Urban Ecosystem-Based Adaptation Training Programme

Module 2: Introduction to EbA

EbA for Urban and Peri-urban Spaces: Using Nature-Based Solutions as a Key Climate Change Adaptation Strategy for Advancing Sustainable Development in Jamaica

Overview of Module 1:
Mentimeter (menti.com) – 4616 5018
Jamaica's Multi-Hazard Environment and Setting the Context for Scaling up the Use of EbA in Jamaica

Module 1 is structured around 6 topics as follows:

Topic 1: Jamaica's Multi-Hazard Environment

Topic 2: A Brief Analysis of Jamaica's Natural Hazard Landscape

Topic 3: State of the Jamaica's Biodiversity and Ecosystems (Discussion)

Topic 4: Climate Change and its Impacts

Topic 5: Future climate change projections and scenarios for Jamaica

Topic 6: Urban and peri-urban issues and challenges in Jamaica

Overview of Module 2: Introduction to EbA

- Topic 1: Introducing EbA
- Topic 2: The Contribution of Ecosystems and Biodiversity to Socio-economic Development and Linkages with EbA
- Topic 3: Review of Ecosystem Services - Regulatory, Production, Information and Carrier Functions of Ecosystems and their Role in Disaster Risk Reduction and Climate Change Adaptation
- Topic 4: Key Terms and Concepts related to EbA
- Topic 5: Using Ecosystems (mangroves, forests, watersheds, coral reefs, seagrass beds etc.) to Reduce Disaster Risks and Support Climate Change Adaptation in Urban and Peri-urban Communities
- Topic 6: The Economic, Social, and Environmental Benefits of EbA to Urban and Peri-urban Areas… Towards sustainable Development
- Topic 7: Advantages of EbA to urban and peri-urban planning and development and defining EbA for urban and peri-urban resilience
- Topic 8: Ecosystem-based Adaptation Options in Urban Areas and Intended Outcomes
- Topic 9: What does Effective EbA Look Like

Objectives of Module 2:

Describe	**The profile of urban and peri-urban areas and support provided by peri-urban areas to urban areas**
Examine	**The list of benefits - products and services - provided by the natural enivronment and ecosystems**
Examine	**Nature-based solutions and the linkages to climate change**
Know	**The different types of NbS and EbA approaches**
Examine	**The relationships among EbA, environmental conservation and management, disaster risk reduction and climate change adaptation**
Explain	**The characteristics of resilient cities**
Understand	**How ecosystems are key to social and economic development and the linkages among ecosystems, climate and hazard resilience and sustainable urban development**
Understand	**The linkages between EBA and EcoDRR**

Topic 1: Introducing EbA

Ecosystem based adaptation (EbA) *uses biodiversity and ecosystem services as part of an overall adaptation strategy to help people and communities adapt to the* negative effects of climate change at local, national, regional and global levels

What is EbA?

- A subset of nature-based Solutions (NbS)) and an umbrella concept that includes EbA approaches to climate change and to Disaster Risk Reduction (EcoDRR)
- The use of biodiversity and ecosystem services as part of an overall strategy to help people adapt to the adverse effects of climate change
- Represents a suite of cost-effective approaches to reduce the vulnerability of urban and peri-urban communities to climate change
- Involves protecting, maintaining, and rehabilitating ecosystems such as wetlands, forests, and agroecological systems
- Also include activities such as reforestation, especially in urban poor communities
- A strategy for adapting to climate change that harnesses NbS and ecosystem services
- Is the use of natural capital by people to adapt to climate change impacts, which can also have multiple co-benefits for mitigation, protection of livelihoods and poverty reduction
- Increases the resilience and capacity of selected ecosystems to naturally adapt to changes, including climate induced changes, over time

Topic 2: The Contribution of Ecosystems and Biodiversity to Socio-economic Development and Linkages with EbA

Environmental quality is inextricably linked to economic and social well-being, as a healthy environment – able to carry out its functions unencumbered – contributes to social and economic development as natural resources and ecosystems provide a range of goods and services

Some Points for Consideration and Discussion

- The list of benefits provided by nature is vast.
- A healthy environment and its associated ecosystems provide services such as nutrient cycling, flood control, climate control, soil productivity, forest health, pollination services, waste assimilation and natural pest control among others
- Environmental well-being contributes to economic well-being when the environment is able to properly carry out its functions.
- Economic activity itself does not present a threat to the environment. It is the speed and scale of this economic activity which presents a threat to the integrity of the environmental support system that underpins economic activity.
- While economic activity is essential for the provision of human well-being, economic activity that does not take into account its effect on the environment through the overexploitation of materials and the unmanaged generation of wastes, will ultimately not only endanger further economic activity, but will result in negative impacts to human economic and social well-being.
- The concept of sustainability has been described as living off the interest of natural capital without harming the principal. The greatest threats to ecosystems are the conversion of land and water habitats for agricultural uses or their destruction by over-harvesting; how we produce human food, animal feed, and fiber will largely determine the preservation of biodiversity and ecosystems.

Case Example: Environmental Services Vital to Agriculture

- Soil Forming and Conditioning – Invertebrates develop upper soil layers through decomposition of plant matter, making organic matter more readily available, and creating structural conditions that allow oxygen, food and water to circulate
- Waste Disposal – Ecosystems recycle, detoxify and purify themselves, provided that their carrying capacity is not exceeded by excessive amounts of waste and by the introduction of persistent (synthetic) contaminants. (Nutrient filtering by mangroves can be likened to oxidation ponds of traditional wastewater treatment plants)
- Pest Control – Predator-prey populations create a self-regulating balance, whereby biological (inter-species) competition keeps more pests in check than could ever be accomplished through the use of pesticides.
- Biodiversity – Ecosystem stability depends on the results of competition between different species for food and space. It is this competition that increases species diversity
- Pollination – 220,000 out of 240,000 species of flowering plants are pollinated by insects.
- Carbon Sequestration – Because biomass has the capacity to store carbon, where the soil is not tilled, or where minimum tillage is practised, soil contributes to carbon retention.
- Habitat – The provision of space, shelter and food for many important macro- and microorganisms, such as earthworms.

Tabletop Discussion...

Let us play
How and Why ?
Apply to Jamaica

- Ecosystem services are important in reducing social, economic and health-related vulnerabilities.
- A decline in ecosystem services impacts the resources available to people and communities which can lead to increased vulnerability to hazards and decrease in resilience.
- Ecosystems that offer nature-based solutions (NBS) also known as green infrastructure may help reduce the risks of grey infrastructure and serve as livelihood support systems for communities and entrepreneurs.
- Peri-urban ecosystems provide resources, buffers and capacities that help reduce vulnerability in urban areas.
- It is important that policy makers mainstream peri-urban ecosystem-based opportunities into development and spatial planning, policies, and other key activities being undertaken by government, businesses, and communities.

Functions of Ecosystems – A Recap

- 4 functions of the natural environment
  - Regulatory functions
  - Carrier functions
  - Production functions
  - Information functions

Ecosystems Support to Disaster Risk Reduction – Some Examples – Fill in the Blanks

Ecosystem	Main Services and Functions	The Cost to Society of Degraded Ecosystems	State of the Ecosystem in Jamaica
Watersheds	• Recharging water catchment and groundwater • Formation of topsoil and sediment control • Regulation of run-off and flood prevention	• Increased land degradation and reduced capacity for agricultural production • Loss of topsoil, causing Reduced productivity of land, increased siltation of rivers and reservoirs due to soil erosion • Reductions in the flow of rivers and increased flooding • Siltation causing reduced storage capacity of reservoirs and dams • Reduction in water quality and quantity (availability) • Higher bill payments for treatment of water due to increased energy consumption • Increased marine and coastal contamination and degradation that adversely affects the tourism industry • Loss of habitat for flora and fauna as well as loss of biodiversity	

Ecosystems Support to Disaster Risk Reduction – Some Examples – Fill in the Blanks

Ecosystem	Main Services and Functions	The Cost to Society of Degraded Ecosystems	State of the Ecosystem in Jamaica
Wetlands	• Flood control • Groundwater replenishment • Shoreline stabilization and storm protection • Sediment and nutrient restoration and export • Water purification • Reservoirs of biodiversity • Recreation and tourism • Reservoir of genes	• Reduction in frontline defence (wind action, wave action and currents) against incoming tropical cyclones (storms and hurricanes), that can then result in damage through flooding and direct destruction of property and even loss of life • Loss of fish and shellfish dependent on wetlands as spawning grounds • Habitat loss for many species of plants and animals and also loss of biodiversity, • Flooding • Land erosion • Loss of materials for construction, fishing and craft • Loss of water purification services – as wetlands play a significant role in purifying water. High levels of nutrients such as phosphorous and nitrogen, commonly associated with agricultural run-off, are effectively removed by wetlands. This is important in preventing eutrophication further downstream, a process that leads to rapid plant and algal growth followed by depleted oxygen levels that affect other species.	

Examples of EbA In Action in 5 Ecosystems

CLIMATE CHANGE IMPACT TARGETED	EBA MEASURE	ELEMENTS OF OUTCOME INDICATORS
Wetlands: Flooding and increased invasive species resulting from extreme rainfall, raising temperatures and increasingly frequent and severe storms	Wetland rehabilitation to reduce flood damage, enable groundwater recharge, improve water quality, and enhance food and income security	Frequency and severity of floods Measures of flood damage Agricultural yields and income
	Wetland protection to encourage growth of spawning nursery grounds and allow vegetation regeneration for flood protection	Measures of species abundance and diversity Measures of water quality Frequency and severity of floods Measures of flood damage Agricultural yields and income
Mountains: Flooding and sediment deposition resulting from extreme rainfall, rainfall variability and increasingly frequent and severe storms	Riparian reforestation/rehabilitation along riverbanks to slow runoff and capture sediment before it reaches the watercourse, thus limiting downstream damage to property and livelihoods	Frequency and severity of floods Sediment load Measures of flood damage (to infrastructure, households, crops)
Drylands: Drought, desertification and soil erosion due to increasing temperatures, reduced and more variable rainfall, and increasingly frequent, severe wind and sand storms	Establishment of a multi-use desert Green Belt to increase water availability, improve soil quality, provide shade and windbreaks, thus improving food and income security	Extent of protective vegetation cover Measures of wind/sandstorm impact Measures of soil quality Water availability Agricultural yields and income (home consumption and market)
Urban: Flooding and soil erosion resulting from extreme rainfall and increasingly frequent and severe storms	Urban reforestation to slow runoff and stabilize soil, thus protecting infrastructure and buildings from flooding, undermining and siltation	Frequency and severity of floods Measures of soil erosion Measures of flood damage to infrastructure and buildings
Coasts: Sea level rise, flooding, coastal erosion and saline intrusion resulting from rising temperatures and increasingly frequent and severe storm surges	Mangrove restoration/ rehabilitation to reduce wave energy, erosion and storm surge water levels, thus limiting coastal flooding, saline intrusion and damage to property and livelihoods	Extent of coastal erosion Frequency and severity of floods Salinity levels in groundwater and farmlands Agricultural yields and income Measures of flood/storm damage

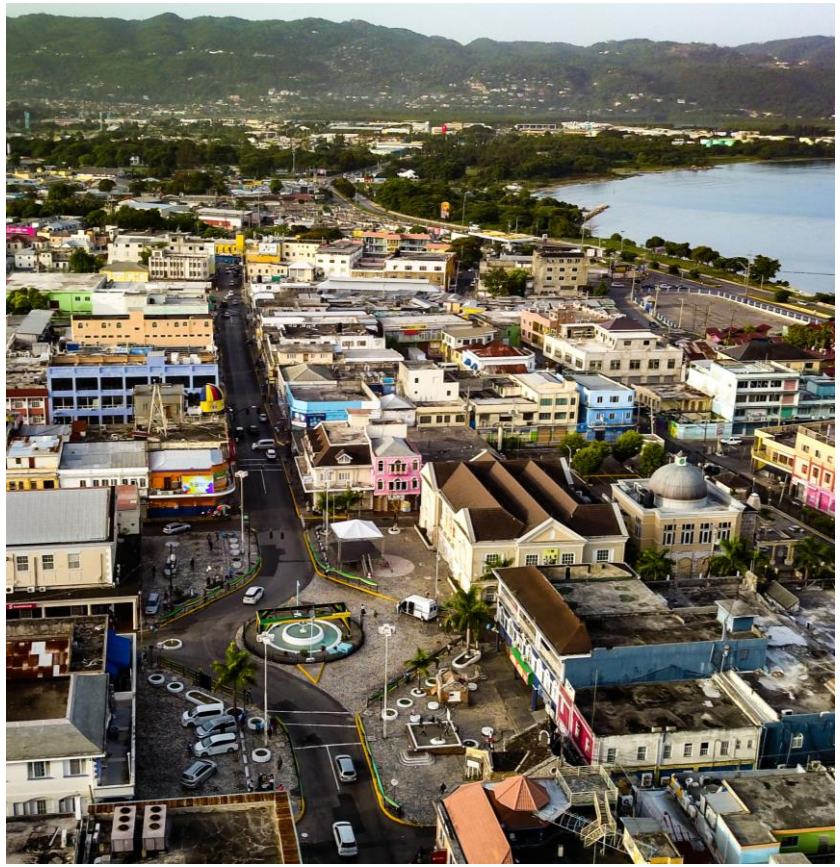
Source: Ecosystem-based Adaptation Briefing Note Series (UNEP 2019)

Topic 4: Key Terms and Concepts related to EbA

Urban and Peri-Urban Areas… Nature-based Solutions…EbA for Climate Change Adaptation… Green Infrastructure… Blue-Green Infrastructure… Green-Grey Infrastructure … Resilience … Resilient Cities… Ecosystem-based Disaster Risk Reduction

EbA Concept #1:
Urban and Peri-Urban Areas/Profile of Urban Areas

- **Profile/Characteristics of Urban Areas**
  - Engines of economic growth and economic hubs
  - Are able to provide opportunities for people and business
  - Dense habitation, infrastructure, businesses, and fast-paced human activities
  - Has increasing demands for services and goods – water-energy-food nexus
  - Contribute to climate change through greenhouse gas emissions
  - Susceptible to the effects of climate change and its effects and climate change is increasingly linked to urban concerns as it exacerbates more risks to infrastructure, people and communities
  - Many environmental and biogeochemical challenges exist within the urban landscape such as stormwater runoff and flood risk, chemical and particulate pollution of urban air, soil and water, urban heat island, and summer heatwaves.
  - Cities, which are rapidly urbanizing and experiencing unplanned development leads to a significant decline in ecosystems and resilient capacities of city systems.



Urban Ecosystems

Urban ecosystems include:

- Green infrastructure in cities, such as parks or gardens
- Natural areas immediately surrounding urban centres, such as wetlands or forests. They help to regulate run-off and water flows, and provide services important to human health, such as air purification, noise reduction, urban cooling, and mental health benefits
- Examples in Jamaica

Profile and Characteristics of Peri-Urban Areas

Transitional zones from rural to urban regions and represent a wide range of uses, such as water catchments, forestry, recreation, productive farming, and offer a unique ambience and lifestyle. Industrial agglomerations, waste treatment plants, recycling, warehouses, agriculture-markets, labour market, goods transit, transportation yards, ecotourism, and several other businesses are common in peri-urban areas.

Peri-urban ecosystems provide resources, buffers and capacities that help reduce vulnerability in urban areas. As such, it is important to mainstream peri-urban ecosystem-based opportunities into development policies, planning and actions. They serve cities through supporting capacities - ecosystem services, rural-urban connect and input-output systems- and assimilating capacities towards urban discharge and waste.

Neither geographically nor conceptually well-defined and consists of complex hybrid systems blending the essence of urban and rural communities.

Usually located between the outer limits of urban and regional centres and the rural environments an ever-changing zone of both interaction and transition due to its geographic location at a city's edge where complex socio-economic processes take place.

Profile and Characteristics of Peri-Urban Areas

In pursuing urban resilience there is need to recognize the role of ecosystems, particularly those in the peri-urban areas. Resilience in peri-urban areas is crucial for a city's functioning, input-output support systems and managing urban resilience and sustainability.

Examples of urban and peri-urban ecosystems include urban trees and biodiversity parks, plantations, nurseries, urban agriculture, wetlands, rivers, etc., but small-scale ecological practices like home gardens, green rooftop, etc. can also be defined as urban and peri-urban ecosystems.

People living in peri-urban areas are generally poor and marginalized and largely depend on wage-earning opportunities in urban areas and primary production-based livelihood (agriculture, aquaculture, orchards, horticulture, etc.) which are sensitive to climate change impacts.

The outward expansion of cities and urban centres, changes in land use patterns and occupations have transformed the rural hinterland into semi-urban areas. Inhabitants in these peri-urban regions are highly vulnerable and increasingly threatened by the deteriorating quality of ecosystems leading to resource scarcity and a host of other problems.

Services Provided by Peri-Urban Areas to Urban Areas

Ecosystem Services	Description
Peri-urban agriculture and good security	• Agriculture services provided by peri-urban areas play a varied role in urban sustainability as well as resilience, ranging from food security to disaster management. • Urban and peri-urban agriculture, particularly in developing countries, play a crucial role in diversifying urban diets and providing environmental services in urban and peri-urban areas (Nambi et al., 2014). • Conversion of agricultural spaces in the peri-urban regions impacts the city adversely and lack of policy framework for peri-urban agriculture impacts urban locales and marginalized and vulnerable groups.
Water security	• Water is usually conveyed from the nearest source to the city (for example from St. Thomas to Kingston), with peri-urban ecosystems playing a vital role in providing cities with drinking water as they ensure flow, storage and purification of water (TEEB, 2011). • Healthy watersheds ensure both water quality and quantity to meet the needs of urban areas. • Healthy vegetation and green spaces in the city vicinity influence the quantity of water availability.
Energy security	• Peri-urban areas can be the location of cogeneration and waste-to-energy plants at the edge of the urban areas which allows a convenient and efficient energy transmission to the consumers and at the same time does not affect densely populated areas.

Services Provided by Peri-Urban Areas to Urban Areas

Ecosystem Services	Description
Health security	• Peri-urban ecosystem provide various health benefits including air purification, noise reduction, urban temperature regulation, etc. • Air pollution from domestic heat, industries, transportation and solid waste burning affects environmental quality and human health in cities. • Vegetation and green spaces help in removing pollutants from the atmosphere and thus improve the air quality of the region. • Trees and soils help in reducing stress-causing noise pollution from heavy traffic, construction works and other human activities through absorption, deviation, reflection and refraction of sound.
Economic security	• Urban and peri-urban agriculture provides food and nutritional security, enhances livelihoods security for urban and rural poor. • For marginalized communities, agriculture forms a key part of diverse livelihood strategies such as a source of income from selling products or as employment.

Tabletop Discussion...

Let is play How and Why ? Apply to Jamaica

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- Ecosystems that offer nature-based solutions (NBS) also known as green infrastructure may help reduce the risks of grey infrastructure and serve as livelihood support systems for communities and entrepreneurs.
- Peri-urban ecosystems provide resources, buffers and capacities that help reduce vulnerability in urban areas.
- It is important that policy makers mainstream peri-urban ecosystem-based opportunities into development and spatial planning, policies, and other key activities being undertaken by government, businesses, and communities.

LOSS OF ECOSYSTEM SERVICES IN URBAN AND PERI-URBAN AREAS

Peri-urban ecosystems are becoming increasingly at risk of environmental degradation and loss of ecosystems goods and services as consumption and waste in peri-urban areas increase due to rapid urbanization and increasing human activity

What is Causing the Loss of Ecosystem Services in Urban and Peri-Urban Areas?

Ecosystem Service	Loss of Service as a Result of:
Provision of water	• Pollution of rivers destroys accessible sources of surface water • Dumping of sewage and solid/liquid waste in peri-urban areas contaminates groundwater • Population growth increases the demand for water supply, and water tables drop as underground aquifers do nor recharge at the same rate as use • Population growth is exerting stress on both surface as well as groundwater and this stress will aggravate with changing climate and unplanned urbanization. • Policies related to water conservation are key to ensure the overall conservation of water resources • Land conversion including concretization by real estate developers are destroying the natural recharge zone of aquifers.
Flood buffers	• Construction on open spaces/green belts prevent natural drainage and exacerbate floods, with acute waterlogging and floods compounding the risk of property damage

What is Causing the Loss of Ecosystem Services in Urban and Peri-Urban Areas?

Ecosystem Service	Loss of Service as a Result of:
Waste assimilation and treatment	• Infilling and destruction of wetlands undermine the ability of the ecosystem to filter refuse • Effluents from peri-urban industry, excessive untreated human waste, and garbage pollute the remaining waterways/wetlands
Food production	• Expansion of the urban fringe, industry and housing developments (both formal and informal) replace productive agricultural land, which often displaces small farmers and can lead to lower volumes of food production and higher food prices, particularly in cities that are highly dependent on nearby agricultural supply.
Climate and air quality regulation	• The clearing of vegetation slows the process of filtering toxic compounds from the local atmosphere. Peri-urban land supports green vegetation cover that absorbs air pollution and ambient heat. As landscapes that used to be permeable and shady become dry and solid, a “heat island” effect can occur, leading to higher temperatures in a region.

.oss of Ecosystem Services in Urban and Peri-Urban Areas – Some Impacts

- Persons living in peri-urban ecosystems are vulnerable and increasingly threatened by the deteriorating quality of the ecosystem leading to resource scarcity and a host of other problems.

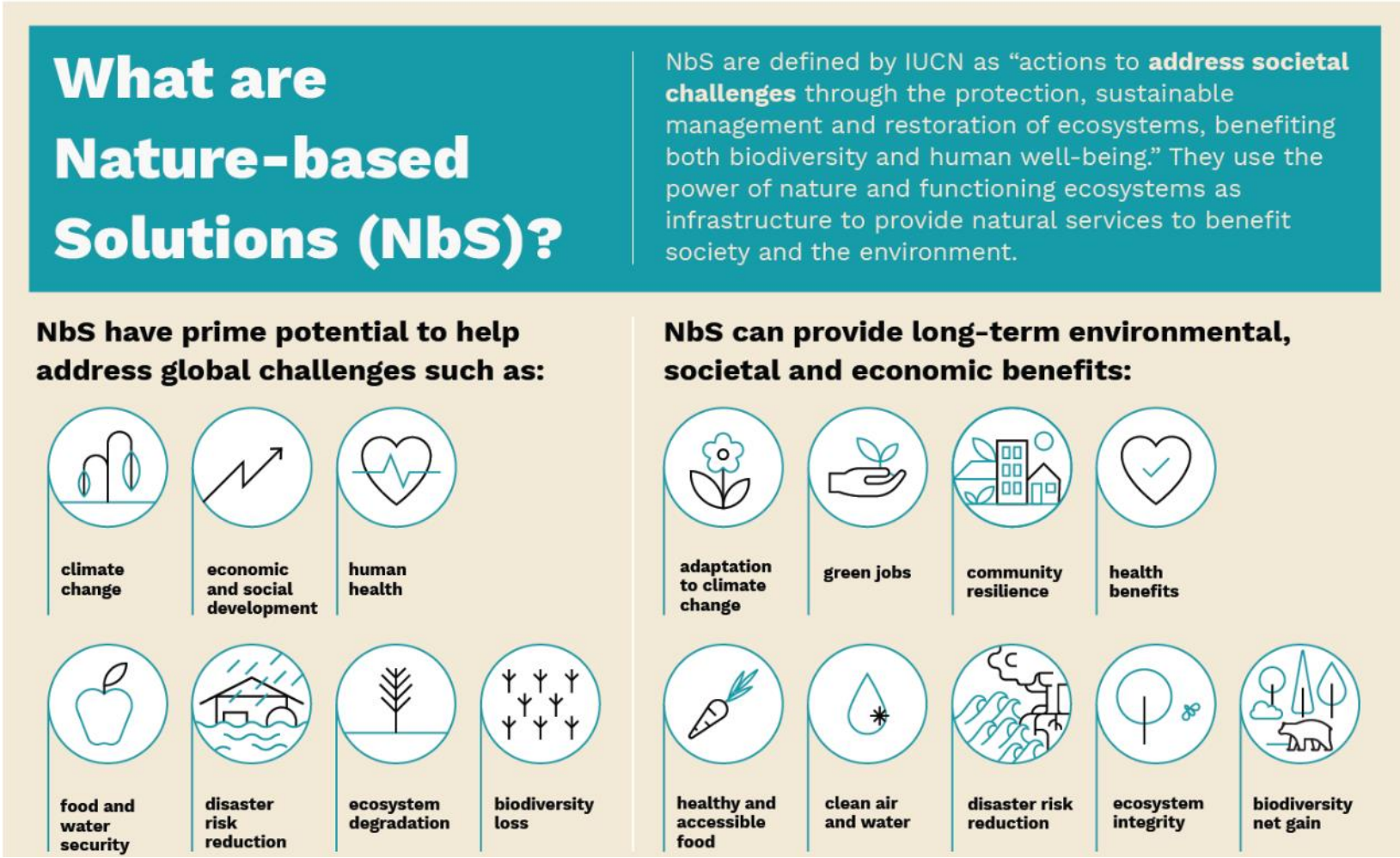
- The poor are disproportionately affected by the loss of peri-urban ecosystems due to their propensity to live in peri-urban areas, their high ecosystem dependence and the economic impacts of land-use changes. The economic impacts of land-use change are disproportionately absorbed by the poor, small scale farmers and fishers, women, and children especially those that are directly involved in peri-urban agricultural activities.

- The destruction of peri-urban ecosystems has a disproportionate impact on the poor, small scale fishers and farmers, and women, as they are less likely to have an alternative source of food, nutrition or income.

- The impacts of unplanned or poorly planned urbanization coupled with extremes of climate change and environmental degradation are not the same for all peri-urban residents. These groups are disproportionately affected by the decline of peri-urban ecosystems due to their propensity to live in peri-urban areas, and their high dependence on ecosystem services.

EbA Concept #2: Nature-based Solutions (NbS)

- Eba is a subset of nature-based solutions (NbS). It an umbrella term and conceptual framework for ecosystem-related approaches.
- Nature-based Solutions or Nature-based Approaches is an umbrella concept that includes Ecosystem-based Adaptation approaches to climate change (EbA) and to Disaster Risk Reduction (EcoDRR).
- NbS goes beyond the traditional biodiversity conservation and management principles
- NbS supports the achievement of a country's development goals such as those related to food security, disaster risk reduction, access to clean water, or health benefits.



Nature-based Approaches and Some Examples

NbS Approaches	Examples
Ecosystem restoration approaches	• Ecological restoration • Ecological Engineering • Forest landscape restoration
Issue-specific ecosystem-related approaches	• Ecosystem-based adaptation • Ecosystem-based mitigation • Climate adaptation services • Ecosystem-based disaster risk reduction
Infrastructure-related approaches	• Natural infrastructure • Green infrastructure
Ecosystem-based management approaches	• Integrated coastal zone management • Integrated water resources management
Ecosystem protection approaches	• Area-based conservation approaches, including protected area management

EbA Concept #3: EBA for Climate Change Adaptation

Climate change impacts such as increased rainfall intensity, storm surges, flooding and urban heat island effects will affect urban systems and the populations and services they support.

Adaptation will be required to cope with these effects.

Some examples of climate change adaptation strategies for urban and peri-urban areas:

- Agriculture innovation: Peri-urban areas can be a catalyst for agricultural innovation and water resources management, and hence, proper management can be a win-win situation to both, i.e., urban communities as well as rural communities on the city fringes.
- Green infrastructure, green spaces and resource efficiency: a network of interconnected green spaces that serves as an infrastructure (similar to electricity, water infrastructure) providing ecological services of climate resilience, disaster risk reduction, wildlife conservation and resource preservation.
- Valuation of ecosystem services to help mainstream strategies for peri-urban ecosystems and resilience into planning, policies, laws and programmes

EbA Concept #4: Green Infrastructure

Focuses on the provision of ecosystem services in cities.

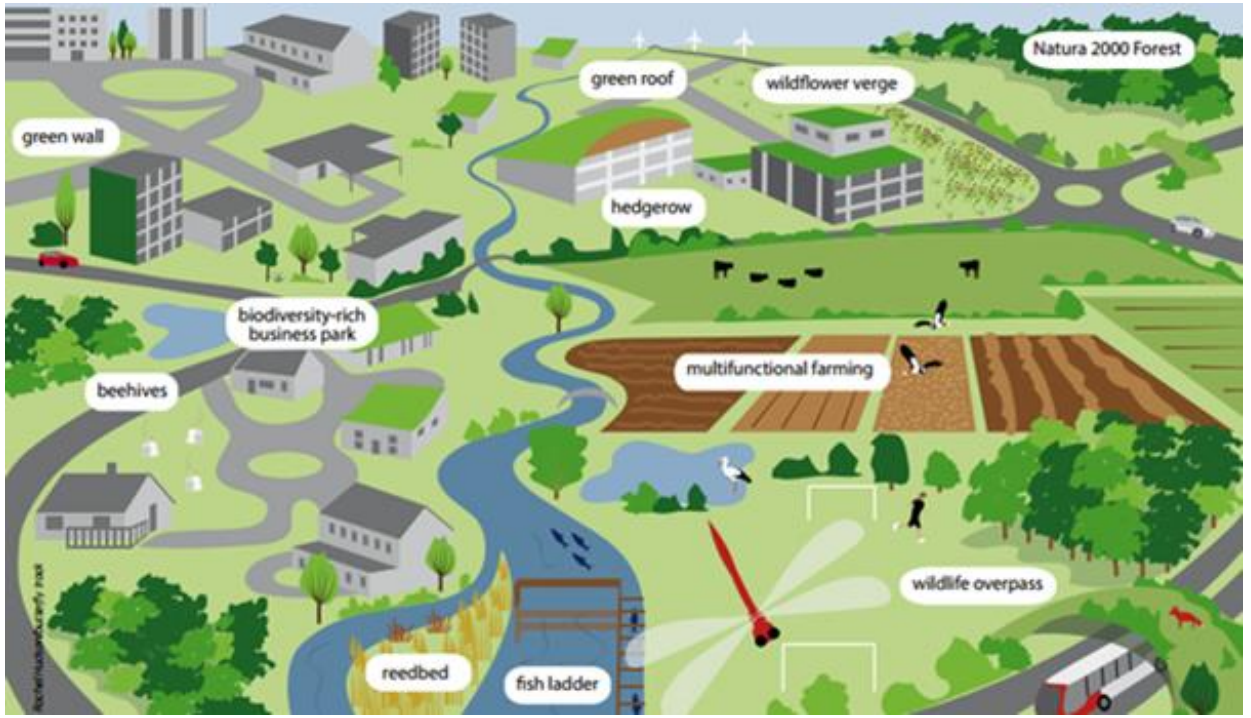
GI, also is defined as vegetation systems intentionally designed to promote environmental quality and can reduce the intensity of heat islands by providing shade and evapotranspiration cooling.

GI also include rivers, wetlands and lakes and also green roofs and green walls, etc. GI is therefore multifunctional.

The GI concept differs from the objectives of greenways which focuses on aesthetics and spaces for recreational purposes.

Poorly designed or managed GI can be a source of pollution and compromise urban biodiversity.

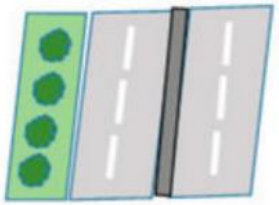
GIs are among the best practices in local governance when combined with traditional grey infrastructure to achieve greater urban sustainability and resilience.



Benefits of GI

- Benefits of green infrastructure include:
  - Health and well-being: Increasing life expectancy and reducing health inequality; improving levels of physical activity and health; improving psychological health and mental well-being.
  - Climate change: Heat amelioration; reducing flood risk; improving water quality; sustainable urban drainage; sustainable transport; improving air quality.
  - Land regeneration: Regeneration of previously developed land; improving quality of the place; increasing environmental quality and aesthetics.
  - Wildlife and habitats: Increasing habitat area; increasing populations of some protected species; increasing species movement.
  - Economic growth and investments: Inward investments and job creation, land and property values; local economic regeneration.

Benefits and Application of GI



Roadside vegetation in the form of bioswales can reduce runoff from impervious surfaces. The key factor is degree of permeability of the soil which can be enhanced through the selection of different vegetation.

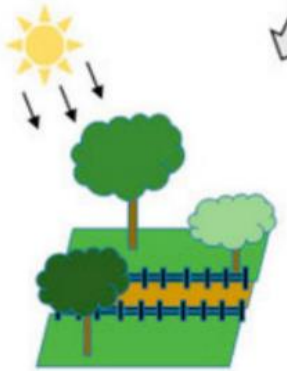
Direct application of plants to the building envelope. Green walls (vine coverage or specially designed modules), and green roofs can contribute to building thermoregulation.

Street vegetation can help to provide shade, as well as a greater sense of wellbeing for residents in urban areas. It can also be used to create green corridors to improve biodiversity.

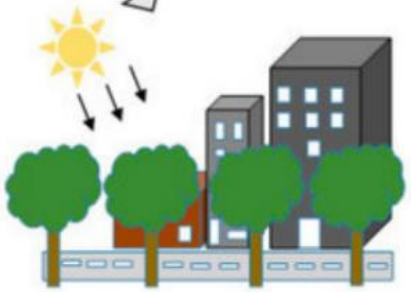
Green Infrastructure.

The integration of plants in the urban environment

Courtyards have been part of vernacular architecture in tropical climates for centuries. When combined with passive ventilation systems they provide cooler air at ground level.



Urban parks can be vital to biodiversity in the urban ecosystem as well as providing space for recreation. Green spaces like parks can sequester more CO_2 than previously assumed and also contribute heavily to absorbing storm water.



Street trees contribute to the fixation of CO_2 and remediation of air pollution. When designed correctly they also provide shading and run-off reduction benefits. Different species are more suited to these application than others

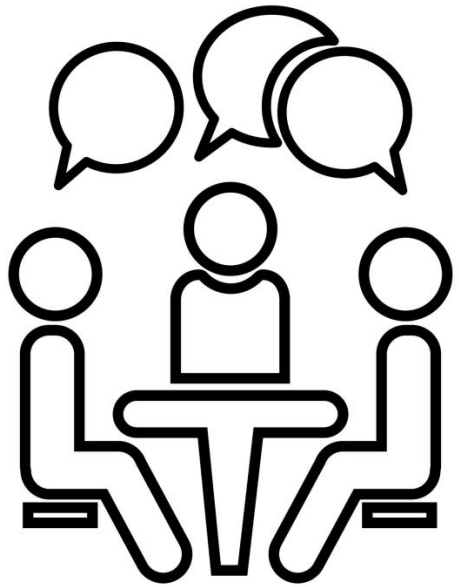
Benefit	Reduces Stormwater Runoff											Improves Community Livability							
	Reduces Water Treatment Needs	Improves Water Quality	Reduces Grey Infrastructure Needs	Reduces Flooding	Increases Available Water Supply	Increases Groundwater Recharge	Reduces Salt Use	Reduces Energy Use	Improves Air Quality	Reduces Atmospheric CO_2	Reduces Urban Heat Island	Improves Aesthetics	Increases Recreational Opportunity	Reduces Noise Pollution	Improves Community Cohesion	Urban Agriculture	Improves Habitat	Cultivates Public Education Opportunities
Practice										CO_2								
Green Roofs	●	●	●	●	○	○	○	●	●	●	●	●	◒	●	◒	◒	●	●
Tree Planting	●	●	●	●	○	◒	○	●	●	●	●	●	●	●	●	◒	●	●
Bioretention & Infiltration	●	●	●	●	◒	◒	○	○	●	●	●	●	●	◒	◒	○	●	●
Permeable Pavement	●	●	●	●	○	◒	●	◒	●	●	●	○	○	●	○	○	○	●
Water Harvesting	●	●	●	●	●	◒	○	◒	◒	◒	○	○	○	○	○	○	○	●

● Yes ◒ Maybe ○ No

Tabletop Discussion… GI

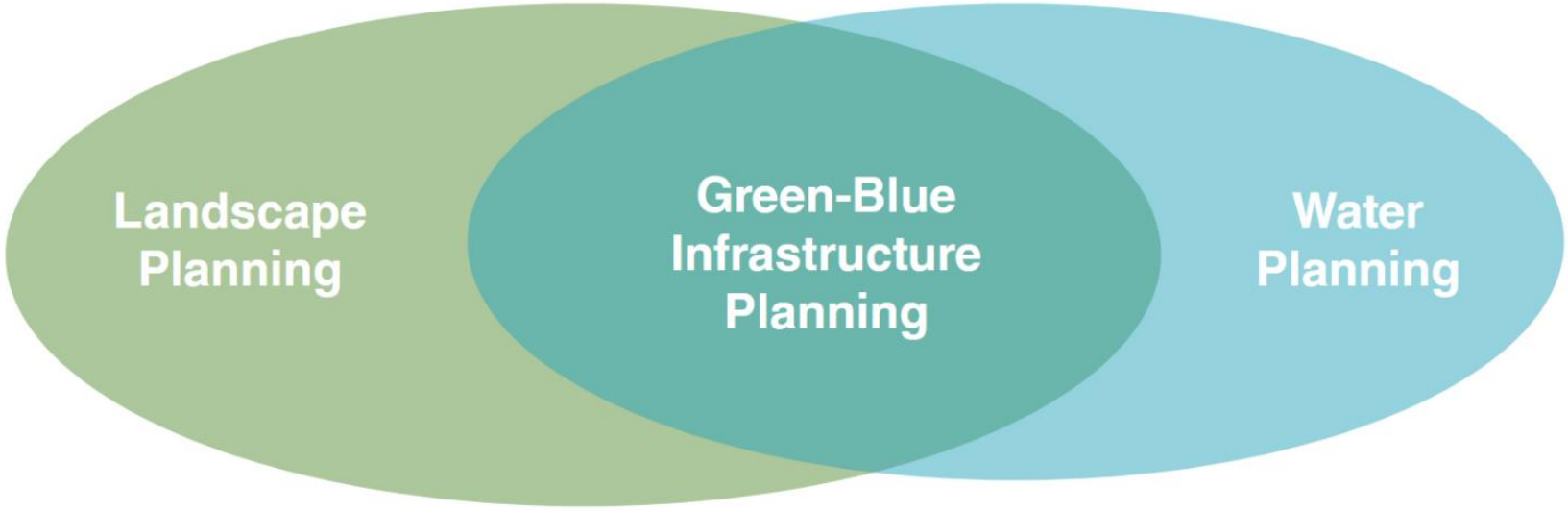
- Provide examples of green infrastructure in urban areas in Kingston or other parishes

- Any missed opportunities?



EbA Concept #5: Green-Blue Infrastructure

- The term ‘green-blue infrastructure’ refers to the use of vegetation, soils and natural processes in an urban context to simultaneously deliver landscape and water management benefits.



Characteristics of Green-Blue Infrastructure

- Green-blue infrastructure can be delivered at a range of scales, from building scale initiatives to precinct scale or regional features. Regardless of scale, these systems will all typically have the following characteristics in common:
  - Vegetation, providing amenity and habitat
  - Soil, of adequate volume, nutrient content and drainage characteristics
  - A link to rainwater, stormwater or recycled water supply, with a frequency and quantity sufficient to support vegetation and soil health
- some systems may provide additional water management functions:
  - Water treatment capacity, utilising natural process to filter local water supplies and reduce pollutants entering local waterways
  - Water storage capacity, using volumes within soils or above ground space to provide detention of stormwater

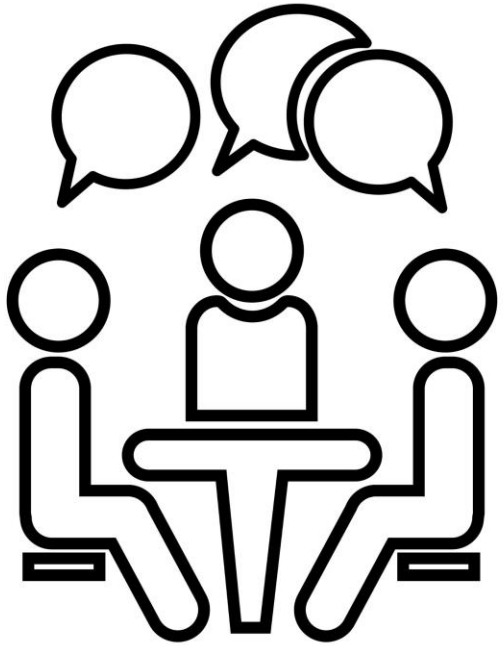
Green-blue infrastructure element		Description
Green roofs		Green roofs are building roofs which have be partially or completely covered in vegetation which is planted into a growing medium sitting above a waterproof membrane. Harvested rainwater can be used for irrigation.
Green walls		Green walls are a vertical garden on the side of a building which comprises vegetation planted within a growing medium which is attached to the wall. Rainwater or greywater from the building can be used to support plant health.
Street trees		Trees planted in growing medium underneath sidewalks which can be designed to be passively irrigated from stormwater runoff from pavements and roads. These can also be designed to enhance stormwater pollutant removal with the inclusion of special filter media. Permeable paving can also be used to channel stormwater into underground soil areas to support trees.
Gardens		Gardens comprise vegetation planted into a growing media (soils). Stormwater can be directed into gardens to provide passive irrigation, or an active irrigation system can be provided, fed by alternative water sources.
Raingardens		Raingardens are garden beds which are designed to capture, detain and treat stormwater runoff as it filters through the underlying filter media before it is discharged at the base of the system either into the surrounding soils or into the local stormwater network.

Green-blue infrastructure element		Description
Sports grounds		Sports grounds are large open space areas which support active recreational activities. These could be irrigated using an alternative water supply or designed to provide stormwater detention and infiltration.
Urban agriculture		Urban agriculture is the local production of food products. This can include community gardens which are open to the public, or commercially viable small-scale urban farms. Suitable alternative water sources can be harnessed for irrigation.
Green corridors		Green corridors are linear green spaces that can provide a range of connectivity services including natural habitat and recreational pathways. These areas are typically located along waterways or other easements.
Ponds and lakes		Ponds and lakes are open water bodies which are designed to permanently hold water. They can be fed by a stormwater supply or a recycled water supply. Vegetation can be included around the edge or in shallow sections.
Wetlands		Wetlands are heavily vegetated water bodies. These systems can either be natural features in the landscape or can be constructed to treat stormwater. They can appear as natural systems or integrated as hard edged features in urban areas.

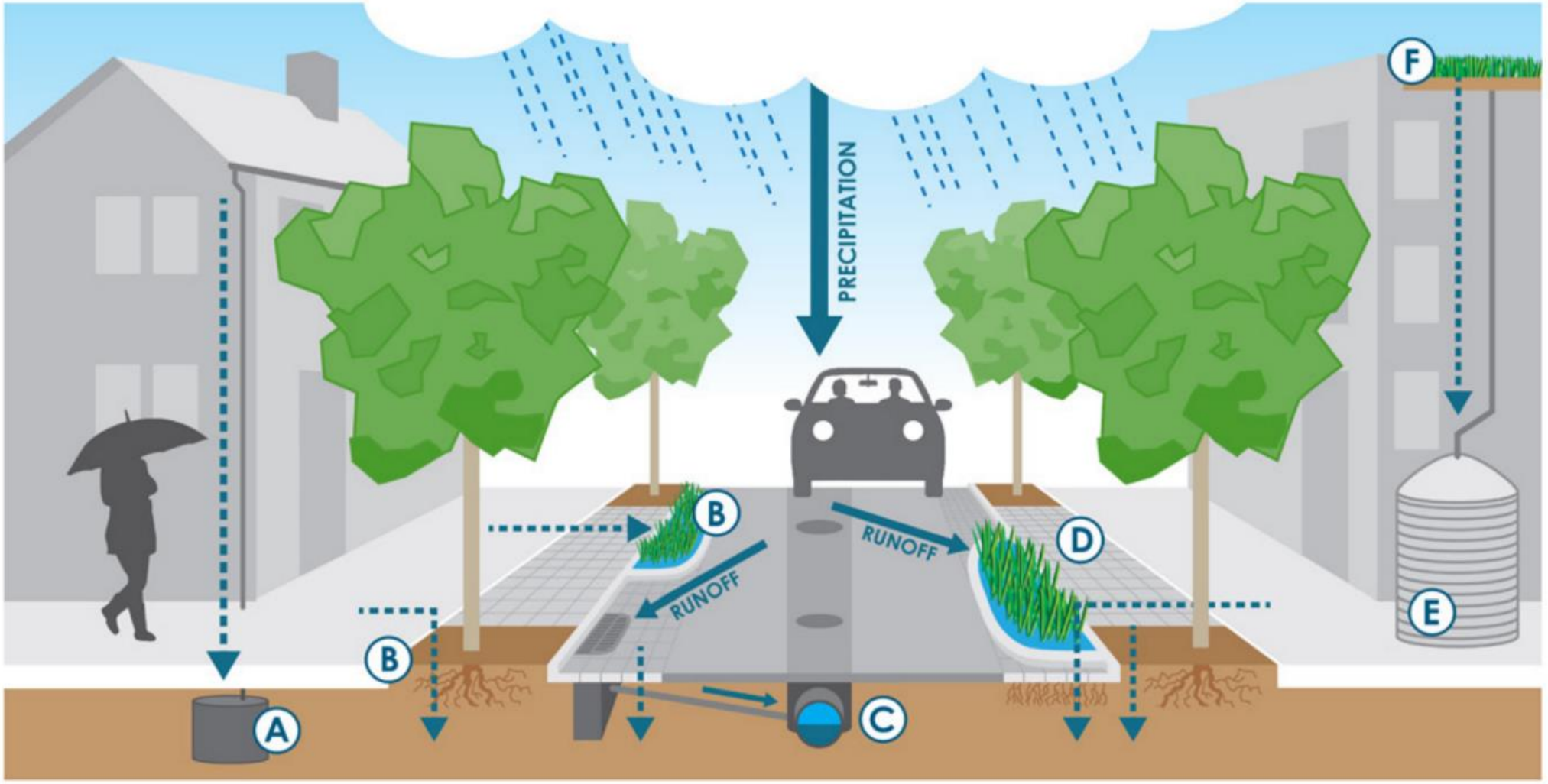
Tabletop Discussion… Blue/Green Infrastructure

- Provide examples of blue/green infrastructure in urban areas in Kingston and other parishes

- Any missed opportunities?



EbA Concept #7: Green-Grey Infrastructure



Source: http://tomorrow.norwalkct.org

Green-Grey Infrastructure

- Green-grey infrastructure combines conservation and/ or restoration of ecosystems with the selective use of conventional engineering approaches to provide cities with solutions for climate change resilience and adaptation benefits.

- An example of green-gray infrastructure is where natural coastal ecosystems – such as mangroves, salt marshes, inter-tidal flats, seagrasses, and coral reefs – are combined with gray infrastructure such as breakwaters, to combine the values of wave attenuation and flood control of natural ecosystems with the benefits of engineered structures.

- In addition, the conservation and restoration of natural coastal ecosystems can extend the lifespan of gray infrastructure, while also supporting fisheries, regulating water quality, and sequestering carbon. The combined solution can therefore be more comprehensive, robust, and cost-effective than either solution alone

- Some of the benefits of green-grey infrastructure include
  - Ecosystems are conserved and/or restored to provide measurable social, environmental, and economic benefits
  - Includes selective integration of a conventional engineering approach
  - Provides climate resilience and/or risk reduction benefit.

-

- Key Critical elements that define the green-grey approach are:
  - Using science and engineering to produce operational efficiencies
  - Using natural processes to maximize benefits (i.e. ecosystem services)
  - Increasing the value provided by projects by including social, environmental, and economic benefits
  - Using collaborative processes to organize, engage, and focus interests, stakeholders, and partners

Tabletop Discussion… Green-Grey Infrastructure

- Provide examples of green-grey infrastructure in urban areas in Kingston and other parishes
- Any missed opportunities?

EbA Concept #8: Resilience

- Resilience is the ability of systems, agents and their interrelations to prevent, reduce, cope and withstand shocks or stresses and bounce back quickly to normalcy after a disaster or crisis, by integrating adaptation and sustainability with disaster risk management.

EbA Concept #9: Resilient Cities

- UNDRR has proposed ten actions to make cities more resilient. These are:
  - Organize for disaster resilience
  - Identify, understand and use current and future risk scenarios
  - Strengthen financial capacity for resilience
  - Pursue resilient urban development and design
  - Safeguard natural buffers to enhance the protective functions offered by natural ecosystems
  - Strengthen institutional capacity for resilience
  - Understand and strengthen societal capacity for resilience
  - Increase infrastructure resilience
  - Ensure effective disaster response
  - Expedite recovery and build back better

- **Using the actions above - On a scale of 1 to 10 – how resilient do you think Jamaica's cities are and why?**

Resilient Cities

- Cities should be considered as dynamic systems

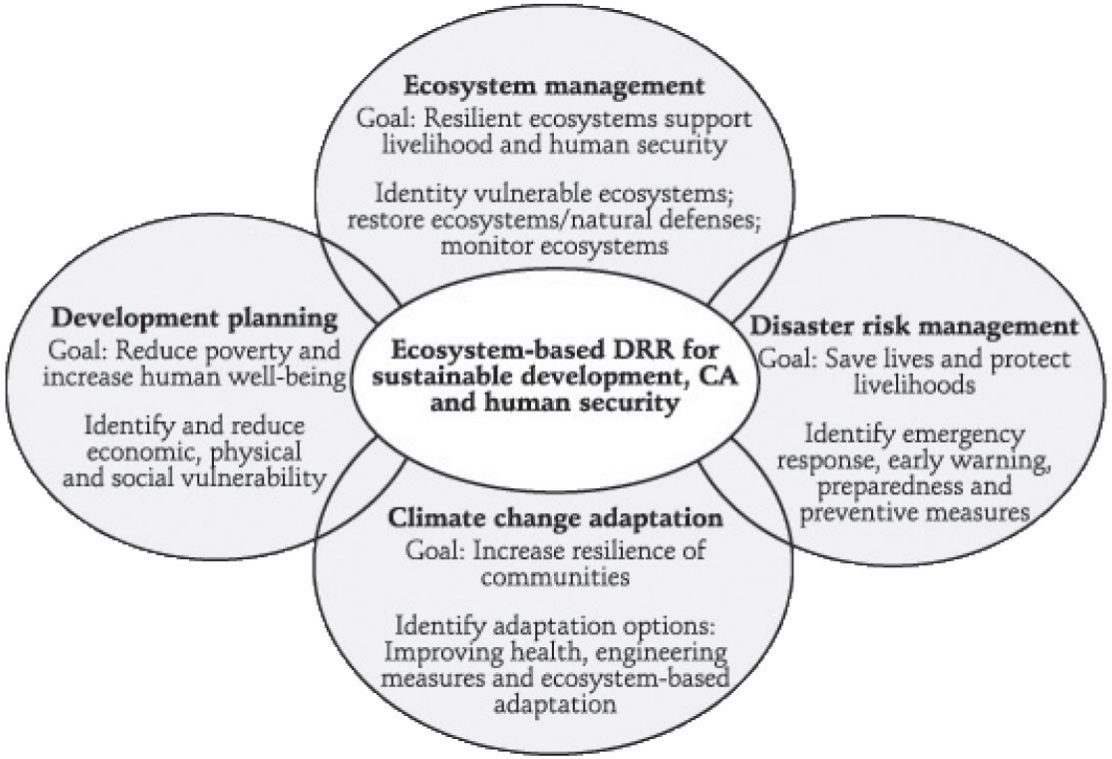
- The resilience of a city depends on the overall performance and capacity of its systems, and not solely on its ability to manage disaster risk, reduce greenhouse gas emissions, or adapt to climate change and impacts thereof.

- Maintaining the health of the peri-urban ecosystem is crucial to developing the resilience of the urban and peri-urban regions. Changes in ecosystem services affect people living in urban areas both directly and indirectly.

- One of the choices to adapt and improve the resilience of peri-urban ecosystems is the ecosystem-based disaster risk reduction approach.

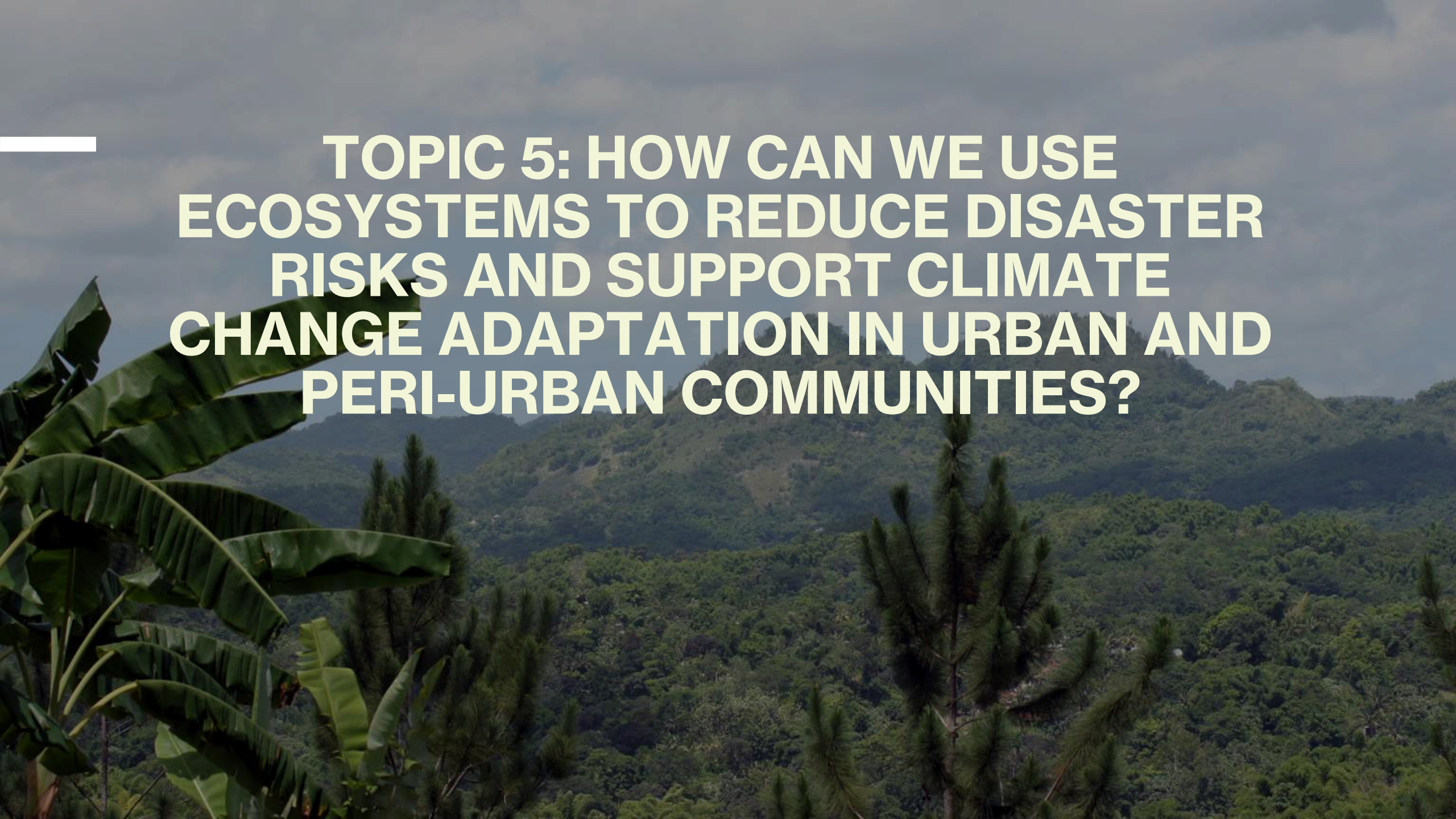
EbA Concept #10: Ecosystem-based Disaster Risk Reduction (EcoDRR)

- **Ecosystem-based DRR is a more sustainable approach to DRR and climate change adaptation**
- **Eco-DRR refers to the use of the natural environment and its ecosystems to buffer the impacts of changing climate, extreme weather events and related hydro-meteorological hazards.**
- **The basic objective of Eco-DRR is to maintain the resilience of natural ecosystems and their services and help communities survive and cope with extreme events.**



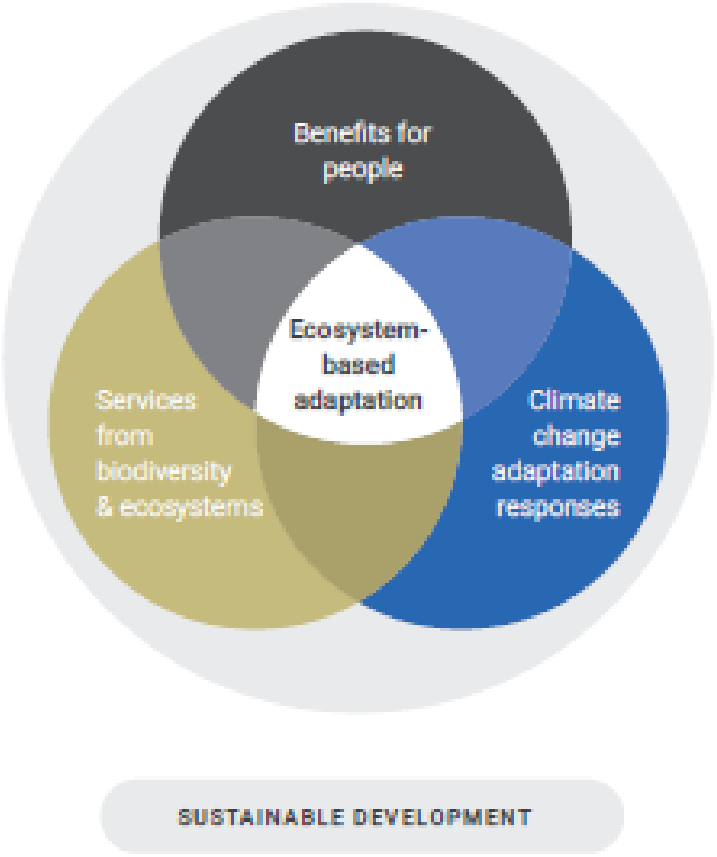
Advancing and Achieving Resilience and Adaptation in Urban and Peri-Urban Areas

- Consider these actions:
  - Promotion of climate-resilient livelihoods strategies in combination with income diversification and capacity building for planning and improved risk management
  - Disaster risk reduction strategies to reduce the impact of hazards, particularly on vulnerable households and individuals
  - Capacity development for CSOs and government entities so that they can provide better support to communities, households and individuals in their adaptation efforts
  - Advocacy and social mobilization to address the underlying causes of vulnerability, such as poor governance, limited control over resources, or limited access to basic services



TOPIC 5: HOW CAN WE USE ECOSYSTEMS TO REDUCE DISASTER RISKS AND SUPPORT CLIMATE CHANGE ADAPTATION IN URBAN AND PERI-URBAN COMMUNITIES?

Integration of EbA into Sustainable Development
Let's Recap



Source: UNEP (2021). Rwanda GEF-LDCF NAP Project: LTRP Proposal

Tabletop Discussion... Benefits of EbA

TOPIC #7: ECOSYSTEM-BASED ADAPTATION OPTIONS FOR CITIES AND INTENDED OUTCOMES

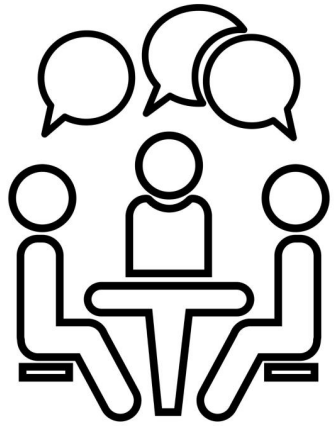
EBA REMEDY	URBAN CHALLENGE	OUTCOME INDICATORS	ECOSYSTEM SERVICE
Urban reforestation: Boulevards, greenbelts, arboretums, grove cooperatives	Flooding and soil erosion Air quality Shade	Severity of flooding Soil erosion metrics Flood damage metrics	Supporting: nutrient cycling, soil formation Provisioning: clean air, fuel Regulating: climate, flooding
Green space creation: Parks, conservation areas, stream restoration, community gardens, groves	Heat islands, heat stress Droughts Air quality Shade	Canopy cover Microclimate temperature and humidity	Supporting: nutrient cycling, soil formation Provisioning: clean air, heat relief, fuel Regulating: climate, water purification Cultural: aesthetic, educational, spiritual, recreationa
Flood risk management zones: Walkways, bikeways, community gardens, playing fields	Flooding Transportation blockage	Infrastructure damage due to flooding; Compare commuting times	Supporting: nutrient cycling, soil formation Provisioning: transport corridors, food growing space Regulating: climate, flood Cultural: aesthetic, educational, recreational
Rainwater harvesting: Grey water supply, run-off diversion, urban gardens, community gardens,	Drought Flooding	Measure of rain accumulated and diverted from drains; usage domestically or for specific purpose	Supporting: nutrient cycling, soil formation Provisioning: water, food Regulating: climate, flood Cultural: aesthetic, educational
Permeable pavements Aquifer recharge and water storage, runoff diversion, walkway safety	Drought Flooding Land subsidence	Groundwater levels; recharge rates; run off; subsidence rates as compared to baselines	Provisioning: water Regulating: flood, water shortages Supporting: nutrient cycling, soil formation Cultural: aesthetic, recreational
Water purification: Urban gardens, water features in parks, artificial wetlands	Water and sanitation	Measurement of contaminant counts as sediments settle, algae and bacteria, etc.	Supporting: nutrient cycling, soil formation Regulating: climate, flood, water purification Cultural: aesthetic, recreational

EBA REMEDY	URBAN CHALLENGE	OUTCOME INDICATORS	ECOSYSTEM SERVICE
Nature connecting corridors: Conservation areas, bird and plant habitats, pollinators, water features, community gardens	Biodiversity loss Habitat fragmentation Water quality	Inventory of biodiversity Measure water and air quality	Supporting: nutrient cycling, soil formation Regulating: climate, flood, water purification Cultural: aesthetic, spiritual, educational, recreational
Urban design/layout: Zoning for air circulation and 15-minute city; resilience design; planning connectivity; green spaces; food production	Urban canyons Air pollution Food deserts	Compare wind speeds and air pollution before and after or unrestored vs. restored	Supporting: nutrient cycling, soil formation
Green ventilation corridors: Conservation areas, green hinterland	Inversion layer formation Heat islands	Measure temperatures at bottom of corridor vs. blocked areas	Supporting: nutrient cycling, soil formation Provisioning: clean air, heat relief Regulating: climate, flood Cultural: aesthetic, recreational, educational
Urban utility services: Composting biodegradable by-products; extracting biogas; production of biosolids from water treatment processes; providing quality fertilizer to food producers	Accumulation of biological waste and subsequent pollution Health issues from decomposing material	Amount of fertilizer sold to outlying farm enterprises; amount of fuel produced; savings of circular economy approach over dumping or landfill	Supporting: nutrient cycling, soil formation, primary production Provisioning: clean water, air, fuel, fertilizer Regulating: climate, disease regulation, water purification Cultural: aesthetic, educational

Source: Based on UNEP (2021b)

Tabletop Discussion... Benefits of EbA

- Discuss the advantages of EbA to urban and peri-urban planning and development in the Jamaica context
- How can we define EbA for urban and peri-urban resilience in Jamaica?



Topic 8 – What does effective EbA look like?

- **Human-centric:**
- **Harnesses nature's capacity to support long-term human adaptation:**
- **Draws on and validates traditional and local knowledge:**
- **Based on best available science**:
- **Benefits the world's poorest**,
- **Community-based and incorporating human rights-based principles**
- **Cross-sectoral and intergovernmental collaboration**
- **Operates at multiple geographical, social, planning and ecological scales**
- **Minimizes trade-offs and maximizes benefits**
- **Provides opportunities for scaling up and mainstreaming**
- **Involves longer-term transformational change**