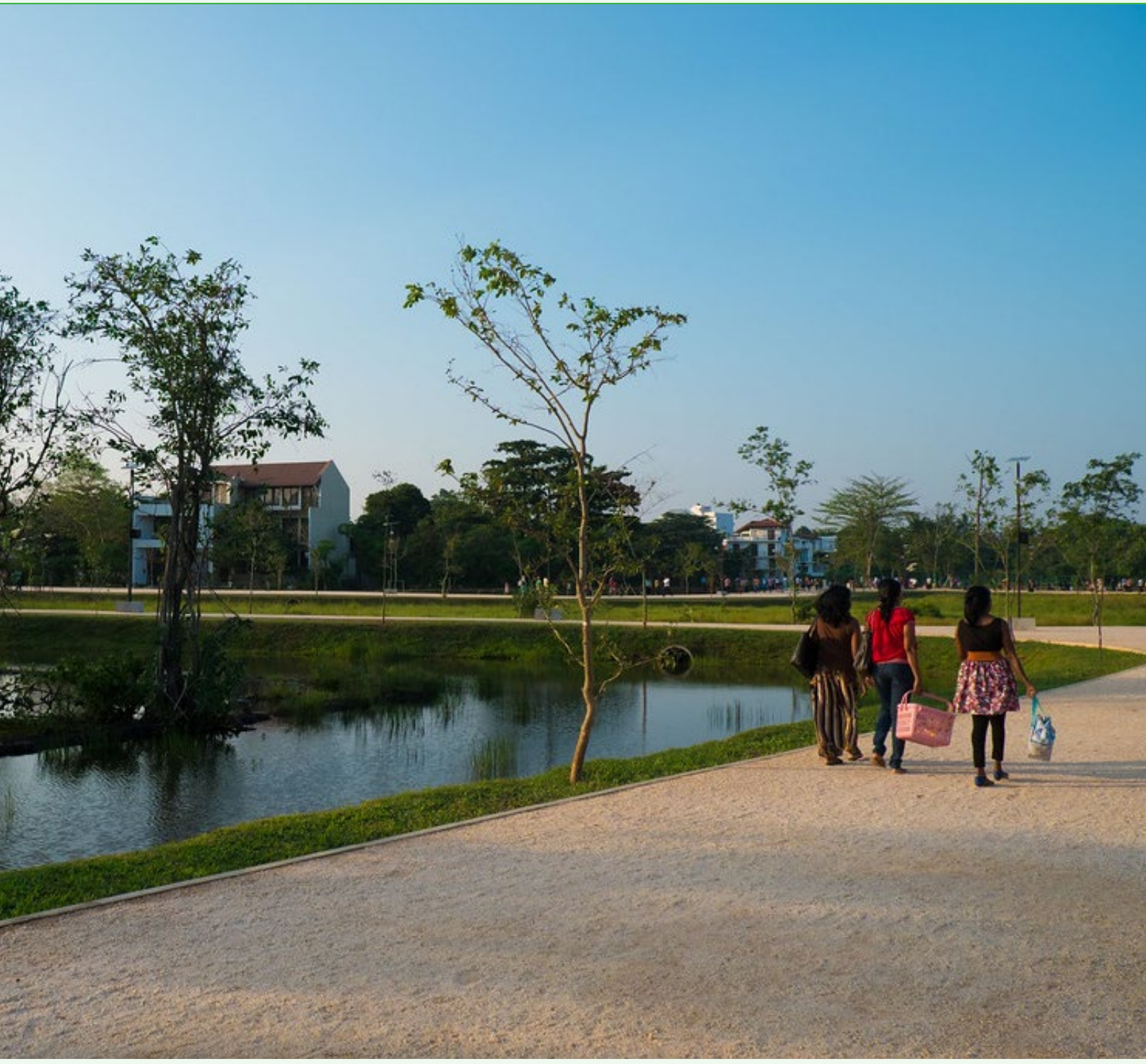
Nature-based Solutions in Urban Regeneration



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This paper discusses how to integrate Nature-based Solutions into Urban Regeneration to advance the Sustainable Development Goals.

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Nature-based Solutions in Urban Regeneration

Figure 1. Hong Kong Wetland Park. Source: Matthias Süßen | Hong Kong, China

Summary

Nature-based solutions (NbS) play a key role in addressing multiple urban issues, particularly climate vulnerabilities and biodiversity loss. They support the restoration of ecosystems, sustainable urbanisation, and increased climate resilience. However, mainstreaming NbS in urban planning faces obstacles, including a lack of integration with existing planning terminology and a 'governance gap' marked by limited collaboration among diverse urban actors and knowledge silos. Integrating NbS into Urban Regeneration initiatives emerges as a transformative strategy, offering a range of positive outcomes including: i) A cohesive, inclusive, and integrated approach to enhancing urban resilience through multi-stakeholder and cross-sector partnerships and by breaking away from siloed thinking; ii) Empowering communities in deprived and disaster-prone zones through targeted, context-specific nature-based regeneration interventions; iii) Providing financial sustainability alternatives to grey infrastructure in regeneration projects; iv) Improving urban temperatures, urban hydrology, natural habitats, biodiversity, climate change adaptation, and carbon emissions; and v) Enabling evidence-based and multi-criteria decision-making, guided by disaggregated community-level data, to enable careful trade-offs between ecological and social dimensions.

Nature-based solutions in cities

Extreme weather events and natural hazards have severe consequences in urban areas. Although higher population densities can reduce per capita greenhouse gas (GHG) emissions, they also often exacerbate climate vulnerabilities. It's crucial to recognise that land use change, particularly urban expansion, contributes significantly to biodiversity loss and habitat degradation. Although agriculture remains a major driver of environmental change, retrofitting urban areas for sustainability is often more complex and costly. Therefore, balancing urban compactness with the preservation and integration of green spaces is essential to effectively address both the climate and biodiversity crises.[1] Consequently, urban design and planning have assumed crucial roles in incorporating sustainable strategies aimed at improving biodiversity protection and climate resilience in cities[2]. The term Nature-based Solutions (NbS) is an "umbrella concept covering a range of ecosystem-based approaches including protection, sustainable management, restoration, and creation of natural or green infrastructure."[3] The International Union for Conservation of Nature (IUCN) defines NbS as "actions to protect, sustainably manage and restore natural and modified ecosystems in ways that address societal challenges effectively and adaptively, to provide both human well-being and biodiversity benefits[4]" NbS are directly related to concepts of green and blue infrastructure (GBI), natural capital, and ecosystem services, among others. The World Bank Group provides a catalogue of 14 urban NbS families[5]: Urban Forests, Terraces and Slopes, River and Stream Renaturation, Open Green Spaces, Green Corridors, Urban Farming, Building Solutions, Bioretention Areas, Natural Inland Wetlands, Constructed Inland Wetlands, River Floodplains, Mangrove Forests, Salt Marshes, and Sandy Shores. NbS are commonly integrated into urban interventions at three spatial scales: the landscape scale (e.g., a river basin), the city scale, and the neighbourhood scale[5] UN-Habitat provides guidance on the most appropriate NbS for different scales and contexts, incorporating a foresight-based model that helps cities decide where and how to develop with minimal risk to nature and people[6]. NbS can also be used to strengthen urban-rural linkages by integrating natural and built environments in areas where urban and rural spaces intersect[7]. At the same time, NbS still face persisting challenges when it comes to their integration into urban planning documents, their financing and implementation. In some cases, NbS may also lead to negative socio-economic impacts if they are not planned or designed well, and can induce displacement, gentrification and inequalities.

NbS therefore offer a cross-functional approach to address environmental degradation and promote urban resilience, while improving the adaptive capacities of vulnerable communities. This approach must ensure investments positively impact marginalized communities and foster public policies that reduce spatial inequalities. By advancing public and private investment in disaster risk prevention and reduction, NbS can simultaneously improve health and quality of life, increase social cohesion, and enhance the quality of urban livelihoods. Ultimately, such strategies can create new economic opportunities and jobs.

Recognizing the importance of NbS in contributing to people's well-being and supporting biodiversity, as well as removing air pollutants and promoting carbon capture

and storage, reducing the urban heat island (UHI) effect by enhancing thermal comfort for people and urban ecosystems, offering significant energy savings and indirect CO_2 reductions, and helping to mitigate flood risks and prevent erosion — as noted in the Sixth Assessment Report by the Intergovernmental Panel on Climate Change (IPCC) — numerous international and regional agreements and initiatives are charting a course towards NbS*. Notably, NbS directly advance multiple Sustainable Development Goals (SDGs): SDG 2 (Zero Hunger), SDG 3 (Good Health and Wellbeing), SDG 7 (Affordable and Clean Energy), SDG 11 (Sustainable Cities and Communities), SDG 13 (Climate Action), SDG 14 (Life Below Water), and SDG 15 (Life on Land). Especially in the urban context, NbS contribute positively to Target 11.4: 'Protect Cultural and Natural Heritage', Target 11.5: 'Reduce the Adverse Effects of Natural Disasters', Target 11.6: 'Reduce Environmental Impact of Cities' and Target 11.7: 'Access to Green and Public Spaces.'

What is Urban Regeneration?

Urban Regeneration (UR) is a comprehensive, area-based and multi-agent collaborative planning process that improves the physical, environmental and socio-economic conditions of an urban area and links the generated benefits to the wider urban fabric of the city. In particular, UR focuses on revitalising underutilized land or distressed urban areas, aiming to restore their functionality and vibrancy. UR strategies often incorporate measures such as adaptive reuse of obsolete infrastructure, brownfield redevelopment, upgrading existing housing stock, enhancing energy efficiency in renovated buildings, and restoring the natural environment. UR builds on earlier approaches such as Urban Revitalization, Urban Renewal, and Urban Redevelopment, which primarily focused on physical transformation, introducing a more integrated and inclusive perspective 3.[3]. Endorsed by UN-Habitat, **UR focuses on enhancing existing assets, including cultural and natural heritage, while ensuring that investments benefit the local community,** in line with paragraphs 38 and 97 of the New Urban Agenda. This comprehensive effort supports equitable infrastructure provision, strengthens local economies, and preserves the environment, thereby creating benefits for the overall city.

In essence, UR is a multidimensional, transdisciplinary and multi-scale process, addressing a wide spectrum of challenges from social deprivation to economic stagnation of urban areas. Notably, UR facilitates "urban co-governance" by involving local governments, city leaders, planners, policymakers, civil society, and investors in the co-design and co-creation of cities. This participatory approach fosters synergy in sustainable urban transitions while mitigating conflicts arising from urban complexity.

The UR process usually involves three key urban assets: 1. **Land**—a valuable resource for municipal governments, particularly for revenue generation. Planning the regeneration of underutilized urban land requires understanding the city's land ownership regime. To control land use and finance urban interventions (including NbS), local governments and planners use regulatory tools such as land value capture mechanisms, land-use planning, zoning regulations, and land readjustment; 2. **Community**—participation and engagement of different groups, especially minorities and marginalized sectors, allows communities to express the real needs of the population and account for social and economic inequalities, by involving them in the decision-making and co-creation of solutions; and 3. **Environment**—underused urban land, often located near water bodies, former industrial corridors, or disaster-prone areas, poses challenges due to past land uses and potential contamination; equally critical is the protection and regeneration of existing natural areas to enhance environmental resilience.vi Consequently, it is crucial to view environmental aspects as integral components in designing sustainable UR projects.

NbS in Urban Regeneration: leveraging comprehensive co-benefits

NbS and UR are mutually beneficial approaches that hold the key to developing resilient and just urban landscapes. The integration of NbS into UR yields a range of tangible co-benefits:

1. **Cohesive, collaborative, and integrated approach to urban resilience:** The comprehensive approach of UR emerges as a powerful catalyst for NbS. It supports operationalisation and implementation, manages trade-offs and conflicts, and addresses social equity. In contrast to conventional urban development, NbS tied to integrated UR initiatives offer a cohesive and adaptive urban development approach. UR fosters collaborative design and decision-making, multilevel governance, and multi-stakeholder and cross-sector partnerships[10] Inclusive and integrated UR facilitated by co-governance and co-creation strategies addresses priorities of municipalities and private sector alongside community needs. It enables a deeper understanding of the local context for NbS implementation, mitigates the potential negative outcomes of NbS interventions, and fosters a sense of belonging and active utilization of co-created urban assets and ecosystem services.

2. **Promotion of inclusivity and economic empowerment:** For NbS to be just and have successful outcomes, individual people, households and communities must be at the centre of NbS planning and implementation. UR processes can play an important role in increasing the diversity of voices in NbS decision-making processes to respect existing cultures and knowledge systems, rather than providing biophysical benefits at social costs. Integrating multiculturalism into NbS can be a way to recognize diverse social and cultural values associated with nature and scale up projects that are relevant to a wider cultural base, thereby[3] fostering a sense of ownership, community pride, and active involvement in NbS interventions[11]. Well-designed, locally and culturally adapted NbS can create diverse job opportunities at different skill levels, diversify income, and improve resilience, providing a rapid and flexible response to economic shocks that can be targeted at deprived communities[12].

3. **Tailored solutions for targeted deprived and disaster-prone zones:** NbS can provide, protect, and support livelihoods in urban areas characterized by inadequate infrastructure and heightened climate vulnerability. These interventions are particularly relevant for communities dependent on natural capital for income, such as those relying on ecosystems for agriculture, fishing, or resource-based livelihoods. Since informal communities often lie in peri-urban areas, they are often more exposed to climate hazards such as floods. NbS can be effective in reducing vulnerability while leveraging the values that such systems inherently provide[13]. For the implementation of NbS in informal settlements, UR can foster a more inclusive and fair adaptation of ecological resources while alleviating socio-economic inequalities by providing potential economic activities and business models that favour economic prosperity for poor communities, ecosystem preservation and restoration, and disaster risk management[14].

4. **A financially sustainable way towards the green future:** NbS offer economic viability and financial sustainability compared to grey infrastructure, in terms of lower implementation costs, high returns on investment (ROI), and greater added value. The delivery of NbS could cost 50 per cent less than grey infrastructure[15] and it is also cost-saving in terms of future operation and maintenance expenses with promising ROI. For instance, nature-based transport infrastructure can yield ROIs 2.5 to 3.5 times greater than its initial investments[16]. Water capturing and restoration through NbS can save $140 billion annually [15]. NbS deliver interconnected co-benefits, including reduced GHG emissions, improved air quality, enhanced urban health and wellbeing, and job creation in the sector—all supported by the financial sustainability of NbS. Moreover, NbS support the transition to climate-resilient economies, as rising funding and NbS-focused investments create unprecedented opportunities for UR projects to advance inclusive, sustainable outcomes.

5. **Sustainable urban planning for ecosystem conservation and restoration:** NbS can contribute to conservation and restoration of natural areas by leveraging ecosystems' services in urban areas, enabling sustainable land planning during UR processes. Such processes can be supported through a multisectoral approach like One Health[17], which is vital for addressing interconnected animal-human-environmental threats. Through the conservation or restoration of key ecosystems, NbS commonly enhance natural habitats — such as wetlands and riparian forests — to mitigate flooding, cool urban areas via vegetation, and enhance biodiversity. They also support carbon storage, storm protection, erosion resistance, and pollution control. Moreover, the conservation and restoration of natural areas in and around cities can provide co-benefits beyond climate regulation. NbS can enhance cultural services by providing recreational spaces, cultural appreciation, and support human health. To ensure that NbS generate conservation, restoration, as well as social co-benefits, it is crucial to develop strategies that follow an inclusive and comprehensive approach, such as UR, to involve stakeholders and communities in guiding regeneration efforts effectively.

6. **Data collection and evidence-based decision for local empowerment of NbS interventions:** UR initiatives often begin with community-level data collection. This data can provide NbS planning insights to highlight specific needs and persistent challenges of the local population, such as inadequate housing, critical infrastructure gaps, limited employment opportunities, a lack of green spaces, and climate vulnerabilities. Collaboration with communities enhances the understanding of specific issues and fosters partnerships that co-design solutions to directly address local needs[14]. For instance, it is important to understand how local communities experience climate change challenges to effectively invest in adaptation measures, including NbS. Urban planners have several methodologies to guide decision-making in UR projects, such as Public Space Assessment Tool, City-Scale Plan Assessment Tool, Our City Plans (OCP) Toolbox, Multi-Criteria Evaluation (MCE) and Multi-Criteria Decision-Making (MCDM), often integrating them with GIS workflows, to streamline complex urban scenarios by offering a logical workflow[18]. In such methodologies, a cost-benefit analysis — often used for assessing trade-offs between ecological solutions and social dimensions — must incorporate the community-level data and be considered as central rather than a mere peripheral component[19].

Belmopan's Master Plan and Green-Blue Network

Region: Latin America and the Caribbean
City/Country: Belmopan, Belize

Focus: Disaster resilience

Belmopan, the capital city of Belize and one of the fastest-growing population centres, faces challenges related to ageing infrastructure, low walkability, traffic congestion, and inadequate housing. Environmental concerns such as flooding, riverine erosion, and hurricanes exacerbate the city's challenges, particularly under the pressure of climate change. In response, Belmopan launched a transformative Master Plan in 2017, introducing a blue-green network to integrate resilient infrastructure through NbS into the urban development **(SDG 11)**.

The blue-green network consists of green streets and cycling routes linking both existing and newly developed public spaces, as well as an interconnected water system that enhances urban drainage and mitigates flooding **(SDG 13)**[20]. This integration of NbS includes low-impact development and climate-resilient designs, such as infiltration trenches and dry ponds that capture and store stormwater, reducing runoff, protecting stream banks, and conserving the biodiversity of natural systems.

Beyond environmental benefits, the Master Plan supports mixed land use, eco-mobility and public amenities. It aims to enhance equal access to diverse public spaces and foster a sense of ownership and well-being among residents. The Plan was developed through a collaborative and participatory effort **(SDG 17)**, led by UN-Habitat and Belmopan City Council, engaging multiple stakeholders through workshops, public consultations with community groups, and co-design initiatives for the green future of Belmopan[21].

This case highlights how cities can integrate NbS into urban planning to address challenges of environmental degradation, climate change, and socio-economic inequality **(SDG 10)**, creating a more resilient and inclusive future.

Nature-based Urban Regeneration: Case studies

KIC Community Garden

Region: Asia-Pacific | Block-scale
City/Country: Shangai, China

Focus: Environmental restoration and social inclusion

KIC Garden (also called Chuangzhi Garden), built in 2014 in Shanghai, China, is a pioneering nature-based regeneration project at the neighbourhood-scale, providing multiple environmental and social benefits **(SDG 11, SDG 13)**. Situated on a 2,200 sqm plot of once-abandoned wasteland amidst fenced residential compounds, the garden emerged as a response to the local government's vision of creating a demonstration open neighbourhood in contrast to prevalent gated communities, by regenerating it into a vibrant public space.

In collaboration with the local NGO 'Clover Nature School' specializing in environmental education for children and youth, the wasteland was regenerated into a green community garden composed of purposefully designed functional zones, including an edible garden, vegetation garden, outdoor green playground, cafe house, children's library and indoor interaction area **(SDG 3, SDG 12)**. The introduction of diverse plant species and rainwater harvesting systems, including those crafted by children, promotes biodiversity and enhances natural water infiltration and resource efficiency **(SDG 9, SDG 12)**

Beyond ecological restoration, KIC garden played an important role in reconnecting the separated neighbourhoods. Community members, including residents from gated compounds, participate in daily and weekly activities, such as urban farming, planting sessions, and environmental workshops **(SDG 3, SDG 17)**. These activities have helped reshape residents' role in neighbourhood development and strengthened their sense of community[25].

Through its nature-based approach and participatory design, KIC Garden demonstrates how small-scale urban interventions can contribute to broader sustainable city strategies, improving social inclusion, environmental sustainability, and climate resilience.

Figure 2. Green Network. Source: UN-Habitat (2017) | Belmopan, Belize

Figure 3. KIC Garden | Shangai, China

Nairobi Rivers Regeneration

Region: Sub-Saharan Africa | River Basin Scale
City/Country: Nairobi, Kenya

Focus: River restoration

Nairobi is traversed by three main rivers — the Ngong, the Mathare and the Nairobi River — which have suffered from severe pollution due to the direct discharge of human, medical and industrial wastes without being properly treated. This has degraded the water quality, clogged waterways and contributed to flash floods, which have led to loss of life, damage to infrastructure, housing, and property, particularly in informal settlements[22].

To address these challenges, the Nairobi Rivers Basin Regeneration Programme was launched with support from UN-Habitat. The initiative follows a comprehensive and participatory approach, outlined in the Nairobi Rivers Recovery Plan 2023, which integrates actions such as catchment protection and restoration, riparian and wetlands reclamation and protection, waste management, and drainage and hydrology **(SDG 6, SDG 15)**.

A key component to the initiative is NbS planning at river basin scale **(SDG 11, SDG 13)**. Strategies include open green spaces, urban forests, and river and stream renaturation to increase infiltration, reduce flooding, and enhance biodiversity. The initiative also promotes a network of safe walkways and bike paths along the river, develops high quality housing in safe areas, and creates a new economic and commercial frontier in the city by attracting investment and introducing livelihood projects, such as urban farming, the development of local eco-industries and waste recycling facilities **(SDG 8)**.

The project engages government agencies, civil society, and private sector stakeholders **(SDG 17)** to ensure an integrated and inclusive approach. By restoring the ecological, economic, and social value of Nairobi's rivers, the initiative demonstrates how urban water systems can be reclaimed as shared public goods, contributing to sustainable urban development and climate resilience[23].

Figure 4. Master Planning of Nairobi Rivers Regeneration; Source: Planning Systems Services | Nairobi, Kenya

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Image credits

Cover photo. Urban Wetlands Park. Source: shruthimathews | **Nugegoda, Sri Lanka**

Figure 1. Hong Kong Wetland Park. Source: Matthias Süßen | **Hong Kong, China**

Figure 2. Green Network. Source: UN-Habitat (2017) | **Belmopan, Belize**

Figure 3. The KIC Garden. Source: Huaiyun Kou, Sichu Zhang, Yuelai Liu | **Shangai, China**

Figure 4. Master Planning of Nairobi Rivers Regeneration. Source: Planning Systems Services | **Nairobi, Kenya**

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