

Adapting to sea level rise:
Reshaping the future of our coastal cities

NATURE-BASED SOLUTIONS FOR RESILIENT COASTAL CITIES



OCEAN & CLIMATE
PLATFORM



SHARING SOLUTIONS WITH COASTAL
CITIES TO TACKLE SEA LEVEL RISE

Sea'ties, an initiative led by the Ocean & Climate Platform to adapt cities to sea level rise

The Ocean & Climate Platform (OCP) is a global network federating over 100 organisations from civil society. Created in the run-up to COP21 in Paris, the OCP promotes scientific expertise on the major role played by the ocean and its ecosystems in the climate system, and advocates for better consideration of these interactions by national and international decision-makers. Building on the wide-ranging expertise of its members, the OCP brings light to concrete solutions to protect the ocean, its biodiversity and the climate.

The Sea'ties Initiative, led by the OCP, aims to facilitate the development of public policies and the implementation of adaptation solutions to support coastal cities threatened by sea level rise. Its main objectives are to compile and disseminate knowledge, to collect and share experiences and to support political action in favour of the sustainable adaptation of coastal cities.

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INTRODUCTION

Nature-based solutions (NbS) constitute strategic options to adapt coastal cities to sea level rise. Coastal ecosystems, when given the time and space, can act as buffer zones to contain erosion and reduce the impacts of extreme climate events. In line with this, NbS are actions that protect, manage, and restore ecosystems to address societal challenges, while also benefiting human well-being and biodiversity. They encompass a diverse range of applications, combinations, and gradients of intervention from ecosystem conservation and restoration to hybrid approaches that combine nature with infrastructure, particularly valuable in urban areas. Despite their potential for long-term adaptation NbS remain limited, isolated and short lived due to numerous challenges.

WHY CHOOSE NBS TO ADAPT COASTAL CITIES?

- **NbS offer a range of co-benefits to address multiple urban sustainability challenges**, such as improving biodiversity, enhancing climate resilience, and promoting socio-economic development and human well-being.
- **NbS can help reconnect ecosystems and populations across urban, peri-urban, and rural areas**, offering co-benefits beyond the boundaries of individual municipalities.
- **NbS are often more flexible, cost-effective, and inclusive** than traditional engineering methods, providing low-regret options for adapting to coastal challenges under various climate scenarios.
- **NbS can support transformational adaptation in coastal cities**, encouraging more flexibility and acceptance of the natural, dynamic changes of coastlines.

WHAT ARE THE CURRENT CHALLENGES IN IMPLEMENTING NBS?

- **Knowledge gaps exist regarding the feasibility, performance, and resilience of NbS to support cities' adaptation**, particularly in data-scarce regions like the Global South and Small Island Developing States (SIDS), and in conditions of increasing pressures from climate change and urban development.

- **Insufficient monitoring, reporting and evaluation (MRE)** hinder the sharing of lessons learnt from past successes and failures, and the capacity to upscale NbS projects.
- **Space availability, land management, and property rights** are frequent barriers in urban settlements, as NbS require to navigate overlapping land tenure systems, conflicting interests, and fragmented administration.
- **Institutional, legal and technical barriers often impede or delay** the deployment of NbS projects which involve innovative processes and adjustments to current practices.
- **Funds are limited and hard to access for NbS**, with economic decision-making tools being often suboptimal to capture and compare their value. Available funds are insufficient for the capacity-building, transaction, and maintenance costs needed for long-term viability.
- **Equity and acceptability of NbS** present additional challenges. They can disrupt traditional methods of stabilising the coastline, making them difficult to embrace. Without active local involvement, there is a risk of exclusion through climate gentrification and land grabbing, which can lead to maladaptation.

WHO IS THIS BRIEF FOR?

This brief is intended for **decision-makers and stakeholders seeking innovative and sustainable adaptation responses for coastal cities faced with sea level rise**, in line with societal, biodiversity and climatic goals.

WHAT IS THE PURPOSE OF THIS BRIEF?

This brief aims to **provide guidance and key levers to overcome the typical challenges** listed above in integrating Nature-based Solutions into adaptation strategies for coastal cities. It is the first instalment of a thematic series titled "Adaptation to sea level rise, how to reshape the future of our coastal cities?" which will also cover social justice and planned relocation.

5 RECOMMENDATIONS FOR POLICY MAKERS

1

Assess the feasibility and track the efficacy of NbS for coastal adaptation through downscaled, multidisciplinary research and iterative monitoring, reporting, and evaluation informed by the inputs of communities and local stakeholders.

2

Mainstream and phase NbS into urban planning, public policies, and utilities, by including the preservation of existing ecosystems in priority and progressing towards transformative projects that address both immediate and long-term adaptation goals.

3

Design and coordinate integrated NbS projects considering socio-economic, demographic, and ecological continuities along the coastline and hinterland. Support these efforts by enforcing existing planning tools and establishing clear partnerships among competent stakeholders.

4

Demonstrate the economic case of NbS projects by using dynamic and holistic valuation tools to capture monetary and non-monetary performance over time, and ensure their long-term viability by investing in the enabling environment and by seeking diverse revenue streams.

5

Prioritise social justice and equity in NbS projects by engaging communities transparently and inclusively at all stages, addressing potential externalities, and ensuring direct benefits for local livelihoods.

1. Assessing and demonstrating the feasibility and efficacy of Nature-based Solutions for coastal adaptation

ASSESSING FEASIBILITY

Downscaled and multidisciplinary research is key to demonstrate and convince that NbS are feasible and effective options for coastal adaptation. Locally relevant assessments should consider unique urban and coastal settings, including ecological, technical, socio-cultural, economic, property, legal, and institutional dimensions, to determine the potential and necessary conditions for developing NbS.

Comprehensive evaluations of the co-benefits relating to adaptation, biodiversity, socio-cultural and economic outcomes - which may surpass those of traditional grey infrastructure - are needed to bolster the case for NbS.

Indigenous and local knowledge is instrumental to improve feasibility assessments. It enhances understanding of the socio-cultural environment in which NbS could be deployed, provides lessons from historical experiences and practices in protecting and

utilising ecosystem services, and supports better evaluation of potential benefits for communities.

Innovation and technologies, such as low-cost sensors and digital twins, can provide municipalities with actionable data. For example, the [SCORE EU project makes use of low-cost sensors](#) to support the tracking of climate hazards impacts on ecosystems.

TRACKING PROGRESS TO ADJUST

Monitoring, Reporting, and Evaluation (MRE) is an iterative process, essential to the adaptive management of an NbS project. Continuous evaluation enables effective operation in conditions of uncertainty by allowing adjustments in response to changing environmental conditions and evolving community needs.

Guidelines and standards to conduct MRE can improve the consistency, interoperability and comparability of NbS projects. Accordingly, the European Commission developed a [handbook for practitioners for “Evaluating the impact of nature-based solutions”](#).

MRE guidelines must be complemented by indicators that capture local realities and needs with inputs from local stakeholders. [The Adaptom project](#) developed a scoring methodology for NbS tested in SIDS, where each initial evaluation benefited from feedback and suggestions from project leaders to improve the score’s accuracy.

LEARNING FROM EXPERIENCES TO UPSCALE

Reporting is essential for upscaling NbS, as it allows practitioners to learn from their peers and avoid common pitfalls. Open-data and knowledge-sharing platforms such as the [Sea’ties’ Map of Solutions](#) or the [RESILAO “Monitoring-Capitalisation” platform \(PRCM\)](#) in West Africa, provide valuable resources. Collaborative and transboundary projects such as the [SARCC](#) project, which mobilises 14 cities and regions across Europe, and peer networks such as the 10 coastal cities’ ‘living labs’ in Europe and Turkey under [the SCORE project](#), are critical for generating and disseminating knowledge, methodologies, and tools for the development of NbS.

2 Developing a pro-NbS environment for integrated and dynamic adaptation of coastal cities

PRIORITISING NBS WHEREVER POSSIBLE

NbS should be strategically prioritised wherever possible and systematically integrated into the solution mix of adaptation strategies. Incorporating NbS into adaptation and urban planning as early as possible can help unlock co-benefits in the short term and accelerate their mainstreaming by demonstrating their low-regret potential.

NbS can be mainstreamed into various public policies - such as economic development, air quality, social and environmental justice, climate change mitigation - to boost their adoption and align efforts toward diverse urban objectives.

Requirements and financial incentives to integrate NbS can also be embedded in service contracts for utilities and network service providers, as seen in the [Highway 37 Redesign in the San Francisco Bay](#). The [European](#)

[Investment Bank \(EIB\) report on NbS](#) further suggests introducing rules and rewards to encourage the delivering of NbS over traditional grey infrastructure.

ORGANISING LAND MANAGEMENT WITH ECOSYSTEMS

Clear real estate management and land use strategies are prerequisites to developing integrated NbS, especially in urban environments where space is limited and conflicts over property and land use are likely to arise.

Application of existing management frameworks is instrumental to support the immediate preservation of coastal ecosystems in public domains along the coastline. The [Barcelona Convention's Protocol on Integrated](#)

[Coastal Zone Management and its provision on setback zones](#) in the Mediterranean; or the ["50 pas géométriques" in French overseas territories](#) are critical tools in that regard.

Public acquisition and management of natural coastal areas can be effective in preventing the degradation of ecosystems and even restoring them. In the industrial and economic zone of Jarry in Guadeloupe, [the Conservatoire du Littoral - a French public administrative body - is responsible for the management and restoration of the mangroves](#) which involves liberating the natural public domain from illegal occupation by neighbouring industries.

Integrating customary governance and land tenure systems, including local leaders and informal settlements, can incentivise communities to prevent ecosystem loss while acknowledging their land rights, as supported by the [Kiwa initiative](#) in the Pacific.

COORDINATING INTEGRATED NBS PROJECTS

Considering ecosystems at scales such as sediment-cell, river basin, or even islands (e.g., [PEBACC "Ridge to Reef" approach in Port Vila, Vanuatu](#)) or otherwise relevant units (e.g., [Operational Landscape Units defined by the San Francisco Estuary Institute](#) in the U.S.) is essential to deploy comprehensive, interconnected and mutually reinforcing NbS projects.



Cross-jurisdictional and multi-stakeholder collaborations allow for the alignment of actions across the socio-ecological continuum of the coastline and leverage collective capacities for robust outcomes. For instance, the municipality of Lamentin in Martinique, collaborated with local businesses on the restoration of mangroves and the mitigation of industrial impacts on ecosystems.

Clear, transparent, and tailor-made partnerships are essential to define the roles, resources and competences of each partner. Intermediaries can help bridge silos between stakeholders from different sectors and organisational cultures. For instance, the SCORE EU project establishes Coastal Cities Living Labs to bring together relevant local and regional stakeholders to co-create Ecosystem-based Adaptation solutions that are well-suited to the unique needs and challenges of each community.

Leveraging existing co-management frameworks is often key to strengthening partnerships around NbS. A prime example is the Marine Protected Area (MPA) of Saint Louis in Senegal, which capitalised on its pre-existing co-management structures among local populations, the MPA authority, and the municipality to develop the NbS and erosion control strategy of the Langue de Barbarie.

PHASING NBS OVER TIME TO OPERATE IN AN UNCERTAIN FUTURE

Phasing NbS over time facilitates the achievement of adaptation objectives in the short, medium, and long term. NbS are flexible options, suited for *Dynamic Adaptation Pathway Policies* (DAPP) where alternative actions are set out over different time horizons and according to changing environmental and social conditions.

Protecting and managing existing coastal ecosystems and restoring degraded ones, should be prioritised. The “1+N model” tested in the Yellow River Estuary in Dongying, China, which involves a year of active restoration (“1”) followed by long-term conservation (“N”), illustrates this approach effectively. Limiting the multitude of human stressors in urban and coastal areas (e.g., land use change, pollution) and regular maintenance of NbS (e.g., invasive species removal, species replantation or substitution) is crucial to support the performance and life expectancy of ecosystems.

Transformational changes can be supported by NbS, including complex measures like planned relocation. For instance, the municipality of Sète in France, decided the dismantlement and relocation of the coastal road inland in combination with the renaturation and restoration of the coastal dune.

3 Ensuring financial viability of Nature-based Solutions

ASSESSING COSTS AND BENEFITS OF NBS

Assessing the costs and benefits - both monetary and non-monetary - of NbS, using a dynamic and holistic approach, can make a compelling case for investments. Beyond traditional cost-benefit analysis (CBA), methods like multi-criteria analysis; cost-effectiveness analysis; decision-making under uncertainty and life-cycle analysis can offer a more comprehensive view of pros and cons. Scenario-based CBA can highlight the increasing co-benefits provided by NbS over time, making it easier to compare upfront and long-term costs. Meanwhile, multi-criteria analysis can be effective to capture the non-monetary socio-economic and environmental benefits of NbS. For instance, [the Med-ESCWET Project \(Plan Bleu\)](#) developed an economic valuation of the ecosystem services provided by wetlands in terms of climate change adaptation in the Mediterranean. Meanwhile, the [Toolkit for Ecosystem Service Site-Based Assessment developed by Wetland-based Solutions](#) offers practical guidance for evaluating nature's benefits to people.

Anticipating the financial demands of NbS projects is paramount to ensure their long-term viability. Costs associated with NbS extend beyond implementation and involve capacity-building, ongoing monitoring, maintenance, and adjustments over time. Hence, it is crucial to regularly assess investments needs and to move away from project-based financing models to seek long-term funding.

FACILITATING ACCESS TO FINANCE FOR NBS

Working across scales, both encouraging the financing of aggregated projects while streamlining financing packages for small-scale projects directly available to local authorities and non-state actors, is indispensable as NbS initiatives tend to be small-scale and isolated. Municipalities' access to financing integrated NbS projects can be significantly improved through harmonised funding streams, mechanisms and requirements.

Enhancing local financial engineering capacities is key to enabling municipalities to formulate and conduct integrated, bankable projects over the long term. Technical assistance in grant writing and fund management is offered by the WACA programme and [RESILAO](#) project in West Africa, and the [California Ocean Protection Council grant writing technical assistance program implemented by Coastal Quest](#) in the United States.

INCREASING FUNDING OPPORTUNITIES

Diversifying and blending funding sources - including public funds, private and philanthropic investments, and crowdfunding - can reduce investment risk, thereby increasing attractiveness for investors. Strategically combining financing sources and instruments throughout the development of NbS projects can broaden financial resources and enhance flexibility to tailor financing solutions to local, evolving, and long-term adaptation needs. Additionally, databases like the [Coastal Funding Database of Coastal](#)

[Quest](#) can enhance access to funding information for municipalities, improving their ability to secure necessary resources.

Public revenue for NbS can be generated through taxes (e.g. green taxes, tourism taxes on private beneficiaries of public natural assets), tax rebates, and loans, directly involving businesses and the public in the financial conduct of NbS projects. [In line with the Target 18 of the Kunming-Montreal Global Biodiversity Framework](#) which set the target to “reduce harmful incentives by at least \$500 billion per year, and scale up positive incentives for biodiversity” by 2030, additional public funds could be redirected to support ecosystem protection and restoration from the phase out of harmful subsidies.

Direct income-generating ventures, such as ecotourism, recreational activities, or farming, can provide local communities with reliable and self-sustaining revenue streams while also supporting NbS projects.



DE-RISKING PRIVATE INVESTMENTS

Strategies that reduce financial risks, known as de-risking mechanisms, are key to fostering private investments, for example through blended finance, green and blue bonds, impact investing, and public-private partnerships. The Europe Investment Bank highlights several mechanisms, including public loans or guarantees (co-fund), securitisation, risk hedging through insurance intervention, or contingent loans and equity-like debt to further de-risk and encourage corporate investment in NbS initiatives.

The insurance sector plays a significant role in investing and covering residual risks of NbS projects. The long-term investment horizons of NbS are well-suited for investors such as insurance companies and pension funds, who can bear a prolonged exposure to risks. Meanwhile,

innovative insurance products such as parametric insurance offer risk-transfer solutions that can integrate the value of healthy ecosystems and provide financial compensation following natural disasters. For instance, the Meso-American Reef Fund's Reef Rescue Initiative plans to pilot parametric insurance policies aimed at funding coral reef restoration and reconstruction. In San Crisanto, Yucatan, AXA Climate is developing a parametric insurance product to boost the resilience of the fishing community against hurricanes by ensuring rapid financing to restore damaged mangrove forests and to repair fishing and ecotourism infrastructure.

4 Advancing social justice and equity through Nature-based Solutions in coastal cities

ENGAGING TO FOSTER ACCEPTABILITY

Engaging communities around the design, implementation and monitoring of NbS is crucial for overcoming resistance, fostering a sense of ownership and justice in ecosystem management. Locally-driven approaches that recognise and empower local and indigenous populations can ensure that NbS projects are culturally and locally relevant. While meaningfully engaging communities can be challenging, guidelines and toolkits, such as the [SCORE co-creation toolkit](#), are available to support municipalities in this process.

Education and communication are pillars of informed engagement. A prospective approach can be useful to understand the obstacles impeding the development of NbS and overcome them, as exemplified by the [CASadapt project](#) in the urban region of Sophia Antipolis, France. Similarly, the [Sustainable Solano project](#), in Suisun City, United States,

engages vulnerable populations in community action connecting neighbours and ecosystems through flood-resilient gardens, annual climate events, high school internship programs and “Flood Walk tours”. Both approaches constitute effective, creative, and cost-efficient methods for raising awareness and supporting engagement in NbS projects.

Transparency about the benefits and limitations of NbS is essential for building long-term trust with communities. Therefore, sharing information and involving communities in pre- and post-assessments is key to ensuring accountability. Online platforms and open data, like the [visualisation toolkit and web-based geospatial viewer from the SARCC project in Europe](#), can facilitate information sharing. Importantly, acknowledging and addressing reluctance and opposition to NbS is necessary for developing inclusive and socially acceptable adaptation strategies.

ENSURING EQUITABLE SOLUTIONS TO AVOID MALADAPTATION

Ensuring an equitable distribution of benefits from NbS among stakeholders is paramount to prevent maladaptation. Integrating NbS projects with social justice goals requires addressing potential externalities that could disrupt coastal and inland livelihoods, such as land appropriation and speculation. Providing alternative livelihoods, poverty alleviation, employment, and gender-sensitive policies can ensure that benefits of NbS reach the most vulnerable groups. In line with this, [the dune restoration project conducted by the Marine Protected Area of Saint Louis, Senegal](#), also facilitated market gardening redevelopment.

Recommended resources and bibliography

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METHODOLOGIES, TOOLS AND PLATFORMS

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