ICLEI Local Governments for Sustainability

Nature-based solutions for sustainable urban development

ICLEI Briefing Sheet - Nature-based Solutions

Planting trees to improve urban air quality, converting abandoned industrial sites into urban parks, greening roofs to reduce buildings' energy use, and restoring degraded wetlands to prevent floods: Nature-based solutions are increasingly being implemented in urban areas to enhance resilience, support sustainable development, and safeguard biodiversity. Good practice examples from Germany and China showcase the potential of nature-based solutions for urban areas emphasizing their multiple social, environmental and economic benefits.

Key messages

- Nature-based solutions are increasingly deployed to address the multiple challenges urban areas are facing and to accelerate sustainable urban development. They constitute 'smart' green infrastructure solutions aimed at increasing the resilience of a city with regard to disaster risk reduction and climate change adaptation. Moreover, they are deployed to advance urban renewal processes and the regeneration of neglected and degraded areas to enhance the livability of a city.
- Nature-based solutions are multi-functional. As opposed to single-purpose grey infrastructure options, they offer numerous co-benefits in terms of public health, social cohesion, biodiversity, climate change mitigation, etc. creating win-win solutions for society, the environment, and the economy.
- Nature-based solutions provide cost-effective approaches to urban sustainability challenges. The additional direct and indirect benefits generated by nature-based solutions are likely to exceed the costs of implementation and maintenance once they are accounted for.
- To leverage their full potential across the entire fabric of the city, the integration of nature-based solutions needs to be mainstreamed. This requires establishing an evidence base for nature-based solutions, advocating their public benefits, and engaging with stakeholders for policy development and urban planning. To put policy into practice, conventional and novel finance mechanisms such as green bonds and taxes need to be secured.

Urban green and grey infrastructure in Beijing, China

The relevance of nature-based solutions in an urbanized world

Cities face a myriad of social, economic and environmental challenges that are expected to be exacerbated by increasing urbanization and the impacts of climate change. Over the past decades, the large-scale replacement of natural ecosystems with built-up areas has put cities and their surroundings under increasing pressure in terms of resource scarcity, degraded air and water quality, reduced availability of green space, etc. In addition, rising global temperatures have led to an increase in the frequency and intensity of natural disasters such as floods, droughts and heat waves leaving densely-populated areas, their citizens and critical infrastructure particularly vulnerable.

Nature-based solutions such as green roofs, floodplains, open green spaces, urban trees and bioretention swales constitute effective means of addressing these challenges. In addition, they safeguard urban biodiversity and increase the attractiveness and quality of life experienced in urban areas.

Overview of key concepts and approaches that have gained traction in the urban context:

*"***Nature-based solutions** are defined as actions to protect, sustainably manage, and restore natural or modified ecosystems that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits." ***(****International Union for Conservation of Nature, 2016****)***

"**Ecosystem services** are the benefits people obtain from ecosystems. These include provisioning services such as food, water, timber, and fiber; regulating services that affect climate, floods, disease, wastes, and water quality; cultural services that provide recreational, aesthetic, and spiritual benefits; and supporting services such as soil formation, photosynthesis, and nutrient cycling." ***(****Ecosystem Millennium Assessment, 2005****)***

Green infrastructure "is a strategically planned network of natural and semi-natural areas with other environmental features designed and managed to deliver a wide range of ecosystem services. It incorporates green spaces and other physical features in terrestrial and marine areas. On land, green infrastructure is present in rural and urban settings. [...] It can sometimes offer an alternative, or be complementary, to standard grey solutions." ***(****European Commission, 2010****)***

Ecosystem-based approaches to adaptation refer to "the use of biodiversity and ecosystem services to help people adapt to the adverse effects of climate change as part of an overall adaptation strategy." (*Convention on Biological Diversity, 2009*)

Nature-based solutions for increased urban resilience

Adapting to climate change and improving urban resilience to extreme weather events and natural hazards are crucial strategic goals for towns, cities and metropolises all over the world. While the challenges differ depending on the local and regional context, nature-based solutions offer the potential to address them, either on their own or coupled with conventional, grey infrastructure solutions. Measures include the conservation, restoration and management of urban and peri-urban ecosystems and the integration of environmental features throughout the urban fabric. As the following examples demonstrate these nature-based solutions provide the crucial regulating and supporting ecosystem services that enhance resilience:

- Permeable surfaces, green roofs, riparian forest systems and floodplains reduce the adverse effects of severe rainfall events. By absorbing excess rainwater they lower the risk of **inner-city flooding** and **water-logging**. Rain gardens, bioretention swales and natural and constructed wetlands collect and remove pollutants from stormwater. Combined with underground cisterns, the purified runoff can be stored for re-use to prevent **water scarcity** during periods of drought.
- Urban areas located in valleys or on hillsides are better protected by planning with nature. Measures such as the maintenance of vegetative cover and afforestation along slopes stabilize soils which in turn mitigates **landslides** and **avalanches**.
- Green infrastructure can mitigate **heatwaves** which are more pronounced in built-up areas due to the high heat absorption rate of grey infrastructure: Urban trees decrease ambient air temperatures, green corridors offer better ventilation and green roofs and walls enhance residents' thermal comfort.
- Areas suffering from **coastal flooding** and **erosion** benefit from the restoration and management of saltmarshes, wetlands, mangroves and oyster reefs. These natural ecosystems form a natural buffer between sea and land which reduces wave intensity and prevents erosion.

Stuttgart: Germany's 'coolest' city

Situated in a valley with a mild, temperate climate and low wind speeds, the southern German City of Stuttgart is particularly prone to the urban heat island effect and poor air quality. To better deal with these challenges and prepare for a warmer future, Stuttgart has implemented a comprehensive set of nature-based solutions coupled with key regulatory policies and incentive schemes. For example, green ventilation corridors have been created to enable fresh air to sweep down from the city's surrounding hills. Prioritizing public health considerations over additional property tax revenues, construction is banned in strategic areas so as not to compromise the effectiveness of these green aeration corridors. A leading pioneer in the realm of green roofs, Stuttgart boasts over two million square meters of vegetated roofs which absorb pollutants and reduce excess heat. Since 1986, the local government has required any new building with a roof pitch below 12 degrees to be equipped with a green roof – a regulation that was extended in 1993 to encompass all new buildings. Tax incentives and tailored financial programs have further contributed to the city's green roof expansion strategy.

The green roof on Stuttgart's town hall

Shenzhen's Sponge City transition

Shenzhen City, situated in China's subtropical south, is faced with heavy downpours during the monsoon season and water scarcity during periods of drought. To address the dual challenge, the local government has long turned to nature-based solutions, particularly during the construction of its Guangming New District. Guangming's People's Sports Center, for example, is equipped with a green roof, raingardens and permeable pavement capable of capturing over 60% of annual rainfall. In 2011, the district was recognized as China's first low-impact development model town in storm water management. To further spur the city's ecological transition, it was selected to take part in the national Sponge City program[1] providing Shenzhen with an additional 1.5 billion yuan (205 million Euros) in subsidies over three years. The action plan set up by the local government foresees the re-designing of an additional 256 square kilometers in 24 areas in a water-sensitive way.

Shenzhen's peri-urban wetland

[1] *Please refer to ICLEI's Sponge City Briefing Sheet for more information on the national program.*

Nature-based solutions for urban regeneration

Availability of and access to urban green space are important indicators assessing the livability of urban areas. Local governments are increasingly turning to nature-based solutions to provide attractive settings and to enhance the quality of life, health and well-being of their residents. Examples include:

- The number of inner-city lanes is reduced to make space for greenways that improve air quality and encourage the use of alternative means of transportation.
- Polluted and degraded rivers and wetlands are restored to near-natural systems simultaneously increasing water quality and property values.

In addition, nature-based solutions are used to spur urban renewal processes through the regeneration of deprived and neglected residential and industrial areas. This becomes especially relevant for cities undergoing a post-industrial transition. Examples include:

- Former factory sites and disused infrastructure are torn down and de-toxified using bioremediation. In turn, they are transformed into public green spaces for recreation.
- Abandoned land is converted into community gardens and urban farms to enhance social cohesion and regenerate disadvantaged urban areas.

European Green Capital 2017: Essen's transition from grey to green

The City of Essen, located in Germany's former industrial heartland, the Ruhr Metropolitan Area, has reinvented itself from a grey, industrialized city to a green city with a high quality of life. While the urban landscape is still spotted with relics from its coal and steel past, hundreds of hectares of green space have been created over the past decades through the conversion of disused factory buildings and mining facilities. The former site of the Krupp cast steel factory, for example, was transformed into a 230 hectares green belt stretching from the city center to the district of Altendorf, while the adjacent industrial wasteland was turned into an 11 hectares add-on to the Krupp Park. The gradual ecological restoration of the Emscher River and its tributaries which historically served as open sewers further contributes to Essen's goal of enabling every resident to access the city's green and blue infrastructure network within a range of 500 meters. By 2020 the conversion of the degraded river system into close-to-nature water bodies will largely be completed. In recognition of Essen's achievements and high ambitions the city was named European Green Capital 2017 and serves as a role model to other post-industrial cities striving for urban renewal and regeneration.

Essen's Krupp Park

The multi-functionality, value and cost-effectiveness of nature-based solutions

Nature-based solutions are also dubbed 'no-regret' solutions since they are multifaceted offering a plethora of co-benefits in addition to the purpose they are intended for. As the following examples show, these include social, environmental and economic benefits drawn from the diverse portfolio of ecosystem services that nature-based solutions provide:

- Green walls and roofs foster urban biodiversity and improve the attractiveness of an area in addition to lowering tenants' cooling costs.
- Urban gardens increase local food sovereignty, enhance social cohesion, provide opportunities for learning and contribute to urban biodiversity.
- Forests and vegetation in and around urban areas sequester carbon, regulate the micro-climate, purify the air and reduce urban noise. In addition, spending time in nature and in direct contact with natural elements enhances mental health and well-being.

There are numerous ways to more specifically identify the direct and indirect contributions of nature-based solutions, such as the monetary valuation of ecosystem services. In China, for example, the air purification and temperature regulating services of Beijing's forest ecosystems have been valued at 7.72 billion yuan (1.03 billion euro) annually based primarily on avoided air pollution charges and electricity savings (Wu et al., 2010).

Due to their multi-functionality, their value and their relatively low cost of implementation and maintenance, nature-based solutions constitute cost-effective approaches to urban challenges, either on their own or in combination with grey infrastructure solutions.

Greenway in Guangzhou

The manifold benefits of Guangzhou's greenway system

The City of Guangzhou, situated in southeast China's Guangdong Province, boasts a comprehensive network of greenways. The linear green spaces combine scenic trails with green belts for nature conservation. By providing safe infrastructure for recreational and commuter use, the greenway system promotes healthy lifestyles and encourages a modal shift from car use to cycling and walking. In addition, the creation of the network has increased tourism and stimulated the local economy since its various corridors and nodes connect most of Guangzhou's cultural and historical sites, museums and recreational facilities. Reflecting the attractiveness of living close to open green space, adjacent property values have gone up by up to 30%.

Key measures for mainstreaming nature-based solutions

Despite growing recognition for the potential of nature-based solutions, operationalizing them into policy and urban planning as well as facilitating their implementation requires additional efforts. Key critical aspects to accelerate these mainstreaming processes include:

- **Establishing an evidence base for nature-based solutions**, for example, by quantifying their ecosystem services and/or assessing their added value and co-benefits;
- **Advocating for nature-based solutions by communicating** their multi-functionality and ability to contribute to various policy arenas such as climate change adaptation, public health, nature protection and economic development;
- **Fostering collaboration across the full spectrum of stakeholders** such as urban planners, utility operators, municipal officials and residents to ensure cross-sectoral buy-in and commitment for nature-based solution policies and planning guidelines;
- **Leveraging conventional sources and unlocking novel mechanisms for financing** such as green bonds, adaptation funds, taxes and fees, public-private partnerships to implement nature-based solutions.

Acknowledgements

Authors:

- Olga Horn, ICLEI World Secretariat
- Qiaoqiao Xu, ICLEI East Asia Secretariat

Contributors/Reviewers:

- Lennart Kümper-Schlake, German Federal Agency for Nature Conservation
- Ulrike Irlich, ICLEI Cities Biodiversity Center

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- "The manifold benefits of...": City of Guangzhou, 2016

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ICLEI World Secretariat
Kaiser-Friedrich-Straße 7, 53113 Bonn, Germany
Email: urban.research@iclei.org

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China's Sponge City concept:
Restoring the urban water cycle through nature-based solutions

By turning cities into "sponges" China aims to restore urban water cycles and improve urban resilience to flood and drought events. The city-wide deployment of nature-based solutions such as green roofs, pervious pavements and bioremediation along with the restoration of urban and peri-urban wetlands and rivers lie at the heart of the national initiative.

Key messages

- The Sponge City concept requires re-designing cities in an ecological, water-sensitive way: In line with low-impact development principles, nature-based solutions[1] are deployed and integrated with grey infrastructure solutions throughout the entire urban and peri-urban fabric to absorb excess stormwater runoff, filter out pollutants and store up to 70% of it for reuse during periods of drought.
- To fully implement China's ambitious Sponge City program which foresees 80% of China's urban built up areas to meet Sponge City building requirements by 2030, the concept needs to be integrated in local policies and urban planning and additional funding needs to be secured.

"**Low-impact development (LID)** is a stormwater management strategy that [...] comprises a set of site design strategies that minimize runoff and distributed, small scale structural practices that mimic natural or predevelopment hydrology through the processes of infiltration, evapotranspiration, harvesting, filtration and detention of stormwater." *(US Environmental Protection Agency, 2007)*

"**Nature-based solutions** are defined as actions to protect, sustainably manage, and restore natural or modified ecosystems that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits." *(International Union for Conservation of Nature, 2016)*

China's urban water challenge

China's urban areas face a myriad of water-related issues ranging from urban flooding, reduced water quality, water scarcity and land subsidence induced by groundwater extraction. Over the last few decades rapid urbanization has replaced large areas of natural ecosystems with impervious surfaces and left many urban areas with outdated drainage systems. As a result, 300 of China's 657 cities fail to meet national flood prevention standards. In 2013 alone, more than 230 cities were subject to urban water-logging. In addition, more than half of China's cities are considered water scarce or severely water scarce. This is in large part due to the over-extraction of groundwater and high levels of water pollution caused by agricultural intensification, industrial and urban expansion as well as the large-scale disappearance of different wetland types. Rising global temperatures are predicted to further exacerbate the intensity and frequency of extreme weather events. Coupled with a projected urban population increase from 54% in 2014 to 70% by 2025, these challenges require an integrated and adaptive approach that enhances the resilience of China's urban areas.

China's response: Creating Sponge Cities

In an effort to improve cities' capacity to address their water-related challenges, China's national government promotes the transformation of urban areas into so-called Sponge Cities. In fact, the ambitious program envisions 80% of China's urban built-up area to be sponge-like by 2030. To accelerate this process, 30 pilot cities including Beijing, Shenzhen, Wuhan and Jinan have been selected to receive financial and technical assistance to redesign their urban areas in a water-sensitive way. This is to be accomplished through the adoption of low-impact development principles and the large-scale deployment of nature-based solutions that preserve, mimic and support the natural water cycle. Concrete measures include the replacement of impervious infrastructure with green roofs, walls and permeable pavement and the revitalization of degraded lakes and wetlands to allow for the absorption of excess rainwater during downpours. In turn, raingardens and bioretention swales are used to collect the runoff and filter out pollutants. Some of the purified water is then sent back to the natural system to recharge aquifers and some of it is stored to ensure availability of water for irrigation and cleaning purposes during periods of drought. The aim is for cities to be able to absorb and reuse nearly 70% of their excess rainwater.

[1] *Please refer to ICLEI's Nature-based Solutions Briefing Sheet for more information.*

Cost-effectiveness and co-benefits

Nature-based solutions often prove to be cost-effective, particularly in terms of implementation. In a comparison of different nature-based solutions conducted by the Chinese Ministry of Housing and Urban-Rural Development, installation costs were as little as RMB30/m^2 (4 Euro/m^2) for vegetated filter strips and RMB200/m^2 (27 Euro/m^2) for permeable pavement (MoHURD, 2014).

Next to future-proofing and enhancing the water resilience of China's cities, nature-based solutions come along with a suite of environmental, social and economic co-benefits. They can improve urban air quality, regulate the micro-climate, sequester carbon, foster biodiversity and offer opportunities for recreation. This is in stark contrast to grey infrastructure measures such as sewers, dikes and concrete walls which are often mono-functional.

Making the Sponge City work

Achieving China's ambitious goal on a local level necessitates overcoming various challenges. Foremost, it requires re-thinking urban areas as complex systems that are embedded in their natural environments. Instead of deploying isolated solutions, the entire urban fabric needs to be re-designed in an ecological way and any future expansion needs to take the urban water-cycle into account. Moreover, it is estimated that one square kilometer of Sponge City re-development will cost 100 million yuan to 150 million yuan (13.5 to 20 million Euro). Yet, given the current and future challenges China's cities face and factoring in the additional benefits that nature-based solutions provide, both inaction and conventional approaches will be more costly in the long-term. Key steps to spur the Sponge City transition at the local level include:

- **Strengthen inter- and transdisciplinary dialogue and collaboration** between local decision makers, natural and social scientists, urban planners and city departments to ensure administration-wide support;
- **Fostering the exchange of good practice examples** with practitioners and other cities to build internal capacity;
- **Adapting local policies and urban planning guidelines** according to Sponge City construction requirements to ensure their consideration in new infrastructure projects;
- **Developing a Sponge City action** plan tailored to the local context;
- **Leveraging private and public sector financing and identifying innovative finance tools** to operationalize the action plan.

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Authors:

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- Olga Horn, ICLEI World Secretariat

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Email: urban.research@iclei.org

Theme III: Ecosystem based adaptation

Ecosystem based adaptation (EBA) is relatively new, especially for cities, and is rising to the fore of adaptation work. EBA considers existing features of urban ecosystems like trees, green and blue spaces, mangroves, and peri-urban agriculture. It reduces vulnerability while maintaining secondary ecosystem services and can span city boundaries. The benefits and services of biodiversity and ecosystems have great potential to support sustainable economic growth and the needs of urban residents.

What can cities do?

Green or blue-green infrastructure is used to implement EBA into planning. This combines considerations of water (blue) and ecosystem services from vegetation (green) to restore the natural water cycle through increased infiltration and up to 90% reduction in runoff and pollutants. The result is multiple co-benefits beyond increased adaptive capacity and the conversion of threats like storm water into resources. In Copenhagen (Denmark), the City's Green and Blue Structure Plan incorporates adaptation, the Cloudburst Plan, and greener living spaces.

To begin, cities should identify natural spaces and their services to assess the potential for local EBA. Weigh traditional infrastructure against blue-green infrastructure during adaptation planning. Lami Town, Fiji, for example, replanted a mangrove forest instead of constructing a seawall.

EBA must also include social considerations. This should link to regional and national strategies e.g. it is predicted that 75% of Nepal's National Adaptation Programme of Action goals could come through EBA, including measures to restore degraded forests and rangelands. Techniques such as ecosystem biotechnology for storm water purification, absorbing pollution, and regenerating waterways are also important (e.g. Lodz, Poland).

Challenges and gaps identified

Watershed based planning and coordination across regions and within municipality departments is lacking. A more thorough analysis of catchments, watersheds, and all possible scenarios – such as the potential for dry zone parks to become lakes or the reverse - is also needed.

Tips for cities

- Research on ecosystem services in Copenhagen revealed willingness among private households to contribute as well as some potential conflicts with other drivers of development.
- Investing in green infrastructure and sustainable management of natural resources pays off. Ways to quantify the benefits include: figures on air pollution removal, added real estate value, taxes to municipalities including the multiplier effect, saved damages in the long term, and the Economics of Ecosystems and Biodiversity (TEEB) metrics. Factor these into accounting and reporting systems.

Defining Green Infrastructure

"An interconnected network of open and green spaces, both natural and designed, that can provide multiple functions and services such as water and air purification, aesthetics, cultural and socio-economic benefits, recreation, and habitat."

Sadahisa Kato, Research Associate, ICAS, Ibaraki University, Japan

"We have to stop degrading ecosystems if they are to help us adapt to climate change."

Keith Alverson,
Head of Climate Change Adaptation Unit, UNEP

Case studies in brief

Rotterdam, the Netherlands

Challenges: flooding, housing, transport, and lack of public space.

Actions: Rotterdam incorporated four clusters of ecosystem services of TEEB (2012) then completed an action and policy review, scenario assessment, and workshops with local practitioners.

Outcome: 34.9 m^2 of green space per person and higher life expectancies. **Innovation:** included watersquares, water living and canal transport, sponge roofs, underground storage for sewage overflow, and resilience profiles combined with GIS data to set new targets for ecosystem services.

Yokohama, Japan

Challenges: 8,500 people/km^2 and 35% blue-green cover.

Actions: The Yokohama Blue-Green Master Plan creates and protects green, enhances blue-green with a watershed based approach, and fosters collaboration and participation.

Lessons learned: planning bodies and green infrastructure should be at the regional scale, implement green infrastructure policies at the city/town scale, coordinate local plans with prefectural (regional) plans, consider different types of "green" together to develop an interconnected network, and apply watershed scale planning.

Ecosystem-based adaptation

Ecosystem-based adaptation (EBA) combines human ingenuity with natural ecosystem services to create living systems that reduce the impact of climate change while providing a range of co-benefits. Incorporating measures such as blue and green infrastructure (GI) into urban environments is a no-regrets approach that addresses multiple climate risks while restoring biodiversity and improving quality of life for residents. GI is easily added as an extra feature in new developments, retrofits, and revitalization projects, however, it is time to move past isolated projects and pursue integrated ecosystem-based approaches linked to overarching development goals. For cities like Copenhagen, Denmark, EBA is the future of city planning, a new precondition that implies a deep transformation in urban planning practices and the way we conceptualize urban space. Key considerations for achieving this transformation include:

Re-evaluation of land use practice and policy

Open space for GI is limited and is being lost to urban creep: London loses 2.5 Hyde Parks of green space annually (Maksimovic & Mirosavic, 2014). Solutions include green planning units, designated eco-districts, and GI zoning ordinances. Cities can use the public domain status of open spaces or purchase development rights for private land. In high density areas, GI can be incorporated into the built environment (e.g. green walls, shade trees, permeable pavement). For instance, Washington D.C., USA has 195,000m2 of green roofs following the passage of a Green Building Act in 2006.

Harmonization with political and economic agendas

Adaptation must work with other political agendas and allow for a balanced approach between development and environmental decisions. Durban, South Africa, for example, has coupled ecosystem restoration with job creation, improving over 3,000 hectares while creating nearly 300 jobs (in 2014). Detrimental impacts of EBA, such as a sharp rise in housing prices, should also be avoided.

Quantifying benefits of GI and ecosystem services

This remains a challenge that requires additional research and more sophisticated modelling systems. However, there is growing evidence of the cost-effectiveness of GI from cities like Philadelphia, USA, which projects a 200% return on its Green City Clean Waters program.

Examples of EBA measures and Green and Blue Infrastructure

Climate Risk	Ecosystem-based solutions	Adaptation services	Co-benefits (cross cutting)
Drought	• Waste water recycling • Rainwater harvesting	• Water conservation	• Nutrient recycling
Temperature extremes / UHI	• Wind ventilation, corridors	• Cooling	• Energy savings • Health
⇕	• Green walls and roofs • Green spaces and parks • River and wetland restoration • Raingarden, bioswale, treepit • Balancing pond, water square	• Thermal insulation • Evapotranspiration • Food production • Natural filtration • Water storage	• Sound buffer • Carbon capture • Recreation • Better air quality • Property values
Heavy rain and flooding	• Permeable pavement • Downspout disconnection	• Restored hydrology • Water storage	• Better water quality
Sea level rise and tidal surges	• Living shorelines	• Coastal buffer • Biodiversity	• Habitats • Aesthetics
All of the above	• Reforestation ,revegetation, including mangrove planting	• Coastal buffer, water capture, shading, etc.	• Invasive species control

Examples and resources:

Tools and cases shared at the congress included:

- The Blue Green Dream project's tools for quantifying GI impacts
- GI site selection strategies from Boston, USA and Bararanquilla, Colombia
- The "Nature of Mainstreaming" toolkit for biodiversity and ecosystem services planning
- National Wildlife Federation's Green Works for Climate Resilience - a community guide to nature based climate planning

Resilient infrastructure

Infrastructure systems and services including transportation, sanitation, waste management, energy provision, and communications are at the heart of urban life and development. In order to simultaneously accommodate urban growth and unavoidable climate change impacts, cities are advised to embed resilience-thinking into current and future infrastructure decisions and investments.

Andre Landwehr, Project Officer, Department of Environment, City of Malmö, Sweden giving an example of how Malmö is using the urban flow model

The first step is to understand how different systems intersect. One concept, presented by Resilient Regions Association, explains the city as a symbiotic system of six Urban Flows: goods, services, money, people, energy, and information. Disasters and other disruptions can shake the operability of these flows, jeopardizing the whole functionality of a city. The MERIT tool helps cities assess the economic impact of infrastructure disruptions. Equipped with this knowledge, cities can build a stronger case for investment in resilience and closer public-private collaboration based on mutual interest.

"The flow perspective allows politicians and businesses who don't think of themselves as working with resilience to see how critical they are for the functioning of their cities under all risk scenarios."

Silvia Haslinger Olsson, Operations Manager, Resilient Regions Association, Malmö, Sweden

Building green, gray, or somewhere in-between

Green infrastructure (GI) is praised for providing a range of co-benefits with relatively low operating costs and energy requirements. However, GI solutions are not always the best option, and may be hindered by a lack of awareness, space, or initial funding. UNEP-DHI's Green Infrastructure Guide for Water Management prompts cities to use available tools, compare results, and make informed decisions for green or gray infrastructure. In the cases of Howard Beach, New York, USA and the City of Essen, Germany, a hybrid "green-gray" approach proved to be the best way to reduce flooding and leverage co-benefits.

Catarina Freitas, Director of Sustainable Environmental Management and Planning Department, City of Almada, Portugal

Mining heat from urban infrastructure

Observed temperatures in cities are often several degrees higher than in their rural counterparts – a phenomenon that will be exacerbated in some cities by climate change. Several architectural and green/blue infrastructure solutions have been identified to mitigate the Urban Heat Island (UHI) effect. These include simple strategies like painting rooftops white to increase reflectivity (albedo), ecosystem-based approaches like routing streams through urban areas and planting trees, and more complex regulations for building design and materials. As the UHI effect intensifies, cities may consider more innovative methods such as converting waste heat to energy, or urban zoning according to energy demand (i.e. building multi-family residential homes next to hospitals for sharing/reusing energy from space heating and cooling).

eThekwini Municipality (Durban), South Africa

Socio-economic values of ecosystems

SUMMARY: eThekwini Municipality is one of the first cities in the world to recognise the economic contribution of open spaces and ecosystems services. To document the important life-sustaining environmental services of ecosystems, the municipality conducted an economic valuation of those services, which has helped inform appropriate management and resourcing of Durban's open space system. With an estimated replacement value of US$ 400 million per year in 2003, excluding the contribution to annual tourism-related turn-over, eThekwini Municipality has made a strong economic argument for conserving its biodiversity.

Biodiversity & Biodiversity Management in Durban

One of Durban's beaches - the tourism potential of natural areas has not yet been factored into the conservative valuation of the city's ecosystems services of US$ 400 million a year.

Durban's wealth of biodiversity and its management challenges

The variety of landforms and climatic conditions, as well as the significant biogeographical position of Durban, has resulted in a wide range of terrestrial and aquatic ecosystems, which are home to a rich diversity of organisms. The challenges to conservation of ecosystems and biodiversity in Durban include:

- land transformation (around 60% of the city has been transformed by urban and rural development);
- invasive alien species;
- uncontrolled mining;
- over-harvesting of fauna and flora.

eThekwini Municipality has reacted with creative and innovative strategies to address these environmental challenges, and in so doing has enhanced social and economic benefits.

Economic value of Durban's biodiversity

The natural ecosystems of the eThekwini Muncipal Area (EMA) provide a range of valuable goods and services to its citizens. These include climate regulation, water regulation, gas regulation, water supply, erosion control, soil formation, nutrient cycling, waste treatment, biological control, food production, natural products and genetic resources. Durban's ecosystems are also of social, recreational and aesthetic value and contribute immensely towards human well-being. The most recent estimate of the value of the natural areas included in Durban's open space system was done in 2003. Result: the replacement value was conservatively estimated at US$ 400 million per annum, excluding the contribution to the tourism sector. Assuming a large part of Durban's tourism rate is linked to its natural environment, then a significant portion of the annual tourism-related turn-over can be added to the amount of US$ 400 million.

The Durban Metropolitan Open Space System (D'MOSS)

Recognising that the city's open spaces, and the biodiversity that they support, supply a range of valuable environmental goods and services, eThekwini Municipality has considered the role of open spaces in designing the Durban Metropolitan Open Space System (D'MOSS).

Much of the desired open space system is not in municipal ownership and is zoned for development purposes. eThekwini Municipality and its partners therefore aim to secure the open space system by activities including: development assessment, development guidelines, environmental servitudes, ecological compensation/ offsets, compliance monitoring and enforcement; land acquisition and conservation management.

Invasive Alien Strategy

Invasive alien organisms pose an enormous threat to Durban's biodiversity assets and could result in major biodiversity losses. eThekwini Municipality is developing an Invasive Alien Species Strategy and a State of Invasive Alien Species Report has been compiled, which details the variety and impacts of invasive species.

For more info on this project, contact:
Errol Douwes
douwes@durban.gov.za

Woman collecting ncema rushes for weaving. Many people rely heavily on environmental goods such as these rushes to make a living.

Involvement in international initiatives

Durban has made a name internationally for its early and comprehensive Local Agenda 21 activities and its long-term strategic planning. It was not surprising that this ICLEI member city co-initiated the Local Action for Biodiversity Project and published the first biodiversity report in terms of the project.

City contacts & profile

A pioneer in acting to address varied biodiversity challenges including climate change

ETHEKWINI municipality is located on the eastern seaboard of South Africa. It covers an area of 2297 km² and contains examples of three of the country's eight terrestrial biomes, namely savannah, forest and grassland. The aquatic environment includes freshwater and marine habitats, 18 river catchments and 97 km of coastline. Durban is the largest port and urban area on the east coast of Africa and has a population of just over 3 million people. It is also the second largest industrial hub in South Africa.

Name: Richard Boon
Department: Environment Management Department
E-mail: boonr@durban.gov.za
Website: www.durban.gov.za

LOCAL ACTION FOR BIODIVERSITY is a global urban biodiversity initiative of ICLEI – Local Governments for Sustainability in cooperation with IUCN. This pilot project of 21 cities around the globe focuses on the key roles that local governments play in conserving the worlds biodiversity and retaining the relationship between people and nature. See: www.iclei .org/lab; lab@iclei .org

COUNTDOWN 2010 is a powerful network of more than 600 partners working together towards the 2010 biodiversity target. Each partner commits additional efforts to tackle the causes of biodiversity loss. The secretariat – hosted by the International Union for Conservation of Nature (IUCN) – facilitates and encourages action, promotes the importance of the 2010 biodiversity target and assesses progress towards 2010. See: www.countdown2010.org

CITIES & BIODIVERSITY is an initiative of local governments and UN agencies to increase awareness on the relevant role of cities and towns for conserving and managing biodiversity. See: www.iclei.org/biodiversity

THE "CITIES & BIODIVERSITY CASE SERIES" is started in 2008 on the occasion of the UNCBD Conference of the Parties (COP) 9 in Bonn/Germanyin May 2008. Funding is provided by UNEP, with co-funding from ICLEI, IUCN and the City of Bonn. The case descriptions are compiled by the "Local Action for Biodiversity (LAB)" project team in the ICLEI Africa Secretariat and ICLEI's International Training Centre.