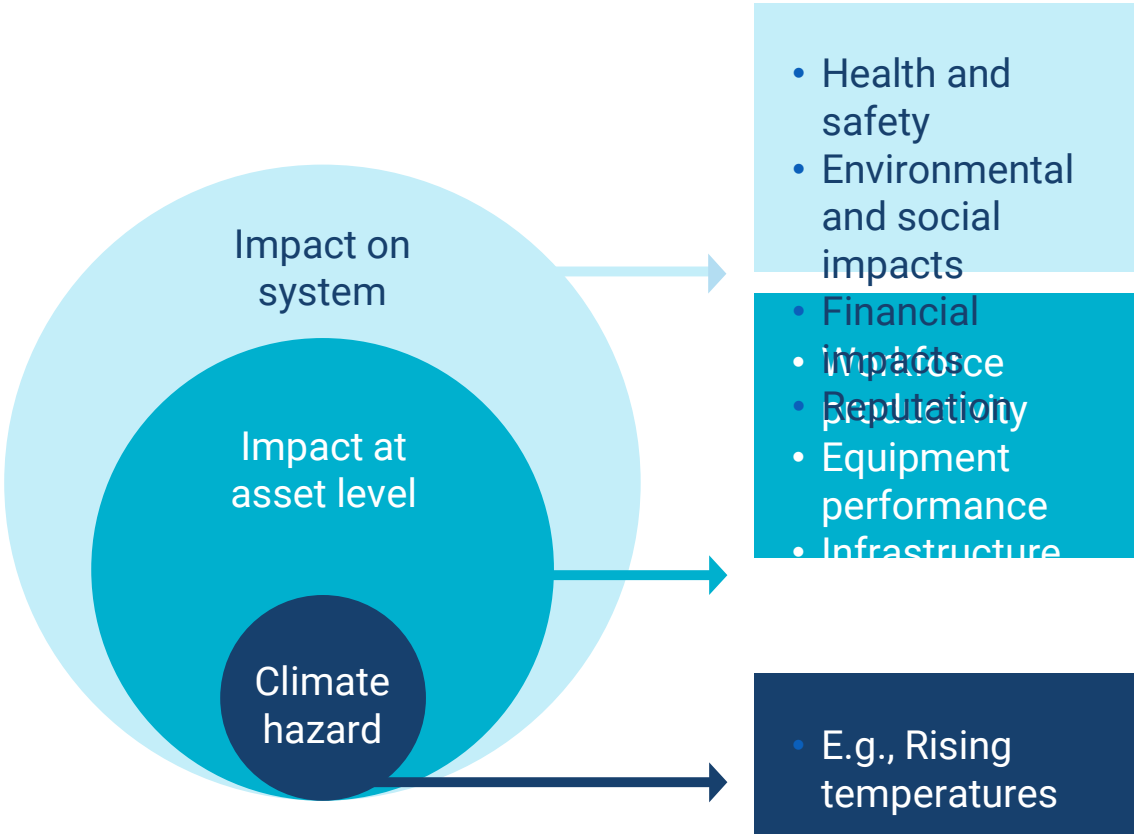
Cascading impacts of climate change

Cascading impacts of climate change

Infrastructure increasingly operates as an interdependent “system-of-systems”, meaning infrastructure assets depend on each other for delivering services

However, this also means there is potential for cascading failures and systemic risks due to climate impacts

A single climate impact on one infrastructure asset or service can cause a cascade of impacts across other assets & services, leading to more severe and pronounced negative consequences for an area.



Cascading impacts of climate change

Irrigation & Food Security

Initial impact: Prolonged drought dries up irrigation canals.

Cascade 1: Farmers lose crops, leading to food shortages and reduced household incomes.

Cascade 2: Loss of local harvests increases dependence on food imports, driving up prices.

Cascade 3: Malnutrition and poverty rise, placing pressure on health and social protection systems.

Hydropower & Energy Systems

Initial impact: Heavy rains cause sedimentation and landslides that block a hydropower reservoir.

Cascade 1: Power production drops sharply, leading to rolling blackouts.

Cascade 2: Water pumping for irrigation and urban supply is interrupted, further stressing agriculture and households.

Cascade 3: Industries dependent on stable electricity (e.g., food processing, cold storage) shut down, triggering job losses.

Cascading impacts of climate change

Inland water transport & trade

Initial impact: Extreme floods alter river flows, making inland navigation unsafe.

Cascade 1: Barges carrying grain and fuel cannot move, disrupting supply chains.

Cascade 2: Trucking takes over transport, causing higher costs and CO_2 emissions.

Cascade 3: Markets face shortages of essential goods, deepening regional inequalities.

Ecosystems & tourism

Initial impact: Heavy rains cause sedimentation and Initial impact: Coral reefs and wetlands are damaged by rising sea temperatures and salinity.

Cascade 1: Fisheries collapse, removing a key food and income source for coastal communities.

Cascade 2: Loss of natural storm barriers increases coastal flooding and damages infrastructure.

Cascade 3: Tourism revenue falls, eroding local government budgets for services and recovery.

Climate impacts on vulnerable groups

People Living in Informal Settlements

- Increased temperatures put pressure on an already-stressed water supply, which has a disproportionate effect on urban poor living in informal settlements. They have to pay high prices to buy water from informal vendors when it is not available.

- Heat-related illnesses, especially of children and the elderly, increase living costs as public health facilities have limited capacity to provide care at affordable cost.

- Insecure tenure of informal settlements restricts household access to electricity to cope with heat. They experience load-shedding more often and need to rely on services from informal vendors.



Photo by Rodger Bosch, AFP

Climate Impacts on Vulnerable Groups

Smallholder Farming Communities

- Communities depending on smallholder farming are highly exposed to changes in rainfall and temperature.
- Climate change has increased the risks they face through prolonged droughts and unpredictable rainy seasons.
- Crop failures due to drought and pest outbreaks linked to higher temperatures reduce food availability and household income.
- Women and seasonal labourers, who rely heavily on agricultural employment, face loss of livelihoods and greater food insecurity during these shocks..



Review Exercise: Climate-resilient infrastructure & services

Develop your understanding of your own context by thinking critically about your infrastructure and services:

- Use the list of hazards and risks you started at the end of Module 1
- Considering this list, which infrastructure and / or services in your context are most at risk?
- What infrastructure or services would you consider a priority for climate risk reduction?
- How might you do this?



Keep your answers on a paper or doc so you can refer to them again.

Climate-resilient infrastructure & services

We need to make investments to ensure that its infrastructure is resilient to climate hazards and so that infrastructure and services protects citizens from negative climate risks. There are a wide range of inter-connected infrastructure systems where you can prioritise climate resilient action:





What makes infrastructure climate-resilient?

It is planned, designed, built and operated in a way that **anticipates, prepares for, and adapts** to changing climate conditions.

It can **withstand** climate-related disruptions and continue to provide services such as power, water, and healthcare services even during crises.

It can **recover rapidly** from climate-related disruptions without rebuilding the vulnerabilities of the past.

It **considers interdependencies** and how changes in one infrastructure system may affect risk elsewhere e.g. an increase in paved surfaces for improved road networks may increase flood risk.

It **supports inclusive social** and economic resilience so that people are less vulnerable to climate hazards.



Dhaka; Photo by Lep tNicolas, Flickr

Two approaches to climate resilient infrastructure

01

Climate Proofing Infrastructure: When building new infrastructure or upgrading existing infrastructure, ensure that the design of the asset can withstand current and future climate impacts

Example: *Upgrade road networks in floodplains using climate resilient design standards and materials, so they can withstand more frequent flooding caused by climate change.*

02

Infrastructure that Addresses Underlying Vulnerabilities: Make infrastructure investments to address peoples' underlying vulnerability so they are less severely affected by climate impacts

Example: *Provide better access to reliable electricity, so that when extreme heatwaves occur, they are not as vulnerable to heat stress and can cool their homes effectively.*



Dhaka; Photo by Bobulix, Flickr

Design principles for climate- resilient infrastructure

01 | Systems Approach

02 | Adaptive Management

03 | Equity & Inclusion



Photo by Luis Tato, AFP

01 | Systems Approach

A systems approach is used to address the interdependencies across different infrastructure assets and services within a city. It considers how individual assets influence one another and how they interact with the overall system.

A systems approach identifies risks to the entire system, including cascading impacts. It also considers that resilience building interventions should increase resilience of the entire system, not just a single asset or sector.

Example: Road infrastructure is interconnected with water management infrastructure, for managing run-off water during rainfall. To increase the climate resilience of road networks, city planners must consider this interconnection. Making drainage systems more resilient will help ensure that roads can cope with future flooding events.



Khulna Dacope Koira, Bangladesh; Photo by Emdadul Islam Bitu, UNDP Bangladesh

02 | Adaptive Management

Adaptive management is a strategy that helps handle the uncertainties linked to climate change over the lifetime of an infrastructure investment. Sources of uncertainty include climate model projections, especially at the local scale, and socioeconomic changes linked to urban growth.

This means **integrating flexibility from the start**, so that infrastructure plans can respond to changing circumstances and multiple possible climate scenarios across the life of the investment. This also reduces costs, avoiding locking in large up-front investments.

Requires **monitoring and evaluating performance** over the lifetime of the investment, which allows decisions to be made at later points in time, according to performance, updates to climate science and attitude to risk. Climate risk assessments (CRAs) are an important input to these decisions.



Khulna Dacope Koira, Bangladesh; Photo by Emdadul Islam Bitu, UNDP Bangladesh

03 | Equity & Inclusion

Equitable & Inclusive Access to Services

Effective infrastructure planning must ensure accessible, reliable and quality services for all. By 2050, urban areas are expecting an influx of 2.5 billion people, mainly in Asia and Africa. By the same year, up to 85% of urban poor neighborhoods are projected to be at risk of flooding, compared to about 60% of the broader urban landscape.

Social factors like gender and age result in differential vulnerabilities from poor access to services, even within vulnerable groups. Vulnerability is not uniform as it is shaped by overlapping factors such as income, disability, migration status, ethnicity, or housing conditions

For example, in poor settlements, women bear the brunt of climate-related water scarcity as they fetch water for households. Reliable piped water infrastructure at the household level can help relieve this burden and contribute to women's well-being.



Kallyanpur slum, Dhaka; Photo by Kibae, UN Photo

Questions

Open Floor

Does anyone have any questions about what makes climate resilient infrastructure?



Photo by Brian Inganga, AP

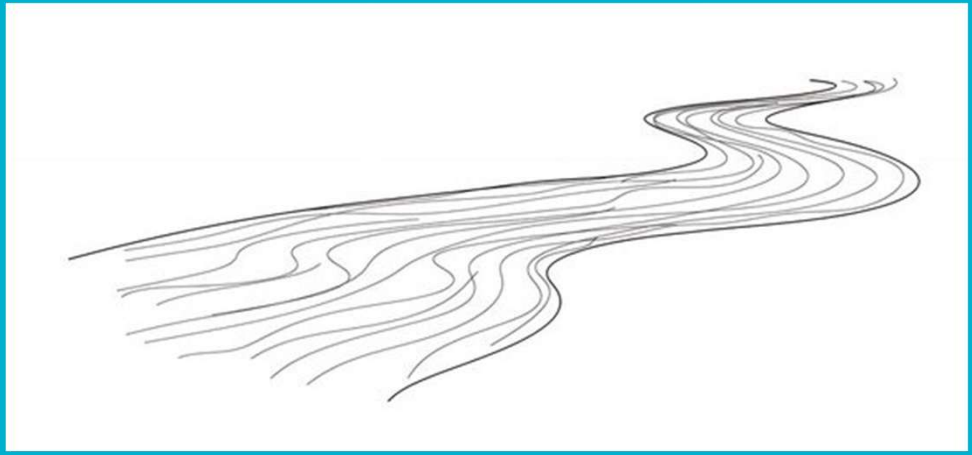
LUNCH



Energiser: River of Life

On an A4 blank piece of paper, draw a river that represents your own timeline on learning on climate, adaptation, water

- Think how the river flows
- What turns, twists and rapids are in your river? What have been your tributaries
- Be creative!
- You have about 5-10 minutes



Once done, please stick the river to the wall and join the discussions

04 | The broader enabling environment

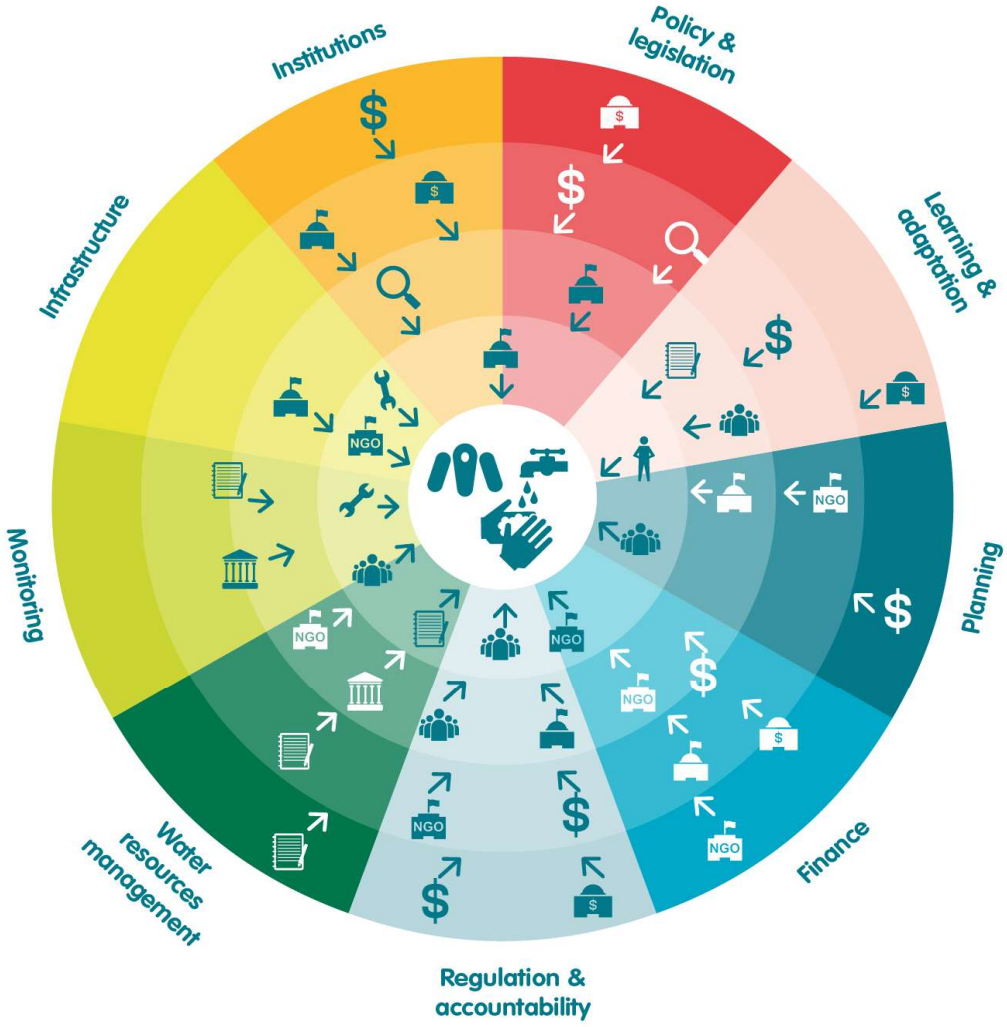


The broader enabling environment - supports non structural measures



Adapted from Agenda for Change

Systems are multi-level



- Government
- Community organisations
- Private suppliers
- Regulators
- Researchers
- Consumers
- Donors
- Development banks
- NGOs

- International
- National
- District
- Community



Policy & legislation: sector policy & strategy, legal framework, norms & standards, by-laws

The mechanisms by which a government sets out its **vision for the sector** (policy) and determines the **legal framework for achieving that** vision (legislation)

- National policy
- Legal framework
- Norms and standards
- National guidelines for development and management of services



Institutions: coordination, roles, responsibilities, capacity, sector mechanisms

The **formal organisational arrangements** in a country's WASH sector;

The **capacity and resources** that each organisation has to perform its role;

The **coordination mechanisms** amongst the organisations.

- Clearly defined roles and responsibilities across governance levels
- Responsibilities and institutional set up for service authorities for different service delivery models are clearly defined
- Clearly defined and filled staffing requirements



Planning: planning & budgeting, capacity & frameworks for planning

Mechanisms, frameworks and capacities for planning and budgeting at different levels.

This is the foundation for implementation of policies to achieve universal access to sustainable services.

- National planning mechanisms exists aligned to WASH targets
- Strategic planning at decentralised levels involving relevant stakeholders
- Includes increasing access as well as ensuring on-going service provision
- Plans include costs and details on funding and financing these

Finance: flows & responsibilities, clear frameworks including life-cycle costs & source identification

- Funding sources for all lifecycle costs components are identified
- No budget gaps
- Responsibility for new infrastructure and major maintenance are defined
- Budgets and expenditure are justified at national government level, legislature & ministry



Infrastructure: development & maintenance, project cycles, asset management, roles

Development

Maintenance

M**echanisms and processes** for developing new infrastructure and maintaining existing facilities.

- Asset ownership is clear
- Adequate and up-to-date asset data
- Responsibility of asset management is clear
- Asset management is done using standardised tools, guidelines and trainings



Monitoring: framework & routine implementation, service levels, use of data

A **systematic way of collecting, analysing** data and actually **using it to inform action and decision making** at multiple levels.

Often produces input for building blocks, e.g. planning, regulation and accountability, learning and adaptation, etc.

- Monitoring includes monitoring of assets, services levels, performance of service providers and service authorities, and systems strength.
- Covers all geographies and service delivery models
- Data is regularly updated
- Data has a clear purpose and is used accordingly



Regulation & accountability:
accountability mechanisms, regulatory framework & capacity

Formal **regulatory mechanisms** and **enforcement processes** as well as other mechanisms **to hold decision makers, service providers and users to account** and ensure that the interests of each group of actors are respected

- Clear regulator models for different, e.g. regulation by agency or by contract
- Covering the different regulatory functions include performance, economic and environmental regulation

Water resources management: allocation & management of resource abstraction, water quality, coordinated efforts

The communication, coordination and control of how water is allocated to different sectors.

- Legislation/policy in place defines priorities and processes related to groundwater and surface water
- Institutions in place to undertake mandated functions
- These platforms/institutions allow representation of service providers and authorities



Learning & adaptation: capacity & frameworks to capture and feedback lessons learned, update & adapt various building blocks

The ability to adapt based on experience and changing circumstances is an essential characteristic of any robust system.

This block presumes inclusive platforms for the **regular sharing** of **information** and **use of data** for critical analysis, with **insights from multiple stakeholders**, including civil society.

- Multi stakeholder institutionalized learning platforms
- Other sectors are represented
- These platforms have bottom-up and top to bottom linkages

Recap exercise

Buzz groups

- In groups of two – three discuss the previous session
- Discuss any questions you have
- Up to 5 minutes. We want to hear a nice Buzz around the room!

If you want to share an experience with the room, please raise your hand.



What is climate finance?

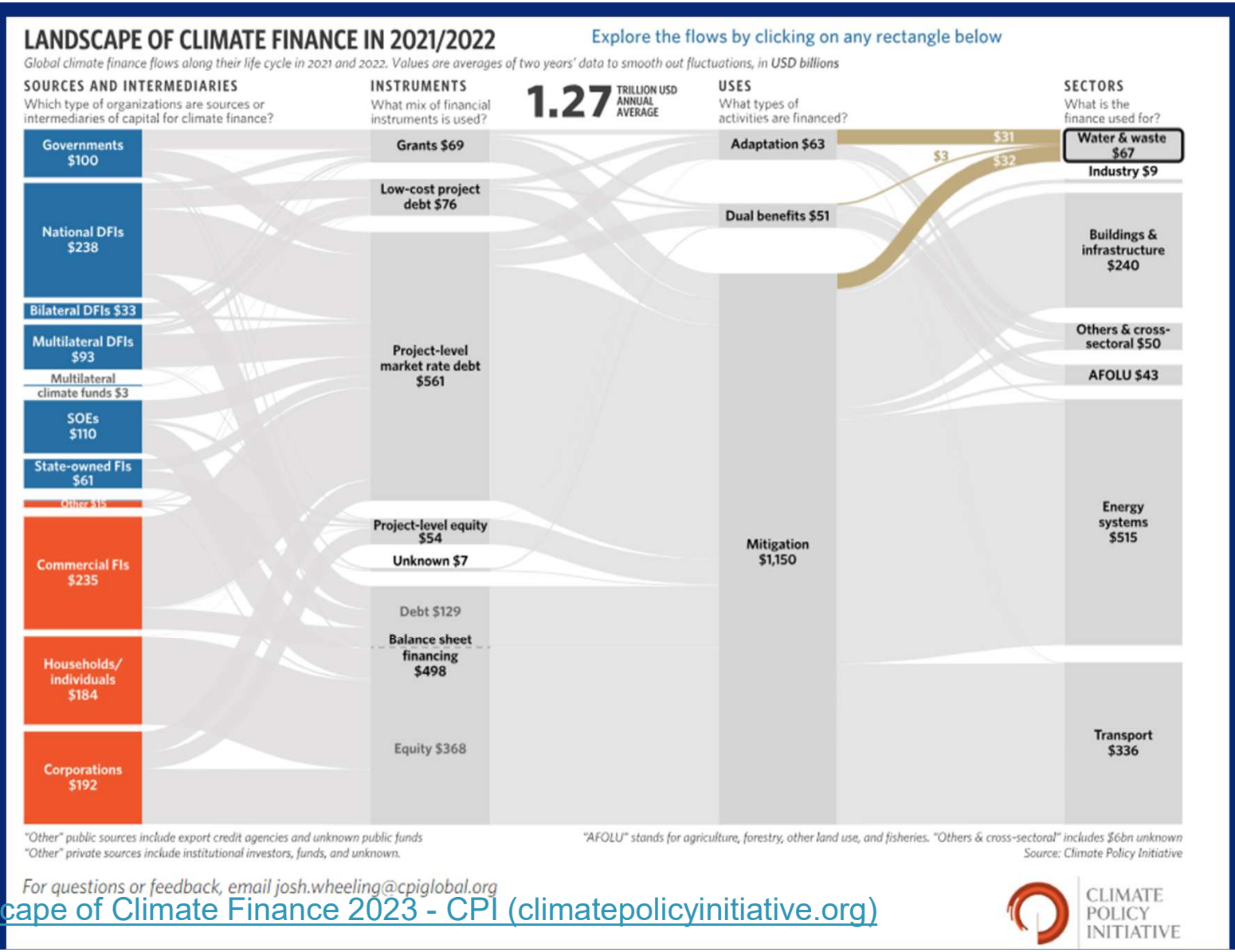
Countries need financial resources to invest in public infrastructure and services. Climate finance refers to money that can be used to make investments that will address climate change.

As climate change accelerates over the coming decades, cities will need larger amounts of finance to make infrastructure resilient to the impacts of climate hazards, and to invest in new infrastructure that makes people resilient to climate impacts.

While climate finance can be used for adaptation & resilience as well as climate mitigation, in this course we focus on finance for adaptation & resilience.



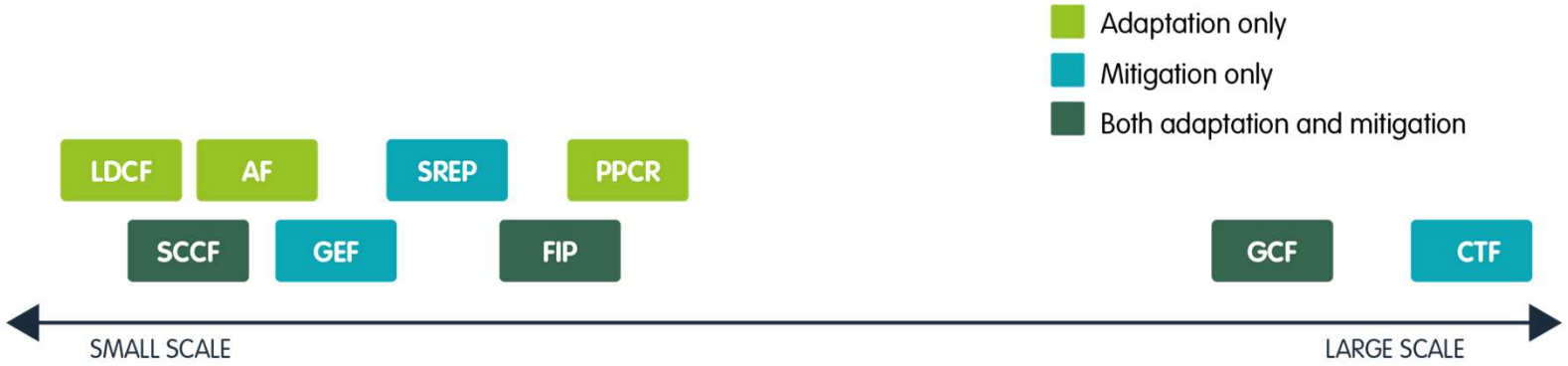
Photo montage by Tom Roberts, Flickr



Global Landscape of Climate Finance 2023 - CPI (climatepolicyinitiative.org)

The largest climate multilateral funds that may be of interest to Water services include

- Green Climate Fund (GCF) (biggest and sole focus on climate change)
- Global Environment Facility (GEF), which comprises the following:
  a. GEF Trust Fund
  b. Least Developed Countries Fund (LDCF)
  c. Special Climate Change Fund (SCCF)
  d. Small Grants Programme (SGP)
- Adaptation Fund (AF)
- Climate Investment Funds (CIF)



Note: LDCF, Least Developed Countries Fund; SCCF, Special Climate Change Fund; AF, Adaptation Fund; GEF, Global Environment Facility; SREP, Scaling-Up Renewable Energy Program; FIP, Forest Investment Program; PPCR, Pilot Program for Climate Resilience; GCF, Green Climate Fund; CTF, Clean Technology Fund.

Adapted from: WRI.

All Climate Finance must have a clear climate rationale and contribute to **additionality**

Additionality is the additional costs required to make a service climate resilient or/and low carbon. This is the part of an intervention that can be directly attributable to climate change. This ensures that as climate finance increases, it does not reduce the funding available for other development needs.

Climate Risk – that speaks to hazards, vulnerabilities, and exposure is a prerequisite for a clear **climate rationale** to address additionality.

Climate Rationale for water services
Examples for floods and droughts

Good examples	Bad examples
• Climate-resilient water infrastructure to survive floods and droughts • Leakage reduction to conserve scarce water resources • Water storage to maintain services during floods and droughts • Addressing new disease vectors	• Increasing per capita water use, increasing population • Urban migration and refugees (unless ‘climate refugees’) • Lack of maintenance • Improving WASH coverage for development purposes

Climate Rationale for water and sanitation services – Examples for sanitation mitigation and adaptation

Good examples	Bad examples
• Climate-proofing hardware and infrastructure to survive floods, fires and droughts • WASH services for persons relocating due to climate change (i.e., 'climate refugees') • Supplying treated wastewater to farmers/industry in drought-affected areas • Reducing the energy use of wastewater infrastructure • Capture and use of biogas as a renewable energy source	• Projects to serve a growing population • Humanitarian interventions (e.g., responses to conflict situations) • Upgrading hardware (e.g., pit latrines to ventilated improved pit (VIP) toilets) • Treating wastewater to prevent pollution

Tips for climate financing

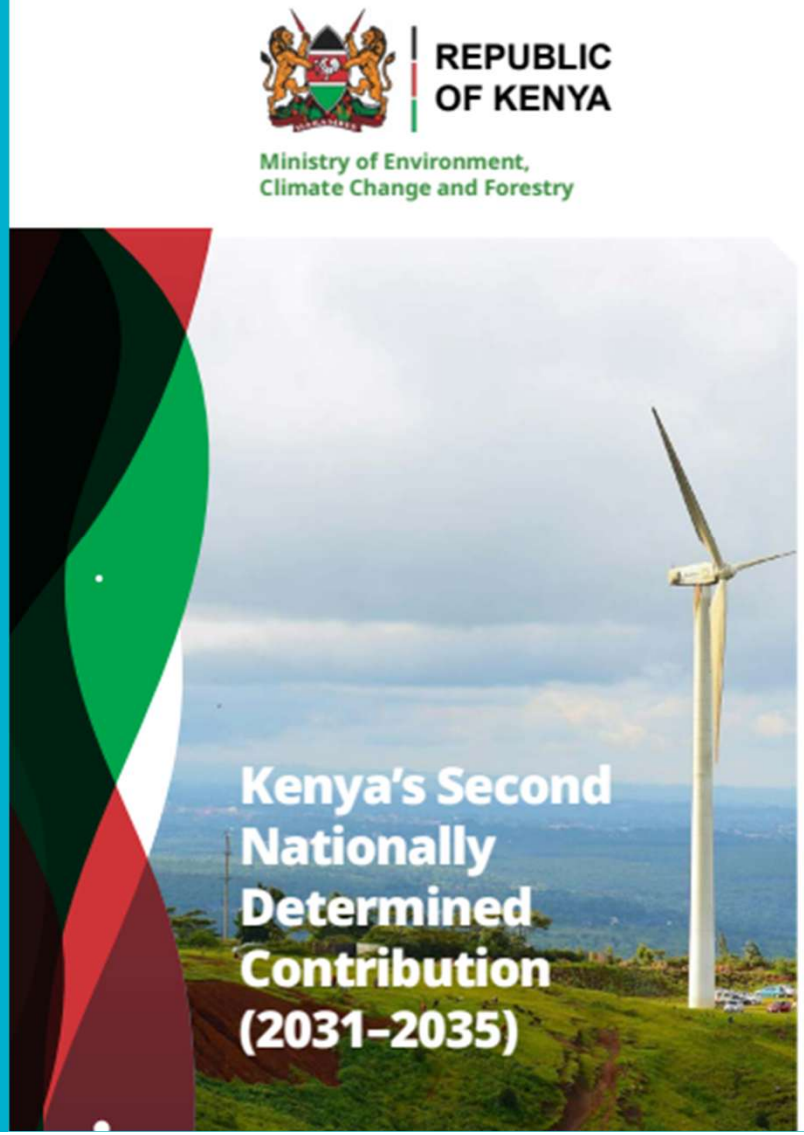
- **Know the landscape!** Who has received funding for what, where, and using which instruments? Who currently has direct access?
- **Develop a climate rationale** (at national or sub-national level) to clearly show **additionality.** Clear articulation of climate risk will be expected.
- Ensure knowledge of **NDC and NAP processes**. Understand the contribution of your proposal to those processes.

NDC exercise

Buzz groups

- In groups of two or three, locate the NDCof Kenya
- Locate the targets that mention water
- Does your work link to any of these?

If you want to share an experience with the room, please raise your hand.



05 | Ways to build resilient infrastructure



Three ways to build resilient urban infrastructure



01 | Structural Measures



02 | Non-Structural Measures



03 | Nature-based Solutions

01 | Structural Measures

Structural measures are physical constructions and assets that are built to reduce or avoid the impacts of climate hazards.

They are also known as ‘hard’ or ‘grey’ infrastructure, since they are often made of concrete or other long-lasting materials.

Examples of structural measures include:

- Strengthening pipes across streams to avoid being washed away during intense run-off
- Retrofitting existing infrastructure e.g. raising the intake of a borehole to protect against sea level rise



01 | Structural Measures

Examples:

- Raising the borehole well head above the flood level to avoid damage to the wellhead fittings.



02 | Non-Structural Measures

Non-structural measures are ‘soft’ measures that reduce climate risks. They focus on improving institutional, organizational and human capacity to respond to climate change.

These non-physical measures include policies, plans, capacity building, investment in data collection and technology, awareness raising, monitoring and evaluation (M&E), etc.

Examples of non-structural measures include:

- Establishing inclusive early warning systems that collect data on climate risks.
- Building capacity of urban actors to ensure basic understanding of climate information and implications on key sectors
- Developing policies & building codes to reduce climate risks and promote resilience of water infrastructure.



Photo by GCA

Combined Structural & Non-Structural Measures

Cities can **combine structural and non-structural measures** for more holistic resilience solutions.

Building resilience of infrastructure has conventionally focused on structural or ‘hard’ measures (e.g. engineering practices). However, deploying non-structural or ‘soft’ measures is equally important – urban actors need appropriate information, capacity and enabling policy environment to take action.

In many cases, the two types of measures are integrated into a resilience intervention. Examples of combined measures could include:

- Physical flood protection measures such as dams and flood defenses, combined with hydrological catchment modelling.
- Water distribution infrastructure and community water management committees that monitor groundwater availability and quality.



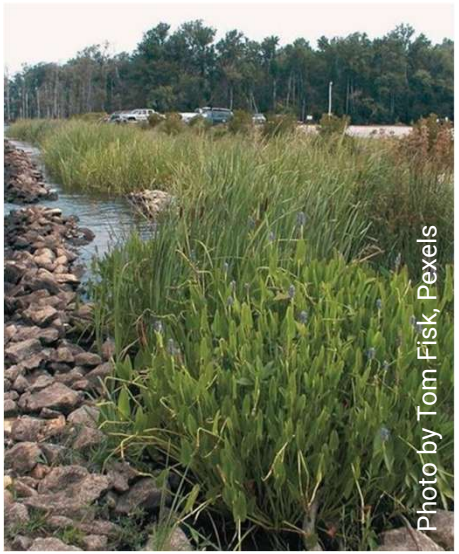
Demonstration of the use of a Tromino, a passive seismic tool used for stratigraph and bedrock mapping, to local water officials, Kenya; Photo by USGS

03 | Nature-based Solutions


Photo by Tom Fisk, Pexels

Natural

Restoration and conservation of natural habitats, with active management


Photo by Tom Fisk, Pexels

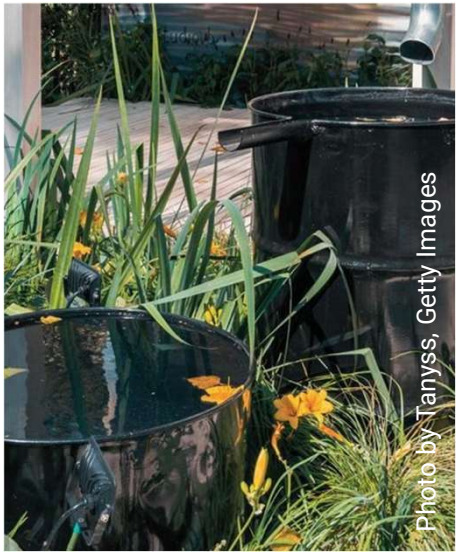
Semi-cultivated

Living shorelines
Constructed wetlands
Hybrid reefs
Riparian buffers


Photo by PixelShot

Cultivated

Bioswales
Rooftop gardens
Urban forests
Green alleys


Photo by Tanyss, Getty Images

Engineered

Permeable pavements
Rainwater harvesting
Groundwater recharge wells

03 | Nature-based Solutions

Nature-based solutions are important because they can reduce some of the negative impacts of grey infrastructure:

The expansion of built-up areas and impermeable surfaces, often at the cost of green and blue (water-based) spaces, heightens the risks associated with climate change including heatwaves and floods.

Urban areas can be 10-15°C hotter than their rural counterparts. Concrete surfaces like roofs and pavements absorb more heat and are resistant to cooling, contributing to the urban heat island effect.

Urban expansion in reclaimed blue spaces, such as degraded lakes and wetlands, disrupts natural drainage patterns, leading to higher instances of urban flooding during heavy rainfall.

NbS approaches that integrate natural ecosystem processes into infrastructure planning offer an effective alternative or addition to traditional built/grey infrastructure.



03 | Nature-based Solutions

Nature-based solutions can complement, substitute for, or protect traditional grey infrastructure to enhance the resilience of service delivery to climate change.

Complement: Restoring watersheds, which serve as ecological infrastructure supplying water to reservoirs, plays a vital role in regulating hydrological processes and maintaining water quality.

Substitute: Using deep-rooted vegetation for slope stabilization offers a cost-effective alternative to building concrete retaining walls, and is estimated to save up to 90% in implementation costs.

Safeguard: Afforesting mangrove forests could protect shorelines from erosion, thus safeguarding nearby roads, buildings, and utilities from wave damage during storms and sea surges.



ICBAAR Project Bangladesh. Photo by UNDP Bangladesh

Mikindani Constructed Wetland

Mikindani struggled with untreated effluent draining into Tudor Creek. Wetlands wasconstructed:

- mimicks the natural filtering process of wetlands to clean wastewater.
- grasses and reeds to absorb and break down pollutants in the water



Sand dams Makueni County

- More than 900 sand dams
- Storing water in sand reduces evaporation
- contamination and disease vectors such as mosquitoes and freshwater snails.
- Low maintenance
- Challenges to extract water safely
- Not all locations suitable



03 | Nature-based Solutions

Benefits of Nature-based Solutions

They provide a range of climate adaptation and mitigation benefits



They additionally offer multiple social benefits



06 | Exercise



Exercise

In groups of two or three brainstorm on Nature based solutions that you can are familiar with

Put them on post-it note

Place them on wall flipcharts under too much, too little and too dirty categorisation

07 | A quiz & end of the day reflection



Photo by Adam Vradenburg on Unsplash

Which are the three options that resilience of infrastructure can strengthen:

1. Guarantees that climate-related extreme weather events will no longer occur or affect infrastructure systems
2. Ensures consistent access to essential services, even during climate-related extreme weather events including floods and heatwaves
3. Eliminates the need for ongoing maintenance and operational management of infrastructure assets
4. Prolongs the lifespan of infrastructure assets, maintaining their functionality and service provision capabilities over time
5. Optimizes resource allocation and streamlines service delivery, leading to more effective and equitable delivery of essential services

Which statement best explains why climate finance must have a clear climate rationale and demonstrate additionality?

1. Because additionality covers the extra costs needed to make services climate-resilient or low-carbon.
2. Because climate finance can replace existing development budgets if climate impacts are expected in the future.
3. Because any development activity automatically qualifies as climate finance, regardless of climate risk analysis.

True or False

Climate-resilient infrastructure is designed to resist climate hazards and does not need to consider recovery, interdependencies, or social impacts.

Which of the following are Nature-based Solutions that strengthen water services? (Select all that apply)

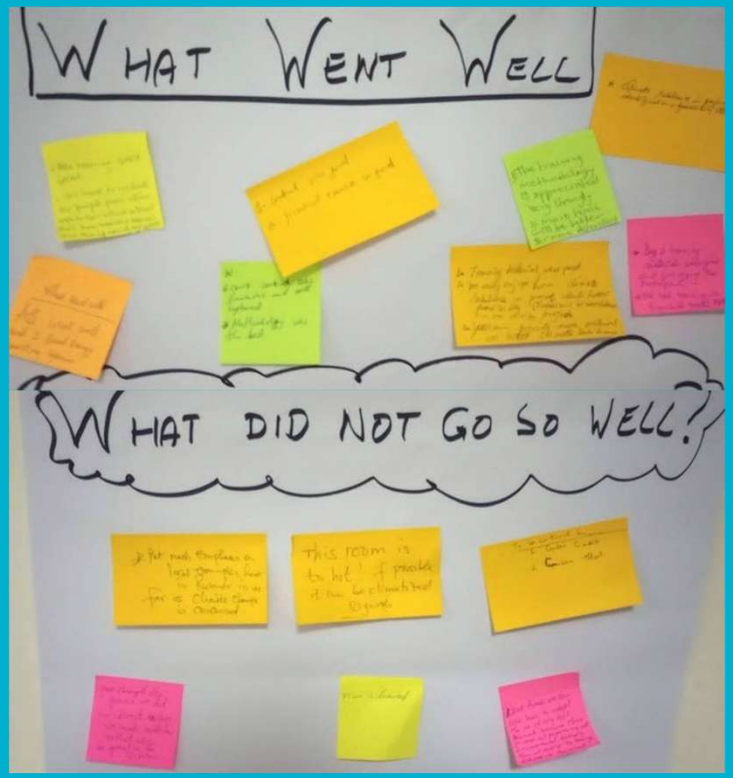
1. Restoring upstream wetlands to reduce flood peaks and protect water intakes
2. Protecting and reforesting catchment areas to improve water quality and reduce treatment costs
3. Using green infrastructure (such as infiltration areas) to recharge groundwater and reduce urban flooding
4. Conserving riparian buffers to reduce erosion and sedimentation in water sources
5. Raising a concrete flood wall around a treatment plant
6. Increasing groundwater abstraction by pumping water to increase irrigation

True or False

A strong system is essential for ensuring the continued functionality of climate-resilient services and practice of behaviors, as well as for delivering acceptable service levels to communities over time.

End of day reflection

- **Yellow post-it**
  what went well today
- **Pink post-it**
  what could be improved of today
- Post them on the evaluation sheet when leaving the room



Key points Module 4

Extra resources Module 4

Rising to the Challenge: Success Stories and Strategies for Achieving Climate Adaptation and Resilience”
World Bank (2023)

"Climate-Resilient Pathways: Adaptation, Mitigation, and Sustainable Development”
IPCC (AR5, Working Group II)

Sectoral guide: Water security | Green Climate Fund
GCF

UTS-ISF, 2023. ClimateFIRST: Climate Framework to Improve the Resilience of Sanitation Technologies: How-to Guide

End of day reflection

- **Yellow post-it**
  what went well today
- **Pink post-it**
  what could be improved of today
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