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MUNICIPAL GOVERNANCE FOR NATURE-BASED SOLUTIONS

EXECUTIVE SUMMARY OF THE UNALAB MUNICIPAL GOVERNANCE GUIDELINES
AUGUST 2019





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1 MUNICIPAL GOVERNANCE FOR NATURE-BASED SOLUTIONS

Cities today are under significant pressure to reconfigure urban systems and structures to facilitate sustainable development while future-proofing themselves against increasing risks associated with climate change. In the past, urban development has had a clear top-down character, with public authorities responding to and managing urban challenges through the institutional framework organised along the lines of the services that public authorities provide. Until recently, these "silos" established on different levels of government were relatively effective in delivering public management. Yet the effectiveness of dealing with complex cross-sectoral issues such as climate change has been limited. At the same time, many cities are experiencing a transformation from "Government" to "Governance", with a shift in the role of local administrations from top-down regulators towards providers of a certain governance "context" to organise activities. In this context, non-state actors such as research institutions, companies, local community groups and other urban actors are playing an increasingly important role in the way cities are planned, built and managed. The effective mobilisation of these actors requires the creation of the right structures and "rules of the game" to steer towards a sustainable and resilient future.

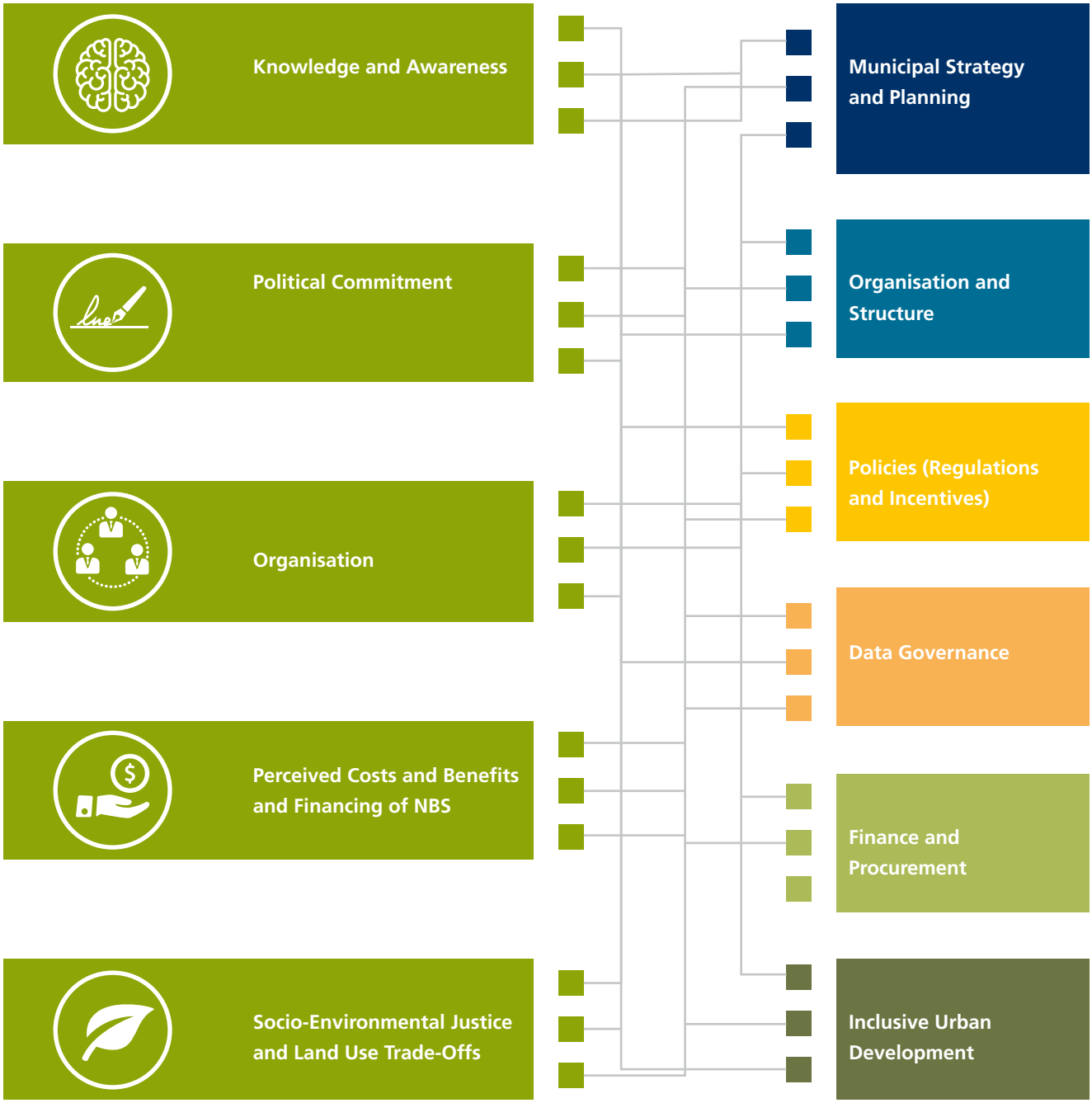
Nature-based solutions (NBS) as a concept has emerged as a promising approach to help cities solve urban challenges while protecting and enhancing natural systems and providing a range of co-benefits to improve the well-being of urban dwellers. As a cross-sectoral concept, the successful implementation of NBS in urban space builds on a combined effort of different actors both inside and outside the municipal organisations, emphasising the importance of understanding the factors that will support or inhibit the effective coordination of these actors. The UNaLab Municipal Governance Guidelines explores a range of governance-related barriers inhibiting the effective integration of NBS in cities, and highlights a range of actions that can be taken to help overcome these barriers. It builds on knowledge developed around governance of NBS through the work in the UNaLab Front Runner cities, Eindhoven (NL), Tampere (FI) and Genova (IT) and other good practices relating to supportive governance structures and processes for NBS in cities.

This executive summary provides an overview of the Guidelines touching on the key findings and takeaways from the report. The first section provides an overview of the governance-related barriers identified together with the partner cities, whilst the second section provides a catalogue of potential actions cities can take to help overcome the identified barriers.

What are Nature-based Solutions?

NBS can be broadly defined as "solutions that are inspired and supported by nature, which are cost-effective, simultaneously provide environmental, social and economic benefits and help build resilience" (European Commission, 2018). Integrating a range of associated concepts such as 'Ecological Engineering' 'Green-Blue Infrastructure', 'Ecosystem-based Adaptation' and 'Ecosystem Services' (Nesshöver et al., 2017), the concept provides an integrative, action-oriented tool for a range of actors to address a range of societal and sustainability-related challenges.

Overview of the approach: Linking governance-related barriers to NBS uptake and actions to help overcome these barriers



MP1 Development of shared visions
MP2 Embedding NBS in existing plans and strategies
MP3 Experimental areas for pilot projects
MP4 Utilising environmental and sustainability management systems
MP5 Development of a resilience strategy
MP6 Awareness campaigns
MP7 Use of Blue-Green Factors

OS1 Structures for cross-sectoral cooperation
OS2 Fostering of informal networks
OS3 Training of administrative staff in cross-cutting issues
OS4 Central contact point for NGOs

RI1 Review of the existing policy framework
RI2 Introducing NBS-supportive building regulations
RI3 Introduction of NBS-supportive zoning regulations
RI4 Introducing incentives to enhance private sector engagement
RI5 Use of compensation schemes
RI6 Use of certification schemes and sustainability programs

DG1 Data management strategy
DG2 Data governance and management within departments
DG3 Data management between municipal departments and agencies
DG4 Data as an instrument for governing external agencies and contractors

FP1 TEV Framework in CBA
FP2 Targeted fees and other charges
FP3 Apply the "polluter-pays" principle
FP4 Issuing green bonds
FP5 Engaging in public-private partnerships
FP6 Introducing MEAT award criterion in public procurement
FP7 Financing across multiple departments

ID1 Integration of social inclusion into green space planning
ID2 Mechanisms to influence housing prices
ID3 Establish a "just-green-enough" approach
ID4 Quantitative and qualitative assessment tools and standards
ID5 PPGIS

2 GOVERNANCE-RELATED BARRIERS INHIBITING THE UPTAKE OF NBS



2.1 Lack of knowledge and awareness

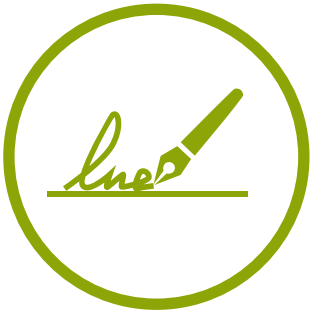
Lack of knowledge and awareness was highlighted regularly as a key barrier to the uptake of NBS in cities. NBS is a rather new and interdisciplinary concept which takes time to embed itself in municipalities, yet a more nuanced perspective highlights some additional insights into this challenge. In particular, a lack of knowledge was identified:

- **Amongst municipal workers:** as a cross-sectoral topic, NBS requires the engagement of multiple departments. In many cases amongst the UNaLab partner cities, the concept is placed more intrinsically within the departments responsible for green space and water management. In order to effectively deploy the concept beyond these departments, a broader level of awareness and exchange is necessary.
- **Amongst decision makers:** in many cases, politicians also do not yet see the potential of NBS to support the city in achieving long term objectives.
- **Amongst local businesses and citizens:** for the effective implementation of NBS, the participation of the private sector is necessary. Multiple cities reported difficulty convincing local businesses to integrate NBS into their strategies. Buy-in is also important amongst citizens, who on one hand can present strong opposition to the implementation of NBS, but also should be considered central partners and co-creators of NBS in the city.
- **About the areas that are at risk of climate change:** in multiple cases it was reported that there is a need for more data related to climate change scenarios to better target and justify the development of NBS. Also beyond a purely climatic perspective, integration of different data sets (such as those related to vulnerable groups, and human settlement scenarios) will help cities better target NBS.
- **About the potential of NBS to address challenges, their co-benefits and the suitable types to employ:** Factors such as the limited evidence base for the ability of NBS to achieve climate related challenges, or knowledge about the potential co-benefits they can deliver.

- **About the functions/services nature provides to cities:** Awareness of the services that nature provides to cities is still considered insufficient amongst partner cities. A few of the partner cities have begun integrating ecosystem services into municipal accounting processes, but there remains limited awareness about the value of the services that existing and future NBS/green infrastructure can provide.
- **About the technical aspects of planning, building, and maintaining NBS:** NBS presents a fundamentally new way of conducting urban development. From a technical perspective, this presents challenges as it requires new processes and techniques to be integrated into engineering and land use planning processes. It has also been highlighted that poor or wrong implementation of NBS and the resulting negative effects are a threat to public perception, acceptance and support. In some cases, the technical knowledge is present but must be effectively distributed, emphasising the importance of learning between cities.

Knowledge and awareness should not only be viewed as a challenge to the successful implementation of NBS. NBS also present an effective tool to raise knowledge and awareness around climate change adaptation and sustainability-related challenges. While concepts such as ecosystem services and green infrastructure can be more difficult for local citizens and companies to grasp, NBS has the potential to communicate the principles of these concept in a way that can be utilised by non-technical individuals.

2.2 Political commitment



Political commitment is seen as an imperative to facilitate the increased uptake of NBS. A clear directive for building a more climate resilient city and making a departure from business-as-usual is a necessary perquisite for the effective uptake of NBS.

City leaders are faced with a range of challenges at any given time and there is a tendency for emphasis to be placed on (often short-term) challenges perceived as more "pressing" such as economic growth, jobs and housing, etc. Considering the long-term benefits that tend to be associated with NBS, this can present a further challenge, particularly in the context of short-term political cycles. It was reported that in some cases, NBS and greening solutions are perceived as expensive and luxury "nice to have" elements rather than being framed in a way that reflects their relevance for core political mandates such as climate change adaptation or ensuring the health and wellbeing of citizens. Therefore, the appeal of NBS can be low for some politicians.

In some cases the topic of "sustainability" has established some prominence on the agenda amongst decision makers, but NBS are not usually integrated into this agenda. More focus tends to be placed on climate change mitigation (rather than adaptation) through the reduction of carbon emissions, neglecting the wider benefits associated with NBS.

In addition, there is a still limited willingness to pioneer and take risks in testing new concepts in most cities. The potential backlash of negative outcomes eventuating from experimentation with a new approach lends to a risk averse administration, focusing on priorities that are tried and tested.

However, experiences from the UNaLab partner cities demonstrate that if framed correctly, NBS and urban greening can be a very powerful topic for politicians during elections, demonstrating the importance of capitalising on policy windows.



2.3 Organisation

How the municipality is structured and organised has been identified as a crucial factor determining the success of many sustainability or nature-based interventions. These themes are interdisciplinary in nature and thus require the cooperation of a range of actors who typically may not have effectively collaborated in the past. NBS present a fundamentally different approach as compared with conventional urban development. A range of factors explain the novelty of NBS:

- As solutions, NBS tend not to be ad hoc - they are not developed to address one specific problem, but a range of interconnected challenges
- The benefits of NBS interventions tend to be abstract, i.e. can be difficult to quantify
- NBS tend to foster a high degree of public (rather than private) goods; therefore, these dispersed benefits cannot be easily allocated to one department or actor, but multiple departments and actors. At the same time, for the effective implementation of NBS at the required scale the cooperation of private actors is necessary.
- NBS benefits tend to relatively long term payoffs

For these reasons, NBS presents an organisational challenge in terms of the necessity to get multiple actors on board to develop an effective coalition to support their uptake. Conversely, the concept presents a potential mechanism to support and foster better cross-sectoral cooperation as a longer-term governance ambition in cities.

Two central perspectives could be identified:

1. **Cooperation within the administration:** The challenges identified reflect the difficulties in deploying a cross-sectoral concept in the context of the existing silos that still largely characterise municipal governance structures. The identified challenges reflect these issues, highlighting aspects such as: data and knowledge sharing between departments and other municipal agencies; cross departmental financing of NBS; a lack of effective planning tools; aspects relating to the procurement processes; and, the effective inclusion of other themes, particularly "health", under the NBS umbrella in partner cities.

2. **Effectively engaging with actors outside of the administration:** Like any intervention that targets urban space there will likely be a wide range of stakeholders potentially be affected by a given NBS intervention. In order to increase acceptance of NBS on behalf of the citizens and other local stakeholders, it is important that effective mechanisms for inclusion of these stakeholders are present. In particular to effectively include citizens in the development of NBS there is a need for the effective integration of new co-creation formats.

2.4 Perceived cost and benefits and financing of NBS



As many of the benefits delivered by NBS are considered public goods they cannot easily be internalised by investors. Often, the direct and indirect impacts and payoffs of NBS require time to become evident, and the estimates of NBS costs and benefits are frequently dependent on individual value judgment (Nesshöver et al., 2017).

Attracting private capital investment in NBS can help to ensure the continuous implementation and mainstreaming of NBS in the context of the limited public budgets. However, private sector investments are also based on potential profits. The intangible and public nature of the benefits delivered by NBS makes the developing of feasible business cases for NBS implementation difficult. At the same time there is a lack of user-friendly tools and methods to account for the benefits delivered by NBS and express these benefits in monetary terms that would in turn help develop the business cases for investing in NBS.

This leads to NBS typically being financed by local governments. In the short-term, local governments might not need to set up additional revenue collection and appropriation systems to fund NBS.

However, long-term funding for NBS may not be stable if other obligations, especially those resulting in short-term benefits, are viewed as higher priorities. Budgetary constraints might imply prioritising other policy areas for funding that have more readily quantified and articulated effects.

Procurement practices may impose additional challenges to NBS implementation and mainstreaming in cities. Often, public procurement officers are subject to many pressures ranging from cutting costs to meeting the demands of internal users and the public. Since NBS lack straightforward business cases, demonstrating their cost effectiveness when compared to conventional solutions for urban development can prove challenging. For this reason, relying on the lowest cost indicator in the public procurement process implies an additional obstacle to NBS implementation.



2.5 Social and environmental justice and land use trade-offs

Any intervention in the urban space will have a range of intended and unintended social, environmental and economic consequences. Such impacts are highly context specific but some general tensions regarding NBS can be identified:

- **Green gentrification:** The term "green gentrification" has emerged to reflect the potential negative impacts of urban restoration. Green gentrification is a difficult challenge as one of the central "selling points" for NBS is that it increases the attractiveness of urban space: with increasing attractiveness, the inevitable consequence is an increased demand in housing and the associated cost. In the context of financing NBS, a central argument (or at least a highlighted co-benefit) for developers to integrate NBS into their plans, is the likely increase in rents over time. This can lead to social exclusion and increasing inequality gaps, at times more strongly affecting those residents for which the green intervention was actually meant to be beneficial (Haase et al., 2017; Kabisch et al., 2017, 2017). This presents a significant challenge for planners to increase the integration of NBS and facilitate urban regeneration, while managing the potential negative social impacts of these interventions.

- **Uneven distribution of NBS:** There are a range of reasons for which cities might deploy NBS and their target areas for implementation usually reflect the challenges they are intended to address. For example, NBS interventions will often target areas that are more prone to flooding or urban heat islands. This can lead to an unequal distribution of the green space within the city if the strategy is not aligned with mechanisms to support green space equality (Kabisch et al., 2017). Lower socioeconomic areas are often associated with higher impacts of both air pollution and urban heat islands (Wolch, Byrne, & Newell, 2014). This highlights the potential for the city to address socioeconomic disparities whilst addressing urban challenges related to climate change and ongoing urbanisation at the same time if an integrated strategy is established.
- **Competition for land resource (building compact cities vs green space accessibility):** With a rapidly growing population, many cities follow the concept of creating a compact city with short distances between services. The wider goal of this vision is to lower the environmental footprint of the city and create sustainable communities by reducing the distances between points of interest, and establishing a critical mass of citizens in a given area (to justify the existence of bus stops, schools, supermarkets, etc.). Such an approach includes high density building, urban infill and functional mix, reducing car dependency and urban sprawl. However, a focus on urban infill creates competition for space and puts increasing pressure on existing green spaces. This is intensified in cities experiencing rapid growth, as pressure for housing becomes a highly political issue and a central priority. Therefore, planners face the challenge of ensuring a compact city while maintaining existing and creating new green and blue spaces.
- **Ecosystem disservices:** Ecosystem services play a central role in justifying investments in NBS. However, some negative impacts of increasing nature in the city has led to the emergence of the term "ecosystem disservices" (Döhren & Haase, 2015). Examples of this include planted trees intensifying allergies and urban wetlands increasing mosquito populations (Döhren & Haase, 2015), as well as a potential for increased water consumption and the emission of greenhouse gases by constructed stormwater treatment wetlands (Döhren & Haase, 2015). Infrastructure damage by tree roots and increased maintenance can lead to additional costs. These aspects are often unavoidable and negative consequences are usually strongly outweighed by the long-term benefits, but it is important that they are taken into account when considering the development of NBS to avoid potential backlash.

3 GOVERNANCE-RELATED ACTIONFIELDS TO SUPPORT NBS UPTAKE

The following section outlines some proposed actions cities can take to help overcome the identified barriers. In this summary, the actions have been shortened. For an extended version of the actions please refer to the report D6.5 Municipal Governance Guidelines.

3.1 Municipal Strategy and Planning

The success of NBS as a concept in supporting positive urban transformation will depend largely on the extent to which NBS become embedded in mainstream urban planning and development processes.

A central overarching challenge communicated by UNaLab partner cities was being able to move beyond piloting and experimentation of NBS to the concept being established as a principle in business-as-usual urban development. This demonstrates the importance of considering NBS in the context of wider urban development practices. In this regard, the intrinsic and strategic integration of NBS as a concept into the "DNA" of the city through elements such land use planning, building codes, and zoning is an important step in this process. Many of the actions highlighted in other sections will play a role in addressing this challenge, but there are a range of additional actions that have been identified within the context of municipal strategy and planning which can help embed NBS in longer planning processes in cities.

MP1 Development of shared visions



An important building block of long-term planning approaches begins with the development of a collective vision. Cities will struggle to define precisely how the city will be in the distant future, but the process of actively and collectively defining what the city should become can support as an effective "guiding star" for urban actors to work towards.

Potential elements:

- Visions at different levels (whole city, local) around different themes (e.g. sustainability, NBS etc.).
- Integration of a wide variety of key stakeholders.
- Linking to goals and milestones.
- Visual representation of the vision.
- Communication of goals and visions.

MP2 Embedding NBS in existing plans and strategies



The action-oriented approach of developing "solutions" differentiate NBS from the other concepts in that it can be employed at a means for actors to achieve existing objectives. Therefore, rather than developing an individual strategy around NBS, there is significant potential to utilise NBS as a "tool" to achieve the objectives highlighted in existing or future strategies.

Potential elements:

- Obvious links to strategies such as Green/Blue Infrastructure; Climate Change Adaptation/ Mitigation; Biodiversity; Water Management etc..
- Less obvious links to strategies such as Social Development; Smart City; Mobility; Energy etc.

MP3 Experimental areas for pilot projects



Experimentation can allow for the development of locally attuned interventions whilst facilitating learning processes between municipal staff, citizens, developers and other possible stakeholders. Experimental areas can also be important mechanisms for cross departmental cooperation, bringing together actors from multiple departments, municipal agencies and other urban actors to work on a specific project. For successful learning and scaling up, it is essential that results of pilot scale interventions and lessons learned are used to systematically inform mainstream urban development.

Potential elements:

- Experimentation with new formats for public space development and management.
- Exemption from certain codes and regulations.
- Development of associated organisational units in the municipal organisation.
- Temporary land-use conversions.

UNaLab Stories: Hiedanranta, Tampere[1]:

For the district development on the grounds of a derelict paper factory, the municipality of Tampere chose to establish a piloting site that is exempt from the municipal mainstream planning processes. The district was labelled "Hiedanranta – Smart and Sustainable City District of the Future" and the development phase started with an international ideas competition where international development agencies were asked to present possible development scenarios. Two ideas were selected by a jury and used in a new process of co-creation with citizens, local companies, local research institutions and municipal employees to develop broad ideas and visions for the district. In a step-by-step process with the help of the Master Planning Department of the municipality, a detailed master plan was developed. From the beginning, the district development was given explicit funding in the city's budget plan. This distinct budget enabled the appointment of a dedicated project team consisting of a project manager and several project employees.

The new district was partly excluded from mainstream legal obligations, e.g., building codes, to allow for new and innovative interventions to be implemented, including new rooftop urban farming systems and a sustainable and decentralised sanitation system. The combination of both experimental approaches, a dedicated project team and funding, and a new and undeveloped municipal plot, is allowing for radically new technologies, management schemes and joint creation methods to be implemented. The municipality as a whole can now learn from the experiences of the project team in regard to the new processes and technologies.

[1] *https://valiaikainenhiedanranta.fi/in-english/hiedanranta-smart-and-sustainable-city-district-of-the-future*

MP4 Utilising environmental and sustainability management systems



"What gets measured, gets managed": In order to ensure objectives in the municipality are being met it is important that the sustainability performance is tracked and assessed in a systematic way. Effective sustainability and environmental management systems supports not only the uptake of NBS, but also paves the way for wider reaching approaches towards more sustainable local practices.

Potential elements:

- Performance monitoring linked to visions and goals related to sustainability and resilience co-defined by urban actors.
- Utilising existing environmental/sustainability management systems such as EMAS, ISO 1400, ecoBUDGET or the Integrated Management System" (IMS).
- SMART indicators (specific, measurable, achievable, relevant and time-bound) adapted to the city's objectives and local context.
- Performance regularly published in a sustainability report.
- Linking budgets to sustainability goals.

MP5 Development of a resilience strategy



In order to effectively respond to anticipated future changes, cities need to undertake strategic action today to enhance their resilience in the future. NBS have been identified as an important tool to help improve urban resilience. Therefore, a good starting point to understand the true benefits of NBS is to look at the city through the lens of resilience. What are the main threats to the functioning of urban systems now and in the future? Which of these systems are crucial for the wellbeing of the citizens? How will climate change likely affect the city? What actions can be taken now to reduce potential shocks? Such questions need to be answered through the development of a comprehensive resilience strategy.

Potential elements:

- Assessment of risks and vulnerabilities in the city.
- Regular risk assessment (on an annual or biannual basis).
- Identification and selection of adaption options including potential NBS to reduce vulnerability to potential shocks.
- Action plan development.
- Ensure sufficient funds for risk assessment and risk reduction measures.

MP6 Awareness campaigns



Raising the awareness of local stakeholders and citizens is vital to implement successful NBS programs. Increased public awareness and satisfaction with green infrastructure projects can lead to increased support for further projects as well as potential opportunities for private stakeholders to be a part of a wider transformation through NBS.

Potential elements:

- Development of a communication strategy targeting internal and external stakeholders.
- Presentations and workshops to inform citizens and other stakeholders.
- Integration of NBS into the municipal presence on social media, city website etc.
- Events for companies and researchers to increase their knowledge on NBS.
- Pilot sites open for public, organised info walks, events, info sheets, etc.
- Cooperation with schools, other educational institutes and NGOs.

UNaLab Stories: Inspiration book for NBS, Eindhoven

In order to spread awareness of the existing NBS in the city, Eindhoven has developed an Inspiration Handbook, showcasing the best practices regarding the development of NBS in the city. The process had a range of important outcomes:

- It allowed key stakeholders to develop a collective definition of NBS. This included key characteristics and objectives, supporting in a process of education and awareness raising.
- It praises local early movers providing incentives for local businesses to use NBS to improve their reputation in the city.
- It provided the municipal workers with a document they could use to spread awareness of NBS and the city's objectives regarding CC adaptation and resilience.

MP7 Use of Blue-Green Factors





The Blue Green Factor (BGF) is a factor-based policy instrument to ensure and maintain desired levels of green and blue in new development projects. As a non-economic valuation method, it scores the relative importance of different green or blue elements at a given site through assessing the ratio of the ecologically effective surface area as a factor of the total land area. This instrument allows developers and designers the freedom to decide how green or blue elements should be incorporated in the respective plans and, at the same time, can be used as evaluation criteria in public procurement or in the distribution of land.

Potential elements:

- Assessment targeting solely storm water retention performance.
- Additional inclusion of climate impact, landscape ecology, diversity, social values of lots, etc.
- Basic excel spreadsheet or a digital app.
- Development of a BGF map for the whole city for monitoring purposes.
- BGF minimums or associated incentives.

3.2 Organisation and Structure

In light of the "siloed" nature of municipalities, with the respective municipal departments developing their own organisational dynamics, the cross-sectoral concept of NBS presents a challenge for cities in terms of the necessity to get multiple actors on board to develop an effective coalition to support NBS uptake. On the other hand, the concept presents a great opportunity to support and foster better cross-departmental cooperation as a longer-term organisational project. Like "sustainability" or "smart cities", NBS as a concept presents a potential tool to help break down silos between municipal departments as it can represent a common project and vision that multiple departments and actors can work towards. Thus, the cross-sectoral nature of the topic should be seen as an opportunity, as well as a challenge.

Every city has its own unique organisational and institutional structure. For this reason, it is difficult to define clear and generic guidelines for establishing effective organisational development. All three UNaLab Front-Runner Cities approached this challenge in very different ways. However, the identified actions highlight some of the central principles that will help cities improve their organisational structure in regard to NBS.

OS1 Structures for cross-sectoral cooperation



Cross-departmental structures can take different forms, such as ad-hoc teams, working groups with regular meetings and common work procedures, cross cutting programs based on city objectives, or new departments focusing on cross cutting themes or targeting a specific urban area. Cities should adopt the organisational structures that are best suited to their own institutional context.

Potential elements:

- Establishment of a cross-departmental body.
- Development of interdisciplinary bodies linked to a specific geographical location.
- Cross-cutting program structures linking departments based on defined strategic objectives of the city.
- Physically locate relevant actors close to one another and provide common workspaces.

UNaLab Stories: Eindhoven's Organisational Web

The city has restructured the municipality to take a more cross sectoral and agile approach to urban development. The former classical top-down organisation type was transformed into an "organisational web". In this web, programme managers work in an interdisciplinary way, connecting the different municipal-internal and external stakeholders of individual development projects. Through this process, the municipality has transitioned from a supply-driven approach of urban services to a demand-driven approach. This change increases the municipality's sensitivity to what is going on outside of the city administration.

OS2 Fostering of informal networks



The establishment of formal cross-sectoral bodies is a central starting point for breaking down silos in the municipality. However, informal networks are an additional factor promoting cross-cutting actions and establishing trust between actors. It is important for local actors to know representatives from other departments personally and be able to contact them directly to organise a meeting or discuss relevant points.

Potential elements:

- Spatially locating actors together (in some cases in the same building) to reduce the costs of interaction and facilitate 'natural' opportunities to interact.
- Providing opportunities for municipal workers potentially interested in NBS and/or similar cross-cutting topics to interact.
- Organisation of events (seminars, workshops etc.) to bring potentially interested parties together to discuss the topic of NBS.
- The provision of time and resources to municipal workers to self-organise.

OS3 Training of administrative staff in cross-cutting issues



Personnel development and training in cross-sectoral issues is an essential part of a learning organisation. Training fosters knowledge transfer, enhances innovation among the employees and improves efficiency.

Potential elements:

- Training and capacity building, targeting processes and methods (e.g. co-creation, design thinking, stakeholder engagement, project management, moderation, communication, etc.)
- Training and capacity building, targeting covering cross-cutting themes (e.g. sustainability, resilience, climate change mitigation and adaptation, etc.).
- Mentoring programs.
- Staff-exchange between departments and municipalities.
- Excursions to other cities.
- Excursions to certain sites within the city.

OS4 Central contact point for NGOs



Local NGOs represent an important potential supporter of NBS. Cities should be establishing effective channels of communication with these actors. This can often be difficult in the context of the dispersed nature of local non-governmental initiatives. The establishment of one NGO representative who acts as a spokesperson for local NGOs and offers a direct line of communication with the municipality can improve the collaboration between these actors and the municipality.

Potential Elements:

- Financing through the municipality.
- Election of the representative.

UNaLab Stories: Trefpuntgroen, Eindhoven

In order to improve the communication and collaboration between the municipality and local NGOs in the city of Eindhoven, a coalition of all active citizen groups related to public space was formed. These groups articulate their comments on individual development plans through one elected spokesperson, who receives a salary from the municipality. Since the introduction of the model, the number of lawsuits against municipal development projects decreased considerably in number.

3.3 Policies (Regulations and Incentives)

The challenge of integrating the diffuse benefits of NBS within existing administrative accounting schemes can limit the obvious "business case" for NBS, which in most cases promise higher social or environmental, rather than clear financial returns on investment. Furthermore, there is a need to involve the private sector in the successful implementation of NBS to create a connected network of green and blue infrastructure, considering that municipal resources and ownership of land are limited and the effective delivery of ecosystem services can only be achieved through holistic and connected development.

With the right tools, policy makers can incentivise the implementation of NBS and strengthen their economic viability. As NBS is a topic that is linked to various disciplines and responsibilities, their realisation is influenced through a wide range of strategic documents and instruments, such as municipal green planning, urban planning, zoning, as well as building regulations, stormwater regulations and environmental levies. Additionally, cities are subject to numerous laws and regulations from different governance levels (European, national, regional and local level interventions) with direct implication for NBS uptake.

General policy principles cities could consider to improve the uptake of NBS include:

- **Using the right mix of policy tools and instruments for guiding behaviour and development:** Cities possess manifold tools and instruments, ranging from rather soft tools such as informational systems to harder command-and-control and economic instruments. These instruments allow policy makers to use them in different areas and urban contexts to influence and incentivise the implementation of NBS and to strengthen their economic viability. It is important to note that all proposed measures, whether regulation or market incentives, should be tailored to the local environment and conditions, creating a realistic, attractive and viable context for the adoption of NBS solutions in future urban planning practices.
- **Effective communication of the policy objectives:** Policy objectives and targets should be well aligned with the cities' overall vision. The creation of summaries, checklists and guidelines for the most relevant policy documents can help to better communicate these and present them in an easy-to-understand way to different local stakeholders. Most importantly, the ultimate goal of the policy/law has to be clear. Furthermore, the inclusion of policy issues in (NBS-related) trainings may help to increase understanding and acceptance.

- **Linking all relevant regulations and their spatial relevance on an easy-to-use platform:** The creation of a space where all relevant policies are gathered and organised and can be found via user-friendly and targeted search options. This could for example be on the city's website.
- **Effective policy monitoring and evaluation:** To ensure the validity and practicability of new measures and evaluate their contribution and effect on NBS implementation, the city should ensure effective policy monitoring and evaluation schemes. These may also enable future improvement and learning opportunities and affect local uptake and perception.
- **Strengthening the science-policy nexus:** In light of the fact that NBS is a particularly interdisciplinary and cross-sectoral topic, cities need to cooperate with different experts and associations to make sure future legislation is effective and knowledge-based. In particular, the cooperation between science and policy making should be enhanced to ensure that new findings and innovative solutions can be quickly taken up and transferred into "real" projects. This approach could also improve the legitimacy of certain policies.
- **Creating opportunities for innovative solutions and pilots to be tested:** As it is difficult and risky to change the entire legislative setting, small-scale experimentation areas which provide greater freedom and serve as testbeds provide a good opportunity to explore future solutions and processes. Such areas could for example be exempt from certain rules or be based on more competitive mechanisms. They could also be used to test new incentive structures and participatory processes. Trial and error processes can be initiated and monitored and successful projects and mechanisms be rolled out.

RI1 Review of the existing policy framework



NBS as such are often not explicitly targeted through local regulations and incentives. Still, as an integral and highly cross-sectoral part in the urban system, they are both supported and inhibited by various policies from different areas. An important step in developing a coherent policy framework is to identify potential synergies and bottle-necks to a desired development trajectory. E.g. do incentives and regulations exist that steer in an undesired direction and how can these be reconfigured to encourage a desired development path? A targeted review and evaluation of the existing policy framework could help to achieve this.

Potential Elements:

- The involvement of various stakeholders and actors in the review process.
- Achieving a good balance of regulations (command-and-control mechanisms) and incentives (market-based instruments).
- Reduction of bureaucracy through removal of redundant rules and regulations.
- Streamlining of national, regional, and local policies to better realise the overarching goals and targets.
- Institutionalising regular review activities to enable continuous improvement.

UNaLab Stories: Eindhoven Green Space Policy Plan [2]

The city of Eindhoven has a Green Space Policy Plan which is updated every 10 years. It describes the green history of the city, the local value of urban green, Eindhoven's ambitions for the future, and the supporting political policy framework. It thus represents the overarching green strategy and guiding principles for green developments in the city, whilst at the same time being used to inspire and inform local stakeholders and citizens. Several local initiatives such as "Trefpunt Groen" (integrator of local environmental NGOs) and the University of Wageningen have been involved in the review and updating process to respect local citizen and NGO perspectives, as well as up-to-date scientific advice. In the plan, NBS are explicitly mentioned as means to achieve the outlined goals and vision. In terms of policies, the Green Space Policy Plan provides an overview of all relevant laws and strategies at the national, regional and local levels and lists the main policy instruments which have been introduced or are currently being developed in this area.

[2] *The Green Space Policy Plan is freely available on the city's website.*

RI2 Introducing NBS-supportive building regulations





Building codes are important instruments to steer urban development in a desired direction. These define and prescribe specific standards for constructed objects, which development projects have to be conform with, in order to obtain building permission. Here NBS should be more explicitly incorporated.

Potential Elements:

- NBS-specific regulations, e.g. new buildings with suitable roofs have to be equipped with a green roof.
- Target-oriented regulations, e.g. green space minimums for specific areas.
- Preserving regulations, e.g. mandatory prefeasibility studies and respective water management plans, which demonstrate that the water retention capacity of the area is not negatively influenced by the proposed activities.

UNaLab Stories: River basin management plans, Genova

The Liguria Region (Department of the Territory, Environment, Infrastructure and Transport) has developed detailed river basin management plans which show individual features, associated risks, and future predictions, and carried out interventions in the area of soil and water management. Focus lies on hydraulic risk management in terms of flood and landslide prevention. They are used as urban planning instruments and are linked to technical implementation rules for the respective zones. Both municipal plans and proposed building interventions have to comply with these guidelines and be approved by the region.

In terms of NBS, the river basin management plans state that "to maintain the natural characteristics of the territory, natural techniques such as renaturing and environmental engineering measures should be preferred whenever possible" (Provincia di Genova, 2014). Furthermore, each proposed intervention has to prove that soil permeability will not be negatively influenced as compared to the prior state or introduce mitigation measures.

RI3 Introducing NBS-supportive zoning regulations



Zoning plans are an important factor in green space planning and are a means to include site-specific preconditions in urban development. Zoning plans are thus often linked to site-specific regulations and norms. In terms of NBS they often aim at protecting green elements or natural features. They are often the basis for more concrete building codes and regulation.

Potential elements:

- The integration and synchronisation of zoning plans into effective tools to facilitate and support the uptake of important norms and requirements (e.g. in GIS planning maps).
- Use of zoning regulations to limit the state of soil sealing in specific areas or zones (e.g. via sealing indexes, construction permits, or mandatory permeability).
- Protection and buying back of land that is of strategic importance, e.g. in terms of green space preservation, connectivity or accessibility.
- Systematic reactivation of plots with an unclear land ownership status.

UNaLab Stories: Regulatory transparency through interactive planning tools, Eindhoven

The new Environmental Planning Act 'Omgevingswet' (2019) of the Netherlands requires cities to feed zoning maps and land-specific information directly into a national platform. By this, it "seeks to modernise, harmonise and simplify current rules on land use planning, environmental protection, nature conservation, construction of buildings, protection of cultural heritage, water management, urban and rural redevelopment, development of major public and private works and mining and earth removal and integrate these rules into one legal framework" (Ministerie van Infrastructuur en Milieu, 2016). In this context, the city of Eindhoven is currently developing GIS zoning maps which will provide an interactive planning tool with area specific information on relevant preconditions and policies.

RI4 Introducing incentives to enhance private sector engagement





Although public green tends to be mainly financed and maintained through the city administration, there is a need to also encourage private land owners to develop and invest more in NBS. Incentives and market-based instruments are perceived as favourable option to create the necessary pull-factors and at the same time show the value that is being created through NBS.

Potential Elements

- Financial incentives, e.g. subsidies, grant programs, rebates and tax incentives, fees, premiums and innovation vouchers.
- Non-financial incentives, e.g. density bonuses, application bonuses, fast track processes zoning upgrades, certification and advertising options.
- Application of polluter-pays principles to generate the resources needed for the incentives.
- Communication strategies to make the incentives well-known and accessible to all stakeholders, as well as to educate about NBS benefits and values.

UNaLab Stories: Innovation Vouchers, Tampere

In Tampere, NBS are developed to improve stormwater management. The largest NBS are located in parks and financed by municipality. Nevertheless, the city has identified the importance of including private land and gardens (green roofs, rain gardens, permeable pavement, etc.) as an important element of the stormwater management system. In the context of UNaLab, the city aims to encourage sustainable measures implemented on private plots through experimenting with innovation vouchers which support the inclusion of NBS in developments of the Hiedanranta district. They may be used to finance planning and/or NBS implementation on private land.

RI5 Use of compensation schemes



Compensation schemes are mechanisms which ensure that the overall function (e.g. ecosystem services) of a specific site is being preserved. Plot owners and developers are requested to provide compensation for depleted ecological services (e.g. through sealing new surfaces; cutting down significant trees etc.).

Potential elements

- Direct substitution through restoring depleted ecosystem services or installing NBS on the same plot, including clear compensation criteria and monitoring of the compensation measures.
- Financial compensation coupled to a compensation funds, which can be used to realise NBS projects throughout the city if direct compensation on-site is not possible.
- Involving a pool of professionals and specialists to support the procedure and evaluation of measures.

RI6 Use of certification schemes and sustainability programs





Several certification schemes and sustainability programs exist with direct or indirect links to urban green and NBS. The main value of such certifications is that if incorporated well, they stand for objectivity, transparency and trustworthiness and are perceived as beneficial by most parties (private, public and citizens). Examples of existing certification systems which include NBS-specific criteria include BREEAM and LEED (from the building sector). Furthermore, cities have also been working with more organisation-related certification schemes such as EMAS, The Natural Step, or agreements such as the Aalborg Commitments to push sustainable and green practices more generally.

Potential elements:

- Embedding certification schemes in existing policy frameworks (coupling with existing incentives and regulations, e.g. building codes).
- Reviewing existing certification schemes to more specifically introduce NBS-related criteria.
- Linking certification to city performance management system.
- Certifying public buildings and organisations.

UNaLab Stories: Tax cuts for certified companies, Eindhoven

In the city of Eindhoven, all companies that are BREEAM certified (by the Dutch Green Building Association) are entitled to company tax reductions. Furthermore, the certificate is perceived as good marketing and communication tool by both public and private actors, as well as by the citizens. Parameters in the BREEAM certificate which are related to ecosystem services enabled by green infrastructure are for example credits for enhanced permeability or run-off capture measures, as well as credits for measures which provide habitat to native species, local food production, building insulation, or cleaner air.

3.4 Data Governance

The emergence of NBS as a concept to support resilience and sustainability in cities has coincided with the wider transformation around "smart cities". The provision and effective management of high quality data is a central supporting mechanism for cities to effectively address their urbanisation challenges through NBS and other approaches. In addition to the implementation of adequate ICT solutions, cities need to organise their data management and data governance structures, which can ensure structural integration, availability and quality of data.

Data governance includes all practices and decisions that aim to define roles and responsibilities, decision frameworks and the business rules for data management (Otto, B. and Österle, H., 2016). Principally, data governance in a city means to manage, regulate and stimulate the provision, use and exchange of datasets from various sources in order to provide a value-added service to all citizens and urban stakeholders. At the municipal level, this involves the provision of open data and dealing with questions about which datasets should be made open and which should not, but also the negotiation with third party data providers that may possess datasets with high relevance to drive a sustainable and resilient development of the city.

Good implementation of a data governance framework can facilitate the implementation, and enhance the sustainability and effectiveness of NBS-based projects. Effective data governance can support the implementation of NBS by:

1. **Providing effective monitoring:** one of the central challenges associated with NBS is the abstract and diffuse nature of the benefits created. Effective data management and innovative impact assessment mechanisms can make some of the value created through NBS more tangible and provide evidence of the benefits for such interventions.

2. **Helping to effectively target NBS:** through hyperlocal, real-time understanding of local conditions (e.g., air quality, flood risk areas, urban heating, biodiversity, etc.), cities are better able to effectively target NBS.

3. **Improving the city's ability to respond to changing conditions:** particularly in the context of water management, the often-decentralised approach to water management through combined grey and green, mixed-use approaches can be significantly aided by the early warning signals and detailed monitoring that are made possible through effective data governance.

4. **Supporting the development of maps for effective green space management:** effective data governance is a prerequisite for the development of data based tools (such as satellite imagery or GIS mapping).

5. **Supporting citizen participation in the identification, protection and enhancement of ecosystem services:** citizen platforms can play an important role in both raising awareness about the services provided by nature, as well as collecting valuable understandings about existing ecosystem services in the city (through, for example, crowd-sourced environmental monitoring).

What can cities do to implement and/or improve their data governance?

Municipalities not only need to organise internal data processes, but also regulate what other stakeholders are allowed to collect and do with public space data. Subsequently, from a holistic city point of view, sustainable data management and governance happens on the following three levels:

- Inside departments and agencies
- Across departments and agencies
- Between municipal departments/agencies and external parties

DG1 Data management strategy



Data management is gaining importance in cities where there is an increasing adoption of new technologies as well as governance requirements. A comprehensive data management strategy should be derived from the local government's long-term objectives and legal requirements. A strategy can help cities to better encompass their data-related goals within sustainable development measures.

Potential elements:

- Definition of long-term objectives and legal requirements.
- Definition of open data through an open data platform to citizens and other stakeholders
- Integration of standards and data platforms required by other governmental levels (e.g., regional, national or EU level).
- Regular updates on data management requirements and strategy itself.

DG2 Data governance and management inside departments





Data governance is a key element for sustainable data management and includes several elements to which the city has to pay attention: monitoring, management roles, data quality measuring, and operational rules.

Potential Elements:

- Defining data management roles and ownership for each data object; a glossary for important terms and data objects; rules for coherencies; processes for data creation, e.g., supported by templates and checklists.
- Establishment of a departmental data model consistent with the city data model (and referring to standards from higher governmental levels).
- Continuously assessing data quality using metrics or key performance indicators; and measuring performance and progress of data management.
- Clearly deciding and defining what belongs to departmental data models and to city data models, and who owns each dataset.

DG3 Data governance and management between municipal departments



Data Governance plays an important role in all levels of a municipality. Therefore, to realise an efficient data governance between municipal departments the following issues should be addressed for urban data objects:

Potential elements

- Regular and systemic monitoring (e.g., use data and process indicators).
- Definition of operative data management roles and highly-ranked civil servants should be added as data owners.
- Implementation of city data model, corresponding business rules for data objects, and a glossary containing important definitions of urban data objects.
- Emphasis on cross-departmental data management.
- Increased transparency regarding internal procedures and policies adopted by the departments.

DG4 Data as an instrument for governing external agencies and contractors



As public space data can be understood as public property, several public authorities have defined data access as a precondition to public contracts (e.g., for the operating of public facilities or even for the sale of a space dedicated to a parking garage). This practice helps municipalities to gain access to data and to guarantee data quality, as well as citizens to use apps that contain data from public facilities via third party apps.

UNaLab Stories: Holistic approach – Eindhoven

Recognising the obstacles that working in silos poses to data sharing and governance, the municipality recently has established a roundtable dialogue with periodic meetings to discuss how to implement a holistic approach towards using, sharing and managing data. A facilitator, independent from all departments, and representatives from all departments including policy advisors and data scientists attend these meetings. Although it is a new procedure, the aim is that data processes are integrated and that data are managed in a smart way.

After the creation of the Data Digitalisation and Classification, the CIO (Chief Information Officer) Office has determined new rules for data ownership. Essentially, all datasets should have an owner (person in charge), who is responsible for the maintenance and update. Every three months, data owners are asked about the datasets and, if changes should be made, to keep them up-to-date. They have also ruled that if a data owner leaves the municipality, the supervisor of that person becomes the new owner of that dataset. Thus, there are no datasets with no person in charge. Finally, the CIO Office is in charge of controlling these processes and that these rules are properly enforced.

3.5 Finance and procurement

For NBS to reach their full potential in providing the environmental and social benefits, the continuity as well as a more mainstreamed implementation of NBS needs to be ensured. This in turn calls for sustainable and long-term financing models. Because NBS interventions often concern public land and/or buildings, the majority of the funding schemes for NBS tend to follow a top-down approach and rely primarily on public budgets. However, cooperation with the private sector should not be overlooked for ensuring long-term financing solutions. Private sector stakeholders could bring more efficiency and additional resources for NBS implementation and mainstreaming. Depending on the local context, engaging with private sector stakeholders could be crucial for the success of NBS projects (e.g., if the land envisaged for NBS interventions is owned by private stakeholders).

Nevertheless, private investors face numerous challenges when considering investments in NBS. Often investors find it difficult to internalise the NBS benefits, as they are for some part public. Also, the payoffs from such investments tend to be long-term, whereas the investment costs are immediate. These factors might discourage private capital investors from NBS and shift their preference towards lower-risk, well-established technologies. In this context, the city administration plays an important role in applying policy tools (e.g. introduce guidelines and/or requirements for incorporating NBS in new developments) and financial instruments (e.g. issuing green bonds) to encourage private sector participation.

Another aspect that influences the success of the NBS uptake is public procurement. Public procurement can serve as a powerful demand-side policy tool and promote the development of innovative solutions to address the key city challenges. However, NBS implementation often calls for new procurement strategies that would enable the procurement officers to account for the full range of NBS benefits and costs and move away from the common "lowest cost" award criterion. The procurement strategy should be carefully designed to encourage the bidders to incorporate NBS and thus provide the best value for money and serve the diverse needs of communities.

General principles cities could follow when considering finance and procurement strategies for NBS implementation:

- **Considering the key players for investment decisions for different types of NBS:** certain NBS (e.g. green roofs) tend to have higher potential to be implemented by private actors, whereas others (e.g. public green space) are typically publicly driven. Based on the nature of NBS, municipalities might need to apply different tools to promote the NBS implementation (e.g. offering incentive schemes to private actors or focusing on increasing internal revenue base)

- **Considering polluter-pays principle when designing new ecological fiscal instruments:** The principle implies that whoever bears the responsibility for the negative (environmental) effects should incur costs associated with the damaging activity (Pitrone, 2013). If polluters are taxed on their harmful activities, society is compensated. This way, not the whole society but only the polluting entities compensate for the negative externalities associated with their operations. Adopting this principle could have the two-fold effect of potentially discouraging harmful activities as well as providing additional revenues to the cities that could be spent to fund interventions like NBS.
- **Targeting of the users of the municipal services:** By introducing targeted fees and charges the cities have the opportunity to relieve some of the burden from the general public and collect additional funds for NBS implementation. For instance, cities might choose to introduce fees in relation to the new real estate developments that require additional public infrastructure investments.
- **Promoting the cooperation with private sector:** This can be done through public-private partnerships (PPPs) that would enable cities to gain access to additional capital and decrease the risks of implementing NBS.
- **Incorporating the cost saving potential of NBS:** NBS interventions do not often yield direct cash flow streams for investors. However, NBS can have high potential to result in cost savings through mitigating key risks in cities (e.g. flood mitigation capacity). This cost saving potential needs to be properly accounted for and incorporated in the NBS business models that could be used to leverage private and/or public funds.
- **Consider bundling NBS interventions to create scale:** bundled NBS have higher potential to fulfil their desired function at scale and thus become fundamental assets constituting the green infrastructure in cities. To ensure the effective management of such infrastructure, cities could initiate the NBS-related asset management plans that would enable them to systematically evaluate the state of NBS, the levels of service NBS provide and the potential financing strategies. The bundling might also make the NBS projects more attractive to be financed though green bonds.
- **Consider alternative ways of requesting works, services and supplies:** Often public procurement officers and the wider public might not be aware of the existence of the alternative solutions to the common grey infrastructure approaches. Due to the strict rules of the public procurement process, the potential suppliers have limited opportunity to propose the alternative solutions. Public procurement officers could introduce new ways of formulating the requests that would give the bidders enough flexibility to propose new solutions. The cities might also consider introducing a design competition stage in the public procurement process of NBS.

FP1 Total Economic Value (TEV) Framework in Cost Benefit Analysis (CBA)



As many goods provided by NBS are intangible, incorporating them into a traditional CBA is difficult. One way to address the problem could be to adopt a TEV framework, which is designed to account for intangible benefits delivered through the ecosystem services. It accounts for the use and non-use values of an environmental good or service. Adopting a holistic CBA would imply that not only the fiscal aspects of a project are taken into consideration, but also the project's effect on the social welfare.

Potential elements:

- Linking CBA to ecosystem services.
- Identifying the potential goods delivered by the selected ecosystem services (including the use and non-use values).
- Selecting appropriate valuation methods for the environmental goods and services delivered by NBS.
- Promoting cooperation with research institutions to carry out the valuation research.

Example:

Singapore is starting a new project aimed at conducting the first national assessment that would quantify the benefits of the environment and account for its natural capital. The project is funded through National Research Foundation and will be implemented as a collaborative research project between Singapore-ETH Centre, Principal Investigators from the National University of Singapore (NUS), Nanyang Technological University (NTU), SEC, and ETH Zurich, with collaborators from the key partners in government including the Centre for Urban Greenery and Ecology (CUGE) at the National Parks Board (NParks) (Natural Capital Singapore, n.d.). The project aims to quantify the benefits delivered by the numerous surrounding ecosystems by using the stated preferences methodology, as well as the replacement cost for the different types of the natural capital approach (En, 2018). The project team plans to develop an interactive digital planning tool that would illustrate the data on the ecosystem services and their benefits as well as economic and socio-cultural value of urban green spaces. This tool is expected to inform the local policy makers on the possible impacts of the urban development plans in Singapore (En, 2018).

Natural Capital Singapore http://www.naturalcapital.sg/

FP2 Targeted fees and other charges



The internal revenues could be strengthened by designing area-specific charges based on the additional infrastructure costs incurred because of the development/reconstruction of the urban districts. Such fees and charges could be targeted at the developers and/or business owners and tenants that would benefit from better infrastructure, including benefits provided by NBS. Such an approach can provide additional internal revenues, the local governments could enhance their ability to introduce and scale up NBS implementation, while at the same time internalising the positive externalities of NBS.

Potential elements

- Development exactions and impact fees.
- Business improvement districts (BIDs).

UNaLab Stories: BID, Eindhoven

The BID in Eindhoven is the largest Business Improvement District in the Netherlands as it includes the entire city centre of Eindhoven. It was created according to the national law, which enables local business entities to organise themselves and hold a vote for establishing the BID. Given that a sufficient turnover is reached as well as 50% of the business owners approve, a BID can be established. The income collected from the tax in the BID area is collected and managed by an association. It is spent on the local initiatives based on the proposals submitted by the local business community members. Even though the fund managing association is independent from the municipality of Eindhoven, the strategic city goals seem to be taken in consideration when allocating the funding. For example, projects aiming at improving the city image by introducing more greenery in the city have received financial support from the association. According to the municipal economic experts, the BID has proven to be a great instrument to mobilise the local business community members including local producers, retail chains and real estate owners and provide financial support for bottom-up urban greening initiatives.

FP3 Apply the "polluter-pays" principle



The "polluter-pays" principle targets fees and other charges for activities that have negative environmental consequences. The fee creates an incentive for actors to reduce the activity and thus the negative outcomes associated with it. In the context of NBS, this could be used to target the challenge the (nature-based) solution is designed to address. This has the potentially double-sided effect of reducing the challenge while generating additional revenue sources.

Potential elements:

- Collecting stormwater/run-off fees.
- Compensation schemes for depleted ecosystem services.

FP4 Issuing green bonds



As NBS can support biodiversity conservation, climate change adaptation and other environmental efforts in cities, green municipal bonds could serve as a means for cities to secure funding for NBS implementation. Green bonds are essentially similar to regular bonds, the difference is that the capital raised by green bonds is used for projects with positive environmental outcomes. Lately, the interest for projects with social and environmental return has been increasing and thus the demand for green bonds. The revenues for green bonds can be achieved through various means ranging from public budget allocations to market returns.

Potential elements:

- Bundling of NBS projects.
- Independent verification of project impacts.
- The projects must generate revenue streams.

FP5 Engaging in public-private partnerships





For widespread uptake of NBS throughout the city, the inclusion of private actors is essential. Public-private partnerships (PPPs) are a viable option to achieve this goal. Public and private entities may enter contractual agreements aimed at creating, operating and maintaining NBS. Such partnerships can emerge through public entities seeking to gain access to additional capital provided by private partners in pursuit of business opportunities. In other cases, public actors might pay private actors for activities that deliver ecosystem services on private land.

Potential Elements

- Business improvement districts (BIDs), sponsorship schemes and green barter arrangements.
- Long-term contracts.
- Payment for Ecosystem Services (PES).

FP6 Introducing MEAT award criterion in public procurement



For effective adoption of the NBS concept and its integration throughout municipal structures, the often prevailing "lowest price offered" mentality in public procuring needs to be overcome within the existing legal framework. If NBS are to be adopted in the mainstream city development, the municipal procurement scheme needs to be able to incorporate the holistic costs and benefits provided by NBS. One approach includes the Most Economically Advantageous Tender (MEAT) criterion when evaluating the bids. This criterion enables the procurement officers to consider qualitative aspects of the proposed solution, in addition to the price dimension.

Potential elements:

- Emphasis on innovation and overall quality over lowest price-offering of the tendered service or a solution.
- Assessment criteria reflecting estimated impact on the lives of the target group.

UNaLab Stories: Innovative procurement, Eindhoven

Eindhoven is experimenting with innovative approaches to public procurement regarding complex projects and solutions. For the procurement of the city's street lighting system, tendering to the lowest price bidder would not ensure a sufficiently innovative and sustainable street lighting solution. Within the legal procurement boundaries, Eindhoven engaged in so-called "best-value procurement". This approach aims to get the best value for the money spent. Applying this logic, the City of Eindhoven engaged in a number of market consultations with potential suppliers. Rather than asking what is the lowest price a solution supplier could offer (limiting potential for innovation), Eindhoven asked what is the most (CO2 savings, positive social impact, public engagement, etc.) that the potential supplier could deliver for a fixed amount of money. This small tweak in framing the procurement process means that rather than just savings, the city looks at the amount of positive benefits that could be created with that investment.

FP7 Financing across multiple departments



Local governments might expand the pool of available funding for NBS by coordinating funding across the budgets of multiple municipal departments. This coordination has potential to enable cost sharing across the budgets of different municipal departments. Also, better coordination across departments could potentially reduce the costs for implementation of NBS, through aligning implementation of NBS with the timing of other street reconstruction projects.

Potential elements:

- Coordination among the "usual suspect" municipal departments of transportation, sanitation, green spaces, water management, housing and urban development.
- Coordination with departments and agencies focusing on health and wellbeing or risk management.

3.6 Inclusive urban development

Ensuring that the improvement of life quality that NBS strive to achieve is shared by all urban inhabitants is a significant challenge faced by urban planners. NBS can be a powerful tool to improve health and wellbeing and support social integration for particular target groups. However, if not properly managed, urban regeneration can improve the lives of some at the expense of others through reinforcing pre-existing disparities between social groups (Haase et al., 2017). NBS have the potential to either increase social divides or act as a bridge improving social cohesion in cities. Whether interventions will tend to induce the former or the latter will depend on the strategy and priorities adopted for the improvement of green spaces.

The term "green gentrification" has become commonplace in planning circles around the world explaining the phenomena of increasing property prices pushing certain groups out as a result of urban regeneration, at times through interventions associated with urban greening. A blueprint for avoiding green gentrification through the implementation of NBS does not exist. However, a range of principles have been identified that can assist cities in dealing with the negative effects of gentrification and uneven distribution of NBS:

- **Awareness:** An important starting point is to ensure that the potential for gentrification related effects remains present in the minds of planners, decision makers and developers when undertaking a strategy of urban regeneration. As such, the city should be able to anticipate the negative outcomes to a certain extent and develop mitigation mechanisms and strategies accordingly. Furthermore, bringing socio-spatial challenges into the forefront of urban regeneration projects should trigger an important discussion regarding these trade-offs whereby stakeholders can better identify priorities. Socio-spatial inequalities should be acknowledged at all stages of urban greening projects: planning, implementation and monitoring.

- **Linking NBS with strategies targeting social inclusion and development:** In many cases, lower socio economic areas and minority communities are associated with higher risk of exposure to air pollution, urban heat islands and lower green space accessibility (Wolch et al., 2014). There is significant potential for NBS to be utilised as a tool to achieve objectives outlines a wide range of different urban strategies (see MP2 Embedding NBS in existing plans and strategies). This highlights the potential for the city to address socioeconomic disparities whilst addressing urban challenges related to climate change and ongoing urbanisation at the same time if these strategies are effectively aligned. For this purpose, an important starting point is to identify target areas in the city that are characterised by particularly low socio-economic standards. This can be conducted through statistical analysis. Once these areas have been identified, they can become priority areas for interventions such as project funding schemes, or target areas for green space enhancement.
- **Understanding NBS as a tool to address a range of challenges:** Planners have to strike a balance between targeting NBS to the areas where the challenges (air pollution, urban heat island, flooding etc.) they are supposed to address are most pressing, on one hand, and ensuring that this does not worsen social disparities, on the other. A good approach is to see urban inequality itself as a challenge to be addressed through NBS and target these areas accordingly.
- **Understand the underlying mechanisms of gentrification:** Evaluating the results of green gentrification is important, but it is also important to understand the underlying processes around gentrification. This means not the increasing housing prices itself, but the processes that lead up to this outcome. Reasons behind this issue could be, for example, increasing tourism, increasing incomes in some specific sectors amongst certain social groups, increasing living costs, or growing competition with other land-use, all of which can increase demand for housing and push up prices in a particular area. By understanding the central root causes of gentrification, it is easier to develop effective strategies and mechanisms suited to the specific urban context.

ID1 Integration of social inclusion into green space planning



Increasing the opportunities for different actors to take an active part in different stages of the planning process will foster inclusivity in green space planning. This can be supported by a variety of different plans and policies such as comprehensive urban development strategies or green space plans. By making social inclusion a key element of these plans, different perspectives can be integrated into the planning process. Such plans and policies need to be long-term and, considering fast-paced development, they need to be updated on a regular basis.

Example: BIP / ZIP, Lisbon

Through gathering statistical information relating to social, environmental and economic factors, the city of Lisbon has identified 67 target areas for project development to improve social cohesion and promote active citizenship. The areas have become targeted for funding of small projects (up to €50,000 per project) through networks of local actors with conditions attached related to the types of actors involved and business/governance model sustainability. There have been a range of successful projects that have helped achieve sustainability objectives. Some projects have directly enhanced ecosystem services in the area, particularly those targeting urban farming projects. In addition local municipal offices have been moved into the zones to as a symbolic and practical initiative. However, perhaps the most valuable element of the initiative is the visualisation of lower socioeconomic areas of the city which would be a useful tool when considering urban regeneration and urban greening (https://cooperativecity.org/2017/05/07/bipzip/).

ID2 Mechanisms to influence housing prices



Many cities around the world have already experimented with different interventions to try to limit the displacement of long-term residents. These include different forms of rent controls and social housing, along with different regulations and policies. Such interventions are very much context, country and city specific and there is no one-size-fits-all policy for every case.

Potential elements:

- Rent controls.
- Social housing minumums for new developments.
- Bottom-up housing concepts/ building cooperatives.

ID3 Establish a "just-green-enough" approach




Curran & Hamilton (2012) propose a "just-green-enough" approach to establish green infrastructure while minimising the negative effects of green gentrification. The idea is that the marginal improvements in life quality as a result of green/blue space upgrades are limited beyond a certain degree of green space enhancement. This means that investments in larger green spaces tend to have limited advantages in terms of subjective well-being, while increasing real estate prices. By making an area "just green enough", social as well as ecological objectives can be obtained without necessarily increasing housing prices significantly.

ID4 Quantitative and qualitative assessment tools and standards



Quantitative and qualitative assessment tools and standards can be useful instruments to foster social inclusion of NBS. On one hand, specific tools can help to find out about the status quo of social inclusion, the distribution of NBS and the quality of already integrated NBS, on the other hand they can help to foster a more inclusive urban development by showing for example which areas are in the greatest need of NBS and by integrating certain standards for green space accessibility.

Potential Elements:

- Green space accessibility standards.
- Environmental Justice Screening and Mapping Tool (EJSCREEN).

ID5 PPGIS



Public participation geographic information systems (PPGIS) can be an effective means of better understanding the quality of green space from the perspective of the users. Utilising online and offline formats, citizens are able to make contributions to a map regarding use and satisfaction with green space. Such an approach can be used instead of or in addition to more traditional approaches (surveys, questionnaires etc.).

Potential elements:

- Planning: e.g., identifying hotspots of value, potential development and redevelopment areas, better targeting green space functions.
- Management: e.g., identifying areas of overcrowding/ lack of maintenance/ places where people feel insecure; better targeting resources and communication activities.
- Design: e.g., protecting valued space; redesigning areas experiencing conflicts; providing inspiration for design of new public spaces (more of what people like).

4 CONTRIBUTIONS

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5 REFERENCES

Curran, W., & Hamilton, T. (2012). Just green enough: Contesting environmental gentrification in Greenpoint, Brooklyn. Local Environment, 17, 1027–1042.

Döhren, P. von, & Haase, D. (2015). Ecosystem disservices research: A review of the state of the art with a focus on cities. Ecological Indicators, 52, 490–497. https://doi.org/10.1016/j.ecolind.2014.12.027

En, S. M. (2018). Project aims to quantify worth of forests and marine habitats. Retrieved from https://www.todayonline.com/singapore/project-aims-quantify-worth-forests-and-marine-habitats

European Commission. (2018). Nature-Based Solutions: Policy Topic: Nature-Based Solutions. Retrieved from https://ec.europa.eu/research/environment/index.cfm?pg=nbs

Haase, D., Kabisch, S., Haase, A., Andersson, E., Banzhaf, E., Baró, F., . . . Wolff, M. (2017). Greening cities – To be socially inclusive? About the alleged paradox of society and ecology in cities. Applied Spatial Analysis and Policy, 41–48.

Hanson, R., Rall, E., Chapman, E., Rolf, W., & Pauleit, S. (2017). Urban Green Infrastructure Planning: A guide for Practitioners. GREEN SURGE. Retrieved from https://www.e-pages.dk/ku/1340/html5/

Kabisch, Korn, Stadler, & Bonn (Eds.). (2017). Nature-based Solutions to Climate Change Adaptation in Urban Areas: Linkages between Science, Policy and Practice. Cham: Springer Open.

Ministerie van Infrastructuur en Milieu. (2016). (Unofficial) Translation of the Environment and Planning Act - Legislative Bill. Retrieved from https://www.omgevingsweb.nl/nieuws/engelse-vertaling-omgevingswet-en-memorie-van-toelichting-bij-de-omgevingswet

REFERENCES

Nesshöver, C., Assmuth, T., Irvine, K. N., Rusch, G. M., Waylen, K. A., Delbaere, B., . . . Wittmer, H. (2017). The science, policy and practice of nature-based solutions: An interdisciplinary perspective. The Science of the Total Environment, 579, 1215–1227. https://doi.org/10.1016/j.scitotenv.2016.11.106

Otto, B. and Österle, H. (2016). Corporate Data Quality. Springer Berlin Heidelberg. 10.1007/978-3-662-46806-7

Pitrone, F. (Ed.) (2013). Fundamental principles of ecological taxation. Retrieved from http://www.iuscommune.eu/html/activities/2013/2013-11-28/workshop2_Pitrone.pdf

Provincia di Genova. (2014). Norme di Attenuazione: Piani di Bacino stralcio sul rischio idrogeologico AMBITI 12 e 13, 14, 15, 16, 17, 18. Retrieved from http://www.pianidibacino.ambienteinliguria.it/GE/ambiti12e13/documenti/Normativa.pdf

Wolch, J. R., Byrne, J., & Newell, J. P. (2014). Urban green space, public health, and environmental justice: The challenge of making cities 'just green enough'. Landscape and Urban Planning, 125, 234–244.

ABOUT UNALAB

The UNaLab project is contributing to the development of smarter, more inclusive, more resilient and more sustainable urban communities through the implementation of nature-based solutions (NBS) co-created with and for local stakeholders and citizens. Each of the UNaLab project's three Front-Runner Cities – Eindhoven (NL), Genova (IT) and Tampere (FI) – has a strong commitment to smart, citizen-driven solutions for sustainable urban development. The establishment of Urban Living Lab (ULL) innovation spaces in Eindhoven, Genova and Tampere supports on-going co-creation, demonstration, experimentation and evaluation of a range of different NBS targeting climate change mitigation and adaptation along with the sustainable management of water resources. The Front-Runner Cities actively promote knowledge- and capacity-building in the use of NBS to enhance urban climate and water resilience within a network of committed partner cities, including seven Follower Cities – Stavanger, Prague, Castellón, Cannes, Başakşehir, Hong Kong and Buenos Aires – and the Observers, Guangzhou and the Brazilian Network of Smart Cities. Collaborative knowledge production among this wide network of cities enables UNaLab project results to reflect diverse urban socio-economic realities, along with differences in the size and density of urban populations, local ecosystem characteristics and climate conditions. Evidence of NBS effectiveness to combat the negative impacts of climate change and urbanisation will be captured through a comprehensive monitoring and impact assessment framework. Further replication and up-scaling of NBS is supported by development of an ULL model and associated tools tailored to the co-creation of NBS to address climate- and water-related challenges, a range of applicable business and financing models, as well as governance-related structures and processes to support NBS uptake. The results of the project will be a robust evidence base and go-to-market environment for innovative, replicable, and locally-attuned NBS.

For more information see: www.unalab.eu


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